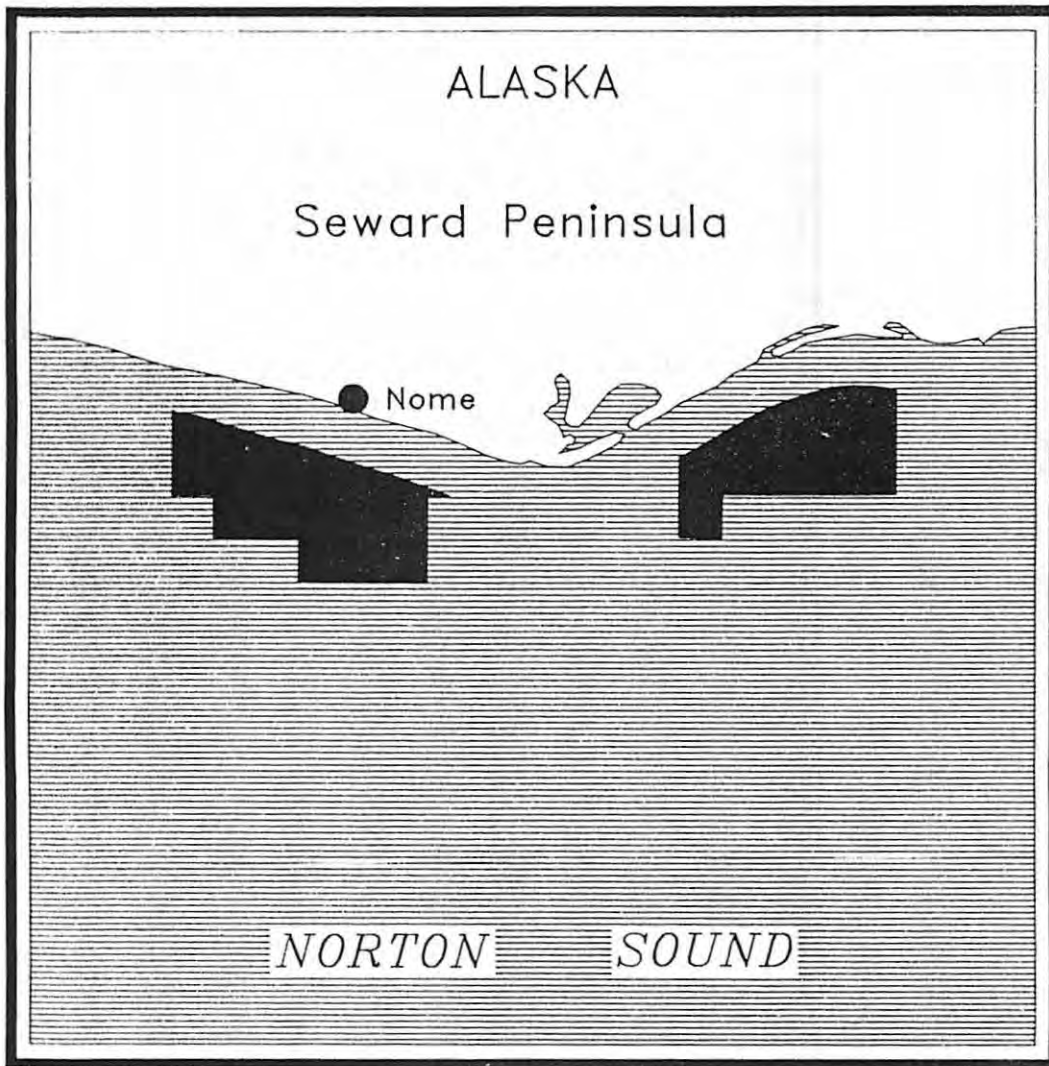


Alaska Outer Continental Shelf

# OCS Mining Program Norton Sound Lease Sale

Final Environmental  
Impact Statement

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## **NOTES TO THE READER:**

### **Disclaimer:**

Potentially affected communities should not use this Environmental Impact Statement (EIS) as a "local planning document." Site-specific planning cannot yet be done and it may be many years hence before such specific projections could be made. The facility locations and scenarios described in this document, which are only representative of the locations and scenarios that presently seem likely, serve simply as a basis for identifying characteristic activities and resulting effects for this EIS. These locations and scenarios do not represent a Minerals Management Service recommendation, preference, or endorsement of sites or development schemes.

### **Mining Scenario**

The offshore dredge assumed for the scenario used in this EIS is similar to the Bima, operated by WestGold to mine the offshore placer deposits in State of Alaska waters near Nome. In September 1990, WestGold announced that the Bima would not be operating during the 1991 mining season due to financial difficulties as well as needed repairs. In November 1990 the Bima was placed on the market for sale. It is considered highly unlikely that the Bima will be operating offshore Nome in the future. In October 1990 WestGold received a 5-year National Pollution Discharge Elimination System permit from Environmental Protection Agency for the Bima. While the Bima or a Bima-type dredge could be used for the proposed sale, the type of dredge that will be used is not known for certain at this time. It should be noted that no exploration, testing, development, or production plans will be approved before completion of a comprehensive environmental evaluation to assure that the activities described will be carried out in a safe and environmentally responsible manner (30 CFR 282.21, 282.25, and 282.28).



Alaska Outer Continental Shelf

# **OCS Mining Program Norton Sound Lease Sale**

**Final Environmental  
Impact Statement**

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# Summary Sheet

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## Proposed Outer Continental Shelf Mining Program Norton Sound Lease Sale

### Environmental Impact Statement

Draft

Final

U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region, 949 East 36th Avenue, Anchorage, Alaska 99508-4302.

1. **Type of Action:** Proposed OCS Mining Program Norton Sound Lease Sale.

Administrative

Legislative

2. **Description of the Proposed Action:** The leasing proposal consists of 59,510 hectares (approximately 147,050 acres) of Outer Continental Shelf (OCS) lands. The 34 whole and partial blocks in the proposed Norton Sound Lease Sale area are located about 5 to 22 kilometers offshore in water depths that range from about 20 to 30 meters. The MMS has estimated that placer deposits of gold in the proposed lease-sale area for a base case could be 530,000 troy ounces. If implemented, this lease sale is tentatively scheduled to be held in June 1991.

3. **Environmental Effects:** The areas proposed for offering pose some potential risk of adverse effects to the environment if explored and developed. The risk is related to adverse effects on the environment that may result from the mining, transportation, and metallurgical processing operations of a mining industry. Socioeconomic effects from onshore activities of this industry could have local and/or State implications. The proposed alternative includes Stipulation No. 1, Environmental Survey and Monitoring Program and Operations Management, Stipulation No. 2, Prohibition of Use of Mercury or other Toxic Substances in Processing, Stipulation No. 3, Baseline and Monitoring Studies on Mercury Levels in Humans, and Stipulation No. 4, Protection of Archaeological Resources as part of the proposal.

These stipulations would reduce the type, occurrence, and extent of adverse effects associated with this proposal. Other measures, which are beyond the authority of this agency to apply, also have been identified. In spite of mitigating measures, some effects are considered unavoidable. For instance, if a mining industry does develop, the destruction of certain immotile organisms in the mine site area would occur.

4. **Alternatives to the Proposed Action:**

a. No Sale (Alternative II).

b. Delay the Sale (Alternative III). This alternative would delay the sale for a 3-year period.

c. Modify the proposed action by deferring approximately 15 blocks southeast of Safety Sound (Eastern Deferral Alternative--Alternative IV).

d. Modify the proposed action by deferring approximately 19 blocks south of Nome (Western Deferral Alternative--Alternative V).

5. **Other Environmental Impact Statements, OCS Reports, Reference Papers, and Technical Papers:** This Environmental Impact Statement (EIS) refers to numerous EIS's, OCS reports, reference papers, and technical papers previously prepared by the Alaska OCS Region. Applicable portions of these documents are referenced in the appropriate discussions throughout this EIS. Copies of referenced documents have been placed in a number of libraries throughout Alaska and in the Department of the Interior Library in Washington, D.C. Single copies of these publications are available from the Alaska OCS Region Library and the National Technical Information Service.

6. **Public Hearings:** A public hearing for the OCS Mining Program Norton Sound Lease Sale was held July 18, 1990 in Nome, Alaska. Oral and written comments were obtained and responded to in this final EIS.

7. **Contacts:**

- For copies of this EIS, contact:

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MMS, Alaska OCS Region  
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# Summary of the Final Environmental Impact Statement for the Proposed OCS Mining Program Norton Sound Lease Sale

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## I. INTRODUCTION

This final environmental impact statement (FEIS) examines: (1) a proposal for leasing submerged Federal lands in Norton Sound for the recovery of gold and any other mineral recovered with gold or other mineral recovered using technology similar to that used for recovering gold; (2) four alternatives to the proposal; (3) the major issues identified through the scoping process and through staff analysis; and (4) the mitigating measures considered as part of the proposal.

The first DEIS was published in November 1988 (USDOJ, MMS, 1988). In order that the results from the most current studies could be reported and integrated in the analysis of effects of the proposed lease sale on the environment, MMS began the NEPA process for a second time with the preparation of the publication of a second DEIS, which was published in June 1990.

## II. DESCRIPTION OF THE PROPOSED ACTION

The proposal (Alternative I) consists of offering for lease 34 whole and partial blocks (approximately 59,510 hectares) in Norton Sound that range from about 5 to 22 kilometers (km) offshore. The MMS has estimated that placer deposits of gold in the proposed lease-sale area for a base case could be 530,000 troy ounces. Alternative I includes as part of the proposal: Stipulation No. 1, Environmental Survey and Monitoring Program and Operations Management; Stipulation No. 2, Prohibition of Use of Mercury and Other Toxic Substances in Processing; Stipulation No. 3, Baseline and Monitoring Studies on Mercury Levels in Humans; and Stipulation No. 4, Protection of Archaeological Resources. Also included are Information to Lessees (ITL) No. 1, Bird and Marine Mammal Protection; ITL No. 2, Arctic Peregrine Falcon; ITL No. 3, Subsistence Activities; ITL No. 4, Coastal Zone Management, and ITL No. 5, Information on Postlease Norton Sound Review Team.

The scenario used to assess the potential effects that placer mining may have on the environment describes possible activities and the timing of events. Exploration activities would take about 3 years once the lease sale is held. A mining period of 14 years is based on comparable mining operations. The base-case-scenario estimate of 530,000 troy ounces of gold is based on the assumption that an average of about 40,000 ounces per year would be recovered over 14 years of mining in two areas. It is assumed that the placer deposits would be mined from a single dredge containing an onboard processing plant to concentrate the recovered gold particles; beneficiation of the ore would be based on gravity concentration techniques. Offshore support activities are expected to include support vessels for anchor handling and dredge movement and helicopters for crew changes and transporting emergency supplies.

The potential effects of this proposal are based in part on the assumptions that gold (1) presently is the only marketable product that economically can be recovered from mining the offshore placer deposits in the proposed lease-sale area and (2) recovery for the base case is estimated to be 530,000 troy ounces. The scenario for this FEIS assumes operation of a continuous mechanical system such as a bucket-ladder, or bucketline, dredge. This type of dredge is similar to the Bima which has been used for mining offshore of Nome. The Bima will not be operating during the 1991 mining season due to financial difficulties and needed repairs. Any proposal for mining would undergo thorough assessment of environmental effects, including a proposal to use a different type of dredge.

## III. ALTERNATIVES TO THE PROPOSED ACTION

A. Alternative II (No Sale): This alternative would cancel the proposed lease sale, tentatively scheduled for June 1991.

B. Alternative III (Delay the Sale): This alternative, which includes Stipulation Nos. 1 through 4 and ITL Nos. 1 through 4, would delay the proposed lease sale for a period of 3 years.

C. Alternative IV (Eastern Deferral Alternative): This alternative, which includes Stipulation Nos. 1 through 4 and ITL Nos. 1 through 4, would defer leasing on 15 whole and partial blocks southeast of Safety Sound.

D. Alternative V (Western Deferral Alternative): This alternative, which includes Stipulation Nos. 1 through 4 and ITL Nos. 1 through 4, would defer leasing on 19 whole and partial blocks located south of Nome.

After a thorough review, the Director, Minerals Management Service (MMS) will decide which alternative or combination of alternatives will be included in the Final Leasing Notice.

#### IV. IMPORTANT ISSUES

In November 1988, the first DEIS was issued. Major effects from the proposal were anticipated for water quality, commercial fisheries, subsistence-harvest patterns, and sociocultural systems based on available data. As defined in the first DEIS, the Proposal did not include stipulations and ITL clauses specifically designed to mitigate adverse effects from mining. The State, Federal, and local government agencies, as well as members of the public, expressed concern that the information used for the first DEIS was inadequate for proper analysis and reasoned decisions. Lack of information was of concern in the following subject areas: the actual level of mercury in the water column; the bioaccumulation of mercury in the food chain; levels of mercury in humans; and the effect of dredging on habitat, particularly for red king crab. Studies were initiated to obtain answers to these questions both through field research and the expert assistance gained in workshops.

A. Human Health: Human health became an issue because of potential bioaccumulation of methylmercury in the food chain from suspension of sediments associated with dredging. The part of the human population most vulnerable to mercury effects are children who as fetuses were carried by women who consumed substantial amounts of seafood which may have elevated levels of methylmercury.

The MMS held a workshop entitled "Mercury in the Marine Environment" (USDOI, MMS, 1989) from November 29 through December 1, 1988. Experts in the areas of mercury in water and sediments, mercury accumulation and effects in organisms, and mercury effects on human health provided their knowledge and expertise to MMS. Also attending the workshop were members of the Federal/State Coordination Team (CT).

In January 1989, a public hearing was held in Nome on the first DEIS. Concerns were expressed about mercury in the marine environment and effects on crab habitat. When the comment period for the first DEIS closed, there remained a concern about the inadequate data on mercury levels in humans.

The MMS review of the preliminary FEIS concluded that appropriate Federal public health agencies should review the EIS for human health concerns. Federal public health agencies, including the Public Health Service and the Indian Health Service reviewed the preliminary FEIS. Their concerns have been incorporated in this EIS.

In March 1989, the preliminary final EIS (FEIS) was sent to the CT for review. Regarding comments that data on mercury levels in humans were inadequate, the MMS coordinated with the Indian Health Service and the Norton Sound Health Corporation (NSHC) to obtain hair samples to be analyzed for levels of mercury and arsenic. The MMS contracted with Battelle Northwest to analyze the hair samples. The 1989 sampling results showed that the methylmercury content in the hair samples was below average for indigenous coastal North American communities.

Results of this study are presented in Section IV.B.15.

This EIS includes Stipulation No. 3, Baseline and Monitoring Studies on Mercury Levels in Humans. The stipulation is to inform the lessee that they will be required to monitor mercury levels in the Nome population if baseline studies indicate elevated mercury levels in humans according to safety standards set by the World Health Organization (WHO) and that the lessee's operations are contributing mercury contamination.

B. Water-Quality Data: Mercury and other trace-metal contamination is an important concern that has developed over the course of preparing this EIS. As a result of concerns regarding the sufficiency of the water-quality data for the proposed lease sale, MMS sponsored studies by the University of Alaska Fairbanks



## Summary of the Final Environmental Impact Statement for the Proposed OCS Mining Program Norton Sound Lease Sale

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(UAF) in October 1988 (Naidu et al., 1989) and by Battelle Northwest in June and September 1989 (Hood, 1989) to obtain additional trace-metal data for the ambient waters in the sale area and inshore waters. Results of these studies are referenced in Sections III.A.8 and IV.B.2.

The 1989 sampling results conducted by Battelle Northwest showed that the levels of mercury in the water column did not exceed established EPA criteria. It appears there is likely no significant mercury contribution to the water column by dredging.

The MMS sponsored a monitoring workshop from November 28 through 30, 1989 (USDOJ, MMS, 1990) to determine how studies for monitoring water quality, habitat alteration, and human health should be designed. Experts in the areas of water and sediment sampling, effects of trace metals in marine organisms, habitat alteration, and mercury effects on human health provided their knowledge and expertise to MMS and, in particular, the authors of the DEIS. Also attending the workshop as active participants were members of the CT. The workshop helped MMS to design environmental monitoring that will allow MMS to see changes that may result from mining.

This EIS includes Stipulation No. 1, Environmental Survey and Monitoring Program and Operations Management. This stipulation requires that appropriate environmental surveys and environmental monitoring programs be conducted to determine if lease operations are resulting in significant effects to the environment. Information obtained from the monitoring program will be used to establish measures to mitigate the effects of the mining program on the environment.

C. **Habitat Alteration:** Dredging would result in major alteration of the habitat and loss of many or most of the associated benthic organisms. Of particular concern is the potential loss or alteration of the cobble habitat that is critical for juvenile crabs and for king crabs in general. Offshore dredging and spoils discharge would result in the destruction of a number of organisms directly, through the mechanical action of the dredging, via processing procedures, or via the disposal of dredged material. Cobble, boulders, or gravel are essential to providing a stabilized substrate needed to provide protection and food resources for young and adult crabs. There are reported high concentrations of red king crab near or within (deeper than) the 30-meter (m) isobath. These concentrations suggest that the area deeper than the 30-m isobath serves as an important and unique crab habitat for Norton Sound and the northern Bering Sea region. The University of Alaska Fairbanks cruise conducted by MMS in the fall of 1989 indicated that the substrate in the lease-sale area graded from a hard consolidated material near State waters to more coarse sand and gravel in the trench area and became more fine and somewhat compacted mud farther offshore.

Although dredging poses unavoidable effects on habitat alteration, such effects can be mitigated. In December 1989, MMS deleted six blocks from the proposal for the protection of the red king crab. This deletion, in combination with the distribution of trench habitat outside the sale area, resulted in a total of about 68 percent of the trench habitat occurring outside the proposed sale area. Approximately 32 percent of the habitat deeper than the 30-m isobath occurs within the lease-sale area and the effects of mining on this area would be monitored in accordance with Stipulation No. 1, Environmental Survey and Monitoring Program and Operations Management. The monitoring program should be able to identify any unique or more limited habitats and communities and allow restriction of dredging activities in them. This would enable the effects on marine plants and invertebrates from habitat alteration to be minimized.

### V. CONCLUSIONS

Table S-1 summarizes the possible effects that could occur as a result of the leasing proposal (Alternative I), alternatives to the proposal (Alternatives II-V), and the cumulative cases. (Table S-2 explains the definitions used for assessing the potential effects of the leasing proposal.) The analyses supporting the conclusions in Table S-1 assume that all laws, regulations, and orders are part of the leasing proposal and alternatives. Summaries of the environmental effects from the proposed lease sale are in Sections II.A.2.f (base case), II.A.3.b (high case), II.B (no sale), II.C (delay the sale), II.D.3 (Eastern Deferral Alternative) and II.E.3 (Western Deferral Alternative).

**This EIS is not intended, nor should it be used, as a local planning document by potentially affected communities. The facility locations and transportation scenarios described in this EIS represent assumptions that were made as a basis for identifying characteristic activities and any resulting environmental effects. These assumptions do not represent an MMS recommendation, preference, or endorsement of any facility, site, or development plan. Local control of events may be exercised through planning, zoning, land ownership, and applicable State and local laws and regulations.**

Table S-1  
Summary of Effects<sup>1/</sup>

	Alternatives									
	I Proposal <sup>2/</sup>	I and Cumulative Projects	II No Sale	II and Cumulative Projects	III Delay the Sale <sup>2/</sup>	III and Cumulative Projects	IV Eastern Deferral Alt. <sup>2/</sup>	IV and Cumulative Projects	V Western Deferral Alt. <sup>2/</sup>	V and Cumulative Projects
<b>Air Quality</b>	NEGLIGIBLE	MINOR	NO EFFECT	MINOR	NEGLIGIBLE	MINOR	NEGLIGIBLE	MINOR	NEGLIGIBLE	MINOR
<b>Water Quality:</b>										
<b>LOCAL<sup>3/</sup></b>	MAJOR <sup>4/</sup>	MAJOR <sup>4/</sup>	NO EFFECT	MAJOR <sup>4/</sup>	MAJOR <sup>4/</sup>	MAJOR <sup>4/</sup>	MAJOR <sup>4/</sup>	MAJOR <sup>4/</sup>	MAJOR <sup>4/</sup>	MAJOR <sup>4/</sup>
<b>REGIONAL</b>	MINOR	MINOR	NO EFFECT	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR
<b>Marine Plants and Invertebrates<sup>5/</sup></b>	MODERATE	MODERATE	NO EFFECT	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MINOR	MODERATE
Red King Crab	MODERATE	MODERATE	NO EFFECT	MINOR	MODERATE	MODERATE	MODERATE	MODERATE	MINOR	MINOR
<b>Fishes</b>	MODERATE	MAJOR	NO EFFECT	MAJOR	MODERATE	MAJOR	MODERATE	MAJOR	MODERATE	MAJOR
Migratory Species	“	MAJOR	NO EFFECT	MAJOR	“	MAJOR	“	MAJOR	“	MAJOR
<b>Marine and Coastal Birds</b>	MINOR	MODERATE	NO EFFECT	MODERATE	MINOR	MODERATE	NEGLIGIBLE	MODERATE	MINOR	MODERATE
Migratory Species	“	MAJOR	NO EFFECT	MAJOR	“	MAJOR	“	MAJOR	“	MAJOR
<b>Nonendangered and Marine Mammals</b>	MINOR	MINOR	NO EFFECT	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR
Migratory Species	“	MODERATE	NO EFFECT	MODERATE	“	MODERATE	“	MODERATE	“	MODERATE
<b>Endangered and Threatened Species</b>										
Gray Whale	MINOR	MINOR	NO EFFECT	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR
Migratory Species	“	MINOR	NO EFFECT	MINOR	“	MINOR	“	MINOR	“	MINOR
Peregrine Falcon	MINOR	MINOR	NO EFFECT	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR
Migratory Species	“	MINOR	NO EFFECT	MINOR	“	MINOR	“	MINOR	“	MINOR
<b>The Economy of Nome</b>	MINOR	MODERATE	NO EFFECT	MODERATE	MINOR	MODERATE	MINOR	MODERATE	MINOR	MODERATE



Table S-1  
Summary of Effects<sup>1/</sup>  
(Continued)

	Alternatives									
	I Proposal <sup>2/</sup>	I and Cumulative Projects	II No Sale	II and Cumulative Projects	III Delay the Sale <sup>2/</sup>	III and Cumulative Projects	IV Eastern Deferral Alt. <sup>2/</sup>	IV and Cumulative Projects	V Western Deferral Alt. <sup>2/</sup>	V and Cumulative Projects
Commercial Fisheries	MODERATE	MODERATE	NO EFFECT	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Migratory Species	<sup>6/</sup>	MODERATE	NO EFFECT	MODERATE	<sup>6/</sup>	MODERATE	<sup>6/</sup>	MODERATE	<sup>6/</sup>	MODERATE
Subsistence-Harvest Patterns	MINOR	MODERATE	NO EFFECT	MODERATE	MINOR	MODERATE	MINOR	MODERATE	MINOR	MODERATE
Sociocultural Systems	MINOR	MAJOR	NO EFFECT	MAJOR	MINOR	MAJOR	MINOR	MAJOR	MINOR	MAJOR
Archaeological Resources	NEGLIGIBLE	MINOR	NO EFFECT	MINOR	NEGLIGIBLE	MINOR	NEGLIGIBLE	MINOR	NEGLIGIBLE	MINOR
Recreation and Tourism	MINOR	MINOR	NO EFFECT	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR
Land Use Plans and Coastal Management Programs	MODERATE	MODERATE	NO EFFECT	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MINOR	MODERATE
Human Health	NEGLIGIBLE	MODERATE	NO EFFECT	MODERATE	NEGLIGIBLE	MODERATE	NEGLIGIBLE	MODERATE	NEGLIGIBLE	MODERATE

Source: MMS, Alaska OCS Region, 1989.

<sup>1/</sup> This table should be used only in the context of the analyses, assumptions, and definitions.

<sup>2/</sup> Stipulations 1, 2, 3, and 4 and ITL's 1, 2, 3, and 4 are part of the Proposal, the Eastern Deferral, and the Western Deferral.

<sup>3/</sup> Local effect somewhere within Norton Sound.

<sup>4/</sup> Effect of turbidity and trace-metal discharges would be NEGLIGIBLE if the conditions of the NPDES permit (as reissued for Bima operations in State waters [USEPA, 1990a,d]) are met for mining dredges; this would reduce the overall effect on LOCAL water quality to MINOR.

<sup>5/</sup> Exclusive of red king crab.

<sup>6/</sup> Effects on migratory species are considered only in the cumulative case. These effects are from cumulative projects nationwide.

<sup>7/</sup> Conclusions reflect potential inconsistencies between effects of the proposal and land use water resource regulations and policies, not effects of the proposal on regulations and policies.

**Table S-2  
Definitions Assumed in Effects Assessment**

NEGLIGIBLE	MINOR	MODERATE	MAJOR
<b>Resource Category</b>			
<b>Air Quality</b>			
Emissions cause measurable increases in concentrations of criteria pollutants (e.g. SO <sub>2</sub> , CO, NO <sub>2</sub> , O <sub>3</sub> , and PM <sub>10</sub> ) over one localized portion of a Federal attainment area, resulting in the consumption of less than 5 percent of the available Prevention of Significant Deterioration (PSD) increment for NO <sub>2</sub> , SO <sub>2</sub> , or TSP or 5 percent of the available National Ambient Air Quality Standards <sup>1/</sup> (NAAQS) concentration for NO <sub>2</sub> , PM <sub>10</sub> , CO, or O <sub>3</sub> ; no observed adverse effects on human health or vegetation; and/or no significant decrease in onshore visibility. <sup>2/</sup>	Emissions cause measurable increases in concentrations of criteria pollutants over more than a localized portion of a Federal attainment area; resulting in the consumption of at least 5 percent but less than 20 percent of the available PSD increment for NO <sub>2</sub> , SO <sub>2</sub> , or TSP or 5 percent of the available NAAQS concentration for SO <sub>2</sub> , PM <sub>10</sub> , CO, or O <sub>3</sub> ; no observed adverse effects on human health or vegetation; and/or significant decrease in onshore visibility.	Emissions cause measurable increases in concentrations of criteria pollutants over more than half of a Federal attainment area (regional effect), resulting in the consumption of at least 20 percent but less than 50 percent of the available PSD increment for NO <sub>2</sub> , SO <sub>2</sub> , or TSP or 5 percent of the available NAAQS concentration for SO <sub>2</sub> , PM <sub>10</sub> , CO, or O <sub>3</sub> ; small but measurable short-term adverse effects on human health or vegetation; and/or significant decrease in onshore visibility.	Emissions cause measurable increases in concentrations of criteria pollutants over more than half of a Federal attainment area (regional effect), resulting in the consumption of at least 50 percent of the available PSD or NAAQS concentration increments; readily identifiable adverse long-term effects on human health or vegetation; and/or significant decrease in onshore visibility.
<b>Water Quality<sup>3/</sup></b>			
	LOCAL—changes in water quality from one or more sources, extending beyond the edge of a mixing zone (100-m perimeter about the dredge footprint), but affecting less than 180 km <sup>2</sup> (30% of the sale area) about each discharge.		
	REGIONAL—changes in water quality over an area of at least 180 km <sup>2</sup> or larger about a discharge source.		
No regulated contaminant (such as mercury or other trace metal) is discharged into the water column, or some amount is discharged, but the resulting concentration of contaminant does not exceed the chronic State standard or EPA criterion.	A regulated contaminant (such as mercury or other trace metal) is discharged into the water column and the resulting concentration of contaminant occasionally exceeds but does not increase the average beyond the chronic State standard or EPA criterion.	A regular contaminant (such as mercury or other trace metal) is discharged into the water column and the resulting concentration of contaminant averages (sampling period set by permit) more than the chronic State standard and EPA criterion, but does not exceed acute (toxic) State Standards and EPA criteria and does not exceed 7,500 ppm suspended-sediment concentration.	A regulated contaminant (such as mercury or other trace metal) is discharged into the water column and the resulting concentration of contaminant is above the acute (toxic) State standard or EPA criterion. Turbidity exceeds 7,500 ppm suspended sediment concentration.
<b>Biological Resources (Lower-Trophic-Level Organisms, Fishes, Marine and Coastal Birds, Nonendangered Marine Mammals)</b>			
No measurable short-term or long-term change in numbers or distribution of individuals occurs in a population.	A specific group of individuals of a population in a localized area and/or over a short time period (one generation or less) is affected; the regional population is not affected.	A portion of a population in the region changes in abundance and/or distribution over more than one generation, but the change is unlikely to affect the regional population.	A population or species in the region declines in abundance and/or distribution beyond which recruitment would not return it to its former level within several generations.
<b>Endangered and Threatened Species</b>			
No measurable change occurs.	A specific group of individuals of a population in a localized area is affected over a short time period (less than one breeding cycle).	A portion of a regional population declines in abundance and/or distribution, and recovery requires more than one breeding cycle <sup>4/</sup> but less than one generation.	A regional population or species declines substantially in abundance and/or distribution, and recovery requires at least one generation. <sup>5/</sup>
<b>Economy of Nome</b>			
Economic effects occur which have no measurable effects on governmental policies, planning, or budgeting, or no measurable effect on the economic well-being of residents of the area.	Economic effects occur which may require slight marginal changes in governmental policies, planning, or budgeting, or may marginally affect the economic well-being of residents of the area.	Economic effects occur which will require some but not major modification of governmental policies, planning, or budgeting, or may create problems such as an increased rate of price inflation or housing shortages, or may substantially affect the economic well-being of residents of the area.	Economic effects occur which will require major changes in governmental policies, planning, or budgeting, or which have the potential to create major problems or to cause important and sweeping changes in the economic well-being of residents of the area.

**Table S-2**  
**Definitions Assumed in Effects Assessment**  
(Continued)

NEGLIGIBLE	MINOR	MODERATE	MAJOR
<b>Resource Category</b>			
<b>Commercial Fishing</b>			
Conflicts are rare. One-year losses to important commercial fisheries do not exceed 1 percent.	Minor conflicts develop. Losses of 1 to 3 percent, for periods of 1 or more years, occur in important commercial fisheries.	Minor conflicts are frequent or significant conflicts occur occasionally. Losses of 3 to 10 percent, for periods of 1 or more years, occur in important commercial fisheries.	Major disruptions to fishing occur. Conflicts are frequent and significantly affected fishing. Losses exceed 10 percent, for periods of 1 or more years, in important commercial fisheries.
<b>Subsistence-Harvest Patterns</b>			
Subsistence resources could be affected but with no apparent effects on subsistence harvests.	Subsistence resources would be affected for a period of less than 1 year, but no resource would become unavailable.	One or more subsistence resources would become locally unavailable for a period of time not exceeding 1 year.	One or more important subsistence resources would become locally unavailable for a period of time exceeding 1 year.
<b>Sociocultural Systems</b>			
Periodic disruption of local sociocultural systems occurs without apparent effects.	Short-term disruption of local sociocultural systems without a tendency toward the displacement of existing institutions.	Long-term (5 years or more), chronic disruption of local sociocultural systems occurs without a tendency toward the displacement of existing institutions.	Long-term (5 years or more), chronic disruption of local sociocultural systems occurs with a tendency toward the displacement of existing institutions.
<b>Archaeological Resources</b>			
No detectable archaeological resources (including landforms and sites) are expected to be present and disturbed.	Few archaeological resources (including landforms and sites) are expected to be present and disturbed.	Some archaeological resources (including landforms and sites) are expected to be present and disturbed.	Many archaeological resources (including landforms and sites) are expected to be present and disturbed.
<b>Recreation and Tourism Resources</b>			
Barely detectable reduction in recreation and tourism aesthetic qualities and economic expenditures.	Slight reduction in recreation and tourism aesthetic qualities and economic expenditures over one-fourth of the area lasting approximately 1 year.	Some reduced recreation and tourism aesthetic qualities and economic expenditures over one-half of the area lasting for approximately 2 years.	Much reduced recreation and tourism aesthetic qualities and economic expenditures over the whole area for approximately 3 to 4 years or longer.
<b>Land Use Plans and Coastal Management Programs<sup>6/</sup></b>			
Proposed activities generally conform with existing land use and have negligible effects on protected coastal resources and uses.	Proposed activities infringe on an existing land use, or create minor effects on protected coastal resources or uses.	Proposed activities alter a preferred land use, or create moderate effects on one or more protected coastal resources or uses.	Proposed activities are incompatible with or displace a preferred land use, or create major effects on one or more protected coastal resources or uses.
<b>Human Health</b>			
No change to the hair-mercury levels of any of the Nome population.	Hair-mercury levels of some of the general population residing in Nome would approach but not exceed recommended levels set for the general adult population. Any changes in hair-mercury levels of pregnant women do not reach 6 ppm. <sup>7/</sup>	Hair-mercury levels of one or more women of child-bearing age (because of potential effects to the developing fetus) residing in Nome would be elevated but would not exceed recommended levels set for pregnant women. <sup>9/</sup>	Hair-mercury levels of one or more women of child-bearing age (because of potential effects to the developing fetus) residing in Nome would exceed recommended levels set for pregnant women. <sup>9/</sup>

Table S-2  
Definitions Assumed in Effects Assessment  
(Continued)

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Source: MMS, Alaska OCS Region.

- <sup>1/</sup> NAAQS are based on the protection of human health. Numerical standards for each pollutant are given in Table III-2. PSD increments are supplements to the NAAQS protecting existing high air-quality areas. Regional refers to effects on areas that are as large as, or larger than, about one-half the area of the North Slope of Alaska. Local refers to effects limited to tens of miles near the shoreline. Short term refers to hours, days, or weeks; long term refers to seasons or years.
- <sup>2/</sup> Visibility criteria are applied only to PSD Class I areas; significance is determined by EPA visibility-analysis guidelines. Long term refers to seasons or years. Short term refers to hours, days, or weeks.
- <sup>3/</sup> a. The State standard and EPA chronic criterion for mercury are both 0.025 ppb.  
b. The acute State standard and EPA criterion for mercury are both 2.1 ppb.  
c. State standards and EPA criteria allow exceedence of trace-metal limits once per 3-years on the average.  
d. For water turbidity, the State standard is 25 NTU and EPA criterion is a 10-percent decrease from seasonally averaged compensation depth.
- <sup>4/</sup> A breeding cycle is the average time period between the births of successive offspring.
- <sup>5/</sup> A generation is the average time period between the birth of the parents and birth of their offspring.
- <sup>6/</sup> Definitions reflect inconsistencies between the proposal and land and water regulatory regimes, not effects of the proposal on the regulations.
- <sup>7/</sup> The WHO environmental health criteria in 1976 established 200 ppb mercury in blood or 60 ppm in hair as the level where effects from methylmercury exposure begin to be seen in adults.
- <sup>8/</sup> "Elevated" is defined as 6-10 ppm in hair.
- <sup>9/</sup> The new World Health Organization (WHO) environmental health criteria document (to be published in 1990) will state that the occasional psychomotor retardation effects from prenatal exposure to methylmercury can be seen in infants and children whose mothers had mercury hair levels between 10 and 20 ppm (Clarkson, 1989, oral comm.)



# **SECTION I**

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## **PURPOSE AND BACKGROUND OF THE PROPOSED ACTION**

## Section I Table of Contents

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## I. PURPOSE AND BACKGROUND OF THE PROPOSED ACTION

**Purpose of the Proposed Action:** The purpose of the proposed action is to offer for lease submerged Federal lands in the Norton Sound in the vicinity of Nome, Alaska, for leasing, mining, and recovery of gold and any other mineral recovered with gold or other mineral recovered using technology similar to that used for recovering gold.

**The Need for the Proposed Action:** There are sufficient National and industry interest and existing economic incentives to support selected commercial-scale mining in the Federal Outer Continental Shelf (OCS). The OCS Mining Program is being developed on a case-by-case basis. The Director of Minerals Management Service (MMS) may offer areas for lease on Department of the Interior (DOI) initiative or when requested by an interested principal. In November 1987, industry requested initiation of a lease sale in the OCS waters in Norton Sound. Also, in November 1987, the State of Alaska expressed interest in forming a cooperative agreement with the MMS to initiate a Federal/State task force on offshore mining in Federal waters. Since offshore mining of gold placer deposits was presently occurring in State waters in Norton Sound, the State expressed the need to evaluate the feasibility of developing mineral resources and developing the technical guidelines and procedures for safe, effective, and environmentally sound exploration and mining of mineral resources on the OCS.

**Background of the Proposed Action:** The DOI believes that recovery of minerals and protection of the environment are compatible and that both objectives can best be met by the planned case-by-case approach which allows for management flexibility, opportunity for effective coastal State participation, and environmental review. The OCS Mining Program does not represent a decision to lease in a particular area. Instead, it is representative only of the DOI's intent to consider leasing in certain areas, and to proceed with the offering of such areas only if it should be determined that leasing and mining would be technically feasible and environmentally acceptable.

Under the Outer Continental Shelf Lands Act, 43 U.S.C. 1331 et. seq. (1982 and Supp. III 1985) (OCSLA), as amended, the DOI is charged with administering the mineral development of the OCS. Pursuant to section 8(k) of the OCSLA, the Secretary of the Interior is authorized to lease any minerals, other than oil, gas, and sulphur, on the OCS on the basis of competitive bonus bidding under such terms and conditions as he may prescribe at the time of offering the area for lease. Included within this authority is the Secretary's responsibility for the design, implementation, and management of OCS minerals development. The term "minerals," as defined in the OCSLA, includes not only oil and gas, but sulphur, geopressured-geothermal and associated resources, and all other minerals which are authorized by an act of Congress to be produced from "public lands" as defined in section 103 of the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1702).

The Mining and Minerals Policy Act of 1970 (30 U.S.C. 21a) establishes that it is the policy of the Federal Government to foster and encourage private enterprise in (1) the development of economically sound and stable domestic mining, minerals, metal, and minerals reclamation industries; and (2) the orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help ensure satisfaction of industrial, security, and environmental needs. The proposed leasing action is consistent with the aforementioned laws and with the Secretary's announced program of January 19, 1982, for OCS mineral leasing activities on the Federal OCS.

The OCS jurisdictional authority of the United States is defined in the OCSLA to include all submerged lands lying seaward and outside the areas beneath navigable waters, as defined in section 2(b) of the Submerged Lands Act of 1953 (43 U.S.C. 1301(b)), as amended (generally 3 geographical miles (mi) from the coastline), and of which the subsoil and seabed appertain to the United States and are subject to its jurisdiction and control.

The OCS extends at least to the seaward limit of the Exclusive Economic Zone (EEZ) as proclaimed by the President on March 10, 1983 (48 FR 10605) and beyond the EEZ in certain locations to the physical limit of the Continental Shelf. On May 30, 1985, the DOI Solicitor issued a formal legal opinion that the DOI is authorized to issue mineral leases within the EEZ of the coastlines of the 50 states.

In the United States, industry interest in OCS mining has been focused on eight heavy metal placers, strategic minerals, sand and gravel, and phosphorite. Furthermore, gold is being recovered in State waters near Nome, Alaska, and sand and gravel in New York State waters.

The U.S. Bureau of Mines (BOM) Open-File Report 4-87, "An Economic Reconnaissance of Selected Heavy Mineral Placer Deposits in the U.S. Exclusive Economic Zone," notes several reported placers offshore Alaska.

The gold placers near Nome are the best known and appear to have the highest potential for near-term development. Onshore placers at Nome have yielded over 5 million troy ounces of gold (1898-1985).

In 1967, the DOI initiated a Heavy Metals Program to explore for valuable minerals not only off the coast of Nome, Alaska, but also off the coasts of California and Oregon. The U.S. Geological Survey (USGS) and the BOM were searching for deposits of gold, silver, platinum, mercury, bismuth, antimony, tantalum, and other heavy metals. Such minerals would be essential to the space program as well as for defense and domestic needs. The outlook was for discovery of deposits of gold, silver, and other metals in the tidelands off Nome's beaches of sufficient value to merit substantial investment of money by the Federal Government and by private industry to bring the precious metals to the surface and process them for use.

The BOM took to the sea in May 1967 using two seagoing vessels containing a variety of instruments to probe the ocean floor off the coasts of Alaska, Oregon, and California. Secretary Udall had stated "This expedition is the most ambitious effort so far in the Department's new heavy metals program which aims at increasing the Nation's recoverable reserves of metals like tin, silver, and mercury, as well as gold. Bureau experts hope to evaluate undersea deposits of these metals--especially gold--with special ocean floor sampling drills suspended from the deck of the Virginia City" (BOM, 1967).

In the Heavy Metals Program, using the vessel Virginia City, a 180-square-mile area of Norton Sound, extending roughly 14 mi east and west of Nome and averaging 6 mi to the south was tested. Approximately 21 tons (T) of sediments, representing 727 individual samples, were processed in the ship's laboratories with microscopic and instrumental analyses for mineral evaluation and deposit characterization. (Alaska Industry, 1969). Out of a total of 62 days in the area, drilling activity was shut down 15 days because of bad weather. In 1986, Inspiration Mines Inc. used a large, bucket-ladder dredge (the Bima) to mine marine placers offshore Nome within the State of Alaska's area of jurisdiction. The Bima produced approximately 3,000 troy ounces of gold from State offshore leases during development testing in 1986.

In 1987, Western Gold Exploration and Mining Company Limited Partnership (WestGold) (formerly Inspiration Mines Inc.) again dredged offshore Nome in State waters. The 1987 season produced 36,709 troy ounces of gold (Table II-4). The company also drilled 548 exploration holes with a Becker drill in the spring and summer of 1987 in State waters.

Production of gold for the 1988, 1989, and 1990 mining season produced 35,554; 30,662; and 15,208 troy ounces of gold, respectively (Table II-4). Due to financial difficulties in November 1990, WestGold was dissolved and the Bima was placed on the market for sale.

#### A. Leasing Process

The OCSLA authorizes the Secretary of the Interior to administer mineral exploration and development on the OCS as well as conserve its natural resources. The law, among other things, requires that the Secretary develop these minerals in an orderly and timely manner to meet the energy and mineral needs of the country; to protect the human, marine, and coastal environment; and to receive a fair and equitable return on the resources of the OCS. The Secretary has full authority to implement the leasing provisions of the OCSLA regarding minerals and to regulate how they will be extracted and produced. Further, the Secretary has authority to cancel a lease or permit for mining of minerals, after a hearing, for environmental reasons, when: (1) continued activity pursuant to such lease would probably cause serious harm or damage to life, property, any mineral, national security or defense, or to the marine, coastal, or human environment; (2) the threat of harm or damage will not disappear or decrease to an acceptable extent within a reasonable period of time; and (3) the advantages of cancellation outweigh the advantages of continuing such lease or permit in force.

The following is a brief discussion of the decision making steps for the OCS Mining Program, Norton Sound Lease Sale.

1. Joint Federal/State Technical Coordination Team: Based on interest in leasing expressed for mining mineral resources, and at the request of the Governor of Alaska, a Federal/State Technical Task Force was established by the Secretary of the Interior and the Governor of Alaska to ensure early and continued consultation in the Norton Sound Lease Sale process. Announcement of formation of the technical task force was February 5, 1988. This technical task force was later organized into a Joint Federal/State Technical Coordination Team (CT) in March 1988.



The goal of the CT is to share in scoping and in evaluating the EIS to assess the development of potential gold placers and other OCS mineral resources (other than oil, gas, and sulphur) and provide comments to the Director of MMS and the Governor of Alaska regarding the possible leasing and development of those mineral resources on the OCS. The CT organization consists of two co-chairmen--one appointed by the Secretary of the Interior and one appointed by the Governor of Alaska. A coordinator was designated jointly by the DOI and the State of Alaska to facilitate the exchange of information and aid in planning or scheduling the CT's activities. Team members include representatives of the DOP's MMS, Fish and Wildlife Service (FWS), USGS, and BOM; the National Marine Fisheries Service (NMFS), Environmental Protection Agency (EPA), U.S. Army Corps of Engineers, U.S. Coast Guard; the State of Alaska's Office of the Governor, Division of Governmental Coordination, and Departments of Natural Resources (Divisions of Mining and Geological and Geophysical Surveys), Fish and Game (Divisions of Habitat and Subsistence), Environmental Conservation, Community and Regional Affairs, and Commerce and Economic Development (Division of Minerals and Forest Products); UAF (Institute of Marine Science), Bering Straits Coastal Management Program, City of Nome, City of Golovin, Kawerak, Sitnasuak Native Corporation, Nome Eskimo Community, Eskimo Walrus Commission, Bering Sea Fishermen's Association, Alaska Miners Association, Friends of the Earth.

Individuals representing claim holders or mining companies or other financial or vested interests are observers to the CT. The observers include Greatland Exploration, Alaska Standard Mining Incorporated, Aspen Exploration, BHP Utah, Englehard West, Inc., Meacham and Associates, ENSR (formerly NORTEC), WestGold, Inspiration Gold Incorporated, Placer Dredging and Technology, Inc., WGM Inc., Charter Resources, Giant Bay Resources, Ltd., Offshore Exploration and Mining, Queenstake Resources, Ltd., Thurman Oil and Mining, Joe Manga, and Ron Martin. Contingent upon the Director's decision, and taking into consideration the recommendations of the CT, the Director may receive and act on indications of interest for OCS minerals other than oil, gas, and sulphur in the Norton Sound Lease Sale area.

The State of Alaska and the DOI entered into a Cooperative Agreement (No. 14-12-0004-60123) on June 20, 1988, for the purpose of providing for an intergovernmental cooperative project to share expertise in developing an OCS Mining Program. The original agreement covered a period of 14 months and has been extended an additional 11 months. An additional extension is being processed.

The CT is the mechanism for information exchanges provided to the State of Alaska as an opportunity to cooperatively participate in the planning and review of prelease documents. Since April 1988, the CT has extensively participated in the prelease process of the OCS Mining Program, Norton Sound Lease Sale.

CT meetings were held April 1, 1988; July 29, 1988; November 1988 in conjunction with the November 1988 Workshop; January 6, 1989; November 1989 in conjunction with the November 1989 Workshop; February 27, 1990; and September 28, 1990. In addition, the CT had the opportunity to review and comment on two preliminary versions of the November 1988 DEIS, the November 1988 DEIS, first preliminary FEIS in March and April 1989, a second preliminary FEIS in June 1989, a preliminary second DEIS in February 1990, the second DEIS in June 1990, and a preliminary FEIS in September 1990.

**2. Request for Comments and Nominations and Notice of Intent to Prepare an Environmental Impact Statement:** A Request for Comments and Nominations (Request) and Notice of Intent to Prepare an EIS (NOI) were notices published in the Federal Register inviting the mining industry, governmental agencies, environmental groups, the State of Alaska, and the general public to comment on areas of interest or special concern in the proposed sale area. The Request and NOI for the proposed Norton Sound Lease Sale were published in the Federal Register on March 11, 1988, (53 FR 8134), requesting comments on areas of interest; suggested rental amounts, minimum bids, and royalty rates; primary term of lease; technology presently available or anticipated for mining the OCS; possible conflicts with coastal management programs; and the possible need for additional geological and geophysical data. Comments on the Request and NOI were to be received no later than 30 days after publication in the Federal Register. The comments received from the Request and NOI are discussed under scoping in Section I.A.4 below and Section I.D. The comments submitted provided information on lease terms and block size and identified significant environmental concerns. The Request area was located in Norton Sound in the vicinity of Nome, Alaska, and covered approximately 141,000 hectares (approximately 350,000 acres) containing 77 blocks.

Ten comments on the Request were received including comments from the City of Yakutat, Trustees for Alaska, NMFS, State of Alaska, WGM Inc., Bering Sea Fishermen's Association, University of Alaska, Kawerak Inc., EPA, and National Oceanic and Atmospheric Administration. Three expressions of industry interest were

received from Westgold, WGM, Inc., and Giant Bay. Interest was shown in the entire Request area. Nominations were also received on 43 blocks outside of the Request area.

3. **Area Identification:** Based on information received from the response to the Request--together with recommendations from the MMS, NMFS, and FWS; the CT; comments from the Governor of Alaska on technological and socioeconomic information; and the DOI's environmental, technological, and socioeconomic information--the Director selects an area for further environmental analysis and study. On May 20, 1988, the Assistant Secretary, Lands and Minerals Management selected 40 blocks in the Norton Sound, an area of 72,148 hectares (approximately 178,282 acres), for EIS analysis as the proposal. The area selected was based on consideration of the comments received on the Request. Certain selected subsistence use areas were deleted in the central, western, and eastern parts of the Request (see Sec. I.D.4). In December 1989 six blocks were deleted from the proposed sale area because of their apparent importance as red king crab habitat. The proposal area was reduced to 34 whole and partial blocks and approximately 147,050 acres (See Fig. I-1).

4. **Scoping:** The NOI, published in the same document as the Request, announces the scoping process that would be followed for the EIS. The Council on Environmental Quality defines scoping as "an early and open process for determining the scope of issues to be addressed in an environmental impact statement and for identifying the significant issues related to a proposed action" (40 CFR 1501.7). It is a means for early identification of important issues deserving analysis in an EIS.

Comments were invited from affected Federal, State, and local government agencies; Native groups; the mining industry; special-interest groups; and any interested persons. Information obtained from the Request and NOI were considered in scoping the EIS.

Based on information gained through the scoping process--which included MMS staff evaluation and input--major issues, alternatives to the proposed action, and measures that could mitigate the effects of the proposed action were identified for analysis in the EIS.

The MMS held a scoping meeting in Nome, Alaska, on March 31, 1988. The results of the scoping process for this proposed sale are presented in Section I.D. of the EIS. After publication of the first DEIS in November 1988, MMS continued the scoping process by collecting new data and refining issues when developing the second DEIS.

5. **Endangered Species Consultation:** Pursuant to Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1536), the MMS consults with the FWS and the NMFS, as appropriate, to determine whether an activity it authorizes, funds, or conducts may affect a species that is listed as endangered or threatened and whether a species may be jeopardized by the proposed action. Section 7(c) of the Endangered Species Act of 1973, as amended, requires that under certain circumstances, a Federal agency prepare a biological assessment for listed and proposed threatened and endangered species or critical habitat that may be present in an area of a proposed major Federal action. The assessment evaluates the potential effects of the action and may also be used to determine whether or not the action will "adversely affect" any listed species or critical habitat and thus require formal consultation. The MMS completed a biological assessment for the proposed OCS Mining Program Norton Sound Lease Sale in March 1988. The biological assessment was submitted to NMFS and FWS on April 4, 1988, for their 30-day review and determination if further Section 7 consultation was necessary. Both NMFS (May 5, 1988, letter) and FWS concurred with the "no adverse effect" findings of the biological assessment and concluded that further Section 7 consultation was not required.

The NMFS, in their concurrence letter (May 9, 1988), recommended that a gray whale monitoring program be required in lease blocks west of 166° W. longitude. The biological assessment addressed a much larger proposed sale area. Since the assessment was written, the proposed sale area was greatly reduced during Area Identification and all potential lease blocks are now east of 166° W. longitude. Also, the MMS notified the NMFS (September 28, 1988) that it had concluded that the new information concerning trace-metal effect would not change the original decision of the biological assessment "no adverse effect" on the gray whale. Therefore formal consultation would not be requested.

The FWS recommended in their memorandum of concurrence (May 24, 1988) that protection measures for nesting peregrine falcons be incorporated into lessees' exploration and mining plans and that water quality meet Federal water-criteria standards for mercury and cadmium. Subsequent to the assessment, and after review of available information, MMS determined there was a possibility that water-quality criteria for cadmium and mercury might be exceeded (see Sec. IV.B.2). Also, FWS then informed MMS that a 1988 peregrine falcon

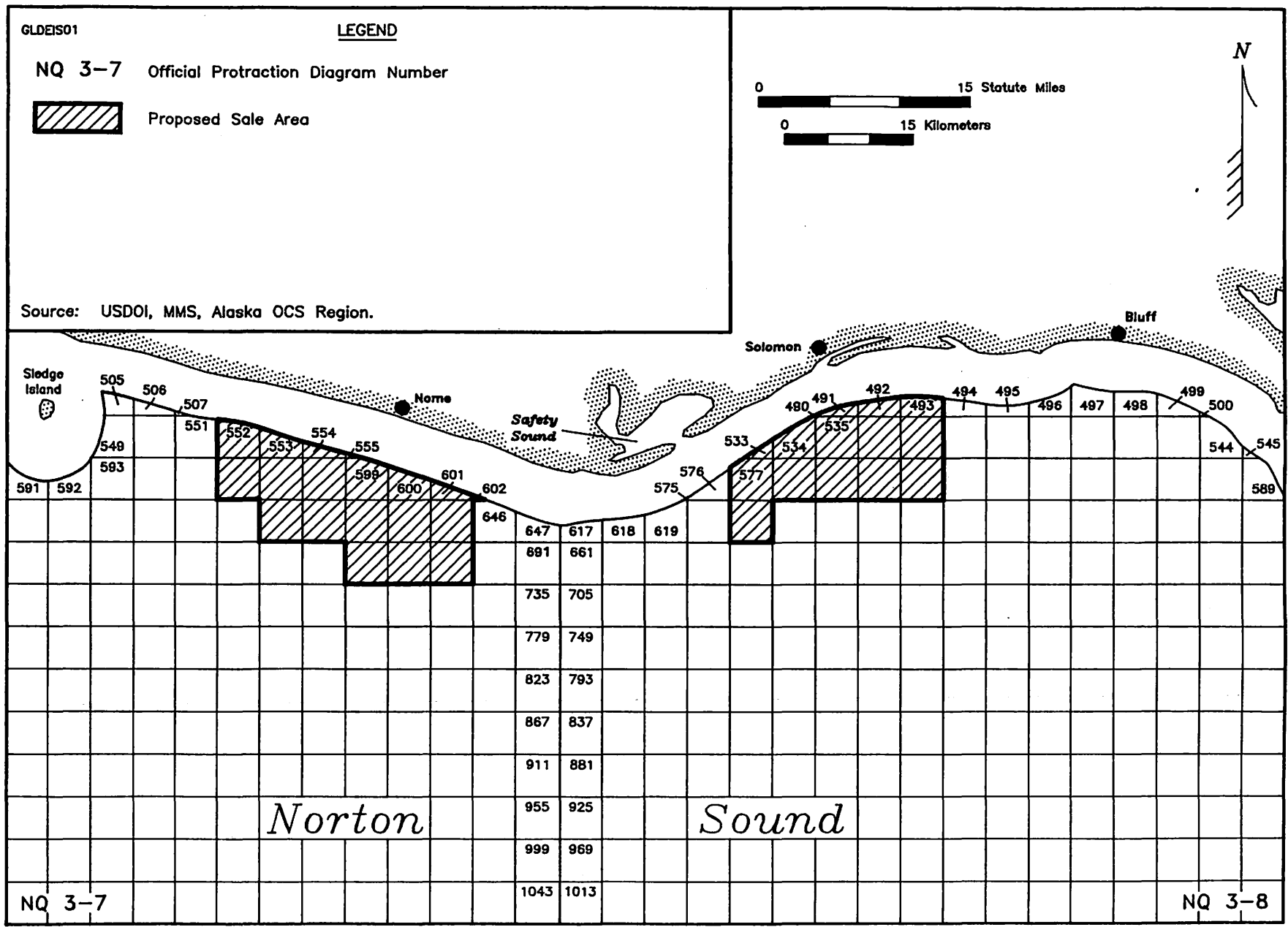


Figure I-1. The Proposal

survey documented additional nesting sites in the area (Ambrose, 1988, oral comm.). Due to this new information, MMS requested initiation of formal Section 7 consultation with FWS by a September 21, 1988, memorandum.

The FWS responded with their June 7, 1989, biological opinion which concluded that the proposed OCS mining activity would not jeopardize the continued existence of the arctic peregrine falcon. The FWS recognized that there could be an "incidental take" of arctic peregrine falcons due to the activities, and provided MMS with "reasonable and prudent measures" and "terms and conditions" to minimize the amount or extent of "incidental take." Subsequently, in recent state-of-the-art sampling and analysis for trace metals in Norton Sound during the summer and fall of 1989, the EPA criteria for mercury and cadmium were not exceeded (see Sec. IV.B.2). Therefore, MMS reinitiated formal Section 7 consultation with the FWS on January 23, 1990 to obtain a new biological opinion which would reflect this updated information.

The FWS reviewed the new information on water quality and the new data collected on mercury concentrations in the Norton Sound arctic peregrine falcon population and concluded in their June 26, 1990, second biological opinion that the proposed mining activity would not jeopardize the continued existence of the arctic peregrine falcon. This conclusion was "based, in part, on the inclusion of Stipulation No. 2 (prohibition of the use or storage of mercury on-board the dredge) in the lease conditions and the assumption that the Federal water quality criteria (marine chronic) for mercury will not be exceeded." The FWS also determined that an "incidental take" was no longer anticipated, as described in their June 7, 1989 opinion. The FWS recommended that the arctic peregrine falcon be included in Stipulation No. 1 as a species to be monitored for accumulation of trace metals and population status.

The NMFS issued an emergency interim rule listing the Steller (northern) sea lion as threatened on April 5, 1990. The MMS reviewed information on Steller sea lions and determined that no "may affect" situation exists for this proposed sale. The MMS notified NMFS of this determination (July 25, 1990, letter) and their reply is incorporated in the FEIS. The NMFS concurred with the MMS conclusion with their October 25, 1990, letter.

(See Appendix B for the biological assessment, biological opinions, and other documentation of the Section 7 consultation process.)

**6. Proposed Action and Alternatives Memorandum and Update Memorandum (UDM):** The purpose of the Proposed Action and Alternatives Memorandum (PAAM) is to present issues and items for decision and preliminary preference to the Director of MMS related to the OCS Mining Program, Norton Sound Lease Sale. More specifically, the purpose of the PAAM is to provide a framework for the Director to (1) make decisions on the Proposal and alternatives that are necessary to the structure and analysis of the second draft EIS; and to (2) indicate preliminary preferences for key lease terms and conditions in order to focus external review and comments. The PAAM contains an up-to-date discussion of the most important issues related to the proposed sale. This includes summarized public comments on these issues so that the Director has an informed basis for making preliminary decisions. The PAAM is the preliminary decision document for the DEIS and the Draft Proposed Leasing Notice.

The PAAM was provided to the CT for review of the preliminary preferences selected by the Director of MMS for the second DEIS and draft PLN. The PAAM was signed by the Director on January 18, 1990 and copies are available from MMS. After CT review, an UDM is prepared to present the most current information and items for decision to the Director of MMS. One of the primary functions of the UDM is to present and address CT comments on the PAAM, environmental analysis in the preliminary second DEIS, and the draft PLN in accordance with 30 CFR 281.16.

**7. Preparation of the Draft Environmental Impact Statement (DEIS):** As required by Section 102(2)(C) of the National Environmental Policy Act (NEPA) of 1969, an EIS is prepared on any major Federal action significantly affecting the quality of the human environment. The Council of Environmental Quality regulations also permit an agency to prepare an EIS whenever the agency believes it would aid in decision making.

The DEIS describes the potentially affected marine, onshore, and human environments; presents an analysis of potential adverse effects on these environments; describes potential mitigating measures to reduce the adverse effects of offshore leasing and mining and possible alternatives to the proposal; and presents a record of consultation and coordination with others during the DEIS preparation.

The document is filed with the EPA, and its availability is announced in the Federal Register. Any interested party may request a copy of the DEIS by contacting the MMS office listed in the Federal Register notice. The public has 45 days to review and comment on the DEIS.

The first DEIS for the Norton Sound Lease Sale was filed with the EPA on November 23, 1988. The public had until January 17, 1989, to review and comment on the DEIS. Major effects from the proposal were anticipated for water quality, commercial fisheries, subsistence-harvest patterns, and sociocultural systems based on available data. As defined in the first DEIS, the Proposal did not include stipulations and ITL clauses specifically designed to mitigate adverse effects from mining. The State, Federal, and local government agencies, as well as members of the public expressed concern that the information used for the November 1988 DEIS was inadequate for proper analysis and reasoned decisions. Lack of information was of concern in the following subject areas: the level of mercury in the water column; the bioaccumulation of mercury in the food chain; levels of mercury in humans; and the effect of dredging on habitat, particularly for red king crab.

On November 29 through December 1, 1988, MMS sponsored a Workshop on Mercury in the Marine Environment. Experts in the areas of mercury in water and sediments, mercury accumulation and effects in organisms, and mercury effects on human health provided their knowledge and expertise to MMS and in particular, the authors of the EIS.

In January 1989, the period for comment on the DEIS closed. Three major concerns were inadequate data on trace metals in the water column, mercury levels in humans, and king crab habitat.

In March 1989, the preliminary FEIS was sent to the CT. The preliminary FEIS incorporated comments on the DEIS. Review of the preliminary FEIS concluded that appropriate Federal public health agencies should review the EIS for human health concerns. The preliminary FEIS was sent to Federal public health agencies, including the Public Health Service (PHS) and the Indian Health Service (IHS) in April 1989.

The MMS responded to concerns over the accuracy of existing water-quality data in Norton Sound and in May 1989 contracted with Battelle Northwest to acquire new trace-metal data using state-of-the-art collection and analytical techniques. A decision was also made to work with PHS and Norton Sound Health Corporation to obtain hair samples of women of childbearing age for mercury and arsenic analyses.

In June and September 1989, water samples were taken and analyzed under contract by MMS to obtain accurate data on trace-metal concentrations in the water column. Also in September 1989, a decision was made to prepare a second DEIS which would reflect the new information on water quality and trace metals in human hair and to include mitigating measures as part of the Proposal. In December 1989, six blocks were deleted from the proposed sale area because of their apparent importance as red king crab habitat. The MMS believes that including the new data on water quality, human health, and the inclusion of the mitigating measures, as well as the reduced area of the proposal (removal of some crab habitat), would more realistically reflect the anticipated outcome of the sale.

The MMS restarted the NEPA process and published a second DEIS in June 1990.

8. Publication of the Proposed Leasing Notice Concurrent with Filing the DEIS with EPA: Prior to offering OCS minerals in an area for lease, the Director will assess the available information including recommendations from the CT to determine lease-sale procedures to be prescribed and to develop a Proposed Leasing Notice which sets out the area to be offered for lease, the proposed primary term of the OCS mineral leases to be offered; lease stipulations including measures to mitigate potentially adverse effects on the environment; and such rental, royalty, and other terms and conditions as the Director of MMS may prescribe in the leasing notice.

The CT reviewed the draft Proposed Leasing Notice in February 1990. An Update Decision Memorandum (UDM) to the PAAM is prepared to address issues raised by the CT in their review of the draft PLN. The UDM provides the framework for the Director to consider CT comments and make decisions for the PLN. The Notice of Availability for a Proposed Leasing Notice is published in the Federal Register and is furnished to the Governor of Alaska. As provided for in 30 CFR 281.16(b), the Governor has 60 days to comment on the PLN. The PLN would propose the number of blocks to be offered, lease sizes, duration of lease, mineral to be leased, environmental stipulations, and financial considerations, which may include rentals, royalties, and bonding requirements. The PLN was published in the Federal Register on June 15, 1990 (55 FR 24430) with comments

due August 15, 1990. Comments were received from the State of Alaska, WestGold, Sitnasuak Native Association, and the Alaska Miners Association.

9. **Public Hearings:** Public hearings are held after release of the DEIS, and specific dates and locations for public hearings are announced in the Federal Register. Oral and written comments are obtained.

A public hearing on the November 23, 1988 first DEIS was held on January 5, 1989, in Nome, Alaska. The public hearing for the second DEIS was held on July 18, 1990, in Nome, Alaska.

10. **Preparation of the Final EIS (FEIS):** Oral and written comments received on the DEIS are addressed in the FEIS, which is then filed with EPA and made available to the public. The availability of the FEIS is announced in the Federal Register.

The MMS withheld completion of the NEPA process of the November 23, 1988, DEIS leading to a FEIS because additional, pertinent data on trace metals in the water and humans were being collected in the summer and fall of 1989. The MMS restarted the NEPA process again with the preparation of a second DEIS published in June 1990.

11. **Decision Memorandum (DM) and Final Leasing Notice:** The DM, which is based in part on the FEIS, includes a discussion of significant information concerning the DOI's proposed lease sale. The DM provides relevant environmental, economic, social, and technological information to the Director of MMS to assist him in making a decision on whether to conduct a lease sale and, if so, what terms and conditions to apply to the sale and to the leases. The entire prelease process culminates in a final decision by the Director of MMS regarding whether to hold a lease sale and, if so, minerals to be leased, lease size, terms, and conditions. The Final Leasing Notice must be published in the Federal Register at least 30 days prior to the sale date. It may differ from the Proposed Leasing Notice depending upon the Director's final decision, i.e., size of lease sale, minerals to be leased, bidding procedures, and mitigating measures.

12. **Lease Sale:** The OCS Mining Program, Norton Sound Lease Sale is tentatively scheduled to be held in June 1991. The Final Leasing Notice will specify which of the bidding procedures will be used. Individuals bid on blocks and bidding units (those listed in the Final Leasing Notice) in a manner specified in the Final Leasing Notice. The MMS assesses the adequacy of the bids. If the bids are determined to be acceptable, leases may be awarded to the highest qualified bidders. However, the Director of MMS reserves the right to withdraw any blocks from the sale prior to written acceptance of a bid, and the right to reject any and all bids (generally within 90 days of the lease sale).

13. **Lease Operations:** Departmental regulations at 30 CFR 282 will govern all operations on leases issued for this proposed sale. The regulations provide that no exploration, testing, development, or production activities, except preliminary activities shall be commenced or conducted on any lease except in accordance with a plan submitted by the lessee and approved by the Director. Plans will not be approved before the completion of comprehensive technical and environmental evaluations to assure that the activities described will be carried out in a safe and environmentally responsible manner. The regulations also provide opportunity for review of plans by State and local governments, other Federal agencies, and other interested parties.

In addition, MMS will conduct environmental assessments on proposed site-specific plans to assess the potential environmental effects of a proposed activity based on the type of operation, including the number of mining activities, amount of area to be dredged, volume of dredged material, and type of processing to be used.

The lessees are required by regulation to monitor activities in a manner that develops the data and information necessary to enable the Director to assess the impacts of exploration, testing, mining, and processing activities on the environment on and off the lease; to develop and evaluate methods for mitigating adverse environmental effects; to validate assessments made in previous environmental evaluations; and to ensure compliance with lease and other requirements for the protection of the environment.

Furthermore, the regulations give MMS the authority to require environmental surveys and the monitoring of operations to ensure environmentally safe operations. The regulations also provide the authority to inspect operations and to suspend operations if they result in significant environmental effects, or if operations are in violation of existing laws, regulations, and lease terms.

## **B. Leasing History**

No Federal offshore lease sales for minerals other than oil and gas have been conducted on the Alaskan OCS. Four offshore sand and gravel lease sales were being considered for 1983-1986: three in the Beaufort Sea and one in the Bering Sea. The Alaska OCS Sand and Gravel Lease Sale I in the Beaufort Sea was proposed for October 1983 (USDOJ, MMS, 1983a). The FEIS was issued in March 1983, but due to the lack of further industry interest the sale was not held. A second sand and gravel sale in the Beaufort Sea was proposed in August 1984, but was cancelled due to negative response to a March 1984 Request for Supplemental Information.

There are State mining lease activities adjacent to the area proposed for sale. The State of Alaska first issued noncompetitive mining leases off Nome in 1966. The State of Alaska currently has 8 offshore mining leases (7 offshore in the Nome area and 1 offshore in the Bluff area). Six of the offshore mining leases in the Nome area are held by WestGold and one is held by NOMEKO. The offshore Bluff lease is held by Auric Offshore Mining Company. Offshore mining activities are currently being conducted by WestGold on one of the leases in the Nome area. No current mining activities have been planned for the lease in the Bluff area.

The State issued a Final Best Interest Finding on June 22, 1989. Beginning July 1989, the State issued offshore prospecting permits (OPP's) to the holders of existing OPP applications for selected areas near Nome, Alaska. The State of Alaska also accepted noncompetitive bids on 19 OPP tracts not under application. As a result, a total of 53 OPP's were issued in the vicinity of Nome, Alaska. The OPP's were issued with 10-year-terms and stretch from Sledge Island east to Golovin Bay off the coast of Alaska in the State's area of jurisdiction adjacent to the sale proposal. Minerals from land under a prospecting permit may not be mined and marketed or used except for limited amounts necessary for sampling or testing. A permit holder may apply for a noncompetitive lease when it has been shown to contain workable mineral deposits. Any area under OPP application either in whole or in part within Safety Sound was rejected by the State. The State deferred determinations on those OPP applications that were in "Special Use Areas" as defined in the Bering Straits Coastal Management Program.

The offshore mining activity by WestGold using the dredge Bima in State waters operated from June 17, 1987 through November 12, 1987, and produced 36,709 troy ounces of gold. The 1988 mining season began May 24, 1988, and ended November 13, 1988, and resulted in gold production of 35,554 troy ounces. The 1989 mining season began June 8, 1989, and ended November 11, 1989, and resulted in gold production of 30,661 troy ounces. The 1990 mining season resulted in gold production of approximately 24,00 troy ounces.

The MMS issued two geological and geophysical permits in 1987. Both permits were issued to WestGold, which operates the Bima in State waters. The MMS issued a geological and geophysical permit to EBA Engineering in 1990.

## **C. Legal Mandates, Authorities, and Federal Regulatory Responsibilities**

The MMS has published three sets of regulations to establish a separate regulatory regime for the leasing, exploration, and development of minerals other than oil, gas, and sulphur on the OCS. The prelease regulations cover geological and geophysical prospecting and scientific research activities conducted prior to lease issuance (30 CFR 280). The leasing regulations address the leasing procedures and the basic lease conditions. These regulations set out a framework for the process from the Request for Information and Interest to conducting the lease sale. Also, the leasing regulations provide that industry can request a lease sale of minerals or that DOI on its own initiative can prepare for the leasing of minerals other than oil, gas, and sulphur (30 CFR 281). The postlease regulations provide the authority to regulate the operations conducted by a lessee or operator on a lease. This includes establishing requirements for environmental surveys, monitoring programs, inspections of operations, and the review and approval of delineation, testing, and mining plans and lease operations. The regulations were written to recognize the special circumstances, issues, and requirements associated with the exploration and development of minerals other than oil, gas, and sulphur (30 CFR 282).

OCS Report MMS 86-003, "Legal Mandates and Federal Regulatory Responsibilities" (Alaska OCS Region Technical Report No. 4, Second Edition [Rathbun, 1986]), incorporated herein by reference, describes legal mandates and authorities for offshore leasing and outlines Federal regulatory responsibilities. The report contains summaries of the OCS Lands Act, as amended, a discussion on authorities of other Federal agencies affecting OCS activities, and a summary of significant litigation affecting OCS leasing policy. Although this report is formatted to the OCS oil and gas leasing program, there is information within the report that would be of interest regarding the OCS Mining Program. This information includes Parts I.A.1, Summary of OCS Law; I.A.4,

Environmental Studies Program; I.A.5, OCS Advisory Board; II, Authorities of Other Departmental Agencies having Direct or Indirect Effect on OCS Activities; III, Statutory Laws; IV, Case Law; and V, Federal Regulations except any information that is specific to oil and gas.

Alaska OCS Region Reference Paper No. 83-1, "Federal and State Coastal Management Programs" (McCrea, 1983) describes the coastal-management legislation and programs of the Federal Government and the State of Alaska.

#### **D. Results of the Scoping Process**

The scoping process for the OCS Mining Program Norton Sound Lease Sale EIS began with the analysis of the responses to the Request for Comments and Nominations and Notice of Intent to Prepare an EIS. A scoping meeting held March 31, 1988, in Nome, Alaska; and CT and MMS staff input was solicited. The MMS prepared a first draft EIS on the basis of these comments and the available scientific data.

1. **Major Issues Analyzed in the EIS:** The major issues listed in Table I-1 resulted from MMS staff evaluation of issues raised during the scoping process for this lease sale. The analysis in this EIS is focused on these issues.

2. **Issues Not Analyzed in the EIS:** The following concerns raised during the scoping process are not analyzed in this EIS for the reasons noted:

a. **Polar Bears and Ribbon Seals:** Polar bear and ribbon seals occur infrequently and in low numbers in Norton Sound. Due to the relative numerical insignificance of these species within the proposed sale area, they are not discussed further.

b. **Community Infrastructure:** Community infrastructure needs are not considered a major issue with respect to this lease sale. Local residents are assumed to comprise 40 percent of the mining workforce, similar to the workforce employed by the current offshore operation. The largest population increase generated by the Proposal is projected to be less than 5 percent of the total population of Nome and this would occur in the year that mining is assumed to begin. This is true in both the mean and high cases. Total population increases over the life of the project still would be less than 5 percent of the Nome population in the base case. This limited increase in population is not expected to stress the current community infrastructure.

c. **Subsistence Activities of Communities Other than Nome:** The proposed sale area is totally within the Nome subsistence-harvest area; therefore, potential effects that occur as a result of the lease sale will affect Nome primarily. Occasionally, seals and walrus may be harvested by residents of other communities in the sale area. Migrating subsistence resources may have the potential to be affected within the sale area and move to other coastal regions, thus, spreading any effects to other coastal communities. This point is addressed in Section IV.B.10.

d. **Analysis of Alternative Dredging Technologies:** The scenario discusses the mining technologies that are most likely to be used to exploit the potential hard mineral resources of the lease-sale area. Alternative technologies are mentioned as options and some of the advantages and disadvantages of using these systems are noted. Regardless of the technologies used, mining the marine-placer deposits in the lease-sale area will alter the environment in basically the same ways. Excavation will disturb part of the seafloor and cause turbidity in the water column in the vicinity of the cutting device. Disposal of the solid wastes also will cause turbidity in the water column and cover some part of the seafloor with a relatively thick layer of coarse-grained sediments and a thinner layer of fine-grained sediments; part of the seafloor that is covered by the disposed sediments most likely will be a previously excavated area. The dispersion of dredged material is affected by many factors. The environmental factors include (1) the characteristics of the dredged material--particle size and composition, and (2) the hydrologic characteristics--salinity, currents, and waves. Operational factors affecting dispersion include (1) dredge type, size, and production rate, (2) cutter configuration and operating rates, (3) discharge rates and the solids concentration of the slurry, and (4) discharge configuration. The variability between these different environmental and operational factors makes it difficult to compare the nature and extent of dredged material dispersion around various types of dredging operations.

e. **Effects Associated with the Onshore Refining and Chemical Treatment of the Placer Ore Concentrate ("Black Sands"):** It is unlikely that there will be any onshore refining in Alaska of the concentrates from offshore leases in the Norton Sound area. Based on an anticipated low gold content, it is



**Table I-1  
Major Scoping Issues**

Issues	Specific Concerns	Discussion Location in EIS
<b><u>BIOLOGICAL RESOURCES</u></b>		
<b>Marine Plants and Invertebrates (including Red King Crab) and Fishes</b>	<b>Effects from: dredging from destruction of bottom habitat turbidity plumes, siltation discharge of dredged tailings toxicity and bioaccumula- tion of mercury and other trace-metal concentrations fuel spills seismic activities reduction in food sources on recolonization on migration patterns of various fish</b>	<b>Sections IV.B.3 and IV.B.4</b>
<b>Marine and Coastal Birds</b>	<b>Effects from: noise and disturbance (vessels, aircraft, and dredging) fuel spills dredging and tailings deposition toxicity and bioaccumula- tion of mercury and other trace-metal concentrations seismic activities reduction in food sources</b>	<b>Section IV.B.5</b>
<b>Endangered Species (Arctic Peregrine Falcon, Gray Whale)</b>	<b>Effects from: noise and disturbance (vessels, aircraft, and dredging) habitat alteration and turbidity toxicity and bioaccumulation of mercury and other trace-metal concentrations fuel spills seismic activities reduction in food sources</b>	<b>Section IV.B.7</b>

**Table I-1  
(Page 2 of 4)**

<b>Issues</b>	<b>Specific Concerns</b>	<b>Discussion Location in EIS</b>
<b>Nonendangered Marine Mammals</b>	<b>Effects from:</b> noise and disturbance (vessels, aircraft, and dredging) dredging and tailings deposition toxicity and bioaccumulation of mercury and other trace- metal concentrations fuel spills seismic activities reduction in food sources	Section IV.B.6
<b>Biologically Sensitive Areas (Sledge Island, Safety Sound, Cape Nome, Nome River, Bluff)</b>	<b>Effects from:</b> dredging and tailings deposition	Sections IV.B.3, IV.B.4, IV.B.5, IV.B.6, IV.B.7
<b>Commercial Fishing (Red King Crab, Herring, and Salmon)</b>	<b>Effects from:</b> the interference of dredging activities with fishing operations reduction in populations and harvest levels of fish	Section IV.B.9
<b><u>SOCIOCULTURAL ISSUES</u></b>		
<b>Subsistence Hunting and Fishing</b>	<b>Effects on:</b> subsistence resources from noise and disturbance (vessels, aircraft, and dredging) from fuel spills contaminating Native foods from losses of subsistence resources accessibility of subsistence resources	Section IV.B.10
<b>Socioeconomic</b>	<b>Effects on:</b> employment and population lifestyle of local residents	Sections IV.B.8 and IV.B.11



**Table I-1  
(Page 4 of 4)**

<b>Issues</b>	<b>Specific Concerns</b>	<b>Discussion Location in EIS</b>
<b>Coastal Zone Management</b>	<b>Analysis of potential conflict between the proposal and the Alaska Coastal Management Program and the Alaska National Maritime Refuge</b>	<b>Section IV.B.14</b>
<b>Need for Further Studies</b>	<b>Monitor marine mammal and fish tissues for increases in toxic metals; monitor abund- ance of infauna and epifauna before and after mining; king crab distribution and abundance studies to determine effects of dredging noise on marine mammals; thickness and extent of settled, dredge-generated sediment and its effect on infauna and sessile species; effects on subsistence</b>	<b>Section II.F</b>

**Source: MMS, Alaska OCS Region.**

expected that the concentrate recovered from mining operations in Federal waters will be shipped to an existing domestic (continental U.S.) or foreign commercial refinery; presently there only are a limited number of refiners that potentially can process low gold concentrate. The concentrate from the Bima contains about 15 to 25 percent gold, and it is estimated that the concentrate obtained from mining in the lease-sale area will have a similar gold content.

f. Reclamation Plans: Nature may be the major reclaimer. In time, waves and currents associated with storms and limited ice gouging will alter the characteristics of the bathymetric features produced by deposition of dredged material. Also, any reclamation efforts would cause additional disturbance effects. Organisms that begin to populate a mined area would be disturbed by the excavations and the disposal operations of any reclamation activities. Also, some sediments would be resuspended causing additional turbidity in the water column and possibly increasing the areas covered by the resuspended sediments.

Most of the deposition of discharged material will occur in the dredged area, so this would help minimize overall changes to the seafloor bathymetry. The discharge of some fine-grained material may be adjusted to minimize water-column turbidity, rather than seafloor bathymetry (as noted in Sec. II.A.2, there may be a relationship between the manner in which fine-grained sediments are discharged and the mound of mud such a discharge creates.) Discharge of material will have to be evaluated to determine water-column turbidity and resuspension potential of fine-grained material deposited on the seafloor.

3. Mitigating Measures Suggested During the Scoping Process: The mitigating measures analyzed to mitigate the possible effects of the Norton Sound Lease Sale are described in Section II.F.2. The analysis in Section IV of this EIS assumes that the measures are in place with the exception of proposed Stipulation No. 5, Arctic Peregrine Falcon Monitoring Program. During the scoping process, the following suggestions for mitigating measures to protect certain resources were received and are discussed below.

a. Trace metals are a potential problem in food chains terminating with humans so it was proposed that predisturbance metal levels in tissues of relevant organisms be measured before and monitored during dredging. It was also proposed that mining operations be suspended or curtailed should monitoring show that serious harm to important marine species is likely. Mercury is an important concern in regard to this lease sale and several potential mitigating measures have been developed to address the issue: (1) Stipulation No. 1--Environmental Survey and Monitoring Program and Operations Management (see Sec. II.F.2) that has direct bearing on this subject, (2) Stipulation No. 2--Prohibition of Use of Mercury in Processing, and (3) Stipulation No. 3--Baseline and Monitoring Studies on Mercury Levels in Humans. The Regional Supervisor, Field Operations (RS/FO) "may require the lessee to modify operations plans to ensure that significant biological populations or habitats deserving protection are not affected."

b. It was requested that the EIS address the need to require monitoring programs as a condition of exploration and mining in this area. The regulations of 30 CFR 282.28(c)(1) require the lessee to monitor activities. Also, see Section II.F.2, Stipulation No. 1, Environmental Survey and Monitoring Program and Operations Management.

c. It was requested that mining be prohibited during periods important to subsistence hunting and during periods that would adversely affect subsistence resources. Since dredging activities can only occur during the open-water season, the same time as most subsistence activities, mining could not be prohibited and be successful at the same time. During the Area Identification process important subsistence harvest areas were deleted from the lease sale area. (See Sec. I.D.4.a for more details.) This reduces some potential conflicts between mining operators and subsistence hunters and fishermen. The MMS will also encourage the lessee to be aware and considerate of subsistence activities conducted during the open-water period and avoid conflict with them. See ITL No. 3, Information on Subsistence Activities, that details subsistence resources and harvest times. See also Alternatives IV and V (Secs. IV.E and IV.F) for differences in effects on subsistence harvests with further reductions in the size of the sale area.

d. It was proposed that provisions for suppressing the suspension of dredge-generated sediments should be included in mining plans for operations. Any dredging operation functioning in the sale area would be required to meet EPA water-quality criteria. There are different techniques for reducing the amount of material suspended during discharge; some of these methods are discussed in Section II.A.2.e. Stipulation No. 1, Environmental Survey and Monitoring Program and Operations Management (Sec. II.F.2) provides for this situation. Any exceedence of the EPA criteria would be detected by monitoring. The RS/FO "may require the



lessee to modify operations plans to ensure that significant biological populations or habitats deserving protection are not affected."

4. Alternatives Suggested During the Scoping Process:

a. During the scoping process for the OCS Mining Program, Norton Sound Lease Sale several commenters suggested three areas for deferral: Cape Nome, Bluff, Sledge Island, and Safety Sound--all important subsistence-resource-use areas of the residents of Nome. During the Area Identification process for this lease sale, these suggested deferral areas were deleted from the proposal, with the exception of 3 blocks: NQ 3-7; blocks 647, 691, and 735. In December 1989, these three blocks and three additional blocks (NQ 3-7; blocks 646, 690, and 734) were deleted from the proposal due to the apparent importance of this area for red king crab habitat. Two deferral alternatives are also being analyzed in the EIS in Sections IV.E and IV.F: the Eastern Deferral Alternative and the Western Deferral Alternative which give further protection to these areas, particularly Safety Sound (see Figs. I-2 and I-3).

b. The State of Alaska requested that MMS defer leasing of disputed blocks around the Nome Causeway. At this time, MMS does not consider these blocks as disputed. The State of Alaska signed a disclaimer to this area on May 9, 1984, prior to the causeway being built. Resolution of this matter is beyond the scope of this EIS because it is not an environmental issue and may involve an agreement between the DOI and the State at the time of the Final Leasing Notice.

c. Delay further mining until results of research done on the Bima are better understood. See Alternative III--Delay the Sale (Sec. IV.D). This alternative analyzes the effects of a 3-year delay that would provide time to review results of monitoring studies on the present dredging activities.

Research done on the activities and effects of these activities is being analyzed as it becomes available. The MMS Environmental Studies Program has done many studies in the Norton Basin area that apply to the general knowledge of the environment and some on effects from muds and cuttings from oil and gas drilling that apply to offshore mining. MMS contracted studies in 1988 and 1989 to gather water-quality data on trace metal concentration. A study also was conducted in conjunction with the U.S. Indian Health Service and the Norton Sound Health Corporation to determine levels of mercury in Nome women of child-bearing age. There also are ongoing environmental studies being conducted by WestGold as a part of the Bima monitoring program to determine the effects of WestGold's mining operations on State leases offshore of Nome. The EIS incorporates the new data and contains an extensive analysis of the available information relevant to the potential effects that may occur as a result of this proposal.

From November 29 through December 1, 1988, the MMS held a workshop entitled "Mercury in the Marine Environment." Experts in the area of mercury in water and sediments, mercury accumulation and effects in organisms, and mercury effects on human health provided their knowledge and expertise to MMS. In November 1988, the first DEIS was issued. Major effects from the proposal were anticipated for water quality, commercial fisheries, subsistence-harvest patterns, and sociocultural systems based on limited available data. As defined in the first DEIS, the Proposal did not include stipulations and ITL clauses specifically designed to mitigate adverse effects from mining. The State, Federal, and local government agencies, as well as members of the public expressed concern that the information used for the first DEIS was inadequate for proper analysis and reasoned decision. Lack of information was of concern for the actual level of mercury in the water column, the bioaccumulation of mercury in the food chain, levels of mercury in humans, and the effect of dredging on habitat, particularly for red king crab. In addition to the State, Federal and local government agencies reviewing the preliminary FEIS, MMS requested a review from public health agencies, including the U.S. Public Health Service (including the Indian Health Service [IHS]), the State Dept. of Health and Human Services, and the Norton Sound Health Corporation (NSHC).

In response to comments that data on mercury levels in humans were inadequate, MMS coordinated with the IHS and the NSHC in October 1989 to obtain human hair samples to be analyzed for levels of mercury and arsenic (results of this study are presented in Secs. III.D and IV.B.15).

In response to concerns that the data for the water-quality for the proposed lease sale were insufficient, MMS sponsored studies by the University of Alaska Fairbanks (USF) in October 1988 (Naidu et al., 1989) and by Battelle Northwest in June and September 1989 (Hood, 1989) to obtain additional trace-metal data for the ambient sale area and inshore waters (results are discussed in Secs. III.A.8 and IV.B.2).



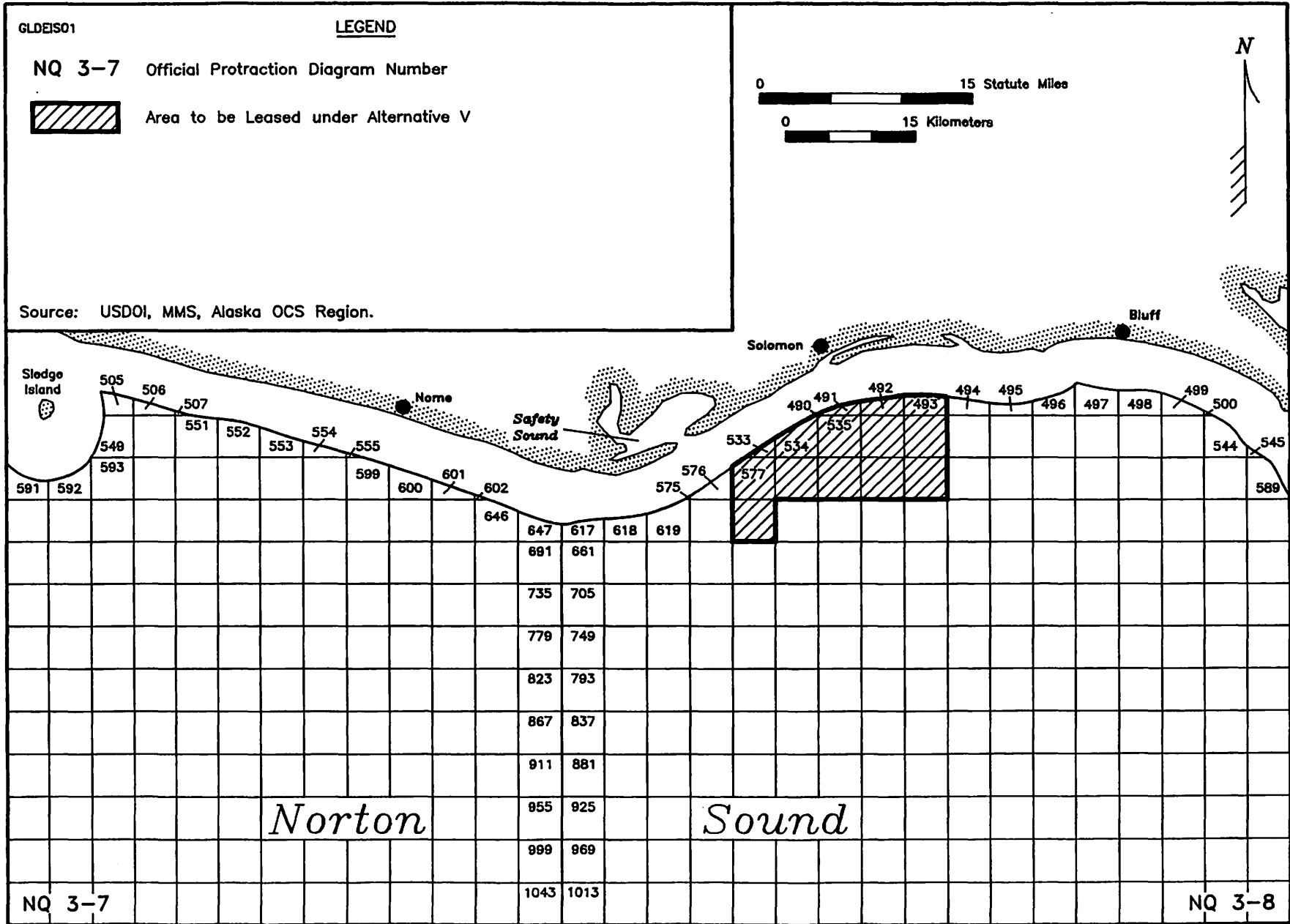


Figure I-3. Western Deferral Alternative (Alternative V)

The MMS sponsored a monitoring workshop from November 28 through 30, 1989, to determine how studies for monitoring water quality, habitat alteration, and human health should be designed. Experts in the areas of water and sediment sampling, effect of trace metals in marine organisms, habitat alteration, and mercury effects of trace metals in marine organisms, provided their knowledge and expertise to MMS, and in particular, the authors of the second DEIS.

The MMS decided to prepare a second DEIS to incorporate all of the new information obtained through these efforts. To accommodate the concern over king crab habitat, six blocks representing prime king crab habitat were dropped from the sale area. In addition, the MMS chose to include as part of the proposal (and the deferral alternatives) Stipulations Nos. 1, 2, 3, and 4 and ITL Nos. 1, 2, 3, and 5. The inclusion of these measures would ensure that any possible adverse effects would quickly surface and be mitigated as appropriate.

**SECTION II**

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**ALTERNATIVES  
INCLUDING  
THE  
PROPOSED  
ACTION**



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### NOTE TO THE READER:

#### Mining Scenario

The offshore dredge assumed for the scenario used in this Environmental Impact Statement is similar to the Bima, operated by WestGold to mine the offshore placer deposits in State of Alaska waters near Nome. In September 1990, WestGold announced that the Bima would not be operating during the 1991 mining season due to financial difficulties as well as needed repairs. In November 1990 the Bima was placed on the market for sale. It is considered highly unlikely that the Bima will be operating offshore Nome in the future. In October 1990 WestGold received a 5-year National Pollution Discharge Elimination System permit from Environmental Protection Agency for the Bima. While the Bima or a Bima-type dredge could be used for the proposed sale, the type of dredge that will be used is not known for certain at this time. It should be noted that no exploration, testing, development, or production plans will be approved before completion of a comprehensive environmental evaluation to assure that the activities described will be carried out in a safe and environmentally responsible manner (30 CFR 282.21, 282.25, and 282.28).

## II. ALTERNATIVES INCLUDING THE PROPOSED ACTION

### A. Alternative I - The Proposal

1. **Description of the Proposal:** The proposed action consists of 34 whole and partial blocks (Fig. II-1) to be offered for lease in June 1991. The total areal extent of the proposed Norton Sound Lease Sale is approximately 59,510 hectares (147,050 acres). The blocks that comprise the proposed action are located about 5 to 22 km offshore in water depths that range from about 20 to 30 m. The MMS has estimated that placer deposits of recoverable gold in the proposed lease-sale area for a base case could be 530,000 troy ounces. Stipulation Nos. 1, 2, 3, and 4 and ITL Nos. 1, 2, 3, and 5 are part of the proposal (see Sec. II.F).

The lease term for an OCS mineral lease for minerals other than oil, gas, and sulphur is assumed for this EIS analysis to be for a primary term of at least 20 years. The lease will continue beyond the specified primary term for so long thereafter as leased OCS minerals are being produced in accordance with an approved mining plan or the lessee is otherwise in compliance with provisions of the lease and the regulations under which a lessee can earn continuance of an OCS mineral lease.

### 2. Activities Associated with the Proposed Action (Base-Resource Case):

a. **Introduction:** The proposed OCS Mining Program Norton Sound Lease Sale is the first such sale proposed for the Norton Sound area. Although mining has not yet occurred in Federal waters, marine placer deposits in State of Alaska waters off the south coast of the Seward Peninsula were mined in the past and are presently being mined for gold.

The Seward Peninsula lies north of the sale area and contains many active and inactive placer and lode mines and prospects as well as known occurrences of metalliferous (metal-bearing) minerals. Placer deposits of the Seward Peninsula have produced gold and other minerals, and the beach placer deposits have been a major source of gold in the Nome area (Cobb, 1973). The lode mines have produced significant amounts of ore from deposits of tin, tungsten, and beryllium minerals and gold (Cobb, 1973). Small amounts of other metals also have been recovered but no currently economic deposits have been identified; uranium, thorium, and rare earth minerals also are present (Berg and Cobb, 1967).

Placers are mineral deposits formed on the earth's surface by the mechanical concentration of heavy, chemically resistant mineral particles from weathered debris by alluvial (river), lacustrine (lake), marine, eolian (wind) and glacial processes; the weathered debris is produced by the decomposition (chemical processes) and disintegration (mechanical processes) of the metalliferous veins, or lodes, and other rocks. Between 1898 and 1987, the Nome Mining District produced 4,561,219 troy ounces of refined gold and 533,032 ounces of silver from placer deposits (State of Alaska, Office of the Governor, 1989); about 76 percent of the historic gold production was derived from beach or strandline deposits. Also, through 1982, 349,560 troy ounces of gold and 48,938 ounces of silver were produced from the Solomon-Bluff District; some of the gold production, about 24,000 troy ounces, came from the Big Hurrah Lode Mine.

Alluvial, glacial, and beach placer deposits were formed on the exposed shelf of the northern Bering Sea/Norton Sound area during the glacial periods of the Pleistocene Epoch when sea level was lowered (Sec. III.A.3). In the proposed lease-sale area, the sediments in these placer deposits were derived from the weathering of rocks on the Seward Peninsula; as noted in Section III.A.3, marine sediments with high concentrations of metalliferous minerals occur relatively near known onshore placer or lode deposits containing minerals of these metals. During the interglacial periods, the placer deposits were modified by the currents and waves of the rising continental seas. Some of these placer deposits were buried by sediments associated with the last rise in sea level that began about 12,000 to 13,000 years ago.

Off Daniels Creek, near Bluff, high-grade gold-placer concentrations were mined with a modified high-line dragline in the 1930's; the dragline operations were done from the ice in the winter (Mulligan, 1971). In 1986, offshore placer-gold mining operations began in State of Alaska waters near Nome after several years of exploration and assessment (Bundtzen et al., 1987); State of Alaska leasing of tracts in the area presently being mined began in the early 1960's.

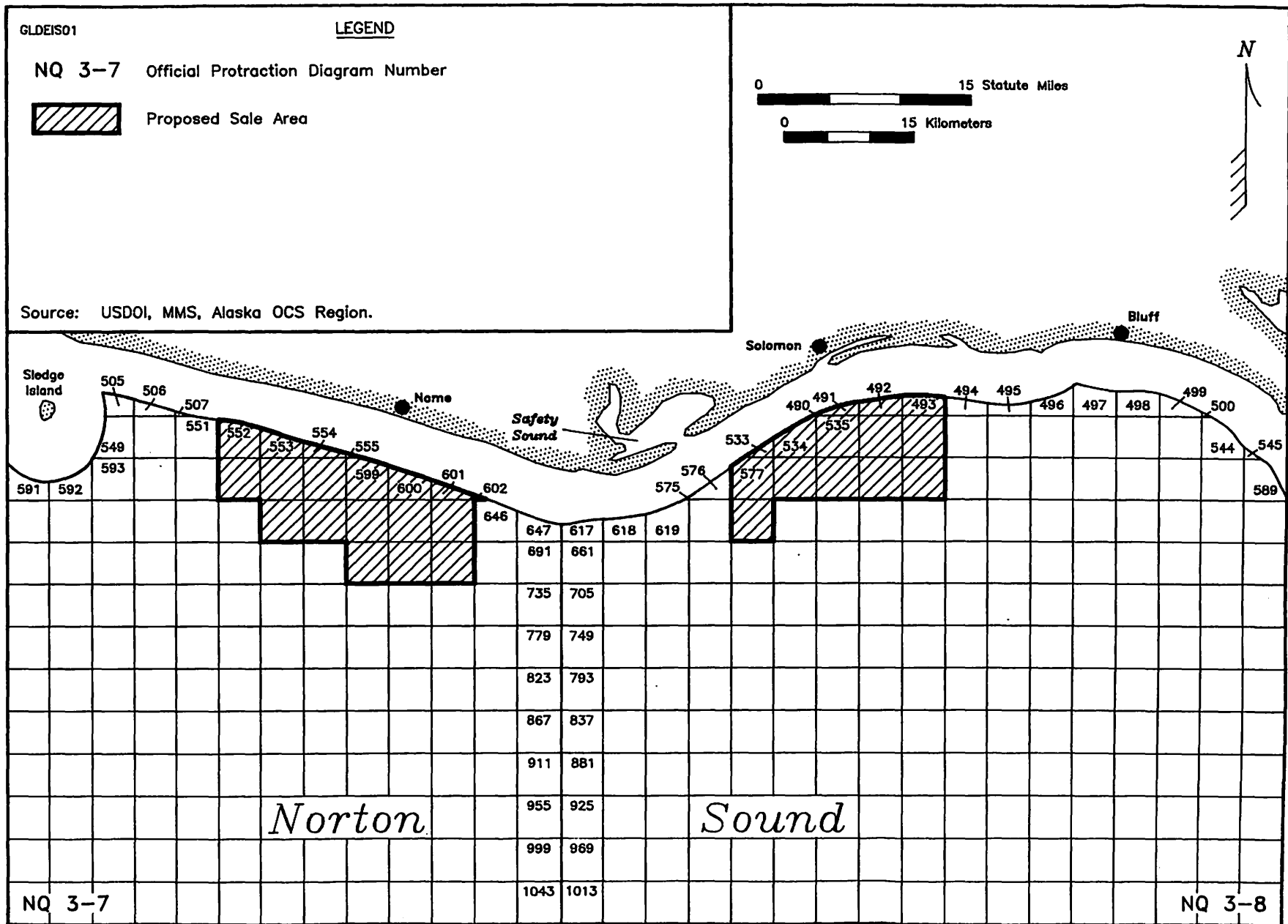


Figure II-1. The Proposal

b. **Resource Estimates and Basic Assumptions:** The gold resources estimated to be recovered from the placer deposits in the proposed lease-sale area are reported by MMS for a (1) base case--530,000 troy ounces--Table II-1 and (2) a high case--1,060,000 troy ounces--Table II-2.

At present, gold is the only marketable product that can be recovered from the mining of offshore Norton Sound placers. Other minerals containing metals may be present and may be recovered by the same processes used to recover gold. However, the remote location of the proposed sale area would limit the types of minerals that might be economically recovered (USDOJ, BOM, 1987).

There is a high degree of uncertainty associated with the gold resource estimates for the proposed sale area. The distribution of gold in the sediments of the continental shelf south of the Seward Peninsula is the product of diverse glacial, marine, fluvial (river), and crustal deformational processes (Kaufman and Hopkins, 1989). The uncertainty is also due to the extremely limited offshore data presently available to MMS. Since the State offshore leases were granted in 1962, over 3,600 boreholes had been drilled on the leases to the end of 1989. Nearly all of these boreholes were drilled by private industry and the data have been kept proprietary. From this rather sizeable data set, information on only 51 boreholes in State waters has been available to the Federal Government. Data from the boreholes in the nearshore area near Nome indicate the largest concentrations of gold are found in the upper 20 m of the sediment which have been extensively reworked (Kaufman and Hopkins, 1989).

In 1987, seven boreholes were drilled by industry in Federal waters just beyond the State leases. The data from these boreholes are proprietary and are restricted to a 1-km line within one Federal OCS tract. These are the only subbottom samples taken within the proposed sale area. Some seismic data are also available in the Federal tracts. These data resulted from a joint USGS/BOM high-resolution, seismic-reflection survey in 1967. More than 500 nautical miles of seismic data were collected nearshore Nome adjacent to the western part of the proposed sale area. Although, most seismic lines were in State waters, some extended into Federal waters. Also, in 1987, private industry obtained a permit to collect about 100 line mi of seismic data in Federal waters. However, no borehole or seismic data are available in the eastern part of the proposed sale area. Since an adequate database is seriously lacking for the resource assessment process, MMS incorporated other information with the limited borehole and seismic data. This includes: (1) the volume of gold extracted from the Nome area during the last 90 years; (2) a published estimate of the possible amount of gold that may still be discovered in the onshore and offshore areas around Nome; (3) using the Bima dredging operation in State waters as an analog; and (4) studying the general geology and ultimately identifying the sediment types associated with gold occurrences onshore and in State waters and projecting this information into Federal waters where data permit.

Sources of published data indicated that about 4.5 million troy ounces of gold have been mined in the Nome District and about 6 million troy ounces total have been mined on the Seward Peninsula since the turn of the century. Alaska Construction and Oil (1987) indicated that another 6 million troy ounces of reserves are thought to exist in the coastal plain between Nome and Anvil Mountain and in the offshore sediments. The source of this estimate cannot be documented or substantiated, but we believe a relatively small part of this total will exist in the proposed sale area if the geologic processes associated with gold mineralization extend into Federal waters.

Gold-bearing sediments were transported onto the continental shelf by rivers, and during glaciation periods, by advancing glaciers. It is known from seafloor mapping that the auriferous (gold-bearing) glacial deposits extend to approximately the 3-mi limit (Nelson and Hopkins, 1972), which suggests that the resource potential in Federal waters is less than that of State waters. Fine-grained gold particles may have been carried beyond the glacial deposits by stream action or ocean currents, but under similar hydrologic conditions coarse-grained gold particles might not be transported as far. Kaufman and Hopkins, (1990) suggested that gold-bearing material may have been transported seaward beyond the margins of the presently submerged glacial moraines by slumping and subaqueous gravity flow, or by melting from the bottom of calving icebergs. If correct, then the gold-bearing sediments might cover a larger portion of the proposed sale area than previously believed. It is also possible that buried glacial deposits exist beyond the currently mapped limit, but because of the general absence of borehole data in Federal waters this has not been determined.

It is not known what the total resource is in the proposed sale area, but by incorporating the above assumptions with the limited MMS data, we can use the Bima operation in State waters as an analog to estimate base and high cases. A one-dredge operation similar to the Bima would be the most likely scenario in Federal waters. For the 1987 and 1988 seasons, the Bima dredged almost 200 acres, and recovered 72,263 troy ounces of gold from approximately 2.4 million m<sup>3</sup> or 3.1 million yd<sup>3</sup> of material. This equates to about 0.030 troy ounces per m<sup>3</sup> or 0.023 troy ounces per yd<sup>3</sup> of recoverable gold. For the Federal operation, the deeper waters will allow

Table II-1  
OCS Mining Program Norton Sound Lease Sale  
Estimated Exploration and Mining Schedule  
Base Case

YEAR	Activity	Mining			
		No. of Dredges	Area (Acres)	Volume (million m <sup>3</sup> )	Gold (Troy Ounces)
1991	Lease Sale				
1992	Seafloor Surveys, Sampling, and Coring				
1993					
1994	Dredge Acquisition or Construction				
1995	Mining	1	50	1.0	25,000
1996		1	100	1.5	40,000
1997		1	100	1.5	40,000
1998		1	100	1.5	40,000
1999		1	100	1.5	40,000
2000		1	100	1.5	40,000
2001		1	100	1.5	40,000
2002		1	100	1.5	40,000
2003		1	100	1.5	40,000
2004		1	100	1.5	40,000
2005		1	100	1.5	40,000
2006		1	100	1.5	40,000
2007		1	100	1.5	40,000
2008		1	50	1.0	25,000
Totals			1,300	20.0	530,000

Source: USDOJ, MMS, Alaska OCS Region.



Table II-2  
OCS Mining Program Norton Sound Lease Sale  
Estimated Exploration and Mining Schedule  
High Case

YEAR	Activity	Mining			
		No. of Dredges	Area (Acres)	Volume (million m <sup>3</sup> )	Gold (Troy Ounces)
1991	Lease Sale				
1992	Seafloor Surveys, Sampling, and Coring				
1993					
1994	Dredge Acquisition or Construction				
1995	Mining	2	100	2.0	50,000
1996		2	200	3.0	80,000
1997		2	200	3.0	80,000
1998		2	200	3.0	80,000
1999		2	200	3.0	80,000
2000		2	200	3.0	80,000
2001		2	200	3.0	80,000
2002		2	200	3.0	80,000
2003		2	200	3.0	80,000
2004		2	200	3.0	80,000
2005		2	200	3.0	80,000
2006		2	200	3.0	80,000
2007		2	200	3.0	80,000
2008		2	100	2.0	50,000
Totals			2,600	40.0	1,060,000

Source: USDOJ, MMS, Alaska OCS Region.

more efficient dredging, but the ore grade is expected to be lower due to the physical characteristics of the glacial advance. Accordingly, the MMS estimated an average dredging rate of 100 acres per year and a gold recovery rate of just over 0.026 troy ounces per m<sup>3</sup> or 0.020 troy ounces per yd<sup>3</sup> from approximately 1.5 million m<sup>3</sup> or nearly 2 million yd<sup>3</sup> of sediment. By rounding our estimates, we can expect to recover about 40,000 troy ounces of gold per year. Next, from available information, the estimated Bima reserves vary widely from about 200,000 troy ounces to 1 million troy ounces of gold, with a project life of anywhere from 5 to 20 years. The MMS has estimated a Federal dredging project to last 13 to 14 years. Allowing for partial dredging seasons at startup and wind-down of the project, the total recoverable gold resource equals 530,000 troy ounces. For the high case, there are not enough data to support varying the recovery rates, etc. to the first dredge; therefore, we assumed that a second dredge would experience results similar to the first dredge. Under this assumption, the total recoverable gold for the high case would be 1,060,000 troy ounces. However, it is not certain that coarse-grained gold particles were transported beyond the currently mapped limit of glacial deposits, so these estimates may be optimistic. Fine-grained gold deposits are more likely to be present, but they would be less economically viable.

In addition to the excavation process, the assumptions used to develop the scenarios also include the timing of activities and the mineral concentration process. Due to the low concentrations of the gold placers, shipping the dredged material to a refinery where the gold is produced in the purity required by market would be prohibitive. Therefore, it is expected that the dredged material would be processed aboard the dredging vessel using a gravity concentration process. The gold ore would be concentrated only to a grade that would be practical for transportation to a refinery where the gold would be produced in required purity standards. The offshore mining operations will be conducted during the ice-free period. The period generally lasts from 120 to 150 days ranging from late May or early June to late October or Early November. Also, because most of the sale area lies in waters deeper than 20 m, exploration activities are expected to take place during the ice-free period.

The strategies used to explore, assess, mine, and process the potential resources in the proposed sale area may vary. These variations are the result of uncertainties with regard to the resources and operational conditions unique to each leaseholder or operator. The development schedules shown in Tables II-1 and II-2 assume that exploration and production operations in the lease-sale area would be a continuation of mining activities in nearby State of Alaska waters. However, if mining operations in the lease-sale area are separate from those operations presently being conducted in State waters, more time would be required between the lease-sale date and the start of mineral production. The additional time, perhaps 6 to 8 years, would be needed to explore the leased area, evaluate the prospects, and acquire or construct the mining equipment if the deposits are to be developed.

The types of activities and schedule of events discussed in the scenarios, Sections II.A.2.c through II.A.3, represent MMS's estimate of mining-related operations that might occur as a result of the lease sale. These estimates are based on (1) nonproprietary geological, geophysical, and resource data and (2) exploration and mining information available to the MMS at the time this EIS was being prepared.

Before significant activity can occur on a lease, the lessee must submit and obtain approval from the Director of MMS (or an official authorized to act in the Director's behalf) of comprehensive delineation (exploration activities), testing (optional step that involves a relatively small scale mining operation to evaluate mining or processing equipment), and mining plans. The final rules governing postlease discovery, delineation, development, and production of minerals other than oil, gas, and sulphur within the OCS of the United States are given in the Federal Register (1989). These plans must describe the activities to be conducted in detail and include (1) exploration and mining and mineral processing methods and rates; (2) transportation corridors; (3) equipment to be used; (4) time periods; (5) locations of activities; (6) the cycle of all material including waste and the method of discharge and disposal; (7) any expected environmental effects; and (8) measures proposed to mitigate any potential adverse environmental effects. Any dredging in Federal waters would also be subject to EPA permit requirements.

The Director shall provide the appropriate State and Federal agencies and other interested parties an opportunity for review and comment on the delineation, testing, and mining plans and any subsequent modifications to these plans. These plans will not be approved before completion of comprehensive technical and environmental evaluations to assure that the activities will be carried out in a safe and environmentally responsible manner.

The strategies and technologies discussed in the following scenarios are hypothetical and are used to identify general types and levels of activities that might occur as a result of the lease sale. They do not represent a recommendation, preference, or endorsement by the U.S. Department of the Interior.

A summary of the estimated level of activities and schedule of events for both the base and high cases is shown in Table II-3.

c. **Exploration Activities for the Base Case (530,000 Troy Ounces):** As shown in Tables II-1 and II-3 exploration of the lease sale area is predicted to take about 3 years. If the lease sale is held in June 1991, the initial exploration would occur from 1991 through 1993; these activities would include seismic surveys and seafloor sampling (coring).

It is assumed that approximately 12,400 line km of seismic surveys will be required to delineate potential gold placers. (This estimate is based on the following: (1) the total length of the sale area is approximately 52 km and the width is about 12 km and (2) the survey lines parallel to the shore will be 60 m apart and the lines perpendicular to the shore will be 305 m apart.) Furthermore, it is assumed that about one-third of the survey, 4,200 line km, would be conducted during the 3-year exploration period and the remainder during the mining phase. Based on the survey rate assumed for OCS oil and gas exploration (site-specific shallow-hazards surveys of 64 line km in 2 days) (USDOI, MMS, 1987), it is estimated the surveys would take about 135 days. For the 3-year-exploration period, it is assumed approximately 1,400 line km of surveys would be conducted during a 45-day period for each of the 3 years. The seismic surveys would include bathymetry, subbottom profiling (with up to several tens of meters of seafloor penetration), and sidescan sonar. The range of operating frequencies of these types of seismic systems varies from several hundred cycles per second to several thousand cycles per second and the energy varies from about 1/10th to 1/700th of that of the seismic systems used in deep seafloor-penetration-reflection and -refraction surveys used for petroleum exploration (Trabant, 1984).

In addition to the exploration activities during the first 3 years, some seismic activities are expected to occur during the mining/production phase to further define future mining areas. These activities are estimated to occur at the rate of about 630 line km per year during a 20-day period. The number of sediment cores that would be required to locate and define the potential mining areas is estimated to be about 17,280. Coring would be done by drilling rigs capable of being mounted on vessels that displace about 1,500 tons. During the exploration and mining periods, 1 coring vessel would be used. The vessel would operate for about 90 days each season and drill about 1,080 cores--about 12 cores per day. (This estimate is based on a line spacing of about 305 m and a hole-spacing interval of about 60 m [Cruickshank and Marsden, 1973]; if gold distribution is irregular more cores may be required.) Exploration activities being conducted in conjunction with mining operations occurring in State of Alaska waters off Nome are summarized in Table II-4. The offshore gold-placer mining is presently being conducted in lease blocks that cover 21,750 acres; these blocks extend from about 2 km east of Nome to about 16 km west and 4 km offshore (NORTEC, 1985).

d. **Production--Placer Mining Activities for the Base Case (530,000 Troy Ounces):**

(1) **Dredge Considerations and Excavation:** For the base case, it is assumed that the gold-placer deposits would be mined from one offshore-mining dredge. Excavation of the placers would be by a continuous mechanical system such as a bucket-ladder, or bucketline, dredge (Fig. II-2). This type of dredge has been used worldwide to mine gold, tin, and platinum placers (Cruickshank et al., 1987). The excavation system of a bucket-ladder dredge consists of a chain of tandem digging buckets that travel continuously around a plate-girder ladder. The ladder is raised or lowered as required by a large hoisting winch through a system of cables and sheaves. Bucket size and speed can be varied with changes in the characteristics of the placer deposit and the volume of material that can be processed through the gold recovery system. Bucket-ladder dredges used in gold-placer mining have recovery and waste disposal systems mounted on the same hull as the excavation system. The U.S. Bureau of Mines (USDOI, BOM, 1987) estimates that the offshore gold placers in the Nome area would be mined by a large-capacity bucket-ladder dredge capable of excavating and processing about 1.25 million m<sup>3</sup> of sediment in less than 5 months.

Mining in the lease sale area is expected to begin in 1995, about 3 to 4 years after the lease sale and continue for 14 years, until 2008. Each year during full production (1995 through 2008), it is estimated that an average of 1.5 million m<sup>3</sup> of sediment from 100 acres would be mined and approximately 40,000 troy ounces of gold recovered. During the first and last years of the mining operation, approximately 1 million m<sup>3</sup> of sediment would be mined in an area covering 50 acres and 25,000 troy ounces of gold recovered (Table II-1). Data presently available to the MMS indicates that dredging to an average depth of about 3.6 m would be required to mine the potential gold bearing placers in the lease sale area. In mining 1.5 million m<sup>3</sup> of sediment, the area directly affected by excavating to an average depth of 3.6 m is about 100 acres. (The extent of the surface directly affected by excavating, in part, is a function of the excavation depth in the sediment. If, for example, the average excavation depth is 3 m, the affected surface area would be about 120 acres; however, if the average excavation

Table II-3  
Summary of Basic Scenario Assumptions Regarding  
OCS Mining Activities in the Norton Sound Lease-Sale Area

	Base Case (Alternatives I, IV, V) Number or Amount	TimeFrame Base Case and High Case	High Case Number or Amount
<b>Proposed Sale Area</b>			
Area -- acres	147,050		147,050
<b>Operating Season</b>		Late May or Early June to Late October or Early November	
No. of Days	120-150		120-150
Operating Days (80% of Operating Season)	100-120		100-120
<b>Exploration (Prospecting)</b>			
<b>Seismic Surveys</b>			
Exploration (Testing)			
Line Kilometers	4,200	1991-1993	8,400
No. of Survey Vessels	1		2
No. of Vessel Operating Days	135		270
Prospect Assessment			
Line Kilometers	8,200	1995-2008	16,400
No. of Survey Vessels	1		2
No. of Vessel Operating Days	260		520
<b>Sampling</b>			
Exploration			
No. of Cores	3,240	1992-1994	6,480
No. of Vessels	1		2
No. of Vessel Operating Days	270		540
Prospect Assessment			
No. of Cores	14,040	1995-2008	28,080
No. of Vessels	1		2
No. of Vessel Operating Days	1,170		2,340
<b>Production (Placer Mining)</b>			
Mining Vessel (Dredges)	1	1995-2008	2
<b>Gold Production</b>			
Total--Troy Ounces	530,000	1995-2008 (14 years)	1,060,000
Yearly Total (Average)			
--Troy Ounces	40,000	1996-2007	80,000
--Troy Ounces	25,000	1995&2008	50,000
<b>Dredging (Excavated Volume)</b>			
Total --m <sup>3</sup>	20,000,000	1995-2008	40,000,000
Daily (Average)--m <sup>3</sup>	12,500-15,000		25,000-30,000
<b>Area Dredged (Excavated)</b>			
Total--Acres	1,300		2,600
Yearly (Average)			
--Acres	100	1996-2007	200
--Acres	50	1995-2008	100
Depth (Average)--m	3.6		3.6
<b>Seawater-Intake Volume</b>			
Gallons/cubic meter mined	3,750-4,500		7,500-9,000
Total--billion gallons	75-90	1995-2008	150-180
Yearly (Average)			
--billion gallons	5.80-6.96	1995-2008	11.60-13.92
Daily (Average)			
--million gallons	58.0		116.0
<b>Solids-Discharge Volume</b>			
Total--m <sup>3</sup>	20,000,000	1995-2008	40,000,000
Daily (Average)--m <sup>3</sup>	12,500-15,000		25,000-30,000
<b>Seawater-Discharge Volume</b>			
Total--billion gallons	75-90	1995-2008	150-180
Daily (Average)			
--million gallons	58.0		116.0
<b>Support Activities</b>			
Vessels (Anchor Handling and Supply)	1	1995-2008	2
Total No. of Vessel Operating Days	1,680-2,100		3,360-4,200
No. of Days/Dredge/Season	120-150		120-150
Helicopter Flights (Round Trips)			
Total	5,040-6,300	1995-2008	10,080-12,600
Yearly	360-450		720-900
Daily/Dredge	3		3
Fuel-Oil Spill (3,500 bbls)	1		1

Source: MMS, Alaska OCS Region.

Table II-4

Summary of Mining Operations in State of  
Alaska Waters for 1987 through 1990

	1987	1988	1989	1990
<b><u>Bima Operations</u></b>				
<b>Operating Times</b>				
Total Number of Operating Days	148 <sup>1/</sup>	170 <sup>2/</sup>	155 <sup>3/</sup>	103
Operating Time--Percent	66	76	71	67
Downtime--Percent	34	24	29	33
<b>Reasons--Percent</b>				
Mechanical	39	48	44	32
Electrical	5	15	6	18
Operational	37	24	17	11
Weather	19	13	33	39
<b>Area Mined</b>				
Acres (approximate)	54	144	79 <sup>4/</sup>	71
<b>Gold Production</b>				
Troy Ounces (approximate)	36,709	35,554	30,662	15,208
<b><u>Exploration Activities</u></b>				None
<b>Number of Cores Drilled</b>				
From Landfast Ice	91 <sup>5/</sup>	528 <sup>6/</sup>		
From Drilling Vessel	548 <sup>7/</sup>	905 <sup>8/</sup>	501 <sup>9/</sup>	
Seismic Survey (line km)	1,100 <sup>10/</sup>			

Sources: Jewett et al., 1989; ENSR Consulting and Engineering, 1990; WestGold, 1990, oral comm.

<sup>1/</sup> June 17 to November 12.

<sup>2/</sup> May 25 to November 12.

<sup>3/</sup> June 9 to November 11.

<sup>4/</sup> The area mined in 1989 includes 16 acres previously mined and 63 acres of new mining.  
<sup>5/</sup> Late March to Early April (16 days). Average core length = 7.5 m.

<sup>6/</sup> February to April 10.

<sup>7/</sup> July 29 to October 12.

<sup>8/</sup> June 8 to September 12.

<sup>9/</sup> June 15 to July 20.

<sup>10/</sup> July 10 to August 12.



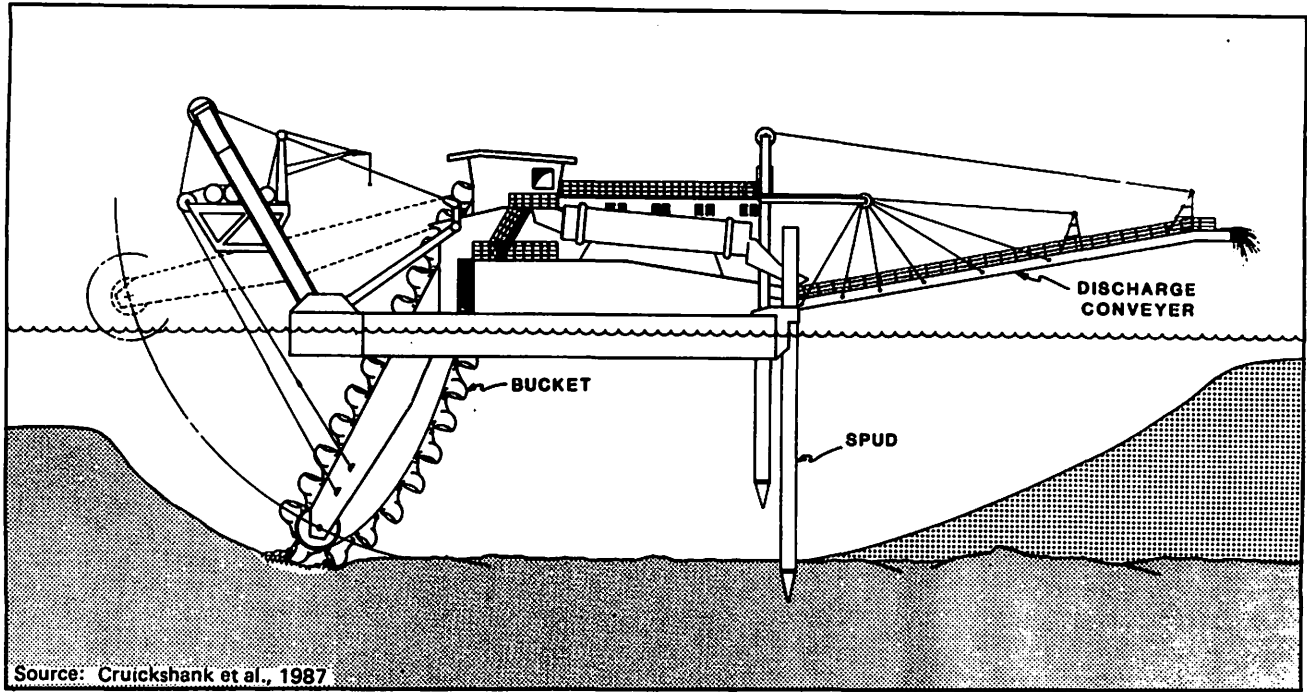


FIGURE II-2. BUCKET LADDER DREDGE USED TO MINE GOLD IN SHELTERED WATERS

NOTE: Spuds are used to control dredge movement in shallow waters. Anchors would be used to control dredge movement in the deeper, more exposed waters of the lease sale area (See Fig. II.A.-2.).

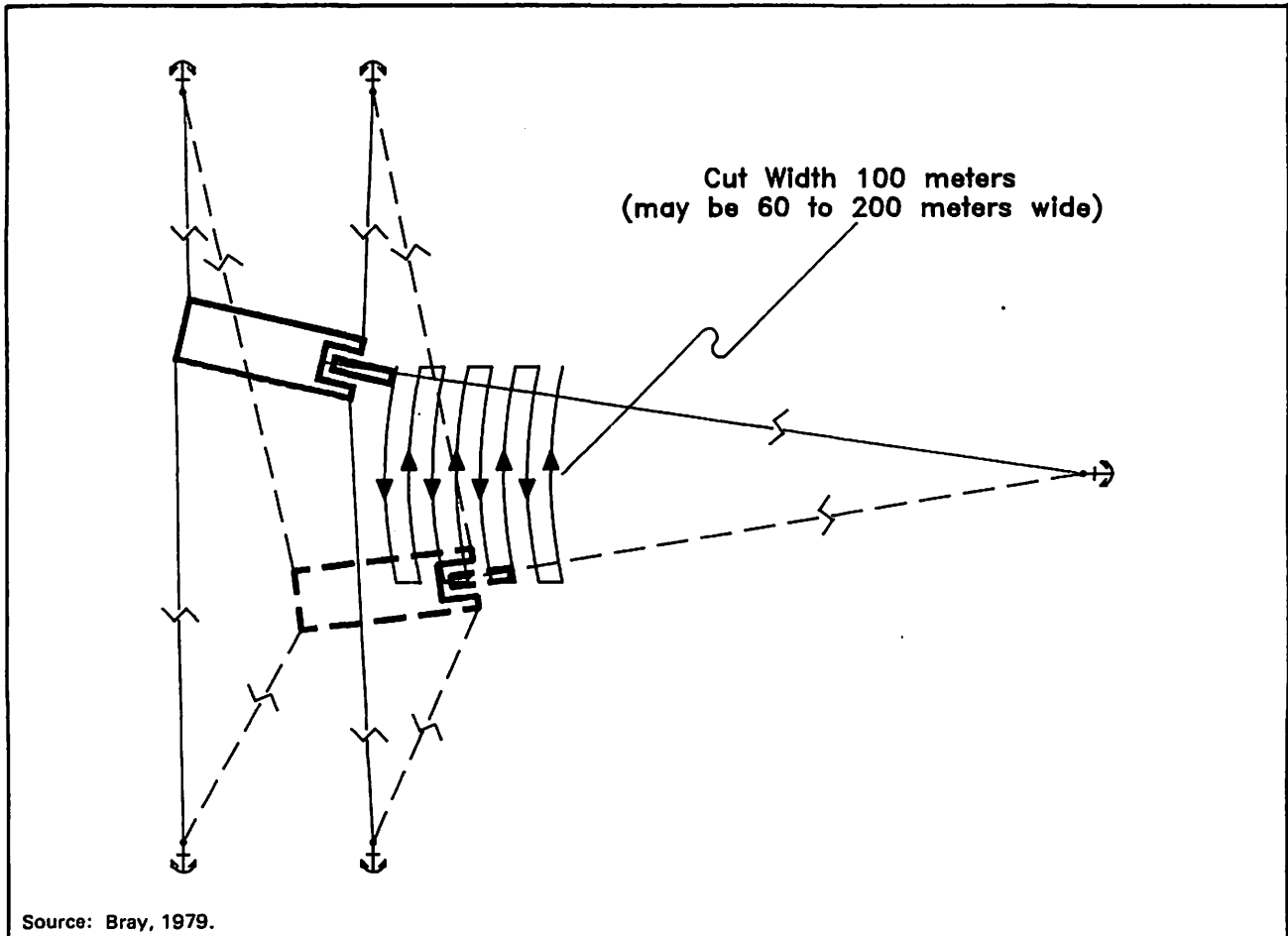


FIGURE II-3. BUCKET LADDER DREDGE OPERATIONS

depth is 9 m, the affected surface area would be about 40 acres.) For the base case it is estimated that a total of approximately 530,000 troy ounces of gold would be recovered from the mining of about 20 million m<sup>3</sup> of sediment in 1,300 acres; mining is expected to occur in a number of separate areas.

Although the ice-free season, as previously noted, was estimated to range from 120 to 150 days, it is estimated that the dredges will be able to operate only about 80 percent of the time--100 to 120 days per season. The downtime would be the result of unfavorable weather conditions or operational requirements (moving the anchors or changing the buckets) and difficulties (mechanical or electrical problems). The operating times of the dredge presently mining the offshore gold placers in State of Alaska waters off Nome are shown in Table II-4. Thus, the average amount of material mined daily is estimated to range from 12,500 to 15,000 m<sup>3</sup> per day per dredge. (The annual extent of the surface area directly affected by excavation also is a function of the dredge-production capacity. If dredges with capacities less than 12,500 to 15,000 m<sup>3</sup>/day are used, the annual areal extent of the surface directly affected by excavation will be less than the estimated 100 acres; however, if dredges with larger capacities are used, the areal extent will be greater.)

The offshore dredge discussed above is assumed to be similar to the Bima which is presently being used to mine the offshore placer deposits in State of Alaska waters near Nome by WestGold. In September 1990, WestGold announced that the Bima would not be operating during the 1991 mining season due to financial difficulties as well as needed repairs. It is uncertain at this point whether or not the Bima will be used in future mining seasons. In October 1990, WestGold received a 5-year NPDES dredging permit from EPA for the Bima; however, in November 1990, the Bima was placed on the market for sale. While the Bima or a Bima-type dredge could be used for the proposed sale, the type of dredge that will be used is not known at this time. Any proposal for mining would require a thorough assessment of potential environmental effects, including a proposal to use a different type of dredge.

The Bima is approximately 170 m (560 ft) long, 43 m (140 ft) wide and 45 m (148 ft) high (ENSR Consulting and Engineering, 1990). The bucket ladder is about 88 m (288 ft) long and contains 134 buckets each of about 0.85 m<sup>3</sup> (30 ft<sup>3</sup>/1.11 yd<sup>3</sup>) capacity. The dredging system has a maximum speed of 40 buckets per minute and is capable of dredging to a depth of 45 m (148 ft) below the sea surface; the theoretical daily capacity of the dredge is about 46,000 m<sup>3</sup>. (Although the dredging system may be capable of operating at 40 buckets per minute, the physical characteristics of the placer deposits, the sea state, and the capacity of the gold-recovery system will determine the actual excavation rate.) Most of the sale area lies in waters 20 to 30 m deep. Thus, a dredge capable of excavating to a depth of 45 m would be able to mine to a depth of 15 to 25 m in the sediments. The dredging rate of the Bima is expected to range from 300 to 1,000 m<sup>3</sup> per hour--7,200 to 24,000 m<sup>3</sup> per day (ENSR Consulting and Engineering, 1990). Under maximum sustained operations, the Bima is expected to dredge 24,000 m<sup>3</sup> per day and use about 58 million gallons of water per day (MGD); the maximum theoretical discharge for the Bima is about 100.6 MGD but under the present configuration it is about 69.3 MGD.

The bucket-ladder dredging operation consists of a series of back and forth maneuvers across the face of the excavation; Figure II-3. When the excavation across the face is completed in one direction, the dredge moves forward and begins excavating in the other direction. The width of the dredge area may range from 60 to 100 m and the advance distance from 0.5 to 2 m (Bray, 1979). Based on 1988 mining operations, the average size of the dredge course for the Bima is about 130 by 240 m (31,200 m<sup>2</sup>/7.7 acres) (ENSR Consulting and Engineering, 1990); it takes about 20 days to dredge this area. As the dredge maneuvers laterally and forward, a heterogeneous mixture of discharged material fills the area previously excavated. A small berm is created at the discharge end of the mining area and a small trench at the excavation end.

The excavated material would be a mixture of marine, river, glacial, and beach sediments containing a variety particle sizes that include boulders (particles larger than 256 mm in diameter), cobbles (64-256 mm in diameter), gravel (2-64 mm), sand (0.625-2 mm), silt (0.0039-0.0625) and clay (particles smaller than 0.0039 mm). Some of the sediments, such as cobble, gravel, and, perhaps, sand, substrates in unmined areas are relict features (Sec. III.A.3) and may be in various states of consolidation; consolidation is defined as the gradual reduction in the volume and increase in the density of sediment in response to increased load, and the process by which loose or soft sediments become coherent and firm. Some of the sediments may be consolidated as a result of glacial loading during the Pleistocene Epoch (Sec. II.A.2).

U.S. flag and reflagged foreign dredges operating on the OCS are subject to (among others) the appropriate (to industrial vessels which includes dredges) U.S. Coast Guard (USCG) requirements contained in 46 CFR, Subchapter I and MMS requirements contained in 30 CFR parts 280, 281, and 282. Included in the USCG requirements are the inspection and certification of the hull and main and auxiliary machinery for self-propelled

dredges; pollution prevention equipment; tanks containing dangerous cargo; and safety equipment. Also required is a stability test of the vessel based on the vessel's plans--this test sets forth the operating draft of the vessel. As part of the mining plan, MMS requires information showing that the equipment to be used (including the vessel) is capable of performing the intended operation in the environment which will be encountered.

(2) **Ore Processing:** The dredge also would contain a processing plant capable of classifying the dredged material--separating the gold particles from the waste part. Because of the very low concentration in the placers, the classification is done as close to the deposits as possible to minimize transportation costs to the refinery where the gold is produced in the purity required by the market. The characteristics of the gold and other detrital particles in the placer deposits will determine the classification process. It is assumed that the gold will be separated from the other particles of the mined material by gravity concentration. This process utilizes differences in particle-settling rates to separate the heavier, more dense gold from the lighter particles in a solid/fluid mixture. The processing plant consists of a series of screening devices and gravity concentrators.

Gravity separation is the most widely used process to recover placer gold particles (Silva, 1986). The various types of modern recovery equipment are able to recover particles that range in size from less than 0.00025 to about 3 cm in size.

Once on board, the excavated material passes through an inclined large-diameter, revolving screen--called a trommel--into which high-pressure water is sprayed. The rotating action of the screen and the high-pressure water breaks up most of the mined material. This material consists of a mixture of consolidated glacial, alluvial, and marine sediments. The smaller particles (less about 2 cm in diameter) pass through the openings in the trommel and are transported to the gravity-concentrating units; the larger particles are discharged into the marine environment.

Although there are various types of concentrators available, it is assumed that mechanical devices, jigs, and shaking tables will be used (USDOJ, BOM, 1987). In this EIS it is assumed that mercury will not be used offshore in any beneficiation process. Jigs are used principally for the recovery of gold, platinum, and other heavy minerals and gemstones (MacDonald, 1983). Jigs consist of perforated flat trays through which water is pulsed up and down. The solid/fluid mixture flowing across the surface is subjected to the action of upward and downward currents that tend to preferentially draw the heavier particles downward and keep the lighter particles in suspension. A slurry, containing gold and other heavy mineral particles, is removed at the bottom of the unit and the lighter particles pass through the jig as tailings. Shaking tables are designed primarily for the wet gravity concentration of fine granular materials. A shaking table consists of an inclined surface covered with riffles and vibrates in a longitudinal plane. As the slurry from the jigs flow across the table, the lighter particles tend to flow over the riffles while the heavier particles move along the riffles as a result of the back and forth movement of the table.

The number and size of the jigs and shaking tables will depend on the characteristics of the sediments processed. The liquid part of the solid/fluid mixture is untreated seawater. For maximum sustained operations for the Bima, the volume of seawater used in the mechanical processing of the placer materials is estimated to be about 58 MGD per dredge--based on excavating 24,000 m<sup>3</sup> per day (ENSR Consulting and Engineering, 1990). The total volume of water used per season (100-120 days) is estimated to range from about 5.80 to 6.96 billion gallons and for the life of the prospect the total volume of water used is estimated to range from about 75 to 90 billion gallons. (For a 1 mi<sup>2</sup> lake to contain 75 billion gallons of water it would have to be about 360 ft deep; 23 ft deep to contain 5.80 billion gallons; and 2 ft deep to contain 58 million gallons.)

The final concentrate will contain gold particles as well as other minerals with relatively high specific gravities (SG)--greater than about 4.7. These may include zircon (SG = 4.7), ilmenite (SG = 4.7), magnetite (SG = 5.2), silver and silver minerals (SG = 5.5-10.5), arsenopyrite (SG = 6.07), cassiterite (SG = 6.8-7.1), cinnabar (SG = 8.1), and platinum group elements (SG = 12-19). Based on an anticipated low gold content in the concentrate, it is expected that the concentrate recovered from mining operations in Federal waters would be shipped to an existing custom domestic (Continental U.S.) or foreign commercial refinery; the process used to refine the concentrate will depend on the gold content and composition. The concentrate from the Bima contains 15 to 25 percent gold and it is estimated that the concentrate obtained from mining in the sale area will have a similar gold content.

(3) **Tailings Disposal:** In addition to the excavated area, the seafloor also is affected by the discharge of material dredged during the placer mining operations. The tailings from the recovery

plant would be returned to the marine environment through a discharge system. Because the volume of the gold concentrate recovered is very small when compared to the volume of material mined, it is assumed for the purpose of estimation that essentially all the sediments mined would be returned to the marine environment after processing. Also, all of the seawater used to process the sediments on board the dredge would be discharged. The discharge occurs behind and relatively close to the area being dredged; thus, most of the material discharged would be deposited in an excavated area as the dredge moves forward and laterally through the area.

The mined sediments, and the seawater used in processing would be discharged through a pipe whose outlet may be located near the seafloor or near the sea surface; the location and configuration of the pipeline-discharge system would be adjusted to minimize water-column turbidity. Surface sediment samples collected as part of the Bima mining operations contained a mixture of particle sizes that range from gravel and larger (0 to 98% by weight), sand (1 to 99%) and silt and clay (0 to 22%) (ENSR Consulting and Engineering, 1990). When discharged into the water column, the sand and larger-size particles settle rapidly to the seafloor, but the fine-grained particles, the silt and clay sizes, settle slowly and cause turbidity downstream from the discharge point; fine-grained particles deposited on the seafloor are easily resuspended by waves and currents. In most of the samples, the silt- and clay-size particles were less than 5 percent (ENSR Consulting and Engineering, 1990). Based on samples taken from the Bima's bucketline in 1988, the silt content of the sediments dredged averaged about 15 percent; samples collected from the bucketline include material excavated from below the seafloor surface.

As noted in Section III.A, the sediments in Norton Sound with the highest concentration of gold particles are usually those mainly composed of sand- and larger-size particles; it is anticipated that most of the sediments in the sale area mined for gold will have a similar grain-size composition.

The sediment-laden waters of the discharge behave as a density current descending rapidly to the seafloor. Some particle segregation, based on settling velocities of individual particles, occurs within the density current. Mixing of the discharge with the surrounding water causes some of the fine-grained particles in the mixing zone to remain in suspension. The impact of the discharge on the seafloor causes the water and sediment to flow laterally away from the impact zone; some of the discharge also may be directed upward. The turbulence associated with the impact of the discharge on the seafloor will likely erode and resuspend material deposited on the seafloor.

Most of the sale area lies in a dynamic marine environment where erosion and reworking of the sediment occurs from storm-generated waves and currents and grounded ice. The bottom currents in the northern part of Norton Sound are competent to transport silt- and clay-size particles in suspension (Sec. III.A.3.a). During westerly flow, these particles would be transported into the Bering Sea and the northerly flowing Alaska Coastal Current; deposition eventually occurs in the central Chukchi Sea. Wind-generated waves would be effective in resuspending fine-grained particles deposited during quiescent periods. Storm surges, particularly the larger ones, have a major effect on the environment. Onshore, these effects can be seen in the flooding of low-lying areas and the erosion along beaches. In the marine environment, there also would be erosion and reworking of the sediments that form or are deposited on bathymetric highs. As noted in Section III.A.5.e, there have been 19 storm surges during the period from 1960 through 1980. Although the number of storms per year varied from zero to two, the average occurrence of storm surges in Norton Sound is about one per year; the 1974 storm surge in Norton Sound is estimated to have a once-in-30-year occurrence period.

The amount of material resuspended depends upon the magnitude and duration of the forces that cause resuspension. The amount of resuspension and the height to which fine-grained sediments are suspended depends primarily on the depth of water, wave height, and length of time that the fluid mud is exposed to the wave activity. As these factors increase in magnitude, so does the degree of resuspension. In most cases, typical tidal current velocities (e.g., 5-10 cm/sec) are much greater than wave-induced velocities except during periods of high winds and waves.

The particles that remain in suspension or are resuspended create a column of turbid water that is continuously supplied with particulate matter from the discharge. The levels of suspended solids in the water column above the fluid mud layer generally range from a few tens of milligrams per liter to a few hundred milligrams per liter (Barnard, 1978). Dredging operations associated with the construction of artificial islands in the Canadian Beaufort Sea have generated turbidity plumes ranging in length from several hundred meters to 4.8 km (Pessah, 1982). Concentrations rapidly decrease with increasing distance downstream from the discharge point and laterally away from the plume center-line because of settling and horizontal dispersion of the suspended solids. The lateral movement depends on existing currents. The turbid water will dissipate through the action of natural

forces after the discharge has ceased and the turbulence caused by the passage of the sediment mass has subsided.

(4) Effects of Placer Dredging on Bathymetry and Sediment Characteristics:

The excavation and discharge/fill cycle will alter small-scale bathymetric features and the characteristics of the sediment deposits in the affected areas. The material returned to the marine environment consists, for the most part, of individual particles that form deposits composed of a mixture of particle sizes; the particle size composition of these deposits will reflect the composition of the excavated material. However, the deposits probably will differ from the excavated material in the amount of compaction and consolidation. Also, if the excavated material consists of a heterogeneous mixture of particle sizes, the characteristics of the surface of the discharged material will probably be different than the surface characteristics of the undisturbed sediments. In some parts of the lease area, particularly those underlain by glacial till, the sediments consist of a heterogeneous mixture of particle sizes.

The specific combination of mixed particles of sand, pebbles, and cobbles in an overconsolidated, silty clay matrix (Kaufman and Hopkins, 1989) is one of at least two different substrates lumped as "cobble" in reports of the Bima monitoring program (Rusanowski, Gardner, and Jewett, 1987, 1988; Jewett, Gardner, and Athey, 1989; Jewett et al., 1990). In the monitoring meetings discussing the Bima operations, this overconsolidated cobble has been described as a cobble pavement, with the cobbles cemented into the sediment to the extent that divers could pry them out only with considerable difficulty. Jewett (1990, oral comm.) has observed that the degree of consolidation of cobble substrates within State waters varies. Cobble substrates support a different biological community than do adjoining sand areas. Cobble further offshore, in deeper water (18 m) was found to support greater species diversity and biomass than did inshore cobble in shallower water (9 m). This latter difference is likely due to a lesser frequency of disturbance--ice gouging, wave action, sand-wave migration--in the deeper offshore, resulting in a more stable biological community.

Because overconsolidated cobble is thought to be a relic landform resulting from glacial pressures, glacial drift, and subsequent wave erosion as sea level rose after glacier retreat (Tagg and Greene, 1973; Kaufman and Hopkins, 1989), this now marine landform and its associated biological community may constitute a unique, limited, and irretrievable resource in Norton Sound. This cobble landform is commonly auriferous and is a target for offshore gold mining in the sale area and inshore State waters (Nelson and Hopkins, 1972; Hood, 1989).

The overconsolidated cobble is thought to lie mostly in inshore State waters but with some patches extending into the OCS lease area (see Fig. 4 of Kaufman and Hopkins, 1989). Surface gravel, overconsolidated cobble or otherwise, is found only in the western basin of Norton Sound, along a narrow, discontinuous strip off of the southwestern coast of the Seward Peninsula (Nelson et al., 1975). Cobble substrates are not found elsewhere in Norton Sound, nor would they be expected to be found, given the limited extent of past glaciation into Norton Sound (Kaufman and Hopkins, 1989) and the widespread deposition of Yukon River sediments elsewhere in Norton Sound (Nelson et al., 1975). The Yukon River plume is generally blocked within 10 km offshore of the southwestern coast of the Seward Peninsula (including the area of cobble) by the back and forth tidal circulation of Bering Sea water over the coastal trench and by nearshore currents inshore of the trench (Dean and McRoy, 1988).

Another "cobble" substrate discussed in the Bima monitoring reports is that which is formed when cobble--surface pavement or other--is dredged and discharged into tailing piles. The tailing piles are uneven, initially with a few meters of relief. At the shallower (9 m) sites, the valleys tend to fill with sand while the hills tend to deflate as sand and finer material is winnowed out, leaving only coarser materials such as piles of cobbles. The winnowing at these shallow-water sites has been attributed to wave action in post-dredging monitoring (Jewett et al., 1990). In the absence of wave action, no similar trend in return to a cobble (pile) substrate has occurred at the single deep water (18 m) cobble site dredged by the Bima. Alteration of substrate type and the potential loss of stability of cobble substrates can have important ramifications for recolonization and recovery of the benthic community (Sec. IV.B.3). Unfortunately, the Bima monitoring reports do not distinguish between consolidated and unconsolidated cobble substrates.

Changes in the characteristics of the seafloor affected by placer dredging can be estimated from models or surveys conducted over a period of time from several to perhaps many years. The part of the seafloor that lies within specific depth ranges can be estimated from bathymetric surveys and the part covered by different sediment types estimated from sidescan sonar sonographs. Models can be used to estimate the area of the seafloor that might be affected by the discharge of fine-grained sediments because bathymetric and sidescan sonar surveys cannot distinguish thin layers of very fine-grained sediments.

To estimate the extent of the seafloor that could be affected by the discharge of dredged material in State waters off Nome, a three-dimensional water and sediment plume model was used. This model, DIFCD, was developed by the U.S. Army Corps of Engineers Hydraulics Laboratory at the Waterways Experiment Station in Vicksburg, MS (EHI and ENSR Consulting and Engineering, 1988). The model simulates the movement of the discharged material as it falls through the water column, as it is transported and diffused as suspended sediment by the ambient current, and as it is deposited on the bottom. The DIFCD is designed to compute the movement of material discharged in a continuous fashion at a constant rate. The model takes into account the ambient environment at the disposal site, characteristics of the discharge material, the disposal operations, and the general physics involved in disposing of matter in the open water. For a typical dredge course, 130 x 240 m (7.7 acres), the results of the modeling indicated that approximately 135 acres of the seafloor could be covered by 1 cm or more of solids settling out of the turbidity plume and the area covered by more than 10 cm would be about 12 acres outside of the dredge course. The material that settles out from the plume consists of fine-grained material that would be resuspended by larger waves and stronger currents and transported away from the discharge area.

For the placer mining operations in State waters off Nome, ENSR Consulting and Engineering (1990) presents two cross-sections showing profiles of the area affected by dredging at excavation depths of 1 and 10 m below the seafloor surface; the size of the dredge course depicted in these cross-sections is 200 by 150 m (30,000 m<sup>2</sup> or about 7.4 acres). For an excavation depth of about 1 m, the cross-section shows the affected area to be at least 1.5 times larger than the course area and the tailings berm at the start of the dredge course is about 1.2 m higher than the seafloor. For the 10 m excavation depth, the affected area is at least 1.8 times larger than the affected area and the tailings berm at the start of the course rises about 8.5 m above the seafloor. At the end of the dredge course, depths below the seafloor surface could be as deep as the excavation depth.

Bathymetric surveys in the area dredged in 1986 indicate that the bathymetry in about 9 percent of the area has changed (ENSR Consulting and Engineering, 1990); Table II-5a. The area is located about 7 mi west of Nome; the area surveyed covers about 28.5 acres. In 1987, the bathymetric survey indicated about 10.7 acres had water depths greater than 14 m, 9.5 acres had depths from 8 to 14 m, and 8.4 acres had depths less than 8 m. In 1989, the survey indicated 10.3 acres had depths greater than 14 m, 12.1 acres had depths from 8 to 14 m, and 6.1 acres had depths less than 8 m. The area affected by these changes covers about 2.6 to 2.7 acres--about 9 percent of the total area surveyed. The greatest change in bathymetry appears to have occurred between the 1987 and 1988 surveys. (Results of other surveys are shown in ENSR Consulting and Engineering [1990]).

Interpretation of sonographs from sidescan surveys in the area off Nome presently being mined for gold has been used to indicate some of the changes in the grain-size characteristics of the surface sediments with time (ENSR Consulting and Engineering, 1990). Based on the acoustic reflectivity of the sediments, the sidescan sonographs have been interpreted to differentiate four sediment types:

Cobble --coarse textured profile with variable granular materials: gravel, cobbles, and boulders.

Sand waves --rippled sand veneer usually associated with a fine sand/silt substrate; wave height varies from 4 to 6 in up to 2 ft.

Sand/fine gravel --Even textured, featureless profile of predominantly high reflectivity sand with gravel.

Sand/silt --No observed texture, featureless profile of predominantly low reflectivity fine sands and silts with trace amounts of or complete absence of coarse-grained material.

Side scan sonar surveys in the 1986 dredge area, Table II-5b, indicate changes in the particle-size composition of the surface sediments with time (ENSR Consulting and Engineering, 1990); the area covered by these surveys is about 95 acres. Interpretation of the side scan sonar records indicate that between 1987 and 1988 there was an increase in the areas covered by cobble and sand waves and a decrease in the areas covered by coarse sand/fine gravel and fine sand/silt sediments. However, between 1988 and 1989, the cobble and sand wave areas decreased but the coarse sand/fine gravel and fine sand/silt areas increased. Between 1987 and 1989 the records indicate about an 18-percent increase in the cobble areas and an 18- to 19-percent decrease in the coarse sand/fine gravel and fine sand/silt areas.

For the control area, Table II-5b where no mining has occurred, the sidescan sonar records also show yearly changes in the area covered by three of the sediment types and that the changes may be positive or negative. The overall changes in the control area between 1985 and 1989 show about a 5-percent increase in the cobble



Table II-5a  
Bathymetric Changes in State Leased  
Mining Areas off Nome<sup>1/</sup>

Year	Area (acres)		
	Water Depths (meters)		
	>14	8-14	<8
1987	10.7	9.5	8.4
1988	10.2	11.9	6.4
Change (1987-1988)	-0.5	+2.4	-2.0
1989	10.3	12.1	6.1
Change (1988-1989)	+0.1	+0.2	-0.3
Overall Change (1987-1989)	-0.4	+2.6	-2.3

<sup>1/</sup> Control Area = 28.5 acres.

Table II-5b  
Sediment Changes in State Leased  
Mining Areas off Nome

Area	Survey	Cobble	Sediment Type (percent of area)		
			Sand Waves	Coarse Sand/ Fine Gravel	Fine Sand/ Silt
1986 Dredge (95 Acres Surveyed)					
	1987	11.6	0.2	43.8	53.4
	1988	41.5	5.4	11.0	42.1
Change (1987-1988)		+29.9	+5.2	-23.8	-11.3
	1989	29.5	1.0	24.3	45.3
Change (1988-1989)		-12.0	-4.4	+13.3	+3.2
Overall Change (1987-1989)		+17.9	+0.8	-10.5	-8.1
Control (67 Acres Surveyed)					
	1985	58.2	3.9	0	37.8
	1986	62.0	0.7	0	37.3
Change (1985-1986)		+3.8	-3.2	0	-0.5
	1987			No Survey	
	1988	53.9	7.0	0	45.4
Change (1986-1988)		-8.1	+6.3	0	+8.1
	1989	63.5	1.2	0	35.3
Change (1988-1989)		+9.6	-5.8	0	-10.1
Overall Change (1985-1989)		+5.3	-2.7	0	-2.5

Source: ENSR Consulting and Engineering, 1990.

area and about a 5-percent decrease in the sand wave and fine sand/silt areas. (Results of other surveys are shown in ENSR Consulting and Engineering [1990].)

Thus, the area affected by placer mining could range from at least 1.5 to 1.8 (for coarse-grained material) to 2.6 to 18.5 (for fine-grained material) times larger than the excavated area. With resuspension and transport of the fine-grained material away from the disposal area, the size of the area affected by mining would be reduced and approach the size of the area affected by excavation and discharge of coarse-grained material. Depending on the competency of the waves and currents to resuspended and transport fine-grained particles, changes in the characteristics of the area affected by mining probably would be episodic, but major changes would be expected during a storm surge.

The occurrence of (1) storm surges, (2) sediment distribution (Sec. III.A.3.a), (3) current scouring (Sec. III.A.3.b), and (4) bottom currents (Sec. III.A.5.c) indicates a dynamic sedimentary environment. Thus, with time, the surface features of the dredged areas will have characteristics that approach an equilibrium with the dynamic forces of the overlying marine environment.

The bathymetric and substrate changes observed in the mined area and the control area described above have taken place in waters 5 to 15 m deep. Similar changes in the characteristics of mined areas in the lease-sale area are expected to occur more slowly. The action of the forces affecting such changes generally are expected to be less and, in the case of sea ice, occur less frequently because the sale area lies in deeper waters.

As noted in Table II-1 a dredge will excavate about 100 acres per year; this is about 0.07 percent of the proposed sale area. (The proposed sale area consists of about 147,050 acres.) The total excavated area over the life of the proposed activity is about 1,300 acres or about 0.9 percent of the sale area.

(5) Supporting Activities: Offshore support activities are expected to include vessels and helicopters. The support vessels would be used principally for anchor handling and dredge movement; they would be on location at or near the dredge site 100 percent of the time. The movement of the dredge anchors depends on a number of factors that include sediment dredging depth, length of the dredge area, and extent of lateral movement. The number of anchors moved at any time also varies. During anchor movement, dredging operations cease. The amount of time involved in moving each anchor would be about 1 hour.

Helicopters also would be used for crew changes and staff transport. These changes would involve about three roundtrips per day for each unit. Thus, during a season there would be between 360 and 450 roundtrip helicopter flights from Nome to the dredges; for the life of proposed activity there would be from 5,040 to 6,300 roundtrip flights.

e. Scenario Options: Although the above scenario assumes that mining/dredging will consist of a bucket-ladder dredge and an onboard gravity separation system to mechanically recover and concentrate the gold, other dredge types and recovery systems may be used. Dredges usually are built for specific types of mining operations; some of the principal factors that determine the type of mining system are listed in Section II.A.2.b. Mining in other areas with different operational parameters may require the construction of a new system or modifications of an existing system. Techniques used to recover the gold from the placer deposits also may be site specific. The Bima (Sec. II.A.2.d) was originally built to mine marine cassiterite (tin) deposits off Indonesia; the production capacity variously has been reported as 8 million m<sup>3</sup> per year (Mining Magazine, 1981) and 1,836 m<sup>3</sup> per hour (USDOI, BOM, 1979). After operating for part of a season off Nome in 1986, the Bima's ore beneficiation system was modified to be more efficient in the recovery of gold. The primary methods applicable to marine-placer deposits include the bucket-ladder and cutterhead-suction dredges (Cruikshank et al., 1987). In its 22nd Annual Directory of Worldwide Dredge Fleets, World Dredging Mining and Marine Construction (1988) lists 110 bucket-ladder dredges used to mine for minerals and 13 bucket-wheel suction dredges. Other applicable dredge types might include bucket-wheel dredges, plain or anchored suction dredges, draglines, clamshells, and hydraulic lift dredges.

Bucket-wheel dredges (Fig. II-4) use a small diameter bucket wheel mounted on a suction ladder to excavate the material. This material is delivered to the mouth of a suction pipe for transport to the surface. The digging capability of the bucket wheel dredge is equal to the bucket-ladder dredge. Bucket-wheel dredges are being used to mine alluvial gold deposits in Indonesia (World Dredging and Marine Construction, 1987b), and cassiterite (tin) in Brazil (World Dredging and Marine Construction, 1987a).

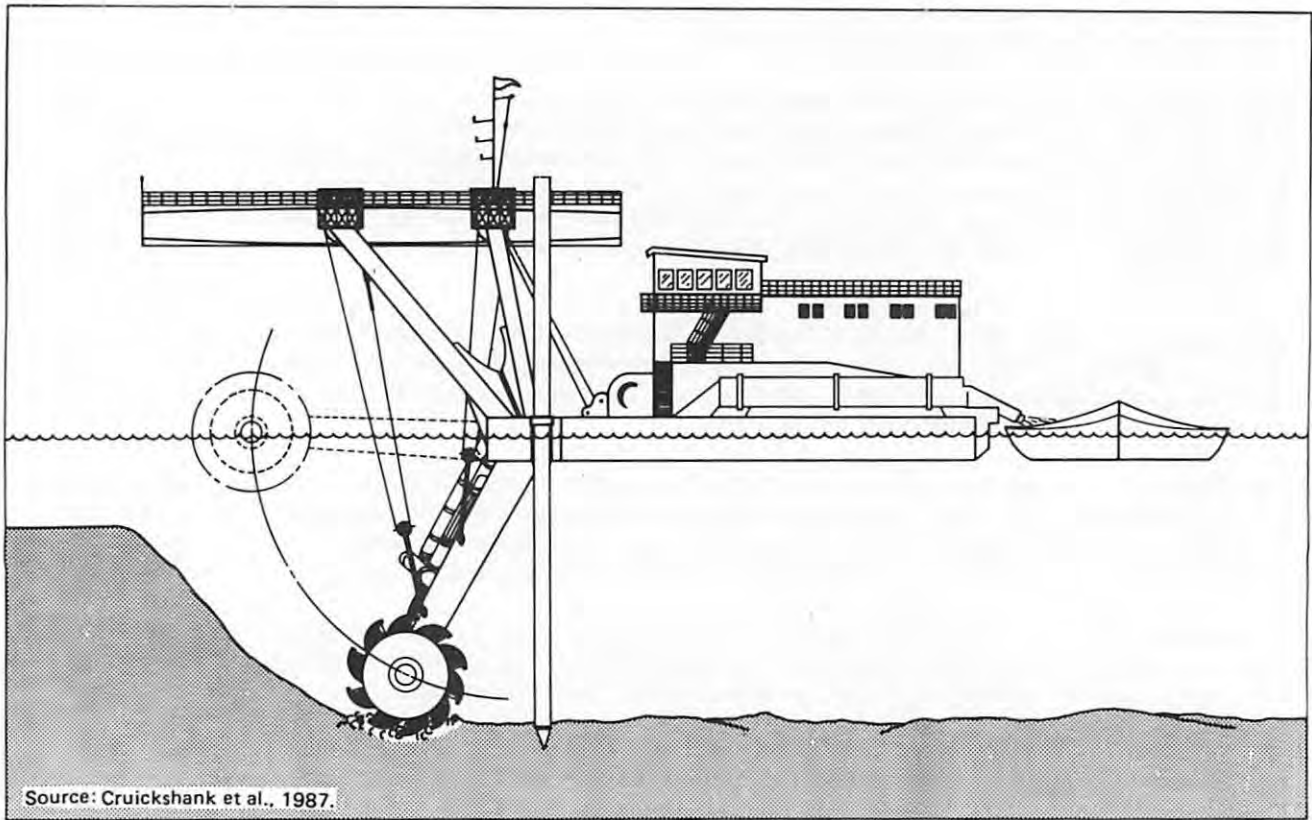


FIGURE II-4. BUCKET WHEEL DREDGE FOR USE IN SHELTERED WATERS

NOTE: Spuds are used to control dredge movement in shallow waters. Anchors would be used to control dredge movement in the deeper, more exposed waters of the lease sale area.

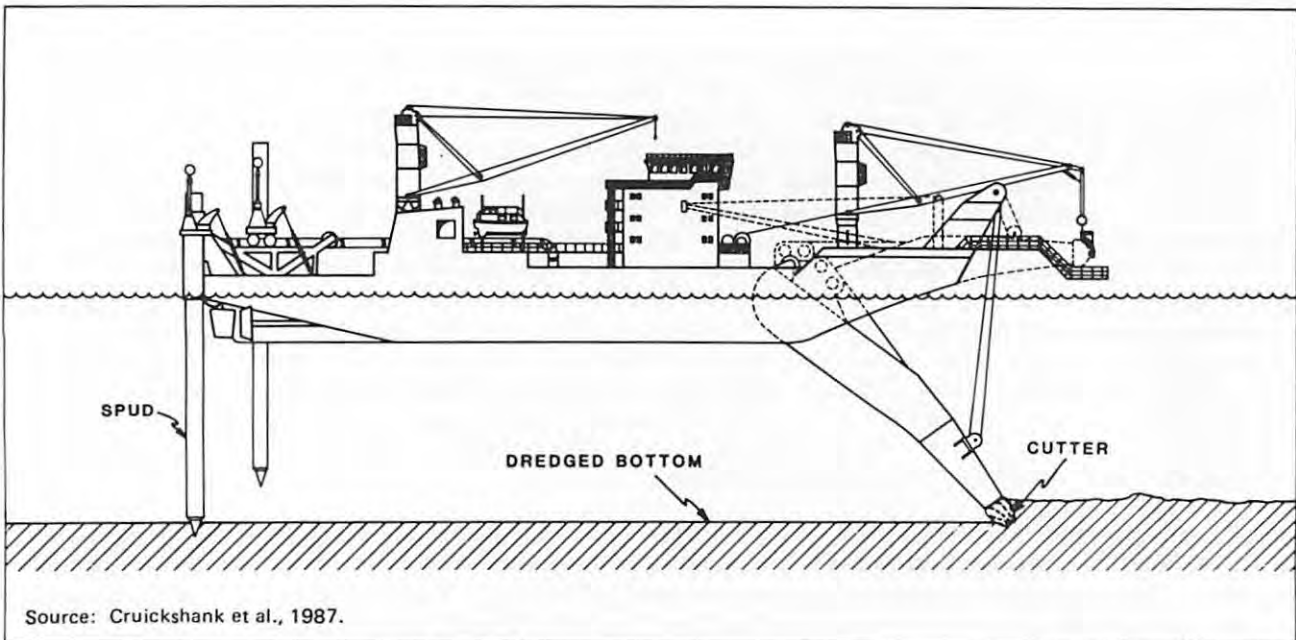


FIGURE II-5. CUTTERHEAD SUCTION DREDGE

NOTE: Spuds are used to control dredge movement in shallow waters. Anchors would be used to control dredge movement in the deeper, more exposed waters of the lease sale area.

Assuming that mining in the lease sale area would be a large-scale operation based on experiences in other parts of the world, the other type of dredge that is likely to be used to mine the offshore placer deposits is the cutterhead-suction dredge (Fig. II-5). The cutterhead-suction dredge is a hydraulic dredging system that uses a rotating, cone-shaped head with cutting edges for excavation; the sediment is then drawn into a suction pipe located within the cutterhead. The cutterhead and suction pipe are mounted on a ladder. The principal uses of hydraulic dredges have been in: (1) digging, deepening, reshaping, or maintaining harbors, rivers, reservoirs, and canals; (2) building dams and levees; and (3) landfill and reclamation projects. Hydraulic systems also have been used to mine sand and gravel, marine-shell deposits, diamonds, and minerals of tin, tungsten, titanium, and rare-earth elements.

Repetitive mechanical excavators; such as shovels, draglines, and clamshells; primarily have been used in small operations (Romanowitz, Bennett, and Dare, 1970). The principal disadvantage of repetitive digging is lack of control. In offshore placers, the operator of a repetitive system cannot determine the efficiency of the excavation or where to position the excavator for maximum recovery--especially when the distribution of the sought after mineral is not uniform.

Plain or anchored suction dredges are widely used to mine sand and gravel (Cruickshank et al., 1987). Removal of material is accomplished through a pipe extending from the supporting vessel to the seafloor. The pump(s) used to raise a solid/water slurry from the seafloor may be mounted on the supporting vessel or on the suction pipe (submersible pump). The use of submersible pumps has increased the effective operating depths of this type of dredge; an anchored suction dredge has been tested for mining metal-bearing muds at a depth of about 2,000 m in the Red Sea (Cruickshank et al., 1987). The vessels that support this type of dredging system may be nonself-propelled barges for operating in shallow waters or large, self-propelled vessels with ship-shaped hulls capable of operating in the open ocean. Carefully operated, this type of dredge can excavate sediments with very little turbulence (PIANC, 1977) which would reduce water-column turbidity caused by excavation. The disadvantage of using a plain or anchored suction dredge, at least for sand and gravel mining, is that the excavation leaves an irregularly shaped bottom.

Several types of dredging devices that use a combination of negative and positive pressures to recover sediments also have been developed. Negative pressure inside the dredge head causes material to flow into the head and compressed air is used to lift the slurry to the surface. The head may be fitted with cutter-type attachments (PIANC, 1977) or water jets (Noakes and Cookson, 1987) to excavate comparatively hard or consolidated sediments. These dredging devices can be used in a variety of environments ranging from the surface zone out to depths of about 600 m. These devices can also be operated so that there is very little turbulence associated with the excavating process. Robotic collector systems that are controlled from surface vessels through an attached electrical umbilical cable also have been developed. The excavated material is transported through risers to surface mining vessels by hydraulic or airlift systems.

In addition, it might be possible to combine two different dredging systems on a single vessel to mine a placer deposit that underlies a relatively thick overburden. A dredge with both the cutterhead-suction and bucket-ladder systems recently has been constructed to mine alluvial gold in the Grey River, South Island, New Zealand (World Mining Equipment, 1988; Col and Hanson, 1989). The cutterhead-suction system is designed to handle 1,530 m<sup>3</sup> per hour of low grade overburden (18-m thick) and the bucket-ladder can handle 800 m<sup>3</sup> per hour of ore from a layer 10-m thick. The cutterhead sweeps the working face in both directions--running either with or independent of the bucket-ladder.

Although different types of excavation systems may be used, the dredge would have to have an onboard plant to process the mined material or be connected to another vessel, perhaps a barge, with the processing facilities. Given the exposed location of the lease area, the mining dredge would probably contain an onboard plant. However, if the processing plant were separate, the supporting vessel would probably be moored alongside the dredge.

Material dredged for such activities as (1) port or channel navigational improvements or (2) sand and gravel recovery are usually discharged at some distance from the excavation sites. Pipelines, barges, or hopper dredges might be used to transport this material. However, the purpose of dredging placer deposits in the sale area is to recover gold--a mineral that is present in extremely low concentrations. Transporting the large volumes of sediment required to recover the gold to disposal sites away from the excavation sites would increase (1) the mining operating costs, (2) vessel traffic (pipelines would not be used in the open ocean), and (3) areal extent of the seafloor affected by the mining operations (dumping the solid waste at other sites would generate sediment

mounds in previously unaffected areas instead of filling in the depressions created by excavating the placer deposits).

To some extent, the pattern of dredged material disposal is apparently controlled by the configuration of the pipeline at the discharge point and by the angle and height of the discharge relative to the sea surface (for above-surface discharges) or the bottom (for submerged discharges) (Barnard, 1978).

In general, a pipeline configuration that discharges vertically into the water column reduces the water-column turbidity and tends to produce fluid-mud mounds with steep side slopes, maximum thickness, and minimal areal coverage. Pipeline configurations that direct the discharge horizontally, or at a low angle to the surface, increase the water column turbidity and tend to produce thin fluid-mud mounds of maximum areal extent. Decreasing the height of the mud mounds also reduces the amount of material that might be resuspended by waves. In evaluating the potential short- and long-term effects of disposing of the dredged sediments, the relationship between mud-mound height and areal extent and the resuspension potential of fine-grained particles should be considered.

Silt curtains--impervious, floating barriers that extend from the surface to specific water depths--have been used to control the dispersion of near surface turbid water; however, they are not recommended for operation in the open ocean, in areas where currents exceed 50 cm per second (1 knot), or in areas frequently exposed to high winds (Barnard, 1978).

Regardless of the system used, mining the marine-placer deposits in the sale area will alter the environment in basically the same ways. Excavation will disturb part of the seafloor and cause turbidity in the water column in the vicinity of the cutting device. Disposal of the dredged material also will cause turbidity in the water column and cover some part of the seafloor with a relatively thick layer of coarse-grained sediments and a thinner layer of fine-grained sediments; part of the seafloor that is covered by the disposed sediments most likely will be a previously excavated area. The dispersion of dredged material is affected by many factors. The environmental factors include (1) the characteristics of the dredged material--particle-size composition, (2) the hydrologic characteristics--salinity, currents, and waves, and (3) water depth. Operational factors affecting dispersion include (1) dredge type, size, and production rate, (2) cutter configuration and operating rates, (3) discharge rates and the solids concentration of the slurry, and (4) discharge configuration. The variability between these different environmental and operational factors makes it difficult to compare the nature and extent of dredged material dispersion around various types of dredging operations (Barnard, 1978).

During the summer of 1989, WestGold conducted test-mining operations in offshore leased areas along the southern coast of the Seward Peninsula west of Nome (ENSR Consulting and Engineering, 1990). (WestGold--Western Gold Exploration and Mining Co.--is the name of the company that presently is mining the gold placer deposits in State of Alaska waters off Nome with the dredge Bima.) The purpose of the test mining is to evaluate different types of dredging systems (ENSR, 1989). The test-mining operations were conducted from a single barge; the barge also supports a small-scale processing plant to recover the gold.

One phase of the testing operation involved the use of a 5-foot diameter bucketwheel mounted on a ladder structure that can be raised or lowered by a crane; the maximum reach of the bucketwheel-ladder structure is 10.6 m below the sea surface. The bucketwheel could excavate sediments to a depth of 4 or more meters below the seafloor. The estimated full-production rate of the bucketwheel ranges from 2,700 to 3,000 cubic m<sup>3</sup> per day.

The second system tested, Tramrod, consists of jointed suction pipes mounted on a tracked, submersible, remotely operated vehicle (ROV). The system is capable of operating in all water depths in the Nome area; it has been successfully used in water depths up to 600 ft in the North Sea. Excavation is limited to 1.5 m below the seafloor on a single pass. The estimated full-production rate for the ROV dredge system ranges from 2,700 to 3,000 m<sup>3</sup> per day.

Excavation rates for the test-mining operations averaged only about 120 m<sup>3</sup> per day; the maximum rate was about 1,135 m<sup>3</sup> per day (ENSR Consulting and Engineering, 1990).

The gold that was recovered as a result of the test-mining program was mechanically concentrated in the processing plant by passing through a series of screening devices and jigs and over a shaking table.

The testing program also evaluated three different types of discharge configurations. One of these configurations consisted of a single or double pipe extending 1.5 m below the sea surface. The second configuration was a

curtain-containment structure surrounding the discharge pipe to a depth of 8 to 10 ft below the sea surface. The third was a diffuser-like device with multiple discharge ports through which the discharge could be directed to pipes with outlets at various depths above the seafloor.

As part of the testing operations, an environmental monitoring program was conducted to (1) assess the water-quality effects and trace-metal releases from the test mining program, (2) provide an adequate database for evaluating full production, and (3) to provide a basis for predicting spatial water-quality changes for establishment of a discharge mixing zone. The monitoring aspect of the test mining was difficult because of short operating periods, frequent shutdowns, and poor weather conditions (ENSR Consulting and Engineering, 1990).

**f. Summary of Effects of the Base Case:**

(1) Effects on Air Quality: Impacts from air emissions under the base case on onshore air quality are expected to be less than 5 percent of the maximum allowable PSD-Class-II increments and would not make the concentrations of criteria pollutants in the onshore ambient air approach the air-quality standards. The effects of air pollutants other than those addressed by standards (effects other than on human health and welfare) would not be sufficient to cause temporary harm to tundra vegetation by acidification, and effects from burning a fuel spill would be short term and local. Consequently, effects on air quality are expected to be NEGLIGIBLE.

(2) Effects on Water Quality: The area affected by increased turbidity and arsenic, lead, copper, and nickel concentrations in the water column would be limited to 34 km<sup>2</sup> about the one dredge in the proposal. Potential modifications identified to date by MMS for a Bima-like dredge would be insufficient to insure that copper concentrations at the edge of the mixing zone would be less than the acute criterion, for a MAJOR effect on LOCAL water quality. A NEGLIGIBLE effect from turbidity and metalliferous-sediment discharges is expected on a REGIONAL basis. The EPA (USEPA, 1990d) considers that in this case and under projected NPDES discharge limitations (USEPA, 1990a), an occasional exceeding of the acute criterion for copper at 100 m by total recoverable--but not dissolved--copper concentrations would have a negligible effect on LOCAL and REGIONAL water quality.

Diesel concentrations within a few kilometers of a spill could reach 1,000 ppb within a day of a spill for a MINOR effect on LOCAL water quality. Concentrations of the diesel above the chronic standard of 15 ppb could persist for days to weeks over a few hundred square kilometers, for a MINOR effect on REGIONAL water quality. The overall effect of all contaminants is MAJOR on LOCAL water quality and MINOR on REGIONAL water quality.

(3) Effects on Marine Plants and Invertebrates (Including Red King Crab): Offshore dredging and spoils discharge have the potential to affect marine plants and invertebrates (including red king crab) via the effects of habitat alteration, including turbidity; entrainment of organisms; exposure to trace metals; noise and disturbance; and a fuel spill. Of greatest concern is habitat alteration, which is likely to lead to a MODERATE effect on red king crabs due to potential loss of critical habitat for juveniles and perhaps females. Other marine plants and invertebrates also are likely to incur a MODERATE effect from habitat alteration. Another area of concern is the absorption and possible biomagnification of trace metals. Effects on marine plants and invertebrates are expected to be NEGLIGIBLE, but consequences may be more severe for higher-trophic-level organisms. Effects of turbidity, entrainment, and a fuel spill are each expected to be MINOR. The overall effect of the proposal on marine plants and invertebrates, including red king crab, is expected to be MODERATE.

(4) Effects on Fishes: Offshore dredging and spoils discharge have the potential to affect fishes via the effects of habitat alteration, including turbidity; entrainment of organisms; exposure to trace metals; noise and disturbance; and a fuel spill. The highest-order effect is likely to come from a fuel spill that contacted fish in nearshore waters. A MODERATE effect is expected if the spill contacted spawning herring or capelin, their developing eggs and larvae in nearshore waters, adult salmon congregating in the nearshore prior to spawning, and outmigrating salmon smolts. MINOR effects on fishes are expected from habitat alteration, turbidity, entrainment, and noise and disturbance. Exposure to trace metals is expected to lead to NEGLIGIBLE effects. The overall effect of the proposal on fishes is expected to be MODERATE.

(5) Effects on Marine and Coastal Birds: Air-traffic disturbance of birds associated with the proposed mining operations, although brief, could reduced migration fitness and winter survival of some waterfowl or shorebirds, but such disturbance events are expected to be infrequent and not affect



overall abundance and distribution of bird populations (MINOR effect). The temporary changes in water turbidity associated with dredging is not expected to affect the overall abundance and availability of the food sources of marine and coastal birds that are widely distributed throughout Norton Sound (NEGLIGIBLE effect). The excavation and deposition of sea-bottom material could potentially mobilize and repartition mercury and other toxic trace metals into the marine environment and could increase the bioaccumulation of these metals in the food chain and in birds.

However, the levels of arsenic, chromium, lead, cadmium, copper, and nickel measured in association with current dredging are expected to have NEGLIGIBLE effects on marine and coastal birds due to the great dilution of these metal concentrations 100 m beyond the dredge. Similar levels are expected to be measured in association with the proposal under the monitoring and operations control program (Stipulation No.1). Mercury is by far the most toxic of the trace metals present in the Nome area, and it can biomagnify in the food chain. However, recent data on accurate mercury levels in the water column associated with current dredging indicate that mercury levels are low and do not exceed EPA criteria and that there would not be any significant increase in mercury bioaccumulation in the food chain or in marine and coastal birds associated with the proposed mining operations (NEGLIGIBLE effect). The overall effect of the base case on marine and coastal birds is expected to be MINOR.

(6) Effects on Nonendangered Marine Mammals: Disturbance events associated with the proposed mining operations could include air- and boat-traffic disturbance of seals, walruses, and belukha whales but such event would be brief. Disturbed seals, walruses, and belukha whales are likely to return to normal behavior and distribution within an hour to a few hours or within a few days (MINOR effect). Sounds of dredging operations might displace some marine mammals within a few to several miles of the dredge when it is operating (MINOR effect). The excavation and deposition of sediments by the dredge are likely to have NEGLIGIBLE effects on the availability of marine mammal food sources due to the small area affected by the dredge. Dredging has the potential to mobilize and repartition mercury and other toxic trace metals present in the sediments and could increase the bioaccumulation of these metals in the food chain. However, the levels of arsenic, mercury, lead, cadmium, copper, and nickel measured in association with current dredging are expected to have NEGLIGIBLE effects on nonendangered marine mammals. Similar levels of these trace metals are expected to be measured in association with the proposed dredging under the monitoring and operations control program (Stipulation No.1). The assumed fuel spill is not likely to reduce the availability of widespread food sources of marine mammals for more than a few weeks at the most very near the spill site (NEGLIGIBLE effect). The overall effect of the base case on nonendangered marine mammals is expected to be MINOR.

(7) Effects on Endangered and Threatened Species: A minor portion of the regional gray whale population and the local population of six arctic peregrine falcon nest sites could be exposed to the following potential effect-producing agents from the proposed OCS Mining Program Norton Sound Lease Sale: habitat alteration, turbidity, trace metals, noise and disturbance, and fuel spills. A few individual gray whales, or small groups, could be affected over a short time period, especially due to noise and disturbance. There would be a potential for a MODERATE effect to the regional arctic peregrine falcon population from trace-metal contamination. However, the effect level would be reduced to NEGLIGIBLE assuming projected low toxic trace-metal levels released by the proposed mining operation (indicated by recent data) and because of the incorporation of Stipulation Nos. 1 and 2 as part of the proposal. The overall effect of the proposed OCS Mining Program Norton Sound Lease Sale on the endangered gray whale and the threatened arctic peregrine falcon regional populations is expected to be MINOR for the base case.

(8) Effects on the Economy of Nome: Employment resulting from OCS mining activity is expected to average approximately 7 percent above the no-sale alternative. An estimated 40 percent of direct OCS mining jobs will go to area residents. This is expected to decrease unemployment and improve income conditions within the local economy. A one-time increase in prices may occur but is expected to be short-lived. The population is expected to average 4 percent above the no-sale case. The effect of the proposal on the economy of Nome is expected to be MINOR in the base case.

(9) Effects on Commercial Fisheries: The commercial fisheries in the vicinity of Nome include harvests of red king crab, salmon, and herring. Red king crab habitat is expected to be disrupted by dredging and the sedimentation from dredging, although this would be mitigated by a monitoring program and would result in a MODERATE effect on the fishery. Dredging is expected to cause resuspension of naturally occurring mercury into the water column. Measured levels of mercury in the water column do not exceed the Federal water-quality criteria. If increased levels of mercury in the water column were to occur, this could cause the closure of the commercial crab fishery for 1 or more years, although a well designed monitoring

program should prevent this from happening and the effect on the commercial crab fishery would be MINOR. The effect of a fuel spill on the commercial salmon and herring fisheries would be MODERATE. The effect of the proposal on commercial fisheries in the Nome area is expected to be MODERATE in the base case.

(10) Effects on Subsistence-Harvest Patterns: Under the base case the alteration of the sea bottom would cause MODERATE biological effects on the red king crab population in Norton Sound. While harvests of red king crab may become more difficult and take longer, harvests of red king crab would still be expected--a MINOR effect--particularly since the primary red king crab subsistence harvest area occurs outside of the proposed sale area. With an environmental monitoring and operations management program and the monitoring of human health, it is not likely that the levels of any trace metals could increase to levels that would affect human health. Thus, subsistence harvests would continue to occur with no decrease in harvests--a NEGLIGIBLE effect on the harvest of subsistence resources. Noise and traffic disturbance is expected to have no more than short-term and temporary disruptions to subsistence harvests--a MINOR effect. The overall effect of the proposed OCS Mining Program Norton Sound Lease Sale is expected to be MINOR in the base case.

(11) Effects on Sociocultural Systems: Effects on Nome's sociocultural systems would occur as a result of industrial activities, changes in population and employment, and effects on subsistence-harvest patterns. These casual agents could affect Nome's Inupiat and Yup'ik social organization, cultural values, and well-being. Nome's non-Native population should not experience more than NEGLIGIBLE sociocultural effects from the sale. Nome is a relatively large--for Alaska (population of 3,872 in 1987, 58% Native [see Sec. III.C.1])--heterogeneous community and should be able to withstand the level of increased population and changes in employment predicted for the proposed lease sale. Thus, only NEGLIBILE effects are expected from changes in population and employment on Nome's sociocultural systems. With the stipulations in place, only MINOR effects are expected on subsistence-harvest patterns. MINOR effects on subsistence-harvest patterns are not expected to result in more than MINOR effects on sociocultural systems.

(12) Effects on Archaeological Resources: If archaeological resources in the proposed sale area were disrupted, Stipulation No. 4 would protect surviving resources. However, it is not likely that there are any archaeological resources in the sale area. No disturbance to onshore resources is expected. Therefore, the effects of the base case on archaeological resources are expected to be NEGLIGIBLE.

(13) Effects on Recreation and Tourism Resources: The effects of the base case would be due mainly to the low probability that offshore recreation and tourism resources (particularly recreational sport fishing, boating, and recreational gold dredging) would be affected by the activities of the sale area. Disturbance to such onshore resources would be modest. Therefore, the effects of the base case on recreation and tourism resources are expected to be MINOR.

(14) Effects on Land Use Plans and Coastal Zone Management Programs: Dredging associated with the base case of this lease sale would lead to significant changes in the benthic environment, resuspend toxic trace metals, and create turbidity. Effects on water quality can be mitigated based on results from the required monitoring program. However, effects on the benthic environment could have MODERATE effects on red king crab and the commercial fishing of red king crab even if monitoring detected potential effects and plans were modified. This outcome is expected to lead to MODERATE conflicts with the offshore habitat. The standard for mining and mineral processing requires that mining activities conform with all other statewide standards of the ACMP. Because effects on the benthic environment could lead to conflict with the habitat standard, it also leads to a conflict with the statewide standard for mining. MODERATE conflicts with the ACMP are expected to occur as a result of activities associated with this lease sale.

(15) Effects on Human Health: Under the base case, an increase in the bioaccumulation of mercury in the marine environment of the Nome area could occur. Mercury is the only trace metal in Norton Sound that could pose a potentially serious health risk to the people of Nome (prenatal and natal life) through biomagnification in the food chain. Other trace metals are expected to have NEGLIGIBLE effects on human health. Mercury is an important issue of the proposal because: (1) previous monitoring reports had indicated mercury levels were high in the water in association with current dredging; (2) mercury can be very toxic (as methylmercury) and can biomagnify in the foodchain; (3) natural and man-made sources of mercury are present in and adjacent to the sale area; and (4) some Nome women of child-bearing age might have hair-mercury levels approaching or exceeding the range at which there could be some risk to prenatal and natal life. It is not likely that levels of any trace metals attributed to the proposed action would be high enough to threaten human health because: (1) the background levels of mercury in seawater in the Nome area are low (1.0 ppt, see Sec. IV.B.2.b) and typical of nonpolluted coastal water (Crecelius, Apts, and Lasorsa, 1990); (2) background

concentrations of mercury in undisturbed sediment samples taken offshore the Nome area are low (0.032-0.038 ppm in three sediment samples); (3) preliminary measurements of mercury levels in the seawater associated with the current dredging operation indicate there is only a slight increase of mercury (0.4 ppt) at the edge of the mixing zone (Creelius, Apts, and Lasorsa, 1990; see Table IV-8) resulting in a total mercury level of 1.4 ppt which is below the EPA chronic criterion level (25 ppt, see Sec. IV.B.2); (4) mercury released into the water column from the discharged sediments is rapidly reabsorbed to the sediments which are dispersed and resettle to the seafloor; (5) the repartitioning of mercury in the sediments is not expected to be measurable in the food chain above background conditions; (6) present indications of mercury levels in subsistence food sources are unusually low for Arctic waters; and (7) recent information indicates that present levels of methylmercury in Nome women of child-bearing age are below the 10 to 20 ppm hair-methylmercury range in which effects on prenatal and natal life could occur (see Sec.IV.B.15). In addition, with the monitoring of dredge operations, including mercury levels in the water and in indicator marine species, under Stipulation No. 1 and the monitoring of mercury levels in women of child-bearing age (Stipulation No. 3), no increase is expected in the exposure of prenatal and natal life in the Nome area to methylmercury that might be associated with the proposed dredging operations. The effect of the proposal on human health is expected to be NEGLIGIBLE.

### **3. Activities Associated with the High-Case Resource Estimate:**

a. **Resource Estimates and Basic Assumptions:** As described in Section II.A.2, the scenarios for the OCS Mining Program Norton Sound Lease Sale are based on the mining of 530,000 troy ounces of gold--the base-case resource estimate. For a high case, MMS estimates the amount of gold to be recovered from the lease-sale area to be 1,060,000 troy ounces--twice the amount of gold estimated for the base case. Because the estimates are preliminary, as noted in Section II.A.2, it is assumed that the level of mining activities associated with the high case would be two times those of the base case. Thus, two dredges would be used instead of one, an estimated 2,600 acres would be mined in place of 1,300 acres, and an estimated 40 million m<sup>3</sup> of sediment would be excavated and processed rather than 20 million m<sup>3</sup>. The amount and rates of material processed for the high case are shown in Table II-3. The types of mining operation for the high case are expected to be similar to those estimated for the base case. Bucket-ladder dredges would be used for excavating the placer deposits and a gravity-concentration process would be used to recover and concentrate the gold. Also, the level of support activities for the high case are estimated to be double those of the base case--Table II-3.

The level of exploration activities is based on the size of the proposed lease-sale area and the level of mining activities--Table II-3. The size of the area for both the base and high cases is the same; thus, the level of seismic exploration activities for both cases is estimated to be similar. However, because the level of mining activities for the high case is estimated to be twice that of the base case, the high-case exploration-sampling activities are estimated to be about double those of the base case. Potential effects of the high case on the environment are analyzed in Section IV.G.

#### **b. Summary of Effects of the High Case:**

(1) **Effects on Air Quality:** The concentrations would be <5 percent of that permitted by national ambient air-quality standards, including the PSD-Class-II increments. The effects of air pollutants other than those addressed by standards (effects other than on human health and welfare) would not be sufficient to cause temporary harm to tundra vegetation by acidification, and effects from burning a fuel spill would be short term and local. Consequently, effects on air quality are expected to be NEGLIGIBLE.

(2) **Effects on Water Quality:** In the high case, increased turbidity would be evident over twice the area affected by the base case but would still be a MINOR LOCAL and NEGLIGIBLE REGIONAL effect, the same as for the base case. The area affected by metals discharge to the water column would be twice that of the base case but would still be a MAJOR LOCAL and NEGLIGIBLE REGIONAL effect on water quality, the same as for the base case.

One major fuel spill is assumed in the high case. Contamination from such a spill would persist on the order of days to weeks. The likelihood of such a spill is unknown, but, on a relative basis, it would be twice as likely in the high case as in the base case. The effect of such a spill on water quality would be the same as estimated for the base case, a MINOR LOCAL and REGIONAL effect. In summary, under the high case, the areal extent of elevated turbidity and trace-metal contamination would be doubled, and the likelihood of a fuel spill (but not its effect) would be doubled. There would be an overall MAJOR effect on LOCAL water quality and a MINOR effect on REGIONAL water quality in the high case, the same as found for the base case.

(3) Effects on Marine Plants and Invertebrates (Including Red King Crab): In the high case, two dredges are assumed to operate, resulting in a doubling of the estimated dredged area (from 1,300 to 2,600 acres, Table II-2). The area affected by changes in bathymetry also doubles in the high case, and an area equivalent to the entire sale area (147,050 acres) could be affected by sedimentation of resuspended materials over the 14-year production period.

The increase in the area of benthic habitat affected by dredging and sedimentation increases the likelihood of higher order effects (MODERATE to MAJOR) on red king crabs since a higher proportion of a high-density area used year-round could be affected, presumably for a number of years. Alteration of gravel or cobble habitat, especially in the trench area, that may be important to juvenile and possibly adult king crabs contributes to determining a MODERATE effect under the high case. Monitoring could limit the effect to MODERATE; without such monitoring, effects could be MAJOR. The effect of habitat alteration on other marine plants and invertebrates also is expected to be MODERATE under the high case.

Although the volume of water used in processing sediments would double under the high-case scenario, the effect on marine plants and invertebrates is expected to remain the same level as for the base case, MINOR. This assessment is based primarily on the broad distributions of adults giving rise to planktonic larvae, the naturally high mortality of planktonic forms, and the assumption that entrainment would affect only some portion of the larval output of a species in the area.

The effects of trace metals and noise and disturbance are expected to remain NEGLIGIBLE, and the effect of a fuel spill is expected to remain MINOR, the same levels as under the base case. The overall effects of the proposal on marine plants and invertebrates (including red king crab) under the high-case scenario is likely to be MODERATE.

(4) Effects on Fishes: Habitat alteration could affect the physical structure of the benthic environment, as well as the distribution and abundance of invertebrates taken as prey by fishes. Even with local depressions in the invertebrate fauna, benthic feeding fishes may not be greatly affected, due to their mobility and opportunistic or generalized diets (Feder and Jewett, 1981; Jewett and Feder, 1980). Local reductions in invertebrate populations would be expected to affect fish populations only if food is limiting to benthic feeding fishes. The effect of habitat alteration on fishes under the high-case scenario is not expected to be different than that under the base case, MINOR.

The doubling of the volume of water used in the processing of sediments would lead to more fish (primarily eggs, larvae, and juveniles) becoming entrained in the dredging operation and would result in the death of greater numbers of these fishes. Of concern would be the entrainment of clumped cohorts of eggs, larvae, and juveniles. The effect under the high case is not expected to be qualitatively different than under the base case and is expected to remain MINOR.

The effects of trace metals, noise and disturbance, and a fuel spill also are not expected to change in effects level from those expected under the base case and should remain NEGLIGIBLE, MINOR, and MODERATE, respectively. Under the high-case scenario, the overall effect of the proposal on fishes is likely to be MODERATE.

(5) Effects on Marine and Coastal Birds: The doubling of the amount of air traffic in support of two dredges under the high case is not expected to significantly increase the frequency or duration of disturbance of seabirds, waterfowl, and shorebirds because most of the traffic is expected to fly offshore between the dredges and Nome and avoid passing over coastal concentrations of birds (MINOR effect). Seabird-food-source abundance and availability beyond a few miles of the two dredges (no more than 4-8% of the sale area) at the most are not likely to be affected. Thus, a NEGLIGIBLE effect on the availability of seabird-food sources is expected. The excavation of 40 million m<sup>3</sup> of seafloor under the high case is not expected to significantly increase the levels or bioaccumulation of mercury or other trace metals in the food chain or in marine and coastal birds as under the proposal (see Sec. IV.B.5.). The effect of a fuel spill on birds is expected to be the same as under the base case (MINOR). The overall effect of the high case on marine and coastal birds is expected to be MINOR.

(6) Effects on Nonendangered Marine Mammals: Two dredges are assumed to operate in the sale area under the high case with about 42 km<sup>2</sup> of benthic or potential benthic feeding habitat of walrus and bearded seal being affected. This represents about 4 to 8 percent of the total sale area and is likely to have a minimal effect on the abundance and availability of walrus and bearded seal food sources which are

wide spread throughout Norton Sound. Occasional aircraft disturbance and short-term displacement (for minutes to no more than a few days) of seals, walruses, and belukha whales is likely to occur (MINOR effect). No significant increase in the bioaccumulation of mercury or other trace metals in seals, walruses and belukha whales is likely to occur under the high case. The effect of the proposal is expected to remain local under the high-case scenario. More widespread changes in benthic habitat and a greater reduction in benthic food sources could occur if the size of the proposed sale area was expanded to a much larger part of Norton Basin Planning Area. The effect of a fuel spill on nonendangered marine mammals is expected to be MINOR --the same as under the base case. The overall effect of the high case on nonendangered marine mammals is expected to be MINOR.

(7) Effects on Endangered and Threatened Species: The OCS dredging/mining activity is assumed to double in the high-case scenario (Table II-3). The overall effects on the gray whale and the arctic peregrine falcon from habitat alteration, turbidity, noise and disturbance, trace metals, and fuel spills are expected to remain local and not significantly raise the effect levels for regional populations above those described for the proposal (base case) (see Sec. IV.B.7). Additional dredging/mining operations would increase the possibility of interaction and effects on the gray whale, but, since few whales frequent the area, the effect is expected to remain the same as the proposal (base case). The doubling of excavation, deposition, and resuspension of marine sediments could release additional mercury and other trace metals into the marine system and increase the risk and extent of potential bioaccumulation in the food chain. However, no significant increase of mercury and other trace metals is expected, the same as the proposal (see Secs. II.F.1 and IV.B.7). Overall effects from the high-case scenario are expected to be the same as the proposal (base case)--MINOR for the gray whale and the arctic peregrine falcon regional populations.

(8) Effects on the Economy of Nome: Employment resulting from OCS mining activity in the high case is expected to average approximately 15 percent above the no-sale alternative. An estimated 40 percent of direct OCS mining jobs will go to area residents. This is expected to improve unemployment and income conditions within the local economy. The effect of the proposal on the economy of Nome is expected to be MODERATE in the high case.

(9) Effects on Commercial Fisheries: The commercial fisheries in the vicinity of Nome include harvests of red king crab, salmon, and herring. Red king crab habitat is expected to be disrupted by dredging and the sedimentation from dredging, although this would be mitigated by a monitoring program and would result in a MODERATE effect on the fishery. Dredging may cause resuspension of naturally occurring mercury into the water column. Measured levels of mercury in the water column do not exceed the Federal water-quality criteria. If increased levels of mercury in the water column were to occur, this could cause the closure of the commercial crab fishery for 1 or more years, although a well designed monitoring program should prevent this from happening, and the effect on the commercial crab fishery would be MINOR. The effect of a fuel spill on the commercial salmon and herring fisheries could be MODERATE. The effect of the proposal on commercial fisheries in the Nome area is expected to be MODERATE in the high case.

(10) Effects on Subsistence-Harvest Patterns: In the base case, MINOR effects are already expected on subsistence-harvest patterns. Doubling the dredging activity in the base case would not increase the MINOR level of effects expected in the base case; however, the effects probably would be intensified. With an environmental monitoring and operations program in place all subsistence harvests would continue to occur. Thus, MINOR effects are expected on subsistence-harvest patterns in the high case, the same as in the base case.

(11) Effects on Sociocultural Systems: The increase in dredging activity under the high case would cause greater increases in population growth and employment. The increase in population growth between the base and high cases is not significant enough to cause more than the expected MINOR level of effects from population growth in the base case. In the high case, MINOR effects are expected on subsistence-harvest patterns, the same as in the base case. As in the base case, MINOR effects on subsistence-harvest patterns would cause disruption to the social organization and cultural values and increase levels of stress in the community. The likelihood of a MINOR effect on subsistence-harvest patterns occurring would double in the high case. With Stipulation Nos. 1 through 3 in place, the effects would not be expected to be higher than MINOR, but the effects would be intensified. Thus, the effect on sociocultural systems in the high case as a result of the MINOR effect on subsistence-harvest patterns also would be MINOR, the same as for the base case. The overall effect on sociocultural systems in the high case is expected to be MINOR.

(12) Effects on Archaeological Resources: The effects of this alternative are due to a higher level of activity from increased dredging affecting submerged archaeological resources and this activity

also affecting the visits to onshore archaeological sites. Such activity would slightly increase trespassing on Native lands where onshore archaeological sites are located and such trespassing would accidentally or intentionally damage sites to a modest degree. Therefore, the effects of the high case on archaeological resources are expected to be MODERATE.

(13) Effects on Recreation and Tourism Resources: The effects of this alternative are due to a higher level of activity from increased dredging affecting offshore recreation and tourism resources and this activity also affecting the visits to onshore archaeological sites used for recreation and tourism. Such activity would slightly increase the number of tourists and recreationists, and this would have a positive effect on the tourism and recreation industry. Therefore, the effects of the high case on recreation and tourism resources are expected to be MODERATE.

(14) Effects on Land Use Plans and Coastal Management Programs: In the high case, the types and levels of effects associated with changes in the benthic environment, resuspension of toxic trace metals, and excessive turbidity are comparable to those identified in the base case of the proposal, although typically they are intensified or more likely. However, monitoring is expected to prevent changes to the benthic environment from raising potential MODERATE effects for red king crab to MAJOR. As a result, the potential for MODERATE conflict with both the overall and the offshore habitat standard of the ACMP, and by extension the statewide standard for mining and mineral processing, that was noted for the base case remains. MODERATE conflict with the ACMP is expected to occur as a result of activities associated with the high case for the lease sale.

(15) Effects on Human Health: The doubling of dredging activity is not likely to significantly increase the amount of mercury in the water or increase the bioaccumulation of mercury in the food chain or in subsistence seafoods due to the very low levels measured in association with current dredging and the expected low levels that would be measured in association with the proposed action under Stipulation No. 1. Other trace metals are very unlikely to pose any threat to human health even if they exceed EPA criteria due to the fact that these metals do not generally biomagnify in the food chain and because concentrations of these metals would be greatly diluted 100 m beyond the dredge and would not significantly accumulate in the food chain. Thus, the effect of the high case on human health is expected to be NEGLIGIBLE. The overall effect of the high case on human health is expected to be NEGLIGIBLE.

## **B. Alternative II - No Sale**

This alternative would eliminate the entire area proposed for leasing from further consideration and would eliminate potential risks to the environment from mineral development in the sale area as well as potential economic benefits such as increased employment opportunities.

## **C. Alternative III - Delay the Sale**

This alternative would delay the proposed sale for a 3-year period. The action scenario would remain the same. A 3-year delay in the sale would allow a minimum amount of time for further studies to be conducted in the lease-sale area to improve the database available for making a decision concerning the leasing of this area for potential placer mineral development. However, baseline and monitoring data could be collected in a manner consistent with the requirements of Stipulation Nos. 1 and 3 which will be adequate to protect environmental resources. Delaying the sale would delay the time during which potential economic benefits would take place, such as increased employment opportunities.

## **D. Alternative IV - Eastern Deferral Alternative:**

1. Description: This alternative would remove from the Norton Sound Lease Sale area 15 whole and partial blocks (about 63,593 acres) located southeast of Safety Sound (see Fig. II-6). These blocks comprise the Eastern Deferral Area.

2. Activities Associated With Alternative IV: For purposes of analysis, the exploration and mining scenarios for this alternative are based on the assumption that the level of activities and timing of events associated with exploration and mining for the Eastern Deferral Alternative would be the same as for Alternative I except that all of the activities would occur in that part of the lease area south of Nome. (See Table II-1 and





Sec. II.A.2 for a complete description.) The MMS estimates that one dredge would operate in the sale area for 14 years and mine approximately 1,300 acres (50-100 acres per year).

Very little sediment, composition, and distribution data are available in the area to be deferred in the Eastern Deferral Alternative, but glaciation was not extensive in this area. Thus, the primary mechanism for transporting coarse, particulate gold to the OCS appears to have been limited. Also, samples collected from the surficial lag deposit contained no gold or only trace amounts (Nelson and Hopkins, 1972). No borehole data have been collected in the eastern area, so subsurface information is nonexistent.

3. **Summary of Effects of Alternative IV:** The analysis in Section IV.E of this EIS shows that air quality of the shoreline area east of Cape Nome would be more protected from offshore emissions because the emissions would be further away from industrial activities. However, the effects on the remaining shoreline would remain NEGLIGIBLE, as for the base case. This alternative would have less adverse effect on local water quality in the area deferred from leasing because dredging discharges and likely the assumed fuel spill would occur away from this area. Overall effects on water quality would remain a MAJOR LOCAL effect because of copper contamination and a REGIONAL MINOR effect because of the assumed fuel spill. Under the Eastern Deferral Alternative, the concentration of activity in the western portion of the sale area could intensify effects on red king crabs since the likelihood of important red king crab habitat being affected is greater, both directly from dredging and from turbidity effects. However, the level of effect is expected to remain the same as for the proposal, MODERATE, based on the inclusion of a monitoring program and operations management stipulation and the previous deletion of 6 blocks of presumed prime red king crab habitat. No reduction in effect levels is expected for fishes since most fishes in the Norton Sound area are very mobile and have broad distributions within the Sound; effects should remain MODERATE. Noise and disturbance, physical habitat alteration, and potential toxic trace-metal effects on marine and coastal birds would likely be reduced from MINOR under the proposal to NEGLIGIBLE. The deferral of lease blocks east of Cape Nome could reduce air and vessel noise and disturbance effects on spotted and bearded seals, walruses, and belukha whales that occur offshore and along the coast of Safety Sound and further east. The overall effect level is expected to remain MINOR (same as for the proposal) for the regional populations of the endangered gray whale and the threatened arctic peregrine falcon. No reduction in effects from MINOR, the same as for the base case, is anticipated on subsistence-harvest patterns under this alternative. The effects on nonendangered species of marine mammals, the economy of Nome, commercial fishing, sociocultural systems, human health, archeological resources, recreation and tourism, and land use plans and coastal management programs remain the same as the base case.

#### **E. Alternative V - Western Deferral Alternative:**

1. **Description:** This alternative would remove from the Norton Sound Lease Sale area 19 whole and partial blocks (about 83,458 acres) located south of Nome (see Fig. II-7). These blocks comprise the Western Deferral Area.

2. **Activities Associated With Alternative V:** For purposes of analysis, the exploration and mining scenarios for this alternative are based on the assumption that the level of activities and timing of events associated with exploration and mining for the Western Deferral Alternative would be the same as for Alternative I except that all of the activities would occur in that part of the lease area southeast of Safety Sound. (See Table II-1 and Sec. II.A.2 for a complete description of the scenario.) The MMS estimates one dredge would operate in the sale area for 14 years and mine approximately 1,300 acres (50-100 acres per year).

The area to be deferred in the Western Deferral Alternative has high resource potential based on available data and the present state of knowledge. The western area is adjacent to active State leases and current dredging operations by the Bima, and is known to have favorable geology for placer gold deposits. This area has been subjected to glaciation that was the primary mechanism for transporting coarse, particulate gold. Available data indicate that glacial deposits extend to approximately the 3-mi limit in the Western Deferral area south of Nome. Adjacent blocks in Federal waters probably have high resource potential, especially where enrichment factors occur such as a submerged strandline or a buried fluvial channel. Nelson and Hopkins (1972) report high gold values in the surficial lag deposit in the western area.

3. **Summary of Effects of Alternative V:** The analysis of Section IV.F of this EIS shows that air quality of the shoreline area west of Safety Sound would be more protected from offshore emissions because the emissions would be further away from industrial activities. However, the effects on the remaining shoreline would remain NEGLIGIBLE, as for the base case. This alternative would have localized benefits for water



quality in the area deferred from leasing because dredging discharges and likely the assumed fuel spill would occur away from this area. The overall effect on water quality would remain a MAJOR LOCAL effect because of copper contamination and a REGIONAL MINOR effect because of the assumed fuel spill. The Western Deferral Alternative would reduce potential effects on important red king crab habitat from habitat alteration due to dredging and resulting sedimentation, with the overall effect reduced from MODERATE to MINOR. Effects to other marine plants and invertebrates are also expected to be reduced from MODERATE to MINOR based on the deferral of more unique or limited substrates found in the western part of the original lease area. As a result, potential conflicts with the statewide standard of the Alaska Coastal Management Program (ACMP) for offshore habitats is reduced; thereby reducing potential conflicts with the ACMP to MINOR. No reduction in effect levels is expected for fishes since most fishes in the Norton Sound area are very mobile and have broad distributions within the Sound. Effects on marine and coastal birds are expected to be the same as for the proposal. A reduction in effects from noise and disturbance to seals, walruses, and belukha whales frequenting coastal habitats west of Cape Nome is expected under Alternative V; however, overall effects are expected to remain the same as for the proposal. Slight reductions in effects on gray whales and arctic peregrine falcons can be expected, but overall effects would be similar to those for the proposal. No reduction in effects from the MINOR level estimated for the base case is anticipated on subsistence-harvest patterns under this alternative. The effects on the economy of Nome, commercial fisheries, subsistence-harvest patterns, sociocultural systems, human health, archeological resources, and recreation and tourism would be the same as the base case.

## **F. Mitigating Measures:**

1. **Existing Measures That Are Part of the Proposed Action and the Alternatives:** Existing laws, regulations, and orders that provide mitigation are considered part of the proposal. The OCSLA grants broad authority to the Secretary of the Interior to manage and regulate many of the activities that relate to the leasing, exploration, development, and production of mineral resources of the OCS. In addition to the OCSLA, the following laws, where applicable, govern the OCS Mining Program:

1. National Environmental Policy Act
2. Endangered Species Act of 1973, as amended
3. Marine Mammal Protection Act, as amended
4. National Historic Preservation Act, as amended
5. Clean Air Act, as amended
6. Coastal Zone Management Act of 1972, as amended
7. Marine Protection, Research, and Sanctuaries Act of 1972, as amended
8. Federal Water Pollution Control Act, as amended
9. Port and Waterways Safety Act
10. Comprehensive Environmental Response Compensation and Liability Act of 1980

The above laws are not inclusive of laws that may regulate the OCS Mining Program. Further, the regulatory regime implementing these laws may require specific permits. One such permit that would be required is a National Pollutant Discharge Elimination System Permit (NPDES) permit. The NPDES permit is issued by EPA in compliance with the Federal Water Pollution Control Act, as amended. At this point, it is believed that no other permits are required.

The USDOJ and other Federal agencies and departments have been given jurisdiction to manage and monitor activities associated with marine-mineral development within the Exclusive Economic Zone (EEZ). These agencies use various Federal and State regulations, lease stipulations, and Notices to Lessees (NTL'S) to mitigate environmental effects or to establish operating standards.

The USCG currently inspects a barge/dredge before it issues a Certificate of Inspection (COI) or a Letter of Compliance (LOC). The USCG inspections include general safety items such as the mechanical, electrical, sanitary, and survival systems of the barges/dredges. The USCG administers applicable regulations to ensure compliance with the conditions of the COI or LOC.

Lessees are required to design, fabricate, and install structures and platforms to assure structural integrity of all installations and structures for the safe conduct of operations considering the specific environmental conditions, as described in 30 CFR 282.27(j). The MMS will approve the use of specific mining structures or vessels, taking into consideration their design capabilities, anticipated environmental conditions, and the type and level of

review conducted by the USCG. The USCG issuance of a COI or LOC does not preclude additional requirements being imposed by the MMS.

The seaworthiness factors of the MMS technical review and approval process for design and fabrication of all OCS mining facilities involves the consideration of "Design Environmental Conditions." The term "Design Environmental Conditions" means the environmental factors producing the most unfavorable effects on OCS facilities. The parameters that describe these conditions reflect the various environmental events that individually or collectively represent the most severe conditions that the facilities are anticipated to experience. Such conditions include, but are not limited to, the following:

1. The maximum wave (corresponding to a selected recurrence period) together with the associated wind, current, and appropriate icing and snow effects.
2. The minimum air and sea temperatures appropriate to the above maximum event.
3. The maximum water level due to tide and storm surge.
4. Maximum ice and wind force in the specific operating area.

The MMS may require lessees to submit a contingency plan prior to receiving approval for the commencement of mining activities involving a dredge (or other mining vessel). The contingency plan would address suspension of mining operations and actions to move or protect the mining vessel in the event the environmental conditions exceed the operating capability of the mining vessel. The contingency plan would address items such as pretension tests and monitoring of the anchoring systems of the vessel to ensure vessel safety under expected meteorological and ocean conditions, monitoring vessel performance, and monitoring and forecasting weather conditions.

**Leasing and Operating Regulations for Minerals Other Than Oil, Gas, and Sulphur:** Final rules for leasing and operations for minerals other than oil, gas, and sulphur are at 30 CFR 281 and 282, respectively. The regulations for operations relating to offshore mineral resources consider the following:

- Review and comment on plans by lessees, operators, Federal agencies, adjacent states and other interested parties
- The Director can request additional environmental data, if needed, to fulfill NEPA requirements
- The Director is responsible for preventing harm or damage to, or waste of any natural resource (including OCS mineral deposits and oil, gas, and sulphur resources in areas leased or not leased), any life (including fish or other aquatic life), property, or the marine, coastal, or human environment
- The Director may direct a suspension of operations if necessary for the initiation and conduct of an environmental evaluation to define mitigating measures to avoid or minimize adverse environmental effects
- The Director may direct a suspension of operations if necessary to facilitate the installation of equipment necessary for safety and environmental reasons
- Delineation, testing, and mining plans will be required prior to the commencement of any activities, except for preliminary activities
- Plans will not be approved before completion of any environmental analysis required by NEPA
- Plans must describe potential environmental effects and the measures that will be used to mitigate or monitor (as appropriate) those effects
- Lessees must notify the Director of accidents, spills, etc., or damage to aquatic life and the environment
- If baseline environmental data are determined inadequate, the Director can require the lessee to collect additional data
- The lessee will be required to monitor activities to assess environmental effects

**2. MMS Mitigating Measures That are Part of the Proposed Action and the Alternatives:**

The following mitigating measures are part of the proposal and the alternatives to reduce or eliminate potential adverse effects identified in Section IV.B. The Director already has made a preliminary decision on these mitigating measures. No mitigating measures are proposed that are not part of the proposed action.

**a. Stipulations:** Stipulations are specific requirements placed on the lessee by the USDOJ to reduce or eliminate potential adverse effects. The following stipulations are part of the Norton Sound Lease Sale:

- No. 1 - Environmental Survey and Monitoring Program and Operations Management
- No. 2 - Prohibition of Use of Mercury or Other Toxic Substances in Processing
- No. 3 - Baseline and Monitoring Studies on Mercury Levels in Humans
- No. 4 - Protection of Archaeological Resources

**Stipulation No. 1. Environmental Survey and Monitoring Program and Operations Management**

The lessee is required to conduct environmental surveys. The survey plan will address water quality, EPA priority trace metals, and the presence, distribution, and composition of biological communities including organisms such as marine mammals, red king crabs, etc. The lessee also is required to conduct environmental monitoring to identify existing conditions and any trends or changes resulting from the mining activity. The environmental monitoring program will address measurement of trace metal concentrations in the water and sediment; bioaccumulation of trace metals in selected organisms such as mollusks, fish, marine mammals, and the arctic peregrine falcon; turbidity and sedimentation; pre- and postmining bathymetric contours; and rate of recolonization of benthic communities. The Environmental Survey and Monitoring Program, including quality control, will be approved and monitored by the Regional Supervisor, Field Operations (RS/FO) as part of the testing or mining plan. The lessee will submit to the RS/FO an annual report with the results of the Environmental Survey and Monitoring Program including trends in trace-metal accumulation in selected monitored organisms. The report will be used by the RS/FO in coordination with appropriate State and Federal agencies to determine if any modification or suspension of operations is necessary to protect the biological resources. If it is determined that testing, mining, or processing activities are contributing to significant adverse effects from (1) an increase in trace metals in the selected marine organisms; (2) habitat alteration; or (3) water-quality degradation, the RS/FO, in consultation with the Environmental Protection Agency (EPA) and the State of Alaska, will determine what regulatory action is necessary and will order modification or suspension of activities, as appropriate. Recognizing that marine discharges, including the discharge of dredged materials, are subject to regulation by the EPA, MMS will coordinate the requirements for the Environmental Survey and Monitoring Program with EPA. The Environmental Survey and Monitoring Program will be evaluated at least once a year and the program may be modified, as appropriate, based on the results of prior surveys and other available information. The lessee shall notify the RS/FO of exceedances of EPA water-quality criteria within 24 hours of becoming aware of such exceedances.

The EPA has the authority to impose requirements on the lessee through the National Pollutant Discharge Elimination System (NPDES) permit process, in addition to those required under the Environmental Survey and Monitoring Program.

**Purpose of Stipulation No. 1:** The purpose of this measure is to require appropriate environmental surveys and environmental monitoring programs be conducted to determine if lease operations are resulting in significant effects to the environment. Information obtained from the monitoring program will be used to establish measures to mitigate the effects of the mining program on the environment.

The lessee's monitoring program would help identify potential problem areas, and the RS/FO, in consultation with other agencies, will analyze the monitoring results. If this analysis indicates that significant adverse effects are occurring as a result of OCS mining operations, then the RS/FO would require the lessee to (1) modify its mining operation to avoid or mitigate such environmental impacts; (2) modify the monitoring program in order to gather additional, site-specific environmental data; and/or (3) specify particular procedures for mitigating environmental impacts. The RS/FO would review the operator's proposal to assess if the modifications are appropriate to protect the environment.



Dredging activities on the OCS off of Nome, Alaska raise concerns regarding elevated or even toxic levels of mercury in the marine environment, as well as effects due to habitat alteration and widespread turbidity and sedimentation.

Of primary concern is the potential effect of elevated mercury levels in the marine environment (see the Purpose of Stipulation No. 2 [no mercury use]). The EPA has developed Federal criteria for water quality of marine waters in order to protect marine resources. The EPA considers more than one exceedance of a criterion in a 3-year period on the average to pose a threat to the resource being protected. The EPA chronic criterion for mercury was established to ensure that mercury contamination of marine foods would be insufficient to threaten the health of the average person. The EPA acute criterion for mercury was set to protect sensitive marine species from mercury toxicity. A special concern for the potential of bioaccumulation of mercury is in the threatened arctic peregrine falcon population. The June 26, 1990, FWS biological opinion recommends the monitoring of the Norton Sound arctic peregrine falcon population status and mercury level accumulation (see Appendix B).

Exceedences of Federal criteria for turbidity, arsenic, lead, copper, and nickel in marine waters are anticipated for the base case by EPA based on existing water and sediment quality and experience in nearby State waters (Crecelius, Apts, and Lasorsa, 1990). (See Sec. IV.B.2.b(1) and (2) for a detailed discussion of Federal water-quality criteria.) Industry monitoring of current gold dredging in State waters has reported turbidity and trace-metal concentrations in excess of Federal criteria and State standards and permit restrictions (USEPA, 1988a,b; Jewett et al., 1990). An effective MMS monitoring program for the proposed sale would ensure that if similar exceedences of turbidity and trace-metal criteria did occur that the exceedences would be detected, resultant effects monitored, and operations ordered modified by the RS/FO as needed.

Another concern regarding this sale is the disruption of the benthic environment. Mining of the sort being conducted in Norton Sound results in total disruption of the sea bottom at the mining site to whatever depth is being mined. The sediments are scooped up by large buckets on a bucket-ladder dredge, processed onboard the dredging vessel, and discharged back into the water. Because of the nature of this mining operation and its potential effects on red king crab, fish species, other biological resources in the food chain, and their uses as subsistence foods, biological surveys and environmental monitoring are proposed to determine what types of habitat and marine resources are there, how they are affected by mining, and if recovery occurs and the recovery timeframe.

#### **Stipulation No. 2. Prohibition of Use of Mercury or Other Toxic Substances in Processing**

The lessee shall not store or use mercury or any other toxic substance for testing and/or the beneficiation of placer minerals onboard the dredging vessel, or any other vessel or offshore structure directly associated with dredging operations. (Beneficiation means: [1] the dressing or processing of ores for the propose of [a] regulating the size of a desired product, [b] removing unwanted constituents, and [c] improving the quality, purity, or assay grade of a desired product; and [2] concentration or other preparations of ore for smelting by drying, flotation, or magnetic separation.)

**Purpose of Stipulation No. 2:** One of the primary concerns regarding the effects of offshore gold mining in the Norton Sound area is the effect of toxic levels of mercury in the marine environment. Mercury is sometimes used in the process of recovering gold and this is why the stipulation is totally restrictive on the lessee; it forbids the use of mercury onboard the dredging vessel. This measure eliminates the risk of a mercury spill because no mercury would be on the vessel. Initial studies conducted by UAF (Naidu et al., 1988) indicated mercury levels in the waters of the sale area were in exceedence of EPA chronic criteria, however, more recent studies conducted for MMS (Crecelius, Apts, and, Lasorsa, 1989) indicated that mercury levels in the waters of the sale area did not exceed the EPA chronic criterion for mercury. The Bima does not use mercury in its processing of gold offshore, and the proposal assumes that mercury will not be used in processing. The June 26, 1990, FWS biological opinion concluded that the proposed lease sale "will not likely jeopardize the continued existence" of the threatened arctic peregrine falcon. This conclusion was based on the inclusion of this stipulation (see Appendix B).

This stipulation would ensure that (1) offshore-processing losses of metallic mercury would not occur from the dredge and that (2) the unlikely event of a mercury spill could not occur if the dredge were lost in a major accident.

### **Stipulation No. 3. Baseline and Monitoring Studies on Mercury Levels in Humans**

The lessee will be required to monitor human health in a manner approved by the Regional Supervisor, Field Operations (RS/FO) if baseline information collected by the MMS or other Federal, State, or regional health agency indicates potential human health problems associated with mercury, and if site-specific environmental survey and monitoring or other information indicates lease activities may contribute to mercury levels adversely affecting human health. The RS/FO may require that monitoring of human health begin at the commencement of mining operations. The lessee will coordinate the preparation of any such human health monitoring program with appropriate Federal and State health agencies prior to submitting it to the RS/FO. For purposes of this stipulation, human health will be considered adversely affected by lease activities if they contribute to mercury levels in humans which closely approach or are at the safety levels established by the World Health Organization. The results of any human health monitoring will be used by the RS/FO in coordination with appropriate Federal and State agencies to determine if any modifications or suspension of operations are necessary to protect human health. If it is determined that lease activities are adversely affecting human health, the RS/FO, in consultation with the Environmental Protection Agency and the State of Alaska will determine what action is necessary and will require modification or suspension of activities as appropriate. Following the initiation of human health monitoring, the RS/FO will evaluate annually for at least 2 years, and as frequently thereafter as appropriate, the need to continue monitoring human health. The annual and any subsequent reviews will be made in coordination with other appropriate Federal, State, and local health agencies. Based on the results of such reviews and monitoring or other information, the RS/FO may require that the monitoring program be modified or eliminated.

**Purpose of Stipulation No. 3:** The purpose of this stipulation is to inform the lessee that they will be required to monitor mercury levels in the Nome population if baseline studies indicate elevated mercury levels in humans according to safety standards set by the WHO and that if the lessee's operations are contributing to mercury contamination. The RS/FO will suspend or modify dredging operations according to 30 CFR 282.13(b)(2) and 30 CFR 282.14(a)(1) if significant bioaccumulation of mercury is indicated or if water quality exceeds EPA Water Quality Criteria. The MMS recognizes the need for baseline information on human mercury levels of the people of Nome. The MMS, in coordination with the U.S. Indian Health Service and the Norton Sound Health Corporation, conducted a baseline study of mercury and arsenic levels in women of childbearing age in Nome in October 1989 (Creelius, Apts, and Lasorsa, 1989). The MMS is considering collecting additional baseline information on human mercury levels and is working with the Norton Sound Health Corporation in their attempts to collect information on the consumption of subsistence foods in Nome. In addition, the MMS has notified State, Federal, and regional health agencies of this concern and is encouraging collection of baseline information on human mercury levels in Nome.

### **Stipulation No. 4. Protection of Archaeological Resources**

(a) "Archaeological resource means any prehistoric or historic district, site, building, structure, or object (including shipwrecks); such term includes artifacts, records, and remains which are related to such a district, site, building, structure, or object (Section 301[5] National Historic Preservation Act, as amended, 16 U.S.C. 470w[5]) "Operations means any drilling, mining, or construction, or placement of any structure for exploration, development, or production of the lease.

(b) If the Regional Supervisor, Field Operations (RS/FO), believes an archaeological resource may exist in the lease area, the RS/FO will notify the lessee in writing. The lessee shall then comply with subparagraphs (1) through (3).

(1) Prior to commencing any operations, the lessee shall prepare a report, as specified by the RS/FO, to determine the potential existence of any archaeological resource that may be affected by operations. The report, prepared by an archaeologist and a geophysicist shall be based on an assessment of data from remote-sensing surveys and of other pertinent archaeological and environmental information. The lessee shall submit this report to the RS/FO for review.

(2) If the evidence suggests that an archaeological resource may be present, the lessee shall either

(i) Locate the site of any operation so as not to adversely affect the area where the archaeological resource may be; or

(ii) Establish to the satisfaction of the RS/FO that an archaeological resource does not exist or will not be adversely affected by operations. This shall be done by further archaeological investigation, conducted by an archaeologist and a geophysicist, using survey equipment and techniques deemed necessary by the RS/FO. A report on the investigation shall be submitted to the RS/FO for review.

(3) If the RS/FO determines that an archaeological resource is likely to be present in the lease area and may be adversely affected by operations, the RS/FO will notify the lessee immediately. The lessee shall take no action that may adversely affect the archaeological resource until the RS/FO has told the lessee how to protect it.

(c) If the lessee discovers any archaeological resource while conducting operations in the lease area, the lessee shall report the discovery immediately to the RS/FO. The lessee shall make every reasonable effort to preserve the archaeological resource until the RS/FO has told the lessee how to protect it.

**Purpose of Stipulation No. 4:** This measure applies to all lease blocks. It protects prehistoric and historic archaeological resources found on lease blocks by surveying the area before exploration and dredging if the RS/FO determines that a resource may exist. Therefore, it also protects historic resources such as shipwrecks if these are found on any lease blocks. The MMS Archaeological Update Report for the OCS Mining Program (see Appendix A) states that the seafloor is locally scoured by the coastal currents and winnowed by storm waves. Ice gouging is present but only to a limited extent due to the divergent flow of this current. Offshore sediments are modern silts to the east of Solomon and relict glacial gravels to the west. Further offshore, these gravels are replaced by modern silts, relict sands, and mixtures of both. Bathymetry, likewise, reveals both modern and relict bedforms. To the west of Cape Nome, modern sand waves and sand ribbons coexist with relict shoreline shoals. Shipwrecks could potentially survive coastal currents, storm waves, and limited ice gouging. Such wrecks, if they exist, would be protected by this stipulation even if exposed on the seafloor.

b. **Information to Lessees:** The mitigating measures considered as information to lessees (ITL's) either (1) state MMS policy and practices that are carried out and enforced, (2) inform lessees about special concerns in or near the lease area, or (3) advise or inform lessees of existing legal requirements of MMS and other Federal agencies. These measures provide positive mitigation by creating greater awareness of these issues on the part of the lessees.

The following ITL's are part of the Norton Sound Lease Sale:

- No. 1 - Information on Bird and Marine Mammal Protection
- No. 2 - Information on Arctic Peregrine Falcon
- No. 3 - Information on Subsistence Activities
- No. 4 - Information on Coastal Zone Management
- No. 5 - Information on Postlease Monitoring

**ITL No. 1--Information on Bird and Marine Mammal Protection**

Lessees are advised that during the conduct of all activities related to leases issued as a result of this sale, the lessee and its agents, contractors, and subcontractors will be subject to, among others, the provisions of the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 U.S.C. 1361 et seq.); the Endangered Species Act (ESA), as amended (16 U.S.C. 1531 et seq.); and applicable International Treaties.

Lessees and their contractors should be aware that disturbance of wildlife could be determined to constitute harm or harassment and thereby be in violation of existing laws and treaties. With respect to endangered species and marine mammals, disturbance could be determined to constitute a "taking" situation. Under the ESA, the term "take" is defined to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in such conduct." Under the MMPA, "take" means "harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." Violations under these Acts and applicable Treaties may be reported to the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (FWS), as appropriate.

Incidental taking of marine mammals and endangered and threatened species is allowed only when the statutory requirements of the MMPA and/or the ESA are met. Section 101(a)(5) of the MMPA allows for the taking of small numbers of marine mammals incidental to a specified activity within a specified geographical area. Section

7(b)(4) of the ESA allows for the incidental taking of endangered and threatened species under certain circumstances. If a marine mammal species is listed as endangered or threatened under the ESA, the requirements of both the MMPA and the ESA must be met before the incidental take can be allowed.

Under the MMPA, the NMFS is responsible for species of the order Cetacea (whales and dolphins) and the suborder Pinnipedia (seals and sea lions) except walrus; the FWS is responsible in Alaskan waters for polar bears, sea otters, and walrus. Procedural regulations implementing the provisions of the MMPA are found at 50 CFR Part 18.27 for FWS, and at 50 CFR Part 228 for NMFS.

Lessees are advised that specific regulations must be applied for and in place and the Letters of Authorization must be obtained by those proposing the activity to allow the incidental take of marine mammals whether or not they are endangered or threatened. The regulatory process may require one year or longer.

Of particular concern is disturbance at major wildlife concentration areas, including bird colonies, marine mammal haulout and breeding areas, and wildlife refuges and parks. Maps depicting major wildlife concentration areas in the lease area are available from the Regional Supervisor, Field Operations. Lessees are also encouraged to confer with the FWS and NMFS in planning transportation routes between support bases and leaseholdings.

Behavioral disturbance of most birds and mammals found in or near the lease area would be unlikely if aircraft and vessels maintain at least a 1-mile horizontal distance and aircraft maintain at least a 1,500-foot vertical distance above known or observed wildlife concentration areas, such as bird colonies and marine mammal haulout and breeding areas.

For the protection of endangered whales and marine mammals throughout the lease area, it is recommended that all aircraft operators maintain a minimum 1,500-foot altitude when in transit between support bases and exploration sites. Lessees and their contractors are encouraged to minimize or reroute trips to and from the leasehold by aircraft and vessels when endangered whales are likely to be in the area. Human safety should take precedence at all times over these recommendations.

**Purpose of ITL No. 1:** Conformance by lessees with the recommendations described above would help to ensure that behavioral disturbance of wildlife, particularly at known concentration areas, would be minimized. Norton Sound is important habitat for some nonendangered marine mammals and locally important marine birds, waterfowl, and the arctic peregrine falcon. The same area is of lesser importance to endangered cetaceans with only a few gray whales using the area. Of particular concern are the seabird colonies at Bluff and Safety Sound, coastal peregrine falcon nest sites near the proposed sale area, and seal haulout areas at Cape Nome to Safety Sound. Compliance with this measure could substantially reduce disturbance and possible injury or mortality of marine birds, arctic peregrine falcons, walruses, seals, and cetaceans by mining activities. Maps available in this EIS or from the RS/FO designate locations habitually used as concentration areas. Block-specific recommendations may be made by the RS/FO, as appropriate. Appropriate authorities may issue more specific regulations under existing legislation that could further minimize behavioral disturbance to wildlife.

ITL No. 2 (Information on Arctic Peregrine Falcon) provides additional and more specific guidance to the lessee for protection of the arctic peregrine falcon nest sites. However, total compliance with aircraft-flight restrictions is not likely to be achieved--different companies and their subcontractors use different air charters, and the awareness or diligence of the different pilots in complying with such restrictions may vary.

Due to the advisory nature of this measure and the characteristics of aircraft and vessel controls, it is likely that some marine mammals (including a few endangered gray whales) and birds would interact with some industrial activities associated with mining operations over the 14-year life of the proposal. It cannot be assumed that inadvertent conflict can be avoided completely or that incidental "taking" would not occur. Some disturbance effects on whales, walruses, seals, and seabirds can be expected.

#### **ITL No. 2. Information on Arctic Peregrine Falcon**

Lessees are advised that the arctic peregrine falcon (*Falco peregrinus tundrius*) is listed as threatened by the U.S. Department of the Interior and is protected by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.).

Peregrines are generally present in the vicinity of the sale area from April to September and are most disturbed by human activities near nest sites. There are 20 known nest sites along the northern shore of Norton Sound (from Cape Prince of Wales to Unalakleet) and six sites are located near the sale area. The conduct of OCS mining activities will not conflict with arctic peregrine falcons if the activities are located away from known nest sites. The lessee should contact the Fish and Wildlife Service (FWS) (Fish and Wildlife Enhancement Office, Fairbanks, Alaska) for information and protection criteria for the known nest sites of arctic peregrine falcons. The FWS will review delineation, testing, and mining plans submitted by lessees to the MMS and therefore the lessee should include arctic peregrine falcon protection measures as part of their plans. The FWS review may determine that certain restrictions could apply to further protect arctic peregrine falcon habitats. Lessees should advise their contractors and/or operators of the protection measures to further assure the protection of the arctic peregrine falcon.

**Purpose of ITL No. 2:** The June 7, 1989, FWS biological opinion recommended that the Norton Sound arctic peregrine falcon population be protected from noise and disturbance resulting from the proposal activities (see Appendix B). Also, according to the Alaska Peregrine Falcon Recovery Team, the primary threat to peregrines during the nesting season is human disturbance. Noise and disturbance from OCS offshore mining and support activities may produce from no effect to severe effects on peregrine falcons adjacent to the sale area, depending upon the nearness and persistence of the disturbance. Compliance by lessees with the recommendations described above should eliminate adverse disturbance effects on peregrines. Likewise, it is believed that disturbance effects can be precluded by consulting with FWS to determine protection measures to incorporate in the lessee's mining plans.

### **ITL No. 3. Information on Subsistence Activities**

Federal and State policies recognize subsistence as a priority use of wildlife resources. Lessees are therefore advised that operations should be conducted so as to avoid unnecessary interference with subsistence harvests. Consideration should be given to species harvested during the open-water season (from mid-May to mid-November) as follows:

1. From the beginning of June through September: marine fish, including salmon, smelt, and herring are harvested along the coast adjacent to the entire sale area, and from the beginning of October through May, tom cod are harvested along the coast adjacent to the entire sale area.
2. From the beginning of December to the end of June and from the beginning of August to October: seals are harvested in the entire sale area.
3. From the beginning of April through the end of June: walrus are harvested in the entire sale area.
4. From mid-April through the beginning of November: waterfowl are harvested throughout the sale area.

Industry is encouraged to consult with local village and regional organizations, including the Eskimo Walrus Commission, Nome Eskimo Community, Sitasuak Native Corporation, King Island Community, Kawerak Inc., Bering Straits Native Corporation, and the Bering Straits Coastal Management Program during all delineation, testing, and mining activities to minimize disturbance of subsistence activities.

**Purpose of ITL No. 3:** The activities, attitudes, and values that surround subsistence form the core of Native culture and is the foundation of the region's economy in the Norton Sound area. Local concerns about effects on subsistence are a major scoping issue. The intent of this ITL is to encourage lessees to conduct themselves in a responsible manner with regard to subsistence activities and thus avoid adverse effects on local subsistence harvests and cultural values.

### **ITL No. 4. Information on Coastal Zone Management**

Lessees are advised that activities described in delineation, testing, and mining plans under leases resulting from this sale that may affect any land or water use or natural resource of the coastal zone are subject to State coastal consistency review pursuant to Section 307(c)(3)(B) of the Coastal Zone Management Act.

Lessees are encouraged to consult and coordinate early with State and local agencies involved in coastal management review while preparing delineation, testing, and mining plans to ensure they are fully aware of policies and requirements of the Alaska Coastal Management Program and approved local coastal management

programs (CMP's). The City of Nome, Cenaliulriit, and Bering Straits Coastal Resource Service Area CMP's have been approved by the State and Federal governments.

**Purpose of ITL No. 4:** The purpose of this ITL is to alert lessees to the fact that when an activity would affect any land or water use or natural resource of the coastal zone, the State reviews the activity for consistency with these pertinent policy areas contained in the ACMP. Furthermore, it informs the lessee that district ACMP policies that supplement the broad statewide standards also may be pertinent. This ITL may help to alleviate potential conflicts with coastal management policies by alerting lessees that Alaska has an approved CMP that has been amended by the CMP's of the city of Nome, Cenaliulriit, and Bering Straits Coastal Resource Service Area.

**ITL No. 5. Information on Postlease Norton Sound Review**

Lessees are advised that, as provided in 30 CFR 282.4, a Postlease Review Team will be established to provide opportunity for representatives from Federal and State agencies and local government organizations to review proposed postlease OCS mining activities. The Review Team also will provide a forum for the exchange of information relating to mining activities. The Review Team will review proposed OCS Delineation, Testing, and Mining Plans and National Pollutant Discharge Elimination System permits, including any associated environmental survey and monitoring plans required by regulation (30 CFR 282), permit, or Lease Stipulation No. 1, and subsequent results.

The Review team will be established in lieu of continuing the Prelease Coordination Team.

**Purpose of ITL No. 5:** The purpose of this ITL is to advise the lessees that a postlease review team is being established. The specifics of this review team have not been decided. The intent of this ITL is to inform the lessee of how the review team will be a part of monitoring in general.

**SECTION III**

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**DESCRIPTION  
OF  
THE  
AFFECTED  
ENVIRONMENT**



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### III. DESCRIPTION OF THE AFFECTED ENVIRONMENT

#### A. Physical Considerations

1. **Introduction:** The OCS Mining Program Norton Sound Lease Sale area is located in the northern part of Norton Sound off the southern coast of the Seward Peninsula. The FEIS for Norton Basin OCS Oil and Gas Lease Sale 100 (USDOI, MMS, 1985a) contained a description of the physical environment of the northern Alaska Bering Sea continental shelf; this includes the Chirikov Basin--the area west of the Yukon River Delta and north of St. Lawrence Island--and Norton Sound. The Mining Program sale area is composed of 2 areas lying in the northwestern part of Norton Sound and from about 5 to 22 km offshore. The western part of the sale area extends along the coast about 20 km west and east of Nome, and the eastern part lies east of Safety Sound and extends along the coast for about 25 km. The geographic position of the Mining Program sale area exposes it to many of the geological, oceanographic, meteorological, and sea-ice processes that affect the Sale 100 area. Thus, the description of the sale area as contained in Section III.A of the Sale 100 FEIS (USDOI, MMS, 1985a) is incorporated by reference and summarized below. The description of the affected environment also contains information specific to the OCS Mining Program Norton Sound Lease Sale area.

2. **Bathymetry:** Water depths within the sale area range from about 20 m to slightly more than 30 m; Figure III-1. The principal bathymetric feature is an east-west trending trough extending through the western two-thirds of the sale area. The axis of the trough lies parallel to the shoreline and is slightly more than 30 m deep.

The sale area lies in the northwestern part of Norton Sound which is a broad embayment in the northeastern Bering Sea. The seafloor within Norton Sound generally lies at depths between 10 to 20 m and slopes to the west. The Chirikov Basin seafloor generally slopes to the northwest and lies at depths of 30 to 50 m.

3. **Marine Geology:** The geologic characteristics of the (1) Pleistocene and Recent geologic history of the northern Alaska Bering Sea continental shelf and the Seward Peninsula, (2) terrestrial placer deposits, and (3) distribution of gold and trace metals in the marine-surface sediments provide a basis for understanding the sediments, the potential for gold placer deposits, and the distribution of trace metals in the sale area.

a. **Sedimentary Processes, Geologic History, and Sediment Distribution:** The sediments of the continental shelf are part of a sedimentary environment that has been affected by glacial, alluvial, eolian (wind), and marine sedimentary processes. During the glacial periods of the Late Pliocene and Pleistocene Epochs when sea level was lower, the present-day continental shelf of the Chirikov Basin and Norton Sound became part of a continental regime. Rivers and streams cut channels throughout the exposed shelf (Hess and Nelson, 1982). Valley glaciers formed in the hills and mountains north of Nome and extended into the present day marine environment off the Seward Peninsula (Hess and Nelson, 1982). These glaciers eroded mineralized bedrock, marine, and older alluvial and beach placers and deposited gold-bearing sediments as much as 5 km beyond the present shoreline of the Seward Peninsula (Nelson and Hopkins, 1972; Kaufman and Hopkins, 1990); the coastal plain of Nome has been overridden by glacial ice at least twice during the Late Pliocene/Pleistocene. The glacial moraine and outwash deposits are composed of a heterogeneous mixture of silt, sand-, gravel-, cobble-, and larger size particles. Data from boreholes drilled in the nearshore area near Nome indicate the sediments in the upper 20 m are composed of mixed particles sizes including sand, pebbles, and cobbles in a silty clay matrix; some of these deposits may be consolidated (Kaufman and Hopkins, 1989). (Consolidation is the gradual reduction in the volume and increase in the density of soil in response to increased load and the process by which loose or soft sediments become coherent and firm.) The continental streams also eroded material from the glacial deposits.

Cobble and fine sand/silt have been described as the principle surface substrates in targeted nearshore mining locations for the Bima (Rusanowski, Gardner, and Jewett, 1987, 1888; Jewett, Gardner, and Athey, 1989; Jewett et al., 1990). Based on discussions during quarterly meetings for the Bima monitoring program, the predredging substrate described as "cobble" in these monitoring reports is the specific combination of mixed particles of sand, pebbles, and cobbles in an overconsolidated, silty clay matrix identified by Kaufman and Hopkins (1989) as the primary texture in the nearshore boreholes.

The Seward Peninsula contains many active and inactive lode and placer mines and prospects as well as known occurrences of metal-bearing minerals. The metal-bearing lodes, or veins, that contain important resources or

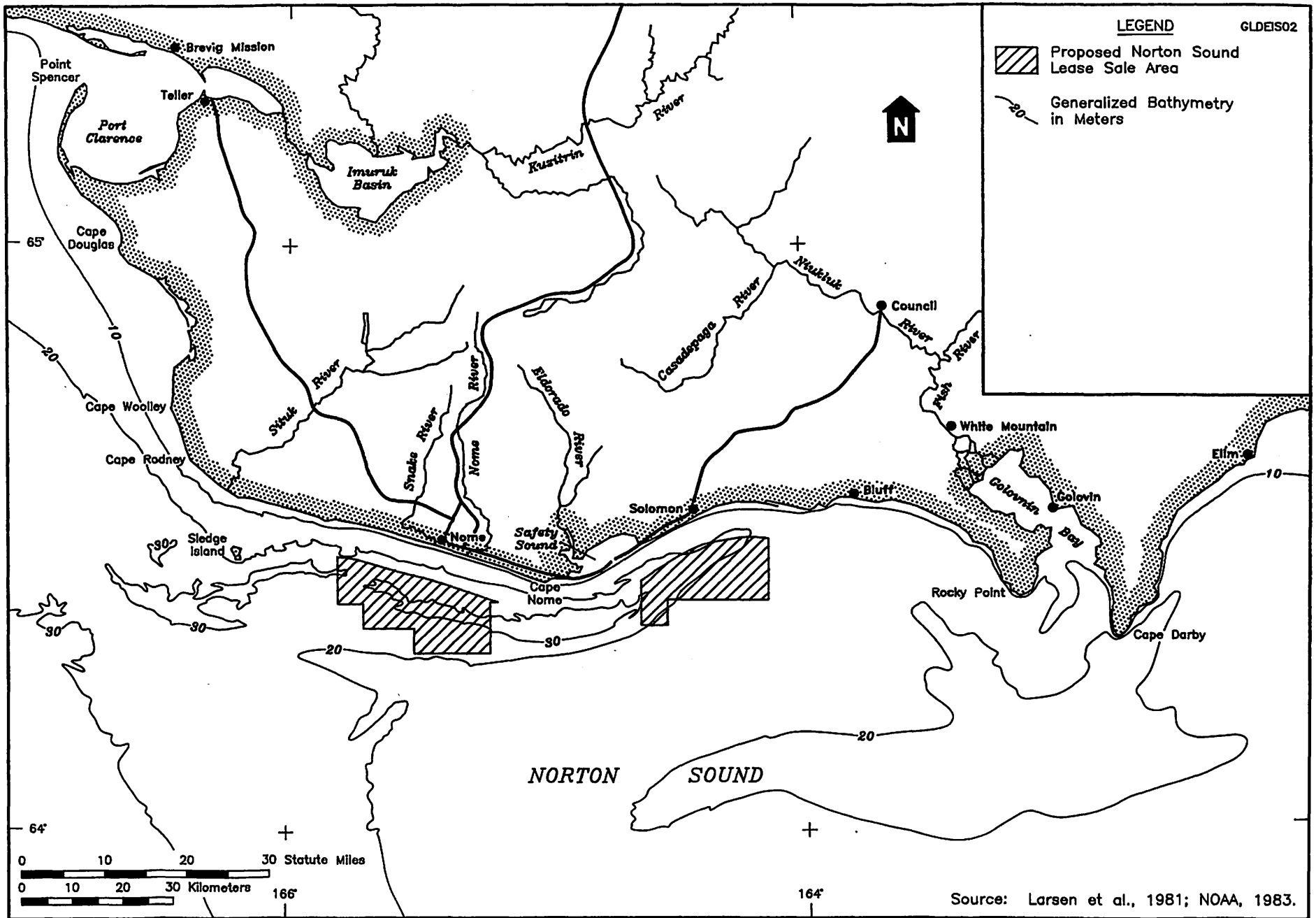


Figure III-1. Generalized Bathymetry (in Meters)

Source: Larsen et al., 1981; NOAA, 1983.

that have produced significant amounts of ore include deposits of tin (cassiterite), tungsten (scheelite), and beryllium ores, and gold (Cobb, 1973). Small amounts of antimony, bismuth, copper, silver, lead, and mercury also have been recovered but no currently economic deposits of these metals have been identified. Zinc, arsenic, molybdenum, uranium, thorium, and rare-earth minerals are also present (Berg and Cobb, 1967; Cobb, 1981). Placer deposits of the Seward Peninsula also have produced gold and other minerals and the beach deposits have been a major source of gold in the Nome area (Cobb, 1973). Common heavy minerals (specific gravity greater than 4.0) include scheelite, magnetite, ilmenite, hematite, stibnite, cassiterite, garnet, and bismuthinite (Cobb, 1973).

During the interglacial periods, sea level rose and sediments deposited during the transgression buried many features and filled the stream channels; these sediments consist of marine sandy silt interbedded with very fine sand layers. Currents and waves of the transgressing and regressing seas removed the finer and lighter particles from exposed glacial and weathered bedrock deposits; this winnowing process produced the lag gravel deposits that overlay the glacial deposits and bedrock. Beaches were also formed by the transgressing sea where the shoreline changed less rapidly (Nelson and Hopkins 1972). Relict beach deposits have been observed on the present-day shelf south of Nome, at depths of about 11, 20, and 24 m (Fig. III-2).

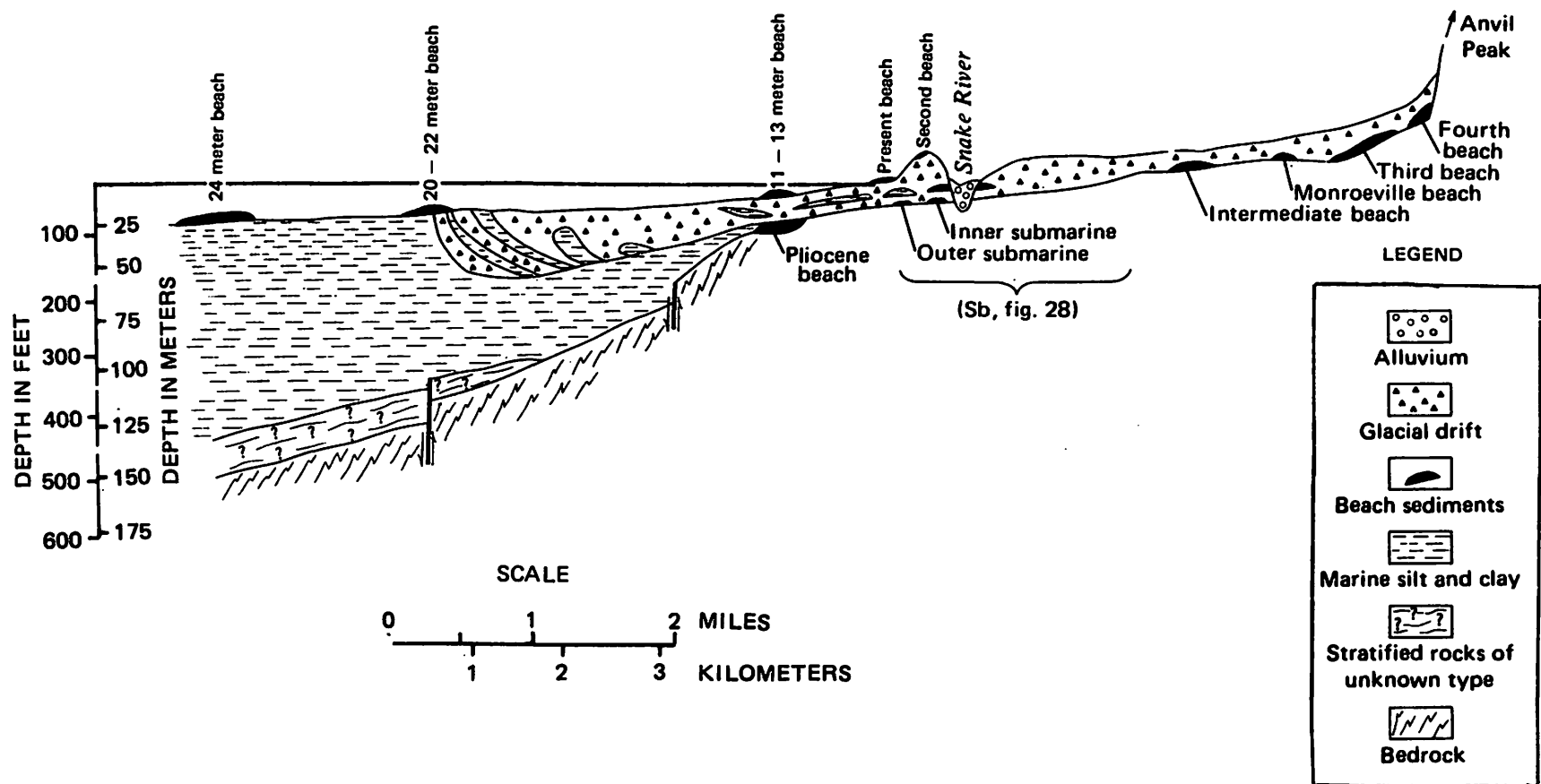
The last transgression began about 16,000 years ago (Kaufman and Hopkins, 1990). The period between 8,000 and 11,000 years before the present was a time of substantial climatic warming accompanied by flooding of the continental shelf; this period represents a transition from the late Pleistocene to the early part of the Holocene (Recent or Modern) Epoch (Kaufman and Hopkins, 1985).

Thus, the surface sediments of the Chirikov Basin and Norton Sound are both relict and modern. The relict sediments were deposited prior to and during the last transgression. They cover most of the surface of the seafloor in the Chirikov Basin and the northern part of Norton Sound. Gravels (and larger size particles) occur as lag deposits that overlie bedrock and glacial deposits (Hess and Nelson, 1982). Gravels that overlie bedrock are found (1) off the northwestern and north-eastern coasts of St. Lawrence Island, (2) in the Bering Strait, and (3) along the coast of the Seward Peninsula between Cape Prince of Wales and Port Clarence, from Cape Rodney to Sledge Island, and off Cape Nome. Glacial lag gravels occur off the northcentral coast of St. Lawrence Island, in the Bering Strait, off the Chukchi Peninsula coast, and off the Seward Peninsula coast east of Cape Nome and in the vicinity of Nome. These lag deposits are relatively thin; they may be as much as 60 cm thick, but the average thickness is about 30 cm (Nelson and Hopkins, 1972).

Relict, fine sand covers most of the northeastern Bering Sea seafloor (Hess and Nelson, 1982). The sands in the deeper part of the area were derived from the Chukchi Peninsula. In the shallower northeastern part of the area, the sands came from the Seward Peninsula (McManus et al., 1972). The relict sands of the western part of the Sphanberg Strait, which separates St. Lawrence Island from the Yukon River Delta, consist of fine sands from the Yukon River. Relict sands also are found as surface sediments in the northern part of Norton Sound (Fig. III-3). These sediments consist of sand-size particles derived from the Seward Peninsula, fine sands from the Yukon River, or a mixture of the two.

The Recent or Modern sediments consist principally of very fine sand- and silt-size particles from the Yukon River (McManus et al., 1977). The Yukon furnishes about 90 percent of the sediment entering the Bering Sea, and the sediment load is estimated to range between 70 and 90 million metric tons per year (t/yr) (Larsen et al., 1981). The summer sediment load of the Yukon River is generally estimated to be about 20 to 30 percent very fine sand, 60 to 70 percent silt, and 10 percent clay (Drake et al., 1980). These sediments cover the southern and central parts of Norton Sound, the eastern part of the Sphanberg Strait, and the northeastern part of Norton Sound (the sediment also includes Norton Bay silt). The Yukon silts and very fine sands also are found in the northern part of Norton Sound but in this region they are mixed with the relict sands derived from the Seward Peninsula. The Yukon River silt deposits in the northern part of Norton Sound only are a temporary feature (McManus et al., 1977); the deposition of these silts in this area is not seen as a northerly extension of the sedimentary environment of the central and southern parts.

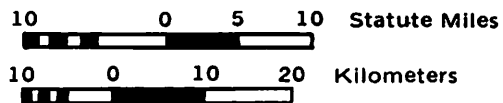
The oceanographic regime of the northern part of Norton Sound is dynamic for fine-grained sediments (McManus et al., 1977). The bottom currents--whether driven by the northerly flow of water through the Bering Sea, the winds, or the tides--are competent to move very fine sand-, silt-, and clay-size particles in suspension; the average velocities of the various bottom currents in Norton Sound are a few tens of cm per second. Wind generated waves are effective in initiating the motion of fine-grained sediment particles deposited in waters as deep as about 20 m; waves generated during storms could initiate particles motion in deeper waters. Silt size



Source: Cobb, 1973. (Modified from Nelson and Hopkins, 1969.)

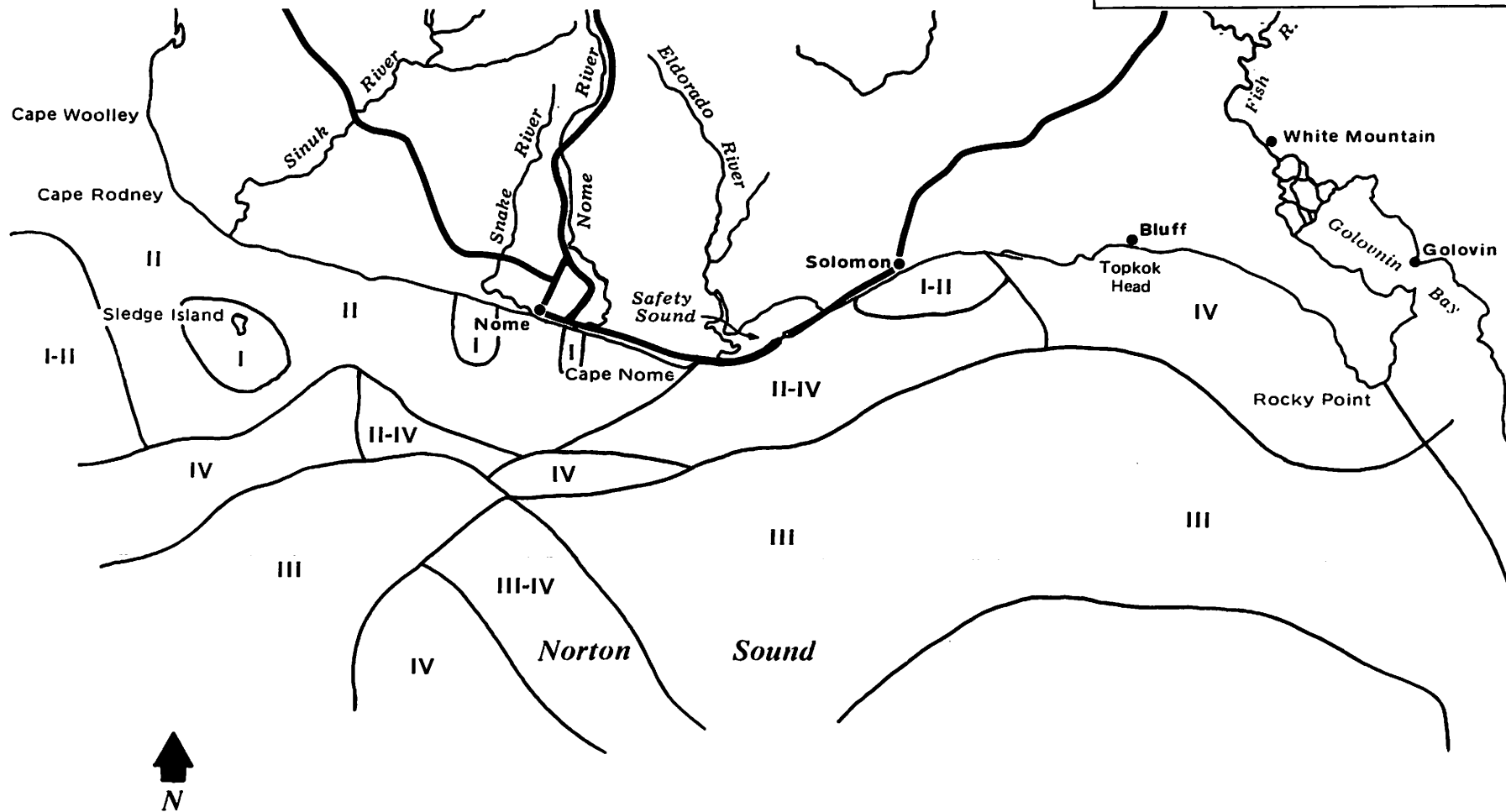
FIGURE III-2. GENERALIZED SEDIMENT PROFILE OF NOME AREA

Minerals Management Service  
 Alaska OCS Region  
 OCS Mining Program  
 Norton Sound Lease Sale



**LEGEND**

I	Gravel	III	Fine Sand
I-II	Gravel and Medium Sand	III-IV	Fine Sand and Silt
II	Medium Sand	IV	Silt
II-IV	Medium Sand and Silt		



Source: McManus et al., 1977.

FIGURE III-3. GENERALIZED SURFACE SEDIMENT DISTRIBUTION



particles have been observed in suspension in bottom waters off Nome and in Norton Sound and this water is transported out of Norton Sound by those bottom currents with a westerly flow.

A substantial amount of the Yukon River silt- and clay-size particles by-passes Norton Sound and the Chirikov Basin and accumulates in the relatively deeper basins of the Chukchi Sea (Drake et al., 1980). A well defined turbidity plume extends north and northwest of the Yukon Delta; Section III.A.8.a. The suspended sediment in this plume is mostly fine silt and clay and the water is a mixture of Alaskan Coastal Water (or Alaska Coastal Current) and Yukon River Water. The general northward drift of the water through the northern Bering Sea transports the suspended sediments and coastal and river water past Norton Sound, through the Bering Strait, and into the Chukchi Sea.

Also, part of the Alaskan Coastal Water and Yukon River Water circulates through Norton Sound in a counterclockwise manner. Some of the sediments being transported by these water masses are deposited in Norton Sound (Drake et al., 1980). However, part of the Yukon River sediments deposited in Norton Sound periodically may be resuspended by storm generated waves and currents and transported out of the sound, through the Bering Strait, and into the Chukchi Sea (Larsen et al., 1980).

Surface sediments in the OCS Mining Program Norton Sound Lease Sale area consist principally of modern silt and medium grain-size sand. The silt is derived from the Yukon River and the sand from the Seward Peninsula. In the eastern part of the sale area, the surface sediments consist principally of a mixture of medium sand and silt and of fine sand. The surface sediments of the western part of the sale area consist of medium sand in the northern part of the area and silt and a mixture of medium sand and silt in the southern part.

The surface sediments lying north of the western part of the sale area are composed of (1) a relatively narrow band of medium sand in a zone of active longshore drift adjacent to the beach, (2) a band (that parallels the shoreline) of gravel interrupted by patches of recently deposited muddy sand, and (3) relict sandy beach gravels at depths of 11 to 13 m, 20 to 22 m, and 24 m (Nelson and Hopkins, 1972); Figure III-3. The relict, lag gravels and muddy sands are relatively thin deposits overlying glacial till and outwash and alluvium deposits. The muddy sands occur in depressions and suggest that strong, bottom currents prevent deposition of modern sediments on the rises.

About one-half of the beaches along the Seward Peninsula north of the sale area are classified by Sears and Zimmerman (1977) as gravels, about 25 percent as sand, 15 percent as boulder, and 10 percent as bedrock.

(1) Distribution of Gold Particles: The relative gold content of samples from the Chirikov Basin and Norton Sound was determined by panning a preconcentrated sample containing all gold particles larger than 0.010 mm in diameter and then counting the number of gold particles and estimating their size; the actual gold content was determined by amalgamation or atomic absorption techniques of the preconcentrate (Nelson and Hopkins, 1972). (Expert panning normally will recover all visible gold particles, but it is highly variable and poor for subvisible particles. Visible gold particles include spheres larger than 0.07 mm in diameter and flakes larger than 0.125 mm in diameter; subvisible gold includes the smaller particles [Nelson and Hopkins, 1972]).

The distribution of gold particles of various sizes in the unconsolidated surface sediments throughout the Chirikov Basin and Norton Sound area suggests the sedimentary processes that have affected their dispersal. The mechanical concentration of heavy, chemically resistant minerals, and gold particles from weathered debris by alluvial (river), marine, and glacial processes forms placer deposits. The weathered debris is produced by the decomposition (chemical processes) and disintegration (mechanical processes) of mineral-bearing rocks. The fine-grained sediments of the area contain small quantities of the smallest visible and subvisible-size gold particles (Nelson and Hopkins, 1972). The general background for the regional median value of pannable particulate gold is about 1 part per billion (ppb) or less. Most gold flakes 1 mm or larger in diameter are found in deposits (1) of offshore glacial drift, (2) near outcrops of mineralized rock on land, or (3) in the vicinity of bedrock exposures on the seafloor.

The surface sediments with the highest gold content and the coarsest particles are the relict lag gravels that overlie the glacial drift (Nelson and Hopkins, 1972). The amount of gold in samples obtained from these gravels is quite variable but about one-third of the samples contained more than 600 ppb: some samples contained as much as 2,500 ppb. The average amount of gold in the underlying glacial till is about 70 ppb.



The maximum observed gold content of the submerged beach ridges is about 58 ppb and is generally highest in places where the submerged beaches cross the glacial drift (Nelson and Hopkins, 1972). The same processes that concentrated gold in the relict gravel overlying the glacial drift also should have operated in the well-defined submerged beaches in places where they consist mostly of material reworked from gold-bearing drift. Also, high concentrations of gold may be present at depth. Seismic-reflection studies across submerged beaches show that the internal structure is similar to that of modern beaches. The highest gold concentrations found during the mining of beaches off Nome early in the 1900's commonly were found at the base of the beach sediments, several feet below the surface. The modal size of the gold particles ranges from about 0.062 to 0.3 mm in diameter and is similar to the size of gold particles in modern beaches.

The gold in the surface samples of the Nome River outwash fan is made up of relatively fine gold particles; the average content is only slightly above the regional background, and the richest samples contained only about 10 ppb (Nelson and Hopkins, 1972). However, some buried and submerged river deposits do have significant gold concentrations. Onshore, the highest gold concentrations in any river and outwash deposits occur at the base while the upper part is relatively barren.

Between Cape Nome and the Solomon River, the gold content in the coarse, nearshore sediment is generally low (Nelson and Hopkins, 1972). Although most of the onshore placer gold in this area has been produced from the Solomon River and its tributaries, the area offshore of the Solomon River is near the eastern margin of the glaciated area and the glaciers have carried the terrestrial debris only a short distance offshore. Also, there are only a few onshore placer deposits between Cape Nome and the Solomon River and this may indicate a low gold content in the adjacent offshore sediments. The largest and some of the trace-size (0.125 mm in diameter) particles in the offshore area have been transported there by glaciers, but most of these size particles were probably carried from offshore Nome sources by longshore drift when sea level was lower.

The content (up to 318 ppb) and coarseness (0.6 to 1.00 mm modal diameter) of the particles suggests that the gold in the Sledge Island area was derived from mineralized bedrock in the offshore area (Nelson and Hopkins, 1972). Also, gold placers are widely dispersed on the nearby mainland.

The gold content of samples taken from the sediments along the Seward Peninsula coast from Cape Rodney to Cape Prince of Wales has average values that are slightly above the regional background--from about 1 ppb to maximum values of about 90 ppb (Nelson and Hopkins, 1972). The presence of coarse-gold particles in the sediments between Cape Rodney and Point Spencer (Port Clarence) and the small and sparsely distributed onshore placers suggest that the gold in this area also may be derived from nearby mineralized bedrock sources. The small maximum size of the gold particles, the low gold content of the sediments, and the lack of gold placers in the adjacent land suggest the gold in the sediment off the Port Clarence/Cape Prince of Wales area has come from distant sources.

The muddy sands that occur in depressions in and adjacent to the sale area also contain gold. However, the content is only slightly higher than the regional background and the particles range in size from the smaller size of the visible range (about 0.125 mm in diameter) to the subvisible range (less than 0.125 mm in diameter). The principal source of this gold is probably the offshore deposits of glacial till. The smallest visible- and subvisible-size particles are carried laterally from the drift along with other fine sediment by longshore currents.

Data from boreholes drilled in the nearshore area near Nome show the sediments in the upper 20 m consist of complex sequences of interbedded glacial, marine, and fluvial sediments (Kaufman and Hopkins, 1989). The boreholes were drilled as part of an exploratory drilling program conducted by the USDOJ in 1967. Fifty-one boreholes were drilled to depths of 30 to 75 m below the sea surface. Changes in the amino acid concentration of molluscan shells indicate the sediments in the upper 20 m of the boreholes were extensively reworked. Reworking is the result of fluctuating sea levels, migrating river channels, and advancing glaciers and crustal deformation following the marine transgression at the end of the Tertiary Period about 2 million years ago. The relative gold content of the sediments is richest in the upper 20 m of the boreholes. The abundant coarse-grained constituents of glacial debris provide an ideal substrate for trapping gold and other heavy mineral grains. Below the 20-meter-borehole depths, the sediments are fine-grained and accumulated in a marine environment; they contain minor amounts of particulate gold transported away from terrestrial sources by rivers and streams. Also, within the area investigated (a relatively narrow tract coinciding with the inferred limits of glacial till), the borehole samples did not show any apparent seaward decline in gold concentration within the upper 20 m. Although the glacial advances since the Late Pliocene-Pleistocene may have ended about 5 km beyond the present shoreline of the southern coast of the Seward Peninsula, coarse grained potentially gold-bearing sediments could be carried beyond the glacier terminus by submarine debris flows and ice rafting.



(2) Distribution of Trace Metals: The normal concentration of mercury in the sediments of the northern Alaska Bering Sea appears to range from less than 0.01 to 0.1 parts per million (ppm) (Nelson et al., 1975). The surface and subsurface samples containing the highest content were obtained within 40 km of the shoreline. The mercury content of marine surface samples ranged from less than 0.01 to 0.23 ppm and subsurface samples ranged from less than 0.01 to 0.16 ppm. The mercury content of samples from beaches along the southern Seward Peninsula ranged from 0.03 to 1.30 ppm.

Mercury is found in the altered zones of metamorphic rocks on the Seward Peninsula and local cinnabar (a mercury-bearing mineral with a relatively high specific gravity--8.10) deposits constitute potential sources of mercury. As with gold, the mercury-bearing minerals may have been carried to offshore areas by glacial and fluvial transport.

In the marine environment, the mercury-bearing minerals may be diluted by the influx and mixing of sediments from other sources (especially Yukon River fine sand or silt) or concentrated by stream and beach processes (during the transgressing and regressing seas) that removed the finer and lighter particles.

Although beach and glacial drift concentrations may be high, the distribution of mercury in the surface sediments is comparable to normal concentrations in unpolluted marine and freshwater sediments in the world (Nelson et al., 1975).

The distribution of other trace metals in the surface sediments of the Chirikov Basin and Norton Sound is also related to the regional sediment sources (Larsen et al., 1980). The association of such metals as aluminum, barium, and potassium, correspond to areas of Recent Yukon River sediment deposition.

Sediments along the coast of Seward Peninsula contain a group of associated metals that include iron, calcium, zinc, copper, and manganese. The relict transgressive sediments of the Chirikov Basin are best represented by the association of boron and vanadium.

The trace metals also may be used to indicate (1) potential placer deposits, (2) areas with naturally occurring high concentrations of potentially toxic metals, and (3) environmental changes (Larsen et al., 1980). Tin, chromium, zirconium, and cerium are found in minerals that are heavy and stable enough to be mechanically concentrated. Anomalously high values of these metals may indicate placer as well as lode deposits.

Cerium is classified with a group of chemically similar elements known as lanthanides. These elements usually occur together and their most common source mineral is monazite (Larsen et al., 1980). Monazite is relatively rare and often concentrated in beach placers. The presence of cerium and other lanthanide elements in the same samples indicates the presence of monazite. The high values of lanthanide elements occur in the sediments on the Yukon Delta; in the southeastern, northeastern, and central parts of Norton Sound; and off Cape Nome and between Cape Rodney and Cape Prince of Wales.

The distribution of chromium, nickel, copper, and zinc in the surface sediments show high concentrations on the Yukon River Delta and along the southern and eastern coasts of Norton Sound (Sharma, 1979); the content of these trace metals generally decreases seaward. The concentration ranges of chromium (30-80 ppm), nickel (20-35 ppm), copper (20-50 ppm), and zinc (20-100 ppm) are similar to concentrations in sediments off other coastal areas of the world. The distribution of these metals suggests they are derived mainly from the Yukon River.

Relatively high concentrations of copper (up to about 25 ppm) and zinc (up to 120 ppm) as well as lead (20-30 ppm), arsenic, and antimony also have been noted along the southern coast of the Seward Peninsula (Larsen et al., 1980); lead (20-30 ppm) is present in the sediments of the Yukon River Delta and southern Norton Sound in relatively high concentrations. The highest values of copper (700 ppm), zinc (1,000 ppm), and lead (500 ppm) were from beach samples near Bluff close to known terrestrial sources of minerals containing these metals. Other naturally occurring, potentially toxic metals detected in beach samples near Bluff include arsenic (maximum 3,000 ppm) and antimony (maximum 1,000 ppm). Cadmium was not detected in any of samples reported by Larsen et al. (1980) (the lower limit of detection was 7 ppm).

Iron and manganese are quite responsive to changing oxidation and reduction environments and often disassociate from their originating minerals (Larsen et al., 1980). If sediments rich in these elements are deposited in a reducing environment, such as one rich in organic debris, the iron and manganese are reduced



and go into solution. When the solution rises, the iron and manganese are precipitated in the oxidizing environment at the sediment-water interface. (Additional information on trace-metal concentration in the sediments of the Norton Basin are shown in Table III-3.)

b. Gas-Charged Sediments and Craters and Current Scouring: Some of the other sedimentary features that occur in the Norton Basin Planning Area also may be found in the sale area. Geological investigations in support of the OCS oil and gas leasing program and in support of other projects have either been reconnaissance in nature and covered relatively large parts of the planning area or have been more specific and covered smaller areas with unique features. The sale area is a very small part (less than 1%) of the planning area. Sedimentary features observed in areas adjacent to the sale area include gas-charged sediments and craters and current scouring.

Gas-charged sediments underlie parts of the Norton Sound and Chirikov Basin seafloors. The composition indicates that the gas forms by microbial decomposition of buried organic matter (possibly the Pleistocene tundra peats) underlying the recent sediments.

Craters have been observed in association with the gas-charged sediments and with buried peaty muds. These associations suggest that the release of gas from the sediments is the likely cause of the craters. The gas generated in the peaty muds builds up with time and is trapped relatively close to the surface. When the sediments are subjected to the fluctuating load of the cyclical storm waves, the gas is vented and the sediment collapses, forming a surface crater. The craters are found in a 20,000-km<sup>2</sup> area of the seafloor in the central and eastern parts of Norton Sound.

Areas in Norton Sound where broad, shallow depressions have been observed include an area southeast of Nome in the central part of the Sound. Scour depressions are formed by strong currents eroding the sediments. Some of these currents may be of limited duration and occur during storms. The presence of ripples indicates that bottom currents in some of the scour areas are stronger than in other parts of Norton Sound with similarly sized seafloor sediments. Bottom-current speeds in the scour areas range from 10 to 35 cm per second during nonstorm conditions. The smaller depressions are more or less elliptical in shape with 10- to 30-m diameters, while the larger depressions are irregularly shaped and 80 to 150 m across; the depressions are usually less than 1 m deep.

c. Faults and Earthquakes: Earthquakes are associated with the displacement of rocks or partially consolidated sediments along fault surfaces. Seismic studies indicate the presence of many deep-seated and near-surface faults in Norton Sound. The maximum magnitude of earthquakes occurring in Norton Sound over the past several years is 4.2. Two earthquakes with magnitudes of 6.0 and 6.5 have occurred on the Seward Peninsula within the last 30 years. Many of the faults in Norton Sound lack surface expression suggesting that movement along the surface may not have occurred in recent times; movement may have taken place continuously during subsidence of the Norton Basin.

4. Climate and Meteorology: The climate of the area is primarily influenced by maritime air from the Pacific Ocean in the summer and by arctic and continental air from the north and east in the winter.

a. Atmospheric Pressure and Winds: During the summer, the atmospheric pressure regime of the northern part of the Pacific Ocean to the Arctic Ocean region is more variable than the winter regime. Low-pressure systems are frequently found overlying the part of the region from the north-eastern Bering Sea to the eastern Beaufort Sea. From June through August, the winds usually are from a southwesterly to southeasterly direction. The summertime windspeeds usually range from about 4 to 9 m/sec. Wind velocities of more than 21 m/sec per second occur less than 10 percent of the time.

During the period from September to May, the atmospheric pressure regime from the northern part of the Pacific Ocean to the Arctic Ocean is most frequently characterized by low-pressure systems lying over the southern part of the region and high-pressure systems in the northern part. Although the low-pressure systems tend to be persistent, when they do move, these systems are often displaced to the south or southwest. High-pressure systems force the air to flow in a spiral fashion toward areas of low pressure and in the winter produce strong northeasterly winds. Surface winds along the coast of the northeastern Bering Sea and Norton Sound are most commonly from the northeast from September through May; in the eastern part of Norton Sound, the winds usually are from the east. The speed of winter time winds usually ranges from 4 to 11 m/sec.

b. Temperature and Precipitation: Along the coast of the Chirikov Basin and Norton Sound, the average winter temperature ranges from  $-24^{\circ}$  to  $-7^{\circ}\text{C}$ , the average summer temperature from  $0^{\circ}$  to  $10^{\circ}\text{C}$ , and the extremes from  $-48^{\circ}$  to  $30^{\circ}\text{C}$ . The average annual precipitation, which includes snowfall, ranges from about 25 to 42 cm; snowfall ranges from about 96 to 203 cm.

c. Fog: Fog may be present in the planning area anytime throughout the year. During the open period, fog (visibility  $< 0.5$  nautical miles) occurs about 5 to 30 percent of the time in the lease-sale area (Brower, Diaz, and Prechtel, 1988).

## 5. Physical Oceanography:

a. Temperature and Salinity: The long-term seasonal, thermal, and saline properties of the northeastern Bering Sea water reflect the seasonal variations in freshwater runoff, solar radiation, and ice cover. The surface layer is more affected by these variations than is the underlying water, and this difference leads to changes in the stratification of the water column. In mid-summer, the surface layer in the Chirikov Basin is about 10 to 15 m thick and in Norton Sound it is about 5 to 10 m thick. By July, the mean surface temperatures for most of the surface water ranges from  $6^{\circ}$  to  $10^{\circ}\text{C}$ . In Norton Sound the mean surface temperature ranges from about  $10^{\circ}\text{C}$  in the central part to  $16^{\circ}\text{C}$  in the eastern part. The mean temperature of the bottom water increases from  $2^{\circ}$  or  $3^{\circ}\text{C}$  in the western part of the area to about  $8^{\circ}\text{C}$  in the eastern part of Norton Sound.

In July, the mean salinities of the Chirikov Basin surface water range from about 31 to 32 parts per thousand, while in the bottom waters they range from 32 to 33 parts per thousand. In Norton Sound, the surface salinities range from about 30 parts per thousand in the western part to about 20 parts per thousand in the eastern part to about 16 parts per thousand along the Yukon Delta. The mean salinities of the bottom waters show the same general trend, but they are several parts per thousand greater.

From fall to early spring, convective cooling affects the water column from the surface to the seafloor and forms a layer that has nearly the same temperature--about  $1.5^{\circ}\text{C}$ --and salinities which range from 32 to 33 parts per thousand. The convective cycle also aerates the water and replaces the oxygen that was used in the lower parts of the water column.

b. Bering Sea Circulation: The general direction of water movement through the Bering Sea is northerly. The basic driving force may be related to a difference in the mean sea level elevation, which is thought to be about 1 m higher in the Pacific Ocean than it is in the Arctic Ocean. Occasionally, the northward water flow also appears to be driven, at least in part, by winds from the south. The major southerly flow reversals occur when strong northerly winds develop over the entire northern Bering Sea and force enough water off the northern Bering Shelf so that the sea level through the Bering Strait region slopes down to the south. The southerly flow of water through the Bering Strait is episodic, but there is some indication that it is more common in the fall and winter than in the spring and summer.

The Alaska Coastal Water is a major, northerly-flowing water mass that moves parallel to the Alaska coast through the Bering Sea and Strait and into the Chukchi Sea. Velocities of the Alaska Coastal Water have been variously reported as having (1) pulses of 50 to 100 cm/sec for several days, (2) a net northward flow of 15 cm/sec, (3) surface velocities of 20 cm/sec in seaward areas, but increasing to 30 to 40 cm/sec within 30 km of the shore, (4) 10 cm/sec along the bottom, and (5) up to 180 cm/sec in the Bering Strait. Most of the Yukon River Water is entrained in the Alaska Coastal Water. A branch of the Alaska Coastal Water flows through the western part of Norton Sound in a counterclockwise direction.

c. Norton Sound Circulation: Norton Sound is a shallow embayment divided hydrographically into western and eastern portions by the constriction between Cape Darby and Stuart Island. The general circulation pattern in Norton sound is cyclonic (counterclockwise) and may be driven, at least in part, by the northward flow of water through the Bering Sea. Water enters the southern part of the Sound and flows out along the northern part. The westward flow of water along the south coast of the Seward Peninsula is a common feature, but it may vary in intensity and extent.

The circulation pattern also extends, with varying intensity, into the eastern part of Norton Sound. Here, the upper layer is more affected while circulation in the lower layer appears to be, for the most part, sluggish. During the summer, waters in the eastern part of the Sound show a tendency to become more strongly stratified

than the western waters. However, severe summer and fall storms are capable of breaking down this stratification.

The mean speed of surface currents in the western part of Norton Sound ranges from about 5 to 20 cm/sec; the maximum velocity is about 50 cm/sec. Bottom-current speeds are about 10 to 20 cm/sec in the western part of the Sound and less than 10 cm/sec in the eastern part.

d. Yukon River Discharge: Most of the Yukon River Water is discharged directly into the Bering Sea from the west side of the Delta. The discharge mixes with the water flowing northwesterly past the entrance to Norton Sound, but some of this water may enter the southern part of the Sound as part of the general circulation pattern. A minor amount of river water is discharged directly into the southern part of the Sound. The discharge of Yukon River water varies seasonally. The lowest discharge rate occur from December through March. In April, the discharge rate begins to increase rapidly and reaches a maximum in June, but, at peak discharge, the Yukon River contributes only about 2 percent of the water flowing through the Bering Strait. From July through November, the discharge rate decreases rapidly.

The waters discharged from the Yukon River are quite turbid. Satellite photographs show bands of turbid water extending along the western and northern sides of the Delta and across the entrance to Norton Sound. The concentration of suspended material in the surface water is greatest near the river mouths and decreases seaward. The suspended matter from the Yukon River enters Norton Sound principally from the southwest and is transported through the Sound in a counterclockwise manner.

e. Storm Surges: When deep low-pressure systems move north-east across the Bering Sea toward Norton Sound, the level of water along the coast rises because of (1) a decrease in atmospheric pressure, (2) wind induced mass transport of water toward the shore (wind setup), and (3) an increase in the height of the surface due to breaking waves (wave setup). These events constitute a storm surge. The hydrographic factor which contributes most to a storm surge is a broad expanse of open water across which the winds blow. Thus, the southern and southwestern coast of the Seward Peninsula, the southern coast of St. Lawrence Island, and the western part of the Yukon Delta are directly susceptible to storm surges. Although the eastern and southern parts of Norton Sound--including the northern part of the Yukon Delta--are not located directly at the end of a broad expanse of open water, they are nevertheless affected because of the general rise in sea level that occurs throughout Norton Sound during a storm surge. Between 1960 and 1981, 19 storm surges have affected the Norton Sound area (Wise, Comiskey, and Becker, 1981); in some years there were no storm surges but in other years there have been two.

Storm surges usually occur in late summer or early fall. They cause the water to rise from 1 to 3.5 m above sea level and flood low-lying coastal areas. Of the 13 reported instances of flooding in Nome, 11 have occurred in the fall, as have 9 of the 10 reported flooding events at Unalakleet (Wise et al., 1981). The major storm event that occurred in the Norton Sound area in November 1974 was estimated to be a once-in-30-years occurrence (Brower et al., 1977). During the storm, maximum sustained winds of about 20 m/sec with gusts to 36 m/sec were recorded. Wave heights were estimated to be between 3 and 5 m.

f. Tides: Throughout much of the Bering Sea continental shelf area, tides are of the mixed, predominately semidiurnal (2 highs and 2 lows per day) type, but in Norton Sound, diurnal (1 high and 1 low/day) tides dominate. The average differences in height between mean-higher high water and mean-lower low water range from about 0.5 m at Nome to about 2 m at Cape Romanof.

6. Sea Ice: The sea ice of the northern Bering Sea is primarily first-year ice. The main features of the sea-ice regime are the shorefast ice, the pack-ice zones, and the persistent polynyas (the sea-ice zones are shown in Fig. III-4). Shorefast ice forms along most of the shorelines of the Chirikov Basin and Norton Sound. The pack ice consists largely of floes which usually are transported southward. Polynyas generally form off the leeward side of east-west-trending coasts and are relatively large open-water areas surrounded by ice where new ice forms during the winter and early spring. Typically, by the first of July the sea ice in the northeastern Bering Sea and Norton Sound has either been transported away or has melted (Wise et al., 1983).

a. Shorefast-Ice Zone: The shorefast-ice zone consists of ice formed along the shore or transported landward by winds or currents. Freezeup along the coasts usually occurs in November but might begin as early as the first part of September or as late as the last part of December.

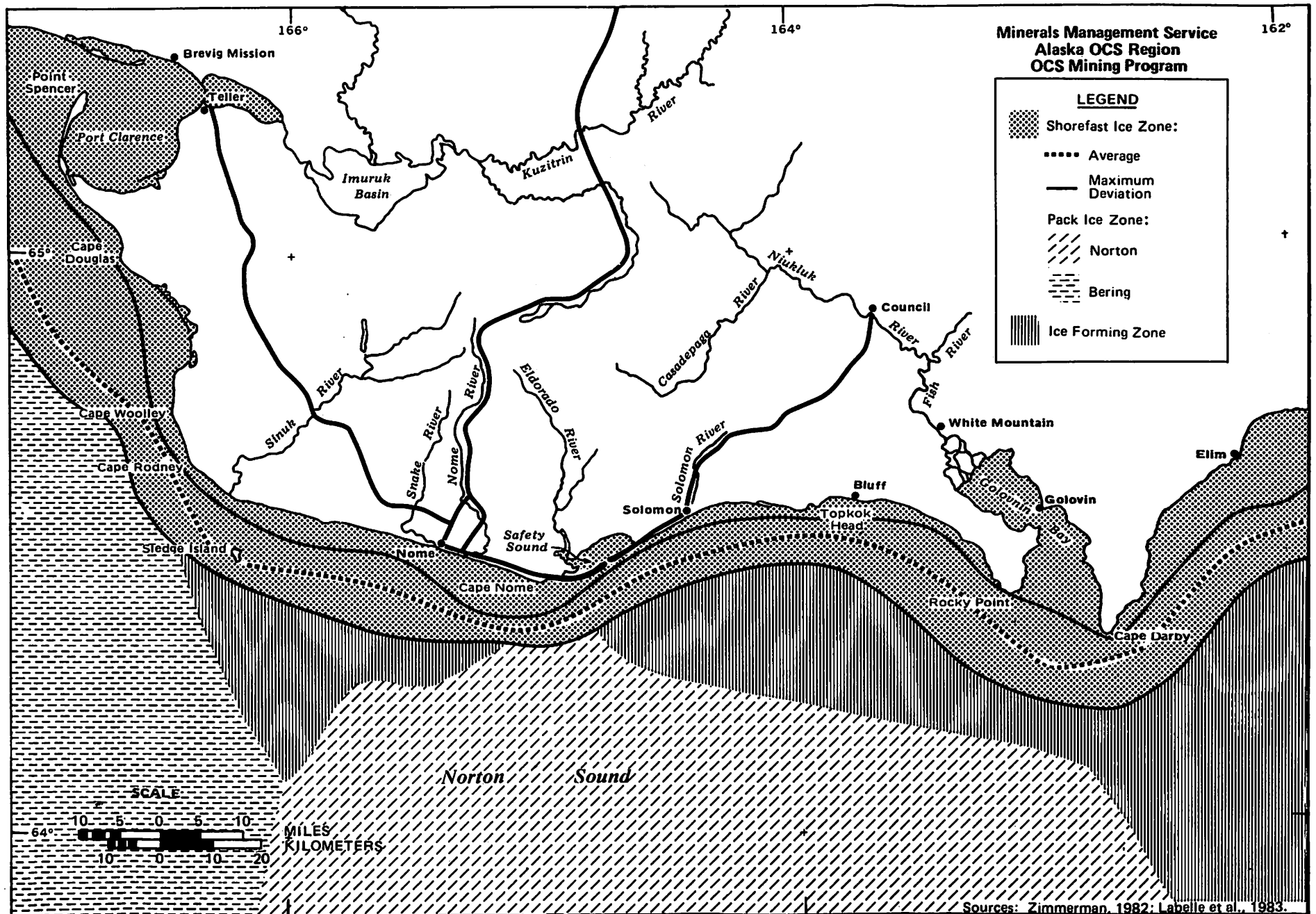


FIGURE III-4. SEA-ICE ZONATION IN NORTON SOUND.

The thickness of undeformed first-year ice is variable, but in Norton Sound it may be about 1.2 m. Thus, along the shore out to a depth of about a meter or so, the fast ice is attached to the seafloor. However, in places, the fast ice can extend out to the 20-m isobath. Consequently, most of the fast ice is floating. The seaward edge of the shorefast ice generally lies between the 10- and 20-m isobaths and is often anchored by the keels of ridges.

The shorefast-ice zone between Sledge Island and Rocky Point may extend from several to about 20 km offshore, the average distance in February/ March is about 10 km. Thus, the northern part of the sale area lies within the average fast-ice zone.

(1) Pileups and Rideups: The onshore movement of sea ice may also cause the ice to form pileups in the shallow water or on the beaches or force the ice to ride up over the beaches. A rise in sea level can lift the fast ice from the seafloor and shore and, when accompanied by strong onshore winds, may move the fast ice (along with some pack ice) inland. Ice pileups and rideups have been observed along much of the Norton Sound and adjacent Bering Sea coastlines. Rideups typically may move inland about 10 m.

(2) Ridges and Rubble Fields: Pack ice moving against the fast ice causes the ice to deform and generate ridges and rubble fields. The ridges have keels which may extend far enough below sea level to become grounded on the seafloor. The grounded ridge zone often determines the boundary between the shorefast ice and the pack ice; this zone has been referred to as the *stamukhi* zone. This boundary is gradational and varies geographically, seasonally, and yearly. Flaw leads often occur seaward of the grounded ridges.

(3) Ice Gouges: Shoreward of the 30-m isobath, linear depressions have been cut into the seafloor sediments by the plowing action of keels of drifting ice ridges; the gouges are most dense in waters 10 to 20 m deep. Typically, the gouges trend parallel to the pack-ice movement, which generally parallels the bathymetry. Thus, in Norton Sound, the gouges generally trend east to west and in the Chirikov Basin they generally trend north to south. Gouge-incision depth usually ranges from 0.25 to 0.5 m deep but may be as deep as 1 m. Ice-gouge widths of 15 to 25 m are most common, but the range is from 5 to 60 m.

The presence of ice gouges indicates an interaction of the moving sea ice with the sediments of the seafloor. The seafloor in the sale area lies at depths between 20 and 30 m. Thus, the surface sediments in the sale area may be affected by the keels of moving ice masses.

b. Pack Ice: The pack ice of the northern Bering Sea and Norton Sound is largely first-year ice that forms in situ. Under the influence of prevailing winds, the pack ice generally moves away from the areas where it forms into more open areas where the floes diverge. The southern part of the sale area lies within the pack-ice zone.

In November, most of Norton Sound is covered by sea ice and the edge of the pack ice in the Chirikov Basin is moving south. From December or January through mid-April, the pack-ice edge will probably be south of the Norton Sound Planning Area. The concentration of ice in the northeastern Bering Sea and Norton Sound appears to be greatest in February when 90 to 100 percent of the area is covered with ice. Although the edge of the pack ice remains south of the planning area through May, ice coverage begins to decrease in March--initially in Norton Sound and then throughout the planning area.

Under the influence of predominately northerly winds, the pack ice that forms in the Chirikov Basin usually moves southward through the Anadyr and Sphanberg Straits. The movement of the pack ice also responds to changes in meteorological events. Winds from the south may reverse the southerly flow and move the ice northward. The northerly flow of ice occurs about 14 percent of the time. Also, easterly winds move the Bering Sea pack ice westward; the westerly flow of ice takes place about 26 percent of the time.

The seasonal pack of Norton Sound usually moves to the west or southwest in response to winds that are predominately from the northeast and tends to merge with the Bering Sea ice along a shear zone at the entrance to the Sound. However, about 30 percent of the time, Bering Sea pack-ice floes are transported into Norton Sound through an area that lies north of the fast-ice zone off the Yukon Delta. Ice movements into Norton Sound may occur when the ice in the Bering Sea is moving either north or south. At other times, the pack ice in Norton Sound circulates in a counterclockwise gyre while the Bering Sea ice flows past the entrance in a southerly direction. The gyre develops north of the fast-ice zone off the Yukon Delta and acts as a transition phase between the inbound and outbound flow of ice.



c. **Polynyas:** Because of the dominant north-northeast wind regime, polynyas are found in the northeastern Bering Sea and in Norton Sound on the leeward side of east-to-west-trending landmasses. Areas where persistent, relatively large polynyas form are south of St. Lawrence Island, along the south coast of the Seward Peninsula between Cape Prince of Wales and Cape Nome, and in the northeastern part of Norton Sound. These polynyas lie seaward of the shorefast-ice zone. New ice forms in the polynyas but is forced out by the winds which generated the polynya. Thus, parts of the sale area lie within an area where polynyas form.

When the winds shift to south-southwest, polynyas form on the north side of east-to-west-trending shorelines and close on the south side. The time required for the shift in the polynya location to occur is about 3 days.

d. **Breakup:** Breakup, or the disappearance of sea ice from along the coast, is a relatively brief event. Breakup usually begins about the middle of May but may not take place until the latter part of June. In April and May, the ice floes begin to move northerly. The dominant northerly winds of winter are subsiding, allowing the northerly currents to carry the ice northward. As the Bering Sea ice is retreating northward, the ice in the eastern part of Norton Sound begins to move toward the southwest, leaving open water behind.

7. **Air Quality:** The existing onshore air quality adjacent to the Norton Sound sale area is considered to be relatively pristine, with concentrations of regulated air pollutants that are far less than the maxima allowed by the National Ambient Air Quality Standards (National standards) and State air-quality statutes and regulations. These standards are designed to protect human health. Under provisions of the Prevention of Significant Deterioration Program (PSD) of the Clean Air Act, existing air quality that is superior to the National standards is protected by additional limitations on nitrogen dioxide, sulfur dioxide, and total suspended particulate matter. Areas in Alaska are currently designated as PSD Class I or II. Class I air-quality designation is the most restrictive and applies to certain National parks, monuments, and wilderness areas. There are no Class I areas in or near the proposed sale area. The entire adjacent shoreline area is designated Class II. The applicable standards and maximum allowable PSD-Class-I, -II, and -III increments are listed in Table III-1.

Emissions originate from widely scattered small sources, principally from residences, small village diesel-electric generators, refuse disposal (dumps), and seasonal activities such as gold mining. The Environmental Protection Agency (USEPA, 1978) prepared emissions-inventory and ambient air-quality estimates for areas in Alaska with relatively low populations. These estimates were derived from general emission-factor relationships with the local economic base and demographic data and indicate compliance with existing air-quality requirements. Since 1978, there has not been any notable increase in emissions sources in the sale area other than from gold dredging offshore of Nome during 1986 and 1987. However, there is little available air-quality-monitoring information from the area with which to quantify ambient pollutant concentrations. The State of Alaska (State of Alaska, DEC, 1987) recently prepared a Preliminary Technical Analysis Document in support of a proposed air-quality permit for the proposed Red Dog mining project, which is located approximately 300 km north of Norton Sound. Based primarily on experience and limited information from similar remote sites, the analysis anticipates that concentrations of most background pollutants will be at or less than the level detectable by air-quality-monitoring instruments, and that the ambient annual average 1-hour concentration for ozone is approximately 50 micrograms per cubic meter ( $\mu/m^3$ ), while the standard is 235 ( $\mu/m^3$ ).

8. **Water Quality:** Aspects of water quality which are of concern are: turbidity, trace-metal concentrations, oxygen concentrations, and hydrocarbon concentrations. In particular, high background concentrations of trace metals occur locally in sediments of northwestern Norton Sound, the area surrounding and including the sale area. Likely existing sources of trace metals and other impurities are river runoff, coastal erosion, onshore and offshore mining activities, oil and gas activities, past fuel spills, and at least one known gas seep.

Very high concentrations of most EPA-priority trace metals have also been reported in waters of Northwestern Norton Sound in recent years (Rusanowski, Gardner, and Jewett, 1987, 1988b; Jewett, Gardner, and Athey, 1989; and Naidu et al., 1989), but these data are now considered erroneous, for the reasons discussed in Section III.A.8.b. The most recent (1989) data for water quality, using state-of-the-art sampling and analytical procedures, indicate that ambient concentrations of trace metals in sale-area waters within northwestern Norton Sound meet EPA criteria and State standards (Creelius, Apts, and Lasorsa, 1990).

Table III-1  
Ambient Air-Quality Standards Relevant  
to the OCS Mining Program Norton Sound Lease Sale  
(measured in micrograms per cubic meter)

Criteria Pollutant <sup>1/</sup>	Averaging Time					
	Annual	24 hr	8 hr	3 hr	1 hr	30 min
Total Suspended Particulates <sup>2/</sup>	60 <sup>3/</sup>	150	*	*	*	*
Class I <sup>4/</sup>	5 <sup>3/</sup>	10	*	*	*	*
Class II <sup>4/</sup>	19 <sup>3/</sup>	37	*	*	*	*
Class III <sup>4/</sup>	37 <sup>3/</sup>	75	*	*	*	*
Carbon Monoxide	*	*	10,000	*	40,000	*
Ozone <sup>5/</sup>	*	*	*	*	235 <sup>6/</sup>	*
Nitrogen Dioxide	100 <sup>7/</sup>	*	*	*	*	*
Class I <sup>4/</sup>	2.5 <sup>7/</sup>	*	*	*	*	*
Class II <sup>4/</sup>	25 <sup>7/</sup>	*	*	*	*	*
Class III <sup>4/</sup>	50 <sup>7/</sup>	*	*	*	*	*
Inhalable Particulate Matter (PM10) <sup>8/</sup>	50 <sup>9/</sup>	150 <sup>10/</sup>	*	*	*	*
Lead	1.5 <sup>11/</sup>	*	*	*	*	*
Sulfur Dioxide	80 <sup>7/</sup>	365	*	1,300	*	*
Class I <sup>4/</sup>	2 <sup>7/</sup>	5	*	25	*	*
Class II <sup>4/</sup>	20 <sup>7/</sup>	91	*	512	*	*
Class III <sup>4/</sup>	40 <sup>7/</sup>	182	*	700	*	*
Reduced Sulfur Compounds <sup>2/,12/</sup>	*	*	*	*	*	50

Sources: State of Alaska, Dept. of Environmental Conservation, 1982, 80 18 AAC 50.010, 18 AAC 50.020; 40 CFR 52.21 (43 FR 26388); 40 CFR 50.6 (52 FR 24663); 40 CFR 51.166 (53 FR 40671).

- <sup>1/</sup> All averaging times may not be exceeded more than once each year, except that annual means may not be exceeded.
- <sup>2/</sup> State of Alaska air-quality standard (not National standards).
- <sup>3/</sup> Annual geometric mean.
- <sup>4/</sup> Class II standards refer to the Prevention of Significant Deterioration Program. The standards are the maximum allowable increments in pollutants allowable above previously established baseline concentrations.
- <sup>5/</sup> The State ozone standard compares with National standards for photochemical oxidants, which are measured as ozone.
- <sup>6/</sup> The 1-hour standard for ozone is based on a statistical rather than a deterministic allowance for an "expected exceedence" during a year.
- <sup>7/</sup> Annual arithmetic mean.
- <sup>8/</sup> PM10 is the particulate matter less than 10 micrometers in aerodynamic diameter.
- <sup>9/</sup> Attained when the expected annual arithmetic mean concentration, as determined in accordance with 40 CFR 50 subpart K, is equal to or less than 50 ug/m<sup>3</sup>.
- <sup>10/</sup> Attained when the expected number of days per calendar year with a 24-hour average concentration above 150 ug/m<sup>3</sup>, as determined in accordance with 40 CFR 50, subpart K, is equal to or less than 1.
- <sup>11/</sup> Calendar quarter arithmetic mean.
- <sup>12/</sup> Measured as sulfur dioxide.

In the discussion of individual parameters, first the existing environment of Norton Basin is described, and then the environment of northwestern Norton Sound is described--the vicinity of and including the sale area near Nome.

a. Suspended-Sediment Load and Turbidity: Turbidity is usually described as either the amount of dry-weight sediment per volume of waters in terms of the light-scattering ability (nephelometric turbidity), or in terms of light-blocking ability (Jackson turbidity) of the suspended-sediment load. Each measure of turbidity is based on different physics and is not comparable with or convertible into units of the others. This section will discuss turbidity in terms of suspended-sediment loads, generally the most accepted measure in quantitative oceanographic research, and the measurement unit in which most background Norton Sound data have been collected.

(1) Norton Basin: The waters of Norton Basin, particularly waters within Norton Sound, are more turbid--contain higher sediment loads and are more opaque--than offshore waters elsewhere in the Alaskan Outer Continental Shelf (OCS). During open water, this greater turbidity is governed by two separate regimes: a quiescent period and a higher turbidity, stormy period in September through November (Cacchione and Drake, 1979). The quiescent regime has relatively low levels of suspended sediment, sediment transport, and sediment caused by tides, mean circulation, and surface waves, but includes the time of peak Yukon River discharge. Storms cause more than 50 percent of annual resuspension and sediment transport. Mid-Sound suspended-matter concentration can increase tenfold during storms because of resuspension of bottom sediments (ECOMAR Marine Consulting, 1983).

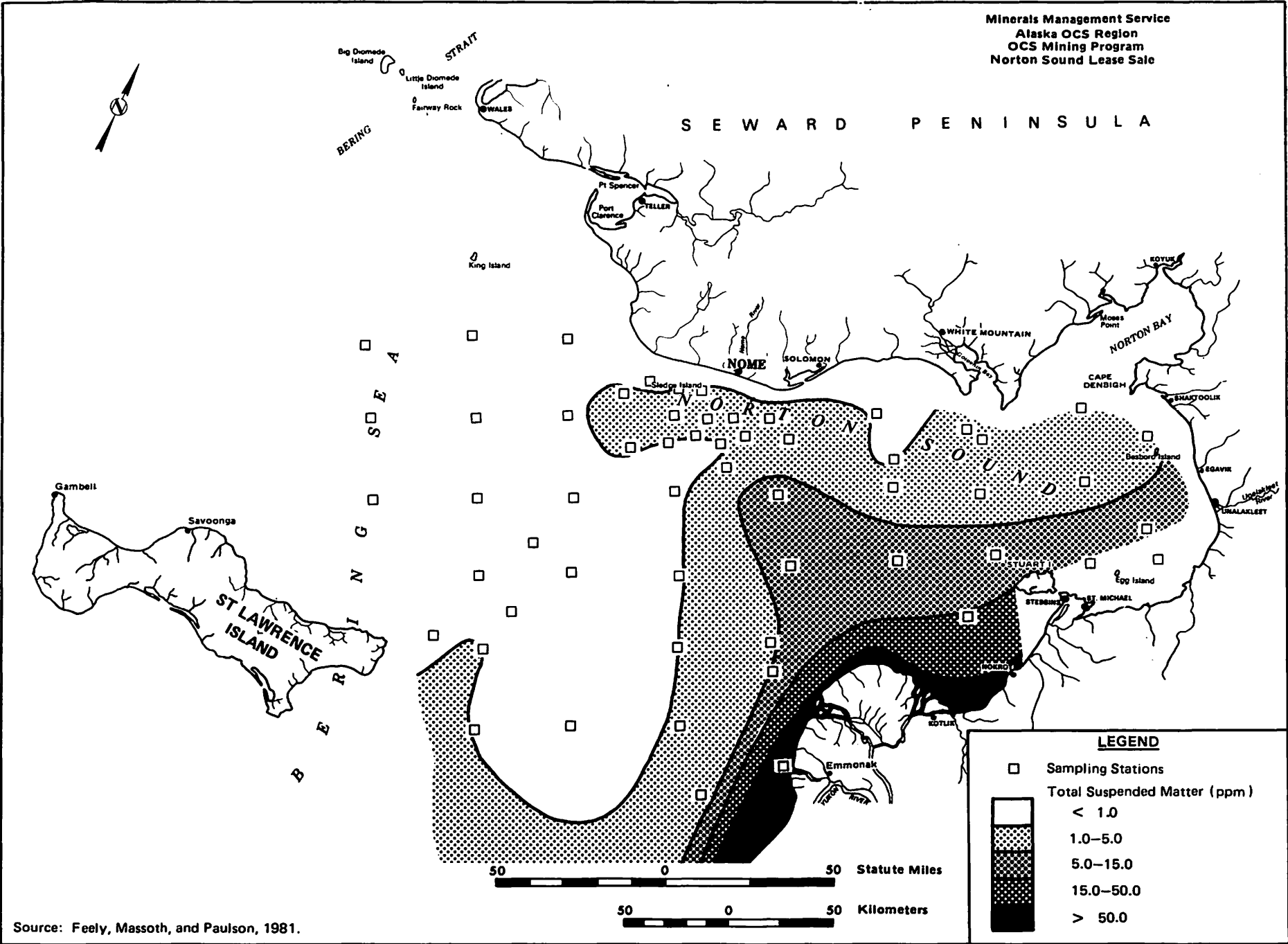
Gray whales, as they feed on the bottom, resuspend an estimated 120 million m<sup>3</sup> (=220 million metric tons [t]) of sediment into Norton Basin waters each summer, mostly in the Chirikov Basin (Johnson and Nelson, 1984).

Most of the annual suspended load of the Yukon River, 70 to 90 million t, enters the Norton Basin during the summer (Sec. III.A.3). In summer, the surface distribution of suspended matter in much of Norton Sound is dominated by this discharge (Fig. III-5). Concentrations of suspended matter are highest at the Yukon River mouth, reaching concentrations of 100 to 154 parts per million dry weight (ppm), and about 90 percent of suspended load is moved in a plume to the north and northwest across the mouth of Norton Sound (Feely, Massoth, and Paulson, 1981; Dean and McRoy, 1988).

However, surface waters in the plume with high (up to 30 ppm dry weight) or moderately high (3-5 ppm dry weight) turbidity extend less than half of the distance between the Yukon Delta and Nome (Dean and McRoy, 1988). Plumes with low concentrations of Yukon silt occasionally extend further north but result in near-surface turbidity on the order of only 1 to 5 ppm dry weight. These latter Yukon plumes can extend to within about 10 km of the north shore of Norton Sound where they are blocked by the back and forth circulation of Bering Sea water over the coastal trench (see Fig. III-1) and by nearshore currents inshore of the trench.

Near-bottom concentrations of suspended matter (Fig. III-6) in Norton Basin tend to be higher than surface concentrations, suggesting resuspension and/or slower sedimentation of materials through the denser bottom waters (Feely, Massoth, and Paulson, 1981). Tidal mixing appears to break down water-column stability and resuspend sediments in bottom waters seaward of the trench. This resuspension causes the local maximum in suspended-matter concentrations evident southwest of Nome.

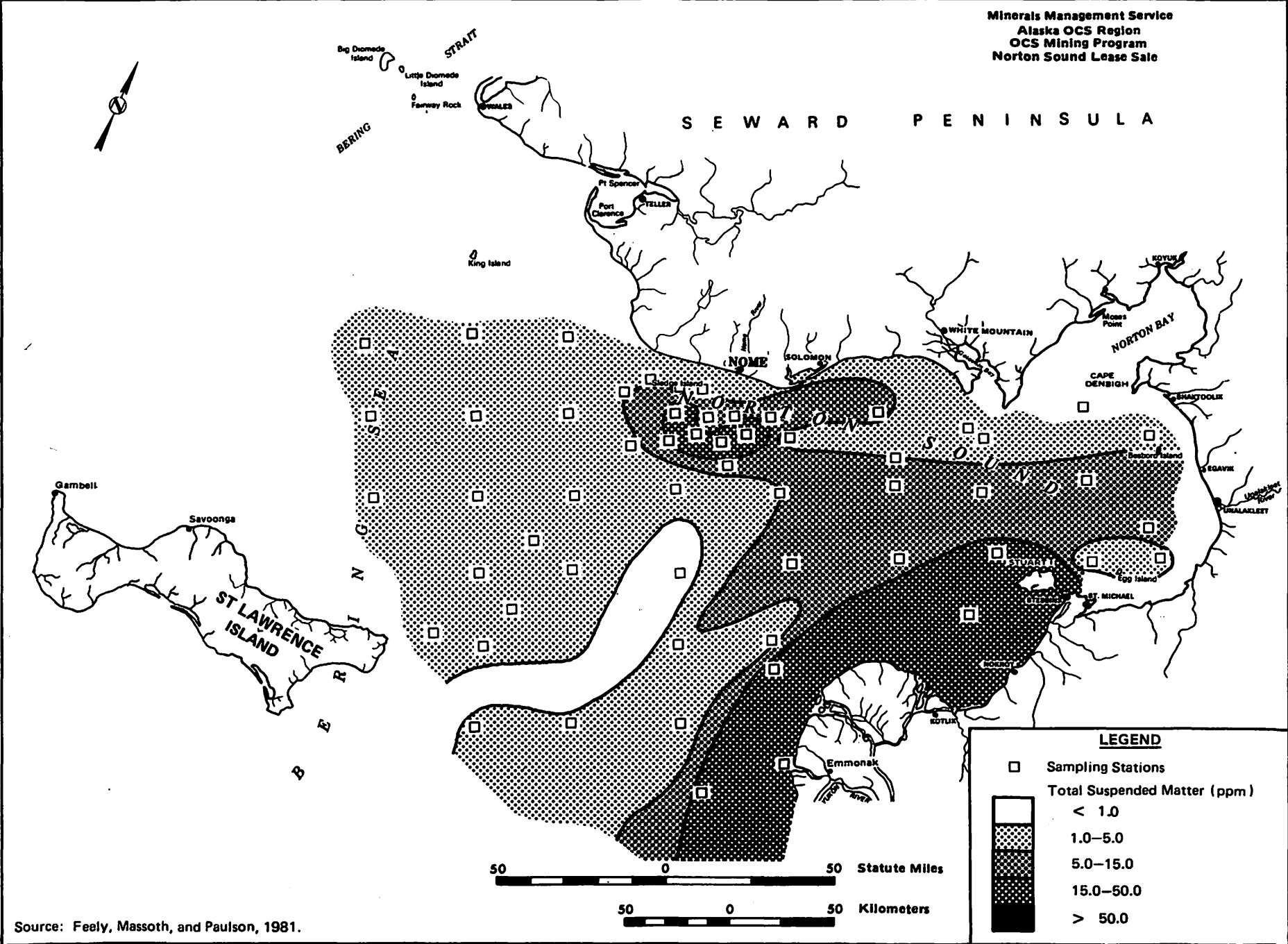
(2) Northwestern Norton Sound: Suspended-sediment concentrations in surface waters of northernmost Norton Sound are lower than elsewhere in the Sound during quiescent summer periods, ranging from less than 1 ppm up to 7 ppm (Fig. III-5; Sharma, 1974). There is no east/west trend in suspended load nor evidence of a turbidity plume from the Snake River. Surface concentrations are highest near the shoreline as a result of coastal inputs of sediments and tidal and wave resuspension of sediments in very shallow waters, averaging over 6 ppm within 2 km of shore, and generally less than 3 ppm in the proposed sale area 5 km to 20 km from shore. Offshore of the sale area, suspended-sediment loads occasionally increase in surface waters during the most northward excursions of the Yukon River plume (Sec. III.A.8(1)). Suspended-sediment loads at 1 to 5 ppm dry weight range only slightly higher than background in these northward plume excursions. The sale area itself is centered over a shallow trench which allows less turbid Bering Sea water to enter and circulate in northwestern Norton Sound. Thus, the sale area represents a turbidity minimum in western Norton Sound, having the lowest suspended-load concentrations along a north/south transect from the Yukon River to Nome. Bottom water concentrations are higher than surface concentrations, ranging between 1 and 17 ppm of suspended sediments. Higher bottom-water concentrations of 30 ppm occur offshore of the sale area and have been attributed to resuspension of sediments by locally strong tidal mixing; such high concentrations may



Source: Feely, Massoth, and Paulson, 1981.

FIGURE III-5. DISTRIBUTION OF SUSPENDED MATTER AT THE SURFACE IN NORTON SOUND, JULY 7-18, 1979

Minerals Management Service  
 Alaska OCS Region  
 OCS Mining Program  
 Norton Sound Lease Sale



Source: Feely, Massoth, and Paulson, 1981.

FIGURE III-6. DISTRIBUTION OF SUSPENDED MATTER AT FIVE METERS ABOVE THE BOTTOM IN NORTON SOUND, JULY 7-18, 1979

occasionally extend northward into the sale area. Suspended-sediment levels during storms would be on the order of tenfold higher than quiescent values throughout the water column. Such elevated suspended-sediment loads, however, would persist from only a few hours up to 2 or 3 days.

In addition, current gold dredging in State inshore waters in the open-water season has a permitted discharge rate of 11,000 t of solids per day (Northern Technical Services, 1986), or about 1.2 million t of solids per year. This mining activity has resulted in a measurable increase in local turbidity over the entire mining season, particularly in mid-depth and bottom waters, extending beyond 500 m downcurrent from the dredge (see Fig. 5.2-14 in Rusanowski, Gardner, and Jewett, 1988). This increase in turbidity near the dredge is much greater than that which would occur in the same location from storm resuspension.

b. Trace Metals:

(1) Norton Basin: Insufficient trace-metal data exist to characterize Norton Basin waters away from northwestern Norton Sound (Table III-2). Considerable data, indicating locally elevated levels of trace metals, exist for surface sediments.

Water Column: Measurements of water-column concentrations over most of Norton Basin are suspect in the sense that recent advances in sampling and storage technology for trace metals in water were not incorporated in any sampling program in Norton Sound until June 1989. Improvements in state-of-the-art sampling for trace metals in water almost invariably lead to lower estimates of trace-metal concentrations. Thirtyfold reductions in mercury concentrations, for example, have been observed elsewhere when the newer sampling technology is used (Gill and Fitzgerald, 1985). Improvements in both sampling and analytical methodology used in northwestern Norton Sound studies between 1986 and 1989 have resulted in a several-hundredfold decrease in reported mercury levels.

Data for only five trace metals (chromium, mercury, lead, zinc, and copper) at only one station have been identified for the area outside of northwestern Norton Sound. Only the reported values for mercury at 0.06 ppb and zinc at 17 ppb are elevated above the other, more recently reported values for marine waters. These two high values are likely artifacts, indicative of sample contamination and of the older technology, rather than of real concentrations. Over most of Norton Basin, concentrations of trace metals are probably well within Federal criteria.

One exception is the area within about 10 to 30 km off the Yukon Delta where suspended sediment concentrations exceed 30 ppm suspended matter (Figs. III-5, III-6). With 60 ppm dry weight copper in suspended matter in Norton Sound (Table III-4), the large suspended-matter loads near the Delta should result in total copper concentrations in the water that exceed the EPA acute criterion of 2.9 ppb copper.

Sediments: Trace-metal concentrations have been relatively well studied in bottom sediments in Norton Basin (Table III-3). Natural, background concentrations of cadmium range atypically high; some Basin sediments could be classified as heavily polluted with cadmium under a classification scheme developed and formerly used by the Environmental Protection Agency (EPA), Region V. (The EPA, Region X--the local EPA Region--has never used this classification and EPA in general no longer uses total sediment concentrations to evaluate sediment pollution or toxicity, but, instead, uses weak-extract concentrations--elutriate and EP-toxicity tests [see Sec. IV.B.2]). The situation is more nebulous for chromium, ranging into the heavily polluted classification, and for zinc, copper, and nickel which range into the polluted classification. For these latter metals, the EPA classification would describe some typical coastal ocean concentrations as polluted. On the other hand, the concentrations that were considered by EPA to represent heavy pollution are also similar in magnitude to soil concentrations causing documented, hazardous contamination of food crops and terrestrial food chains (Kloke, Sauerbeck, and Vetter, 1984). In any case, the EPA classification should be considered to highlight high concentration rather than demonstrate anthropogenic contamination.

The Seward Peninsula and St. Lawrence Island are highly mineralized, resulting in potentially high local concentrations of many trace metals in Norton Basin sediments. Along the southern coast of the Seward Peninsula, the highest values for arsenic (3,000 ppm), copper (700 ppm), zinc (1,000 ppm), and lead (500 ppm) are reported from modern beaches near Bluff in northwestern Norton Sound (Larsen et al., 1980; Nelson et al., 1975). The high copper, lead, and zinc values extend 20 km offshore. The overall mercury average for Norton Basin sediment is only 0.03 ppm. Most of this mercury was thought to be present as the heavy mineral cinnabar; however, a recent EPA study looked for but did not detect any cinnabar in soil and sediments with similar mercury levels near Nome (USEPA, 1987b). Bioavailability of this mercury is discussed in Sec. IV.B.2.6. At

Table III-2  
Trace-Metal Concentrations in Norton Basin Waters  
(parts per billion)

	Arsenic	Chromium	Mercury	Lead	Zinc	Cadmium	Copper	Nickel
Snake River Estuary	3.9	-- <sup>1/</sup>	0.004	0.4	2.8	0.02	1.0	1.7
Northwestern Norton Sound <sup>2/</sup>	0.8	--	0.001	0.1	<0.65	0.06	1.0	1.7
Remainder of Norton Basin <sup>3/</sup>	--	0.9	<u>0.06</u> <sup>4/</sup>	0.2	17	--	0.2	--
Southeastern Alaska	1.1	--	0.0004	0.1	1.0	0.1	0.6	0.6
Puget Sound	1.7	--	0.001	0.1	1.0	0.1	0.5	0.5
Typical Worldwide Marine Total <sup>5/</sup>	2 <sup>6/</sup>	0.3	0.001 <sup>7/</sup>	0.01	1	0.04	0.3	0.3
EPA Marine Criteria <sup>8/</sup>								
Chronic	36 <sup>9/</sup>	50 <sup>10/</sup>	0.025	5.6	86	9.3	NONE	8.3
Acute	69 <sup>9/</sup>	1,110 <sup>10/</sup>	2.1	140	95	43	2.9	75

Sources: Hood, 1989; Crecelius, Apts, and Lasorsa, 1990.

<sup>1/</sup> Dashes denote no data.

<sup>2/</sup> At least 2,000 m from Bima, most samples from sale area.

<sup>3/</sup> One station in southwestern Norton Basin; Burrell, 1978; U.S.S.R. State Committee on Hydrometeorology and Environmental Control and USDOJ, FWS, 1982.

<sup>4/</sup> Single underlining denotes values that exceed EPA chronic criteria.

<sup>5/</sup> Bernhard and Andreae (1984).

<sup>6/</sup> Burton and Statham (1982) in Langston (1990).

<sup>7/</sup> Gill and Fitzgerald (1985).

<sup>8/</sup> Recoverable; USEPA (1986a); Federal Register (1986, 1987).

<sup>9/</sup> As Arsenic<sup>+3</sup>.

<sup>10/</sup> As Chromium<sup>+6</sup>.



Table III-3  
Trace-Metal Concentrations In Norton Basin Sediments  
(parts per million dry weight)<sup>1/</sup>

	Arsenic	Chromium	Mercury	Lead	Zinc	Cadmium	Copper	Nickel
Snake River Estuary <sup>2/</sup>	<u>22-160</u>	10- <u>37</u>	<0.1-0.44	7-28	-- <sup>3/</sup>	<0.01-0.15	--	--
Northwestern Norton Sound <sup>4/</sup>								
Total <sup>5/</sup>	2.7- <u>140</u>	4- <u>101</u>	<0.002-0.41	0.6- <u>92</u>	3- <u>400</u>	0.01- <u>39</u>	2.5- <u>60</u>	<2.6- <u>93</u>
Strong Reducing Acid Extractable <sup>6/</sup>	0.6- <u>6.2</u>	<0.2-2.7	--	2.9-17.1	<0.2-38	<0.02-4.2	<0.2-5.3	--
Weak Acid Extractable <sup>7/</sup>	--	--	--	--	5.1	--	0.6	1.4
Remainder of Norton Basin								
Total <sup>8/</sup>	<u>6.9-20</u>	10- <u>150</u>	<0.01-0.23 <sup>9/</sup>	7- <u>45</u>	20- <u>210</u>	1- <u>11</u> <sup>10/</sup>	3- <u>60</u>	7- <u>90</u>
Weak Acid Extractable <sup>11/</sup>	--	--	--	--	2.5-9.1	0.1 <sup>7/</sup>	0.3-2.2	1.8-4.3
Average Total, World Coastal Oceans <sup>12/</sup>	--	10- <u>100</u>	0.01-0.07 <sup>13/</sup>	2-20	5- <u>200</u>	0.2-3.0	5- <u>40</u>	16- <u>47</u>
Pollution Classification <sup>14/</sup>								
Nonpolluted	<3	<25	<1	<40	<90	--	<25	<20
Moderately Polluted	3-8	25-75	--	40-60	80-200	--	25-50	20-50
Heavily Polluted	>8	>75	>1	>60	>200	>6	>50	>50

<sup>1/</sup> Single underlining denotes values which could be classified as moderately polluted and double underlining denotes values which could be classified as heavily polluted.

<sup>2/</sup> Surface sediments only (0 to ≤2 feet); USDOD; COE, 1980.

<sup>3/</sup> Dashes denote no data or standard.

<sup>4/</sup> Including proposed sale area.

<sup>5/</sup> Sharma, 1974; Nelson et al., 1975; Robertson and Abel, 1979; Larsen et al., 1980; Northern Technical Services, 1985, 1986a; Rusanowski, Gardner, and Jewett, 1988; Jewett, Gardner, and Athey, 1989; Naidu et al., 1989; USDOD, COE, 1989; Crecelius, Apts, and Lasorsa, 1990. Locally, higher anomalies of arsenic (3,000 ppm), mercury (1.3 ppm), lead (500 ppm), zinc (1,000 ppm), copper (700 ppm) and nickel are present nearshore (Larsen et al., 1980).

<sup>6/</sup> Naidu et al., 1989.

<sup>7/</sup> One sample (Burrell et al., 1981).

<sup>8/</sup> Sharma, 1979; Larsen et al., 1980; Robertson and Abel, 1979. Locally, higher anomalies of chromium (1,000 ppm) and mercury (0.96 ppm), and also zinc, copper, and nickel are present (Larsen et al., 1980; Nelson et al., 1975).

<sup>9/</sup> Nelson et al., 1975.

<sup>10/</sup> Sharma, 1974.

<sup>11/</sup> Burrell et al., 1981.

<sup>12/</sup> Sale 87 FEIS (USDOI, MMS, 1984b).

<sup>13/</sup> Central Bering Shelf and Chukchi Sea (Nelson et al., 1975).

<sup>14/</sup> Former standard used by EPA Region V (Engler, 1980); see text.

**Table III-4**  
**Trace-Metal Concentrations in Norton Basin**  
**Suspended Sediments**  
**(parts per million dry weight)<sup>1/</sup>**

	Chromium	Mercury	Lead	Zinc	Cadmium	Copper	Nickel
<b>Yukon River</b>							
Alakanuk	147	-- <sup>2/</sup>	--	--	--	320	109
Pilot Station	48	--	--	49-142	--	24-148	--
Estuary, surface	120	--	--	180	--	60	59
<b>Norton Sound</b>							
Eastern	170	--	--	240	--	61	54
Central	55-140 <sup>3/</sup>	--	--	220	--	60	58
<b>Norton Basin</b>							
Western	90	--	--	170	--	40	30

Sources: As indicated in footnotes 1 and 3.

<sup>1/</sup> Feely, Massoth, and Paulson, 1981.

<sup>2/</sup> Dashes denote no data.

<sup>3/</sup> ECOMAR Marine Consulting, 1983. Sampled during high winds, up to 40 km/hr.

least mercury and gold are concentrated in relict gravels in Norton Basin (see Nelson et al., 1972, 1975; Nelson and Hopkins, 1972; Sec. III.A.3). Tin concentrations of the order of 10 ppm are found off Cape Prince of Wales (Nelson, 1971). Local concentrations of tin up to 20,000 ppm occur very close to shore in State waters off of Cape Prince of Wales.

**Suspended Sediments:** Data for suspended sediments in the water column exist for only four metals: chromium, zinc, copper, and nickel (Table III-4). The suspended sediments are enriched relative to bottom sediments for all four metals. Feely, Massoth, and Paulson (1981) concluded that chromium, copper, and nickel, but not zinc, in the suspended sediments of Norton Sound are primarily associated with inorganic clay minerals derived from the Yukon River and resuspended sediments. The particulate copper concentrations in Norton Sound waters offshore of the Yukon Delta exceed the EPA acute criterion of 2.9 ppb copper when converted to units of the criterion.

The enrichment of copper and these other metals in the suspended sediments, relative to their concentration in bottom sediments, suggests that metals are concentrated in the finer sized sediments. This enrichment in waterborne metals is in contrast to the situation in bottom sediments where the deposition of Yukon River sediments appears to dilute background trace-metal concentrations.

## (2) Northwestern Norton Sound:

**Water Column:** Water-column data for seven trace metals were collected in June and September 1989 for the sale area and inshore waters using state-of-the-art sampling and analytical procedures (Table III-2). These new data, unlike earlier data collected with lesser methods that were not state-of-the-art, indicate that ambient concentrations of arsenic, mercury, lead, zinc, cadmium, copper, and nickel in the sale area and most inshore waters are below EPA criteria. The concentrations of copper and nickel are high when compared with measurements from other waters. Most of the mercury, cadmium, copper, and nickel is in dissolved form, and most of the lead is particulate. Data are not yet available to characterize arsenic, chromium, or zinc partitioning between dissolved and particulate phases. Unpublished WestGold data for June and July 1989, indicate that chromium concentrations both upcurrent and downcurrent of the Bima inshore State waters are below EPA criteria and State standards.

Measurements made for MMS downcurrent of the Bima on three dates in 1989 indicate local exceedance of the EPA acute criterion for copper at 100 meters downcurrent of the dredge, and suggest local exceedance of EPA chronic criteria for lead and nickel downcurrent of the dredge (Crececius, Apts, and Lasorsa, 1990).

**Sediments:** In the sediments, concentrations of chromium, zinc, cadmium, copper, nickel, and probably arsenic and lead range higher in northwestern Norton Sound than elsewhere in Norton Basin. Based on metal content, any sale area sediments with metal content in the upper concentration range could be classified as heavily contaminated with regard to arsenic, chromium, lead, zinc, cadmium, copper, and nickel. In particular, concentrations of arsenic and cadmium appear to range exceptionally high.

Roughly 10 percent of the over 200 sediment samples taken by Nelson et al. (1975) in Norton Basin exceeded 0.10 ppm mercury, particularly those collected along the southern coast of the Seward Peninsula (Fig. III-6a). Some of this mercury may be mineralized; cinnibar is present on the Seward Peninsula (Moffit, 1906; Brooks, 1908, 1914, 1921; Cathcart, 1922; Nelson et al., 1975; Larsen et al., 1980). However, locally near Nome, some metallic mercury has been derived from losses during onshore gold mining and processing. In the estuary of the Snake River, which has been subject to such mining and processing activities, mercury concentrations are relatively high, with three of six surface-sediment samples reaching at least 0.29 ppm mercury (USDOD, COE, 1990). Mercury was used in amalgamation in almost all gold-placer mining at least into the 1930's (Gardner and Johnson, 1934). Mercury use continued in the Nome mining district (including the Snake River watershed) into 1985 (USEPA, 1987a). Gold production from onshore-beach strandlines in the Nome mining district from 1898 to 1987 was 3,449,000 troy ounces (State of Alaska, Office of the Governor, 1989). In addition, placer gold produced from the Solomon-Bluff District immediately onshore of the eastern lease blocks totaled 325,560 troy ounces. Total strand-line production between the two districts totaled 3,774,560 troy ounces of gold. Historically, using the mercury amalgamation process, the amount of mercury lost was equal in weight to the amount of gold recovered (Wise, 1966; McCredie, 1983).

Based on this relationship, on the order of 120 metric tons of mercury may have been discharged to the soils, sediments, and tailing piles in the Nome mining district since 1898. Metallic mercury, in fact, could still be panned from Nome beaches at least 7 decades after discharge (Nelson et al., 1975).

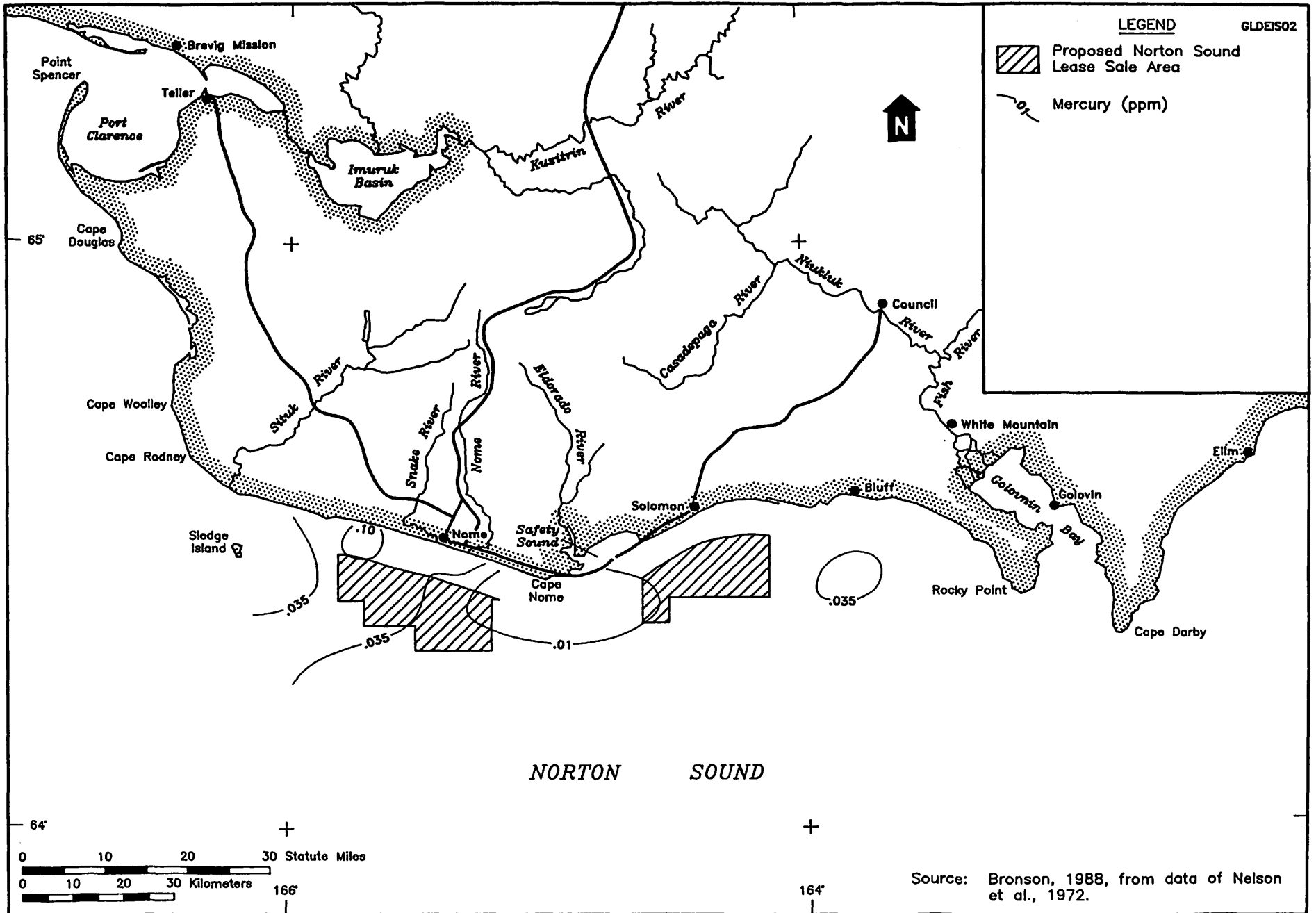


Figure III-6a. Distribution of Mercury (ppm) in Surface Sediments (0-10 cm) in Northwestern Norton Sound

The marine sediments offshore of Nome, also contain high gold concentrations; the richest part of one such deposit averaged 920 parts per billion (ppb) gold (Nelson and Hopkins, 1972). Modern beaches near Bluff are very high in arsenic, mercury, lead, zinc, copper, and antimony (Larsen et al., 1980).

Gold, tin, antimony, arsenic, chromium, lead, and mercury are concentrated in the heavy-mineral fraction of the sediments by the same depositional and erosional processes in Norton Sound, and, therefore, higher concentrations of gold should be accompanied by higher concentrations of these elements (see Sec. III.A.3; Cathcart, 1922; Fleischer, 1970; McCarthy et al., 1970; Sharma, 1974; Green, Bundtzen, and Hansen, 1988; Nelson et al., 1975, 1977; Jewett et al., 1990). Past mining activities in and around the Snake River are the suspected source of high arsenic concentrations (150 ppm) in surface sediments (0 to  $\leq$  2 feet) in the turning basin of the Snake River estuary (USDOD, COE, 1990). Offshore, an association between mercury and gold has been obvious in the Bima monitoring data. Reported mercury concentrations in sediments being mined for gold (Rusanowski, Gardner, and Jewett, 1988) are severalfold higher than anticipated on the basis of mercury concentrations measured earlier in sediments collected without regard to gold content in pre-mine sampling (Northern Technical Services, 1985). Concentrations of copper, cadmium, and zinc, on the other hand, are associated with clay and organic carbon rather than with the heavy-mineral component of the sediment in Norton Sound (Sharma, 1974); concentrations of these metals would not be expected to covary with gold concentrations. It is not clear how well the behavior of metallic mercury would mimic that of mineralized mercury because of metallic mercury's recent (in a geologic context) addition to the environment.

In suspended sediments within the water column, concentrations of three of the four metals studied, copper, nickel, and chromium, do not appear to vary significantly across Norton Sound. Factors controlling these three metals would be the same as those controlling for Norton Basin as a whole, as discussed in Section III.A.8.b(1).

Concentrations of zinc in suspended sediments in northern Norton Sound, however, are higher than elsewhere in the Sound (Feely, Massoth, and Paulson, 1981). The high zinc values have been attributed to remineralization (= solubilization) of zinc in the sediments with subsequent release of the zinc into the water column. This zinc is then coprecipitated or adsorbed onto the finer particulates in the water column. Chemical partitioning of samples with high zinc values in experiments indicated that the bulk of zinc in the suspended sediments is weakly bound, and, therefore should be considered biologically available. Because the zinc is concentrated on the finer particulates, the zinc would also tend to remain in suspension, with concentrations on a per-dry-weight basis increasing as less-enriched, coarser particulates settled.

c. Oxygen:

(1) Norton Basin: Cold-climate waters such as those in Norton Basin generally contain more oxygen than warmer climate waters because of the greater solubility of oxygen in colder water. Norton Sound stratification breaks down in the fall as surface waters cool, and convective mixing from fall to early spring aerates the bottom waters and replenishes its oxygen content (Sec. III.A.5). In addition, the colder water temperatures limit decomposition and consequent oxygen demand throughout the water column in winter, and also in the deeper, and still cold, bottom waters in summer. Concentrations of oxygen in temperate oceans of the world range up to 5 milliliters (ml) dissolved oxygen per liter, while northern oceans range around 6 to 7 ml oxygen per liter (Horne, 1969).

(2) Northwestern Norton Sound: Oxygen concentrations are high both in surface and bottom waters. Oxygen concentrations of almost 9 ml per liter persist even in the bottom waters in summer (Hood et al., 1974)--concentrations that are about 20-percent higher than those that occur elsewhere in northern oceans.

d. Hydrocarbons:

(1) Norton Basin: Outer Continental Shelf Environmental Assessment Program (OCSEAP) investigators have analyzed the sediments of Norton Basin for total carbon, organic carbon, aliphatic hydrocarbons, aromatic hydrocarbons, and pelagic tars. The data indicate that Norton Basin has not been subject to measurable hydrocarbon pollution.

There is no evidence of petroleum hydrocarbons in the water column of Norton Basin. Background hydrocarbon concentrations in the water averaged 0.7 ppb (Shaw, 1977). Shaw also made 13 tows of 740 m<sup>2</sup> each to collect

floating tar in Norton Basin in 1976 (Shaw, 1981). No tar was found in any sample. A gas seep has been located in central Norton Sound, south of Nome. The seep is primarily composed of thermogenic carbon dioxide with lesser quantities of thermogenic natural gas (Kvenvolden et al., 1981). Concentrations of dissolved hydrocarbon gases in near-bottom waters--where highest concentrations should occur--are on the order of 0.14 to 1.4 ppb by weight (Cline, Feely, and Young, 1978). The larger value is the result of strong thermal stratification at the time of sampling. About 99 percent of the hydrocarbon gas is methane, indicative of natural, and not pollutant, origin.

Organic carbon in the sediment is mostly terrestrial in origin, having been carried into the Basin by the Yukon River (Verkatesan et al., 1981). Only 0.02 to 0.5 percent of the organic carbon is hydrocarbon. Aliphatic hydrocarbons average 5.9 ppm of sediment dry weight and aromatic hydrocarbons only 2.7 ppm (OCSEAP data, National Ocean Data Center [NODC]/NOAA data bank). Such concentrations are the typical levels found in unpolluted marine or freshwater sediments. Even samples taken near a thermogenic gas seep in Norton Sound appeared to be uncontaminated (Verkatesan et al., 1981).

(2) Northwestern Norton Sound: Water concentrations of petroleum hydrocarbons have not been analyzed within northwestern Norton Sound, but are likely low and similar to the 0.7 ppb found in other Norton Basin waters. However, minor fuel spills near Nome (such as the 1977 spill of 140 bbl of diesel [one-third recovered] from an onshore tank onto the shoreline and into the Snake River [Allen, 1978]), and any residue of a major underground fuel leak in Nome that was cleaned up in 1985 could contribute to local hydrocarbon concentrations near Nome and in the sale area. A plume of dissolved ethane in bottom waters (0.003 ppb, tenfold background) extends from the gas seep 40 km south of Nome through the portion of northwestern Norton Sound containing the sale area; however, ethane and higher-molecular-weight gases contribute negligibly to the total content of dissolved hydrocarbon gases in area waters (Cline and Holmes, 1978). The overall concentration of dissolved hydrocarbon gases in near-bottom waters--where highest concentrations should occur--are on the order of 0.3 to 0.4 ppb by weight, and are almost entirely methane in the sale area and other portions of northwestern Norton Sound.

On the basis of three stations, aliphatic hydrocarbons averaged 6.3 ppm of sediment dry weight and aromatic hydrocarbons averaged 3.6 ppm of sediment dry weight (OCSEAP data, NODC/NOAA data bank). Both averages for northwestern Norton Sound are greater than the basin-wide averages, and both result from the relatively high hydrocarbon content (9.6 ppm total aliphatic hydrocarbons and 7.5 ppm total aromatic hydrocarbons) of the single sediment sample offshore of Nome and within the sale area. Even these latter values, however, fall within the range typical for unpolluted sediments.

Within the Snake River estuary, the several fuel spills that have occurred over the last few years have affected sediment hydrocarbon concentrations (USDOD, COE, 1990). Aliphatic hydrocarbons averaged 12 ppm in three sediment samples and diesel was detected at more than 1 ppm (34 ppm) in one of five surface samples (0-2 ft; USDOD, COE, 1990). These concentrations are too low to make the estuary a significant source of hydrocarbons to the marine environment.

The apparent absence of significant petroleum contamination in water and sediment is substantiated by the measured rates of petroleum-related bacterial activity in sediment and water samples from the sale area and other parts of northwestern Norton Sound (and Norton Basin) and also indicate a lack of exposure to petroleum pollution (Haines and Atlas, 1983).

## **B. Biological Resources**

1. Marine Plants and Invertebrates (Including Red King Crab): In this section, the pertinent information on marine plants and invertebrates in pelagic and benthic communities is summarized.

a. Pelagic Community: This section concerns the pelagic community and concentrates on planktonic organisms living in the water column; pelagic fishes are discussed Section III.B.2, Fishes. Planktonic organisms are those organisms occurring in the water column that are subject to the vagaries of the water's movements; they are unable to swim very effectively against currents. Two basic groups comprise the plankton: (1) phytoplankton, the primary producers or plants of the plankton, and (2) zooplankton, the animal component of the plankton.

Phytoplankton: Primary productivity measured near Nome in July 1973 ranged from 238 to 498 milligrams of carbon per square meter per day ( $\text{mg of carbon/m}^2/\text{day}$ ), comparing favorably with average summer estimates

for the southeastern Bering Sea (Goering, 1972). Annual values, however, could be expected to be relatively lower for Norton Sound due to the shorter ice-free period (Redburn, 1976).

The transfer of the organic matter produced at the ice edge, under the ice, or in open-water phytoplankton blooms to primary consumers or higher trophic levels depends on the structure of the grazing community within the water column. Where phytoplankton are efficiently grazed, there is little direct transfer of carbon from the primary producers to the benthos (those animals living in association with the bottom). With changes in zooplankton composition across Norton Basin, the extent to which phytoplankton are efficiently grazed may vary, thus affecting the input of carbon to the benthos.

**Zooplankton:** The zooplankton assemblages found in the proposed lease area can be termed: the middle-shelf/coastal assemblage and the nearshore assemblage, based on the distribution of zooplankton species (see Fig. III-B-2 in the Sale 100 FEIS [USDOI, MMS, 1985a] for distribution and species composition of these assemblages). Some detailed information on the abundance of the nearshore assemblage can be found in Neimark (1979).

These distribution patterns are basically known from summer observations; there also may be species shifts seasonally. For example, Neimark (1979) found Acartia clausi to be the predominant zooplankton in the nearshore region of Norton Sound. As he sampled further offshore, the predominance of A. clausi diminished, and A. longiremis increased in abundance. A. longiremis is typically a more oceanic species with a more northerly, cold-water distribution (Brodski, 1964). Neimark (1979) postulates that during autumn, A. longiremis might succeed A. clausi in the nearshore regions in response to seasonal changes in the environment. In general, nearshore regions of Norton Sound evince a lower species diversity, presumably because fewer species can tolerate the wide-ranging salinities and temperatures.

The differences in zooplankton in the various regions (nearshore, mid-shelf, and oceanic/outer shelf) are reflected in general differences in body size and life history. In the nearshore and inner Norton Sound regions, the zooplankton is dominated by small-bodied copepods (e.g., Acartia spp. and Eurytemora spp., approximately 1 mm long). In the offshore, more pelagic environments, larger zooplankton like Calanus spp. (2-8 mm long) are abundant (Cooney, 1977).

In the middle and inner coastal shelf regions, smaller herbivorous and omnivorous copepods predominate. These zooplankton overwinter as adults and must first feed before reproducing. Generation time for these copepods in the cold (usually less than 1° C) shelf water of the early spring is 1 to 2 months. This results in a lag period between the initiation of the bloom and an increased abundance of grazers. Peak densities of grazers are reached after the end of the spring bloom. Also, the small copepods skew the grazing pressure to the smaller plant cells in the primary producer group. The larger cells and active chain formers then "bloom" under relaxed grazing stress (Alexander and Cooney, 1979; Goering and Iverson, 1981). As the season progresses, vertical mixing of the water column by storms and tidal exchange increases nutrient recycling and prolongs the bloom (Cooney, 1981). The mean-consumption rate of phytoplankton is about 200 mg of carbon/m<sup>2</sup>/day in the southeastern Bering Sea (Lewbel, 1983). Cooney (1981) calculates the grazing efficiency for the middle and inner shelves to be 2 percent and 3 percent, respectively. As a consequence, over three times as much phytoplankton remains ungrazed in the midshelf region as in the outer shelf (Dagg et al., 1980). Sinking of the ungrazed phytoplankton provides a large carbon source for the benthos. The presence of a rich stock of benthic invertebrates (Johnson, 1953, as cited by Redburn, 1976) in Norton Sound is suggested by the high abundance of the pelagic larvae of echinoderms, mollusks, and annelids present during July and August.

#### b. Benthic Communities:

**Invertebrates (Subtidal Communities):** The marine benthos within Norton Sound tends to reflect overlying water-mass-transport and productivity regimes. In the more sluggishly rotating eastern section of Norton Sound, large amounts of detrital organic carbon from the Yukon River and other sources accumulate, and soft organic sediments rich with microbial populations are found. Deposit feeders (e.g., polychaete worms, small clams, cockles) and associated predators (large snails, crabs, and bottomfishes) are common in this area.

The western section of inner Norton Sound (still east of the boundary zone) is also a depositional environment, but sediments here are resuspended and redistributed by more vigorous currents. Species present are characteristic of unstable depositional environments (e.g., the polychaete worm, Pectinaria; the sand dollar, Echinarachnius; the clam, Yoldia; Menzel and Wright, 1982).



Collectively, the invertebrate epibenthos (organisms living on the surface of the bottom) in the Norton Basin is dominated by echinoderms. This group comprises 80 percent of the invertebrate biomass (Jewett and Feder, 1981) and over 60 percent of the combined invertebrate and demersal (living close to or associated with the bottom) fish biomass (Wolotira et al., 1977). Starfish are the primary group of echinoderms present. Asterias amurensis dominates this group, making up 51.9 percent of the total invertebrate biomass in the Norton Basin (Jewett and Feder, 1981). Other relatively abundant echinoderms include the starfish Asterias rathbuni, Evasterias echinosoma (largest catch was southwest of Nome), Lethasterias nanimensis (greatest density 80 km southwest of Nome), and Leptasterias polaris acervata; the green sea urchin, Strongylocentrotus droebachiensis; and the basket star, Gorgonocephalus caryi. In the Norton Basin, the starfish A. amurensis feeds primarily on the green sea urchin, S. droebachiensis, and the sand dollar, Echinarachnius parma, while L. polaris acervata feeds on E. parma, the bivalves Cyclocardia spp. and Serripes spp., and barnacles. The starfish, E. echinosoma feeds also on Serripes groenlandicus, the Greenland cockle (Feder and Jewett, 1981).

Although echinoderms dominate biomass estimates, the most species-rich group is the mollusks, contributing 76 of the 211 species in 13 phyla sampled in Norton Basin by Jewett and Feder (1981). Mollusks account for 5.1 percent of the biomass in Norton Basin, and gastropod mollusks are the most abundant invertebrates of potential economic importance in the region (Wolotira, 1980). The whelk, Neptunea heros, is the dominant mollusk both in biomass and abundance (Wolotira, 1980). In Norton Basin, this species accounts for 75 percent of the region's snail biomass and is estimated to have a population of 56 million snails (Wolotira, Sample, and Morin, 1977). Neptunea heros has centers of distribution in two areas of Norton Basin: (1) nearshore, west of Golovnin Bay and (2) somewhat offshore and east of St. Lawrence Island (Wolotira, 1980). This species has potential for a commercial fishery, as it is abundant, and its average size (4" shell) and weight (0.25 lb) are similar to snails commercially harvested by Japan in the eastern Bering Sea (Wolotira, 1980).

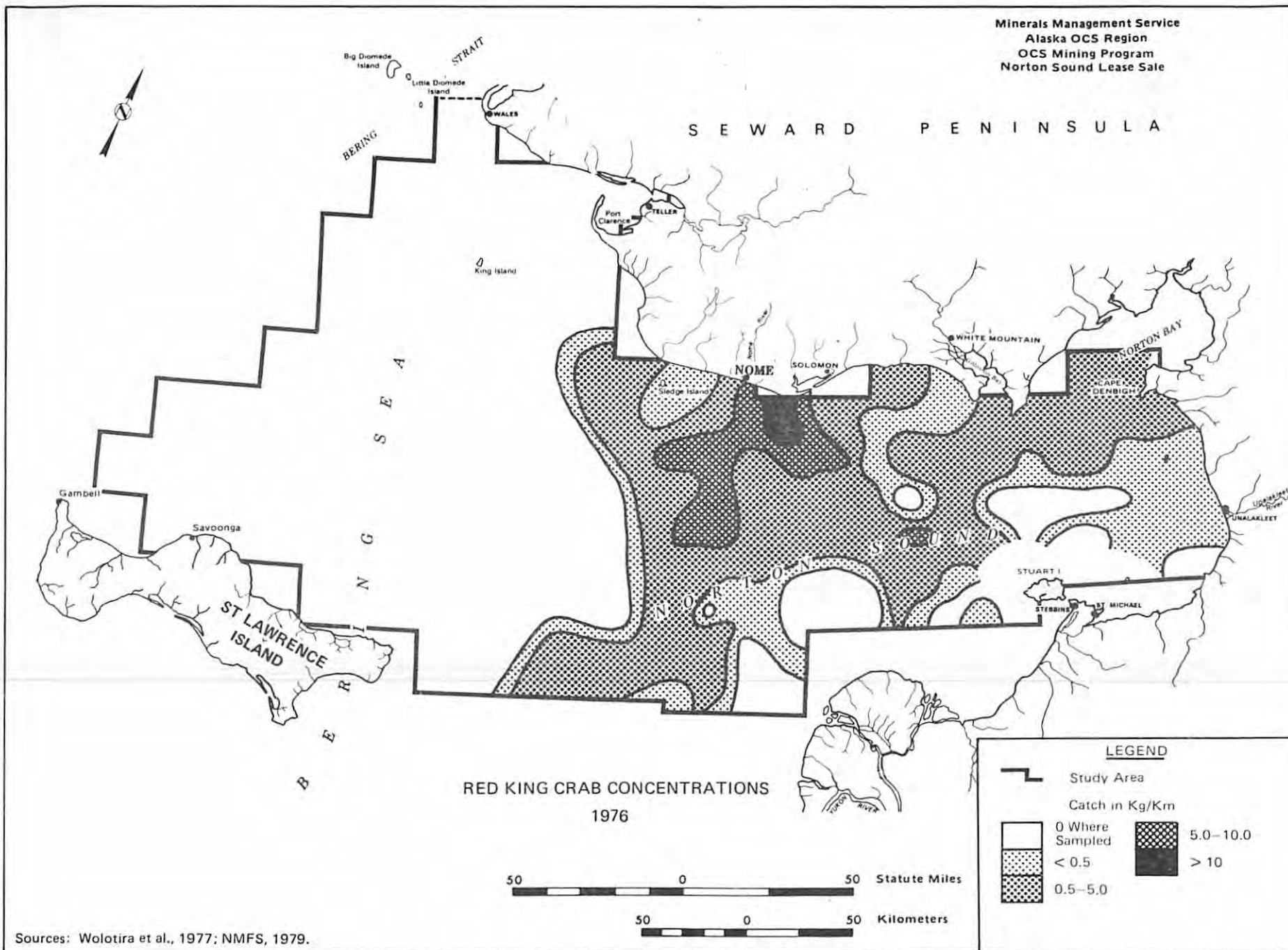
Arthropods contribute 8.4 percent of the biomass and 52 species to the invertebrate benthos of Norton Basin (Jewett and Feder, 1981). The red king crab is the most important component of the arthropod biomass (Jewett and Feder, 1981). Two species of king crab are found in the Norton Basin, differing in their distributions and abundances. The red king crab is found in the more central and eastern parts of the Basin generally between 166° or 167°W. longitude and 163°W. longitude (Figs. III-7, III-8, and III-9). Results of seven crab pot surveys conducted between 1976 and 1982 indicated that red king crab were concentrated in a 111-km<sup>2</sup> area to the southeast of Sledge Island (Powell, Peterson, and Schwartz, 1983). Results of commercial fishing activities also substantiate this distribution (ADF&G, 1986). Of particular note is the extremely high concentration of legal male red king crabs south of Cape Nome, at a station just outside of the lease area (Fig. III-9). The population in 1976 was estimated at 5 million individuals with a biomass of approximately 3,500 t (Wolotira, Sample, and Morin, 1977). Estimates of the population size of legal male crabs are shown in Table III-5.

#### According to ADF&G (1984a):

"The Norton Sound king crab population in 1976 was largely composed of recruit and prerecruit crab. Crab abundance reached its peak in 1978 when it is estimated there were 11 million pounds of legal male crab. From 1979 to 1982 the population experienced very low recruitment and the fishery was almost entirely supported by older postrecruit crab. This is apparent from the average weights of the commercial catch, which have increased from 2.7 to 3.7 pounds. As a result of fishing and natural mortality the abundance of legal crab dropped to an estimated 1.3 million pounds in 1982. Increased abundance of sublegal crab in both the National Marine Fisheries Service (NMFS) and the Alaska Department of Fish and Game (ADFG) 1982 research surveys indicated that improved recruitment should result in a moderate increase in the abundance of legal crab."

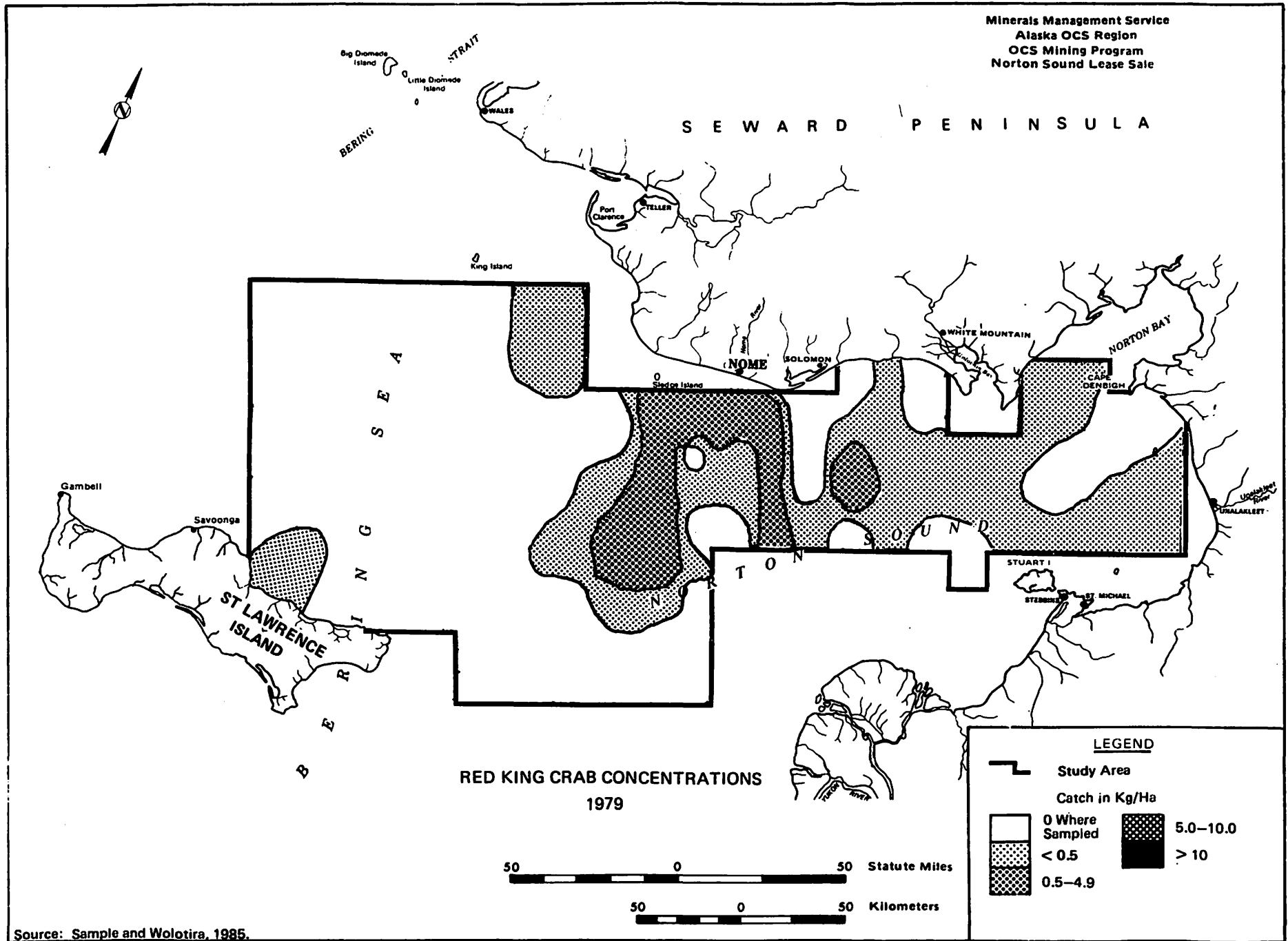
The blue king crab is found in the more western areas of Norton Basin (see Fig. III-B-6 in the Sale 100 FEIS; USDOJ, MMS, 1985a), and it may be found in the westernmost part of the lease area near Sledge Island (Wolotira, Sample, and Morin, 1977).

Several life-history characteristics of both species' populations in Norton Basin differ from populations in other shelf regions of Alaska. Both species appear to have much slower growth rates in Norton Basin (Wolotira, 1980), and females mature at sizes 30-percent smaller than other populations in the southern Bering Sea (Otto, MacIntosh, and Fukuyama, 1979). The maximum size of king crabs in this region also seems smaller than in other areas: 99 percent of the crabs collected in the 1976 demersal (bottom) survey were smaller than the minimum sizes associated with commercial fisheries in other regions (Wolotira, 1980). Based on the size-



Sources: Wolotira et al., 1977; NMFS, 1979.

FIGURE III-7. DISTRIBUTION AND RELATIVE ABUNDANCE OF RED KING CRAB IN NORTON BASIN AS SURVEYED IN 1976



Source: Sample and Wolotira, 1985.

FIGURE III-8. DISTRIBUTION AND RELATIVE ABUNDANCE OF RED KING CRAB IN NORTON BASIN AS SURVEYED IN 1979



**Table III-5  
Commercial Harvest of Red King Crabs in  
Norton Sound, Summer Fishery, 1977-1986**

Year	Legal Male Pop. Est. <sup>1/</sup>	Commercial Harvest <sup>2/</sup>	Number of Vessels	Crab/ Pot	Avg. Wt.	Exvessel Price	Fishery Value Millions \$
1976 <sup>2/4/</sup>	8.1	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1977 <sup>5/</sup>	10.0	0.52	7	36	2.7	0.75	0.229
1978 <sup>5/</sup>	11.0	2.09	8	64	3.0	0.95	1.897
1979 <sup>4/</sup>	5.4	2.93	34	28	3.0	0.75	1.878
1980	6.6	1.19	9	29	3.6	0.75	0.890
1981	4.7	1.38	36	11	3.7	0.85	1.172
1982	1.3	0.23	11	6	3.6	2.00	0.405
1983	2.1	0.37	23	12	2.8	1.50	0.537
1984	2.7	0.39	8	14	2.8	1.02	0.395
1985	2.4	0.43	6	11	2.9	1.00	0.427
1986 <sup>6/</sup>	2.8	0.33	9	10	3.2	1.50	0.491

<sup>1/</sup> Population estimate prior to fishery in given year in millions of pounds.

<sup>2/</sup> No commercial fishery in 1976.

<sup>3/</sup> Millions of pounds.

<sup>4/</sup> Population estimate derived by National Marine Fisheries Service.

<sup>5/</sup> Population estimate derived from catch per pot from commercial fishery.

<sup>6/</sup> ADF&G, 1987.

maturity differences observed, Wolotira (1980) suggests that the Norton Basin stocks of red and blue king crab may be independent from stocks inhabiting other regions of Alaska.

Red king crabs in Norton Sound spend their entire lives in shallow water (less than 36 m), probably due to the absence of deeper water in which to migrate (Powell et al., 1983). This is unlike king crabs in more southerly parts of Alaska that migrate in spring into shallow water to molt, mate, and spawn, and then in the fall, migrate into deeper waters to feed (Lewbel, 1983, citing Powell and Nickerson, 1965a, 1965b; Powell, 1969). There are seasonal movements of at least the adult male red king crabs. Crabs are found in the winter right up against the beach (Len Schwarz, 1985, oral comm.), but in the summer, males move seaward in a southwesterly direction and presumably return northeastwardly in the fall (Powell et al., 1983). Since many tagged crabs have been picked up during the commercial fishery, there may be a bias in our knowledge of movements based on the areas that are open to fishing.

Female crabs may carry up to 200,000 eggs in their brood pouch for a year. After the larvae hatch, they pass through four molts in the plankton and then settle as juveniles (Lewbel, 1983). At least in some regions, king crabs mature after 4 or 5 years (Gusey, 1979). Juvenile red king crabs in Norton Sound appear to have a fairly similar distribution to the adults, with areas of higher abundance somewhat south of Nome (Powell et al., 1983).

Diets of adult red king crabs in northern Norton Sound have been examined in offshore and inshore areas (Feder and Jewett, 1978, 1981; Rusanowski, Gardner, and Jewett, 1988) and the results of the various studies are compared by Rusanowski, Gardner, and Jewett (1988). The diet information suggests that red king crabs are opportunistic, generalized feeders; the most frequently consumed prey items varied in rank order of occurrence in each of the studies, with the exception of fishes, which had the highest frequency of occurrence in both 1986 and 1987. Frequently eaten prey include: fishes, bivalves, brittle stars, crabs and other crustaceans, polychaete worms, sand dollars, hydroids, sea urchins, and gastropods (snails). Postlarval crabs in the Kodiak region feed on small epibenthic organisms settling out from the water column (eg., diatoms, copepods, ostracods, etc.) and detrital material (Jewett and Feder, 1982).

In Norton Sound there are both commercial and subsistence fisheries for red king crab. The commercial king crab fishery (based mainly on red king crabs) in Norton Sound was started in 1977. Areas of most intense fishing pressure are in the northern portion of the Sound--particularly the region from Cape Rodney to Rocky Point and extending south to 63°N. latitude. The region 25 km south of Cape Nome is also an area where king crab and many other epifaunal species (sea stars, urchins, shrimp, two species of hermit crabs, the crab *Hyas*, and gastropods) occur in high abundance (Jewett and Feder, 1981). Subsistence fishing for king crabs occurs near most Norton Sound communities during the winter (ADF&G, 1984a).

Another arthropod species, the tanner crab (*Chionoecetes opilio*), was the most abundant crab species in Norton Basin in 1976 and 1985 demersal surveys, but the individuals were small and were nearly all juveniles (Wolotira, 1980; Stevens and MacIntosh, 1986; Fig. III-10). Biomass was estimated to be 1,400 t with a population size of 52 million crabs in 1976 (Wolotira, Sample, and Morin, 1977). The population estimate for the 1985 NMFS survey was approximately 87 million crabs, virtually all of which were immature (Stevens and MacIntosh, 1986). In the 1976 survey, few adult females were found, but their size at maturity was similar to that of other eastern Bering Sea stocks (Otto, MacIntosh, and Fukuyama, 1979). Tanner crabs in Norton Basin appear to be basically the juvenile portion of a crab population which extends out of the Basin (Wolotira, 1980). The major prey of the tanner crab are bivalves (*Nucula* spp.), brittle stars, sea urchins, sand dollars, polychaetes, and shrimp (Lewbel, 1983).

Stoker (1981) conducted an extensive survey of infauna (and some epifauna) from the southeastern Bering Sea into the Chukchi Sea, including intensive sampling in the western section of Norton Basin. Cluster analysis was performed on the benthic samples, yielding a broad geographical pattern in location of associated groups of species. The physical factor most directly correlated with the distribution of faunal assemblages and major individual species was sediment type. He suggests that the summer bottom temperature (see Neiman, 1968; Filatova and Barsanova, 1964) and water-mass distribution also critically affect faunal distributions.

Several other studies, in addition to Stoker's, have examined infauna (and sometimes epifauna as well) in more restricted areas near or within the lease area. As suggested by Stoker, substrate type and water-mass characteristics influence faunal assemblages. Stoker (1978, 1981) found that the biomass of benthic animals was dominated by bivalve mollusks and echinoderms, with large numbers of sedentary polychaetes also present. The number and biomass of crustaceans was much lower than in the central and western parts of the northern





Bering Sea. The cluster group predominating in Norton Sound included the bivalve mollusk, Serripes groenlandicus; the polychaetes, Myriochele heeri and Sternapsis scutata; the brittle star, Diamphiodia craterodmeta; and the basket star, Gorgonocephalus caryi. Oliver et al. (1983a) sampled infauna near or within the lease area while sampling sites where walrus had been feeding. Near Sledge Island, at a depth of 24 m, the small brittle star, D. craterodmeta, was most abundant, sometimes forming a dense carpet of inter-woven arms. There were apparently few large living bivalves; those present were mostly Macoma spp., plus some Mya truncata. Near Cape Nome, at a depth of 17 m, the abundant infaunal organisms were the tube-building polychaete worm, Myriochele oculata; the tube-building amphipod, Protomedea fasciata; and the infaunal tunicate, Rhizomogula sp. Mya truncata was the only abundant large bivalve found (greater than 5/m<sup>2</sup>), and was the major walrus prey taken at Cape Nome. Oliver et al. (1983) also noted that starfish (primarily Asterias amurensis) increased in number from Cape Rodney to Cape Nome, and were the predominant large epifaunal animals observed.

Feder and Mueller (1974) sampled the benthos near Nome, at depths from 13 to 34 m. Most of the reported sampling was conducted within 3 mi of the coast and thus was outside of the lease area. In sandy, gravel/rock habitats, they found echinoderms to be most common and the greatest contributor to benthic biomass. The soft coral, Eunephthya, and some shrimps were also common. In mud/sand areas, polychaete worms were more important, and the brittlestar, D. craterodmeta, was abundant in all of the grab samples.

In the Rusanowski, Gardner, and Jewett study (1987, 1988), both sand and cobble substrates at varying depths (8-48 ft) were sampled. At sand stations, polychaete worms and crustaceans were the predominant groups, with polychaetes accounting for from 57 to 95 percent of the total invertebrate density. In the cobble areas at intermediate depths (23-25 ft), most of the invertebrate density was contributed by crustaceans, polychaetes, and mollusks. At the deeper stations (30-35 ft), polychaete worms predominated. Mollusks, crustaceans, and echinoderms were relatively more important in the cobble versus sand communities.

Rusanowski, Gardner, and Jewett (1987) found that:

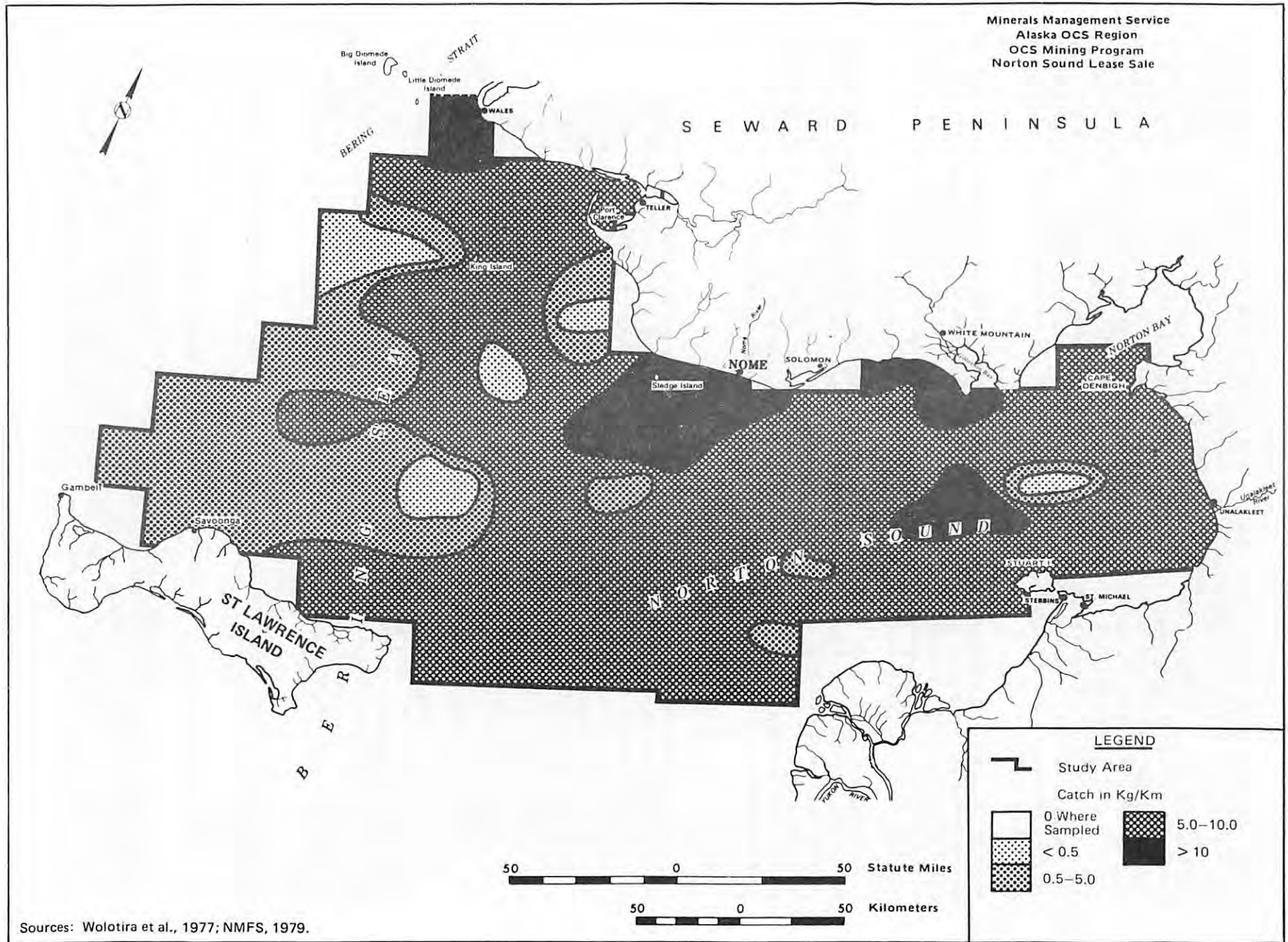
"The sand infaunal community is dominated by several polychaete worms including Magelona sacculata, Spiophanes bombyx, Travisia pupa, Nephtys caeca and by the clams, Macoma lama and Tellina lutea. The sand dollar, Echinarachnius parma, is also a visible member of the community. The cobble benthic community is dominated by the mollusc[s], Mytilus edulis and [crustacean] Balanus [Semibalanus] balanoides; several polychaetes, including Spirorbis cf. abnormis; the echinoderms, Diamphiodia craterodmeta and Strongylocentrotus droebachiensis. The amphipod, Anonyx sp., is also abundant in cobble areas. Those organisms appearing to be somewhat ubiquitous for both sand and cobble habitats include the polychaetes Glycinde picta, Myriochele occulta, Spio cf. filicornis, Scoloplos armiger, Typosyllis alternata and Ampharete acutifrons; ribbon worms (Cerebratulus sp.); the cumacean, Lamprops quadruplicata; and the amphipods Bathymedon sp., Westwoodilla caecula and Acanthostepheia berhingiensis."

2. **Fishes:** The fishes and invertebrates in Norton Basin are derived from both subarctic-boreal and arctic-marine communities. The approximately 87 fish species found in the Norton Basin can be divided into three distinct groups (Wolotira, 1984, oral comm.): (1) coldwater fishes indigenous to arctic-marine waters (e.g., arctic cod, longhead dab, and arctic flounder; (2) subarctic-boreal fishes whose distribution is centered south of Norton Basin in the Bering Sea or the Pacific Ocean (e.g., salmon, saffron cod, yellowfin sole, starry flounder, and Pacific herring; and (3) anadromous freshwater fishes (e.g., Dolly Varden, whitefishes, and smelts).

The areas extending offshore from Nome and coastally from Bluff to Golovnin Bay contain some of the highest biomasses of fishes and invertebrates in the Norton Basin area (Fig. III-11).

The following discussion considers first, demersal fishes, followed by pelagic fishes, and then "other" fishes.

a. **Demersal Fishes:** The demersal fishes of Norton Basin are dominated by cods and flatfishes, which comprised over 75 percent of the demersal fish biomass estimated in 1976 (Wolotira, Sample, and Morin, 1977). Saffron cod and starry flounder are the predominant demersal forms; saffron cod is by far the most abundant (see Table III-3 in the Sale 100 FEIS; USDOJ, MMS, 1985a). Several other demersal fish species are relatively abundant, including the shorthorn sculpin, yellowfin sole, and Alaska plaice.



Sources: Wolotira et al., 1977; NMFS, 1979.

FIGURE III-11. DISTRIBUTION AND RELATIVE ABUNDANCE OF TOTAL FISH AND INVERTEBRATES IN NORTON BASIN AS SURVEYED IN 1976

Saffron cod is the most important demersal fish species in the Norton Basin in terms of abundance and biomass; it figures importantly in marine mammal diets and is harvested for subsistence purposes.

Saffron cod accounted for nearly one-half of the demersal fish biomass in the Norton Basin in 1976 (Wolotira, Sample, and Morin, 1977). It was frequently encountered in nearshore areas during ice-free months, with highest abundances found in the Port Clarence/Grantley Harbor area and in Golovnin Bay (Wolotira, Sample, and Morin, 1977; Barton, 1978; Figs. III-12 and III-13). During the summer, offshore concentrations have been found in outer Norton Sound, west of 163° W. longitude out to about the 25-m isobath. Most individuals have been found in depths less than 50 m throughout the northeastern Bering Sea and Norton Sound, with most occurring in depths less than 40 m (Wolotira, 1984). In other regions, adult saffron cod apparently move from nearshore areas in winter to offshore areas in summer. These movements apparently are related to spawning and feeding activities (Wolotira, 1984). Spawning in Norton Sound occurs in very shallow water from late fall (Wolotira, 1984, oral comm.) to early winter (ibid, citing Turner, 1886), with females releasing from 25,000 to 210,000 adhesive eggs (Morrow, 1980) onto clean sandy bottoms or fine pebbles (Musienko, 1970). Larvae hatch from April to June and are planktonic for several months (Morrow, 1980). In Norton Sound, they have been found in surface waters in early summer (Barton, 1978). They have frequently been found under the bells of the large jellyfish, *Cyanea ferruginea* (Andriyashev, 1964, cited by Morrow, 1980). Smaller individuals tend to be found in shallower and more nearshore locations than larger fish (Wolotira, 1984). Large individuals are found more sparsely distributed and somewhat more offshore. Surveys conducted in 1976 and 1979 have indicated highly variable year-class strengths (Wolotira, 1984). The saffron cod is a major food item in the diets of marine mammals occurring near shorefast ice and also is caught by coastal inhabitants through nearshore ice during the winter months (Wolotira, 1984, oral comm.).

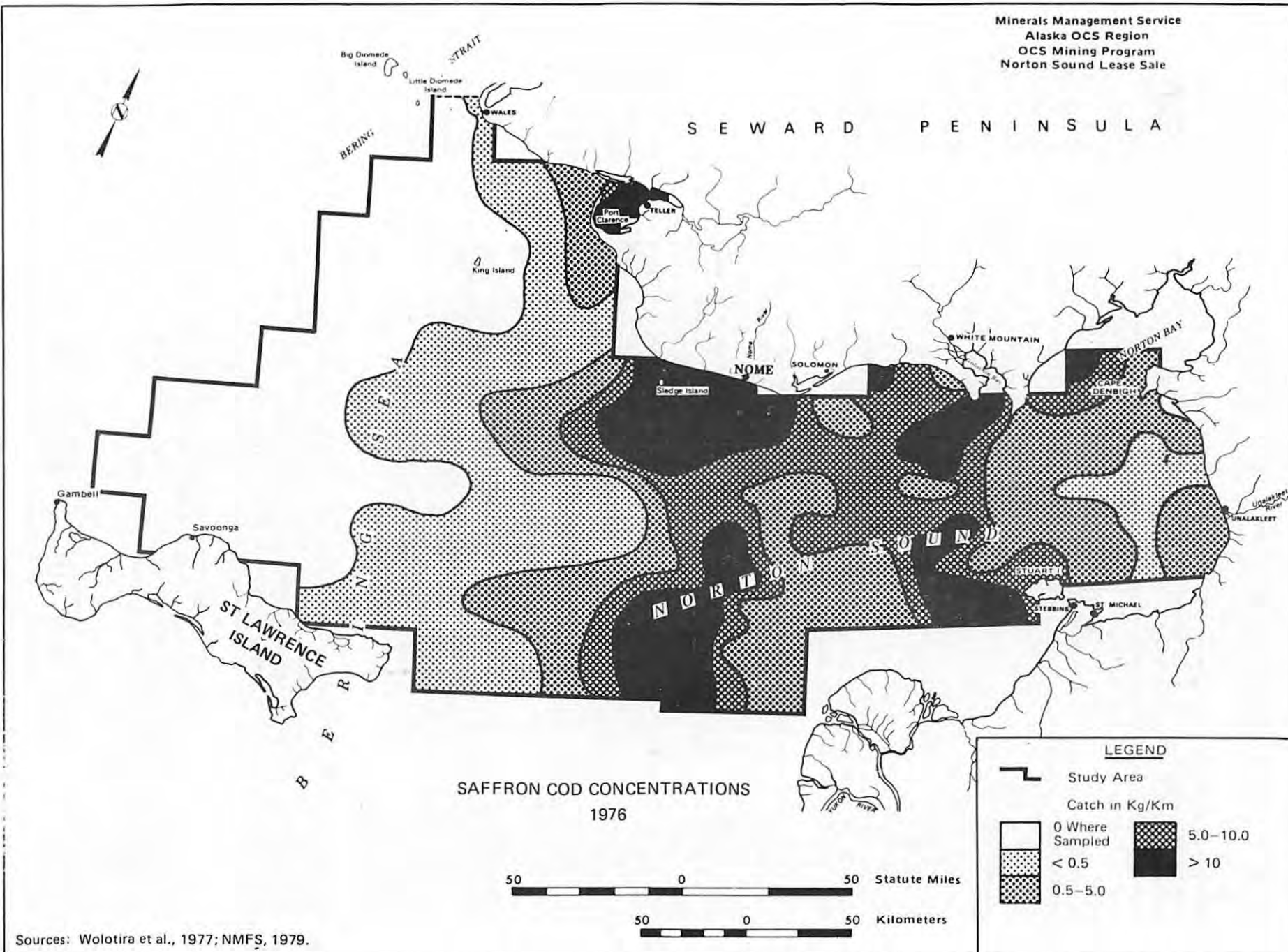
Starry flounder comprised about 10 percent of the total demersal fish biomass estimated from 1976 surveys and was the most abundant flatfish present in Norton Basin (Wolotira, Sample, and Morin 1977). This species was found inshore wherever coastal sampling was performed, occurring in greatest quantities in Golovnin Bay (Barton, 1978; Figs. III-14 and III-15). Offshore concentrations seemed to center in the outer portion of Norton Sound; however, few individuals have been found in the offshore waters from St. Lawrence Island to the Bering Strait. In other areas starry flounder make inshore/offshore migrations with the seasons, tending to move into deeper water in the winter (Morrow, 1980). In adjacent waters of the Gulf of Anadyr, spawning seems to occur primarily in June (Pertseva-Ostromova, 1960). The eggs are pelagic and float near the surface (Morrow, 1980). A medium-sized female (56.5 cm standard length) was estimated to contain 11 million eggs (Morrow, 1980). Sexual maturity is attained at 2-plus years for males and 3-plus years for females (Morrow, 1980). Larval fish feed on plankton; then, after assuming a demersal lifestyle, starry flounder feed on larger invertebrates including clams, snails, starfish, amphipods, polychaete worms, crabs, mysids, and nemertean. Only the larger flounders (greater than 45 cm) seem to eat fish (Morrow, 1980).

Although arctic cod were not abundant in the 1976 demersal survey, the biomass estimates by Wolotira, Sample, and Morin (1977) should be considered conservative, since this species is semipelagic in habit. Even with the low biomass estimate, arctic cod was estimated by Wolotira, Sample, and Morin (1977) to be the second most numerous fish species in the Norton Basin. Adult fish usually are associated with some substrate, either the sea bottom or the underside of ice (Morrow, 1980). They also demonstrate onshore/offshore migrations related to spawning or the movements of ice (Morrow, 1980). At times, large schools are found in restricted areas (Sekerak, 1982).

Fish become mature between 2 to 4 years of age, and spawning apparently occurs during the winter (Sekerak, 1982). Eggs are large and buoyant and may require several months to hatch (Morrow, 1980). Young-of-the-year are planktonic until the end of their first growing season (Bain and Sekerak, 1978). Both larval and adult arctic cod feed primarily on plankton (Morrow, 1980). These fish are quite important in the diets of marine mammals and seabirds, and Sekerak (1982) feels that no alternative food source of equivalent value is present.

b. Pelagic Fishes: The pelagic fish resources in the Norton Basin are known from multiyear, commercial- and subsistence-catch statistics, plus data from the 1976 to 1977 demersal surveys indicating nearshore distribution patterns for juvenile fishes. Pelagic fishes in the Norton Basin include five species of Pacific salmon, Pacific herring, rainbow or toothed smelt, capelin, other salmonids (Dolly Varden and whitefishes), and other smelts.

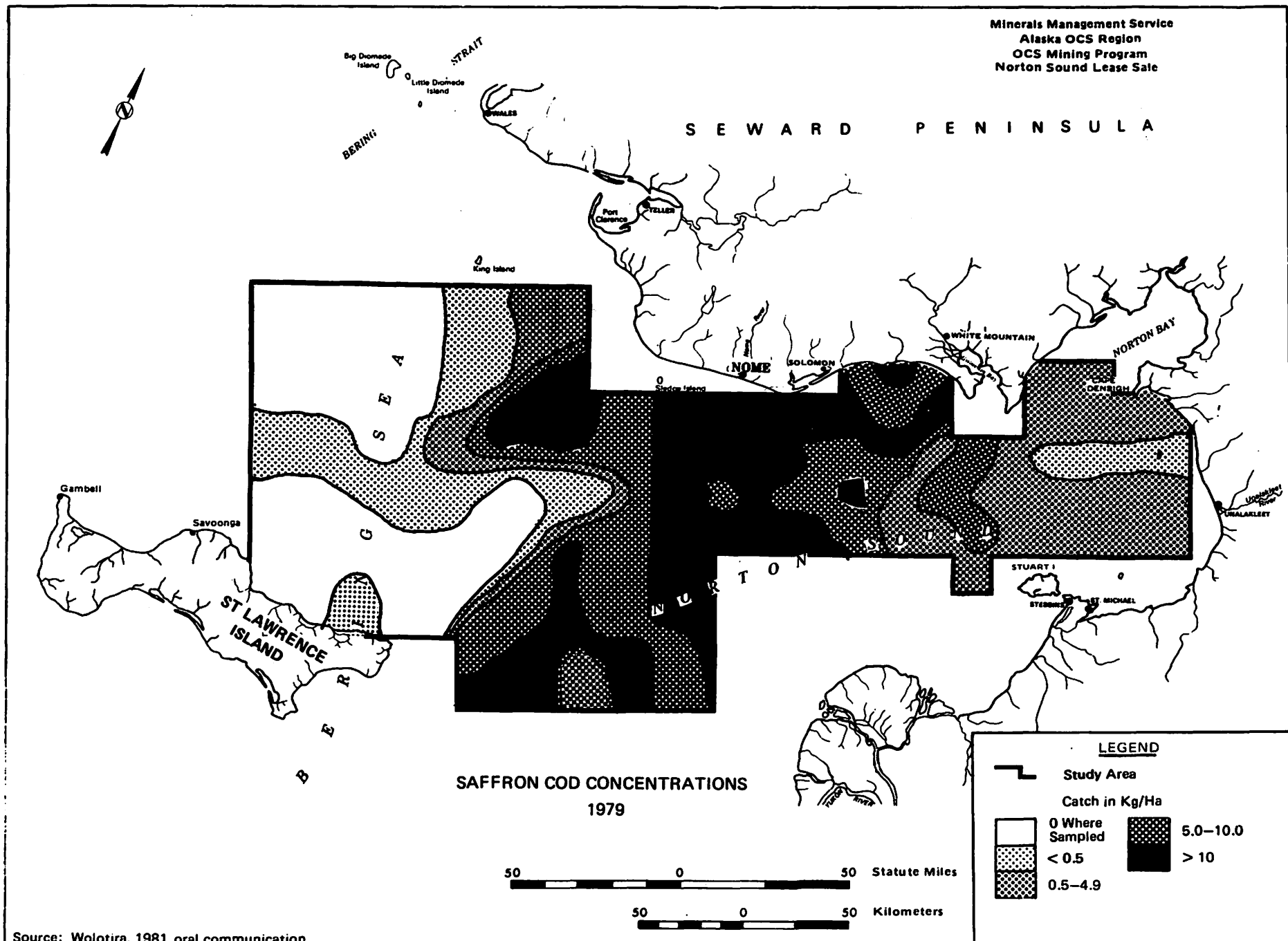
Salmon: All five species of North American Pacific salmon occur in the Norton Basin area. Salmon in the vicinity of the lease area include individuals heading for rivers near the lease area as well as fish passing through the area on their way to rivers to the east, south, and north. When commercial- and subsistence-catch statistics



Sources: Wolotira et al., 1977; NMFS, 1979.

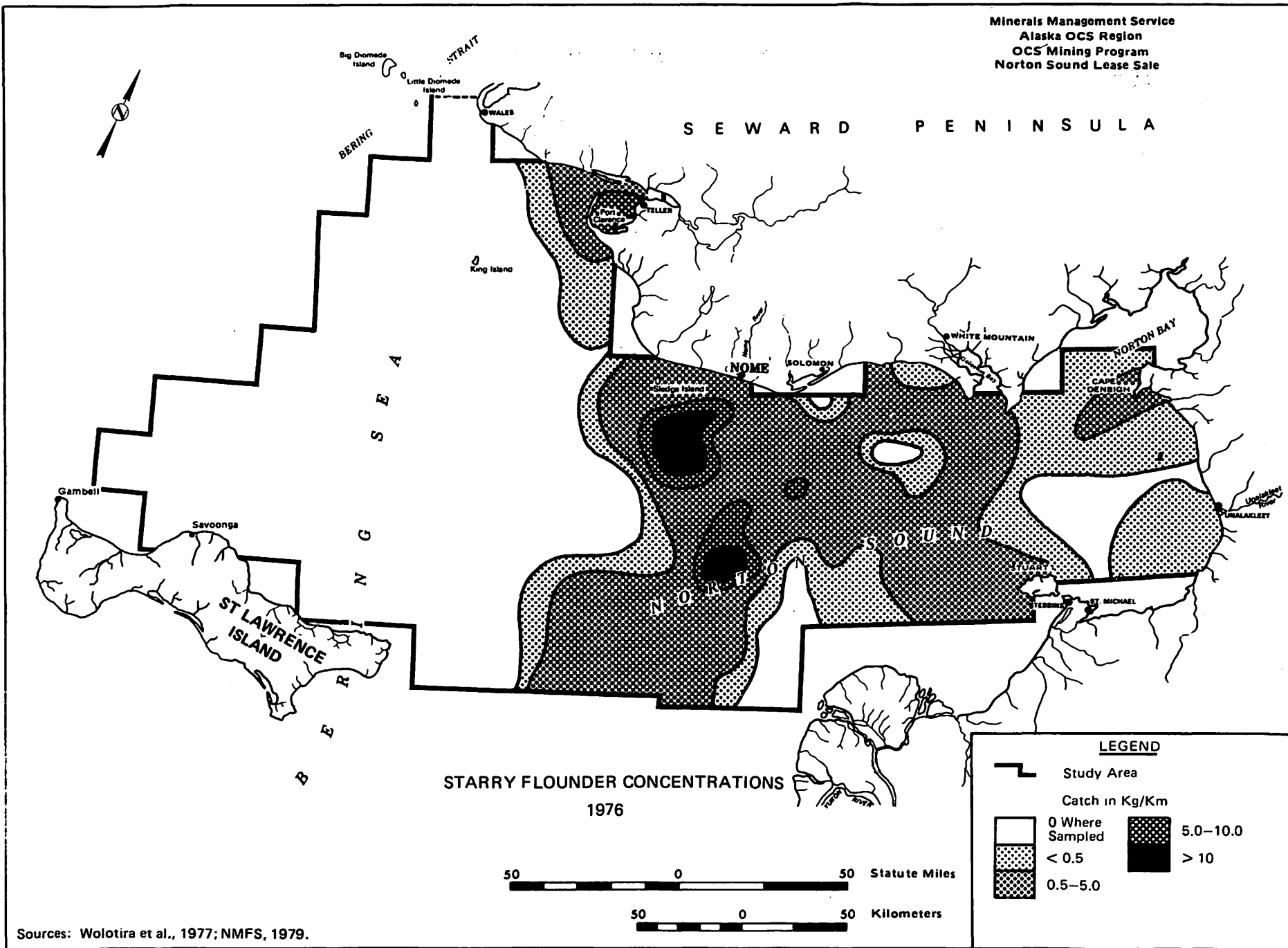
FIGURE III-12. DISTRIBUTION AND RELATIVE ABUNDANCE OF SAFFRON COD IN NORTON BASIN AS SURVEYED IN 1976

Minerals Management Service  
 Alaska OCS Region  
 OCS Mining Program  
 Norton Sound Lease Sale



Source: Wolotira, 1981, oral communication.

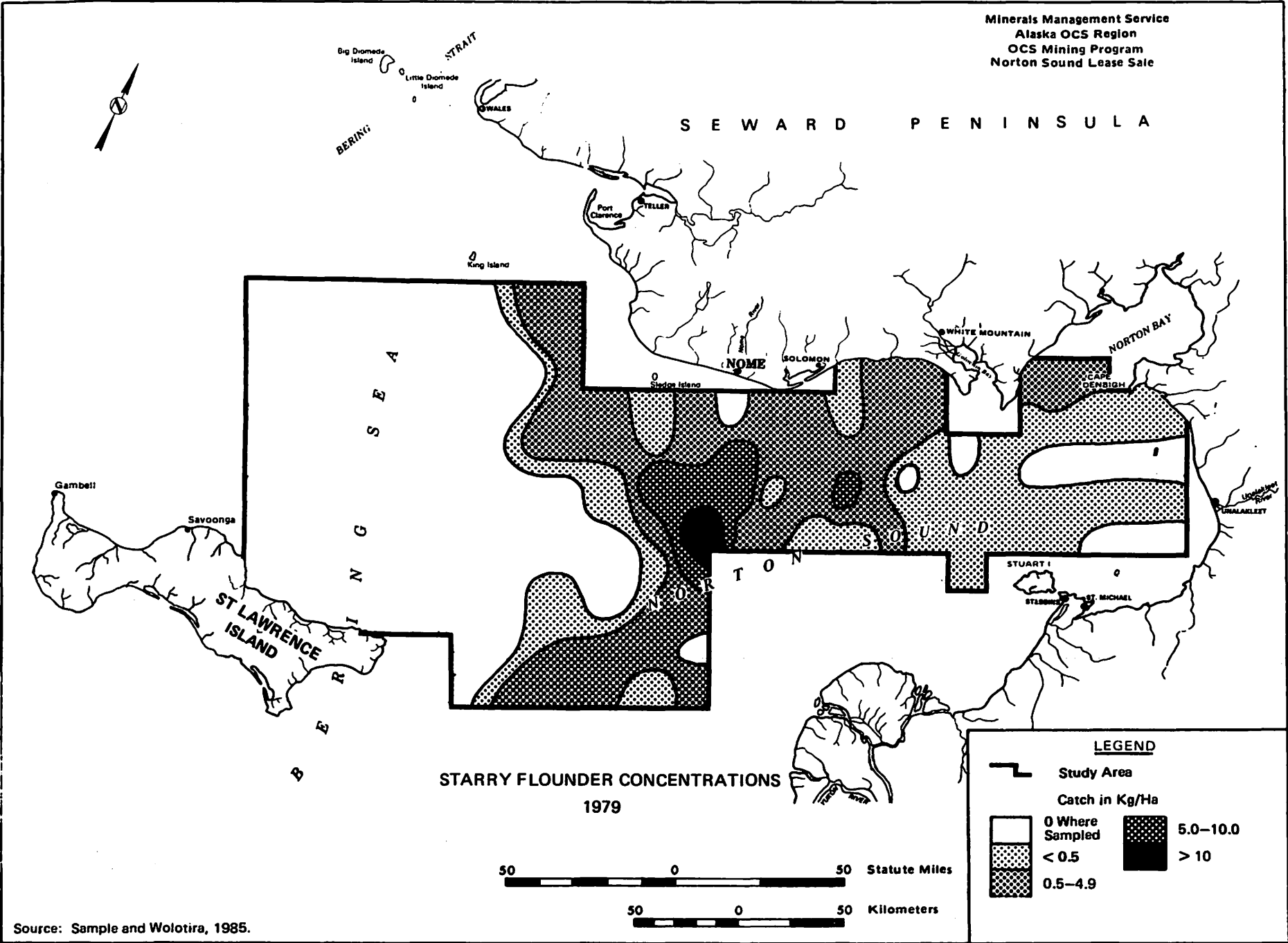
FIGURE III-13. DISTRIBUTION AND RELATIVE ABUNDANCE OF SAFFRON COD IN NORTON BASIN AS SURVEYED IN 1979.



Sources: Wolotira et al., 1977; NMFS, 1979.

FIGURE III-14. DISTRIBUTION AND RELATIVE ABUNDANCE OF STARRY FLOUNDER IN NORTON BASIN AS SURVEYED IN 1976





Source: Sample and Wolotira, 1985.

FIGURE III-15. DISTRIBUTION AND RELATIVE ABUNDANCE OF STARRY FLOUNDER IN NORTON BASIN AS SURVEYED IN 1979



from the Nome subdistrict (ADF&G: Penny River to Topkok Head) are examined, it becomes clear that chum and pink salmon are much more abundantly caught than are coho and chinook salmon, and sockeyes are only rarely caught (Table III-6). Salmon rivers north of the lease area include the Sinuk, Penny, Snake, Nome, Eldorado, Bonanza, Solomon and Fish Rivers (Fig. III-16). The Eldorado River produces the largest number of salmon in the Nome area, followed more distantly by the Nome River, but the Nome River receives the highest use. Other principal salmon rivers in the region include the Yukon, Unalakleet, Shaktoolik, Koyuk, Kwiniuk, Tubutulik, Kachavik, and Boston Rivers.

Adult salmon are found nearshore and in bays or estuaries from the time of ice breakup (about mid-June) until mid- to late August. Species vary in the timing of their occurrence in nearshore regions, with chinook salmon being the first species present, followed by sockeye, chum, pink, and coho (see Fig. III-B-11 in the Sale 100 FEIS; USDOI, MMS, 1985a). Surveys in 1976 and 1977 provided information on the distribution of juvenile salmon in Norton Sound. These surveys indicated that juvenile pink and chum salmon appeared in nearshore coastal waters at the time of ice breakup, about mid-June (Barton, 1978). Juveniles remained nearshore until mid-July, then moved offshore (Barton, 1978); they were still present offshore in late September (Wolotira, Sample, and Morin, 1977). Studies in British Columbia have suggested that juvenile pink and chum salmon remain in nearshore waters throughout the summer (Manzer, 1956).

Pacific Herring: This is an important marine pelagic species in the Norton Basin (Burns et al., 1982) by virtue of its link in the marine foodweb (extending up to humans) and its harvest in both commercial and subsistence fisheries.

The life cycle of the herring follows a cyclical pattern of spring spawning in shallow coastal waters, growth of larval and juvenile herring in coastal environments, then migration to deeper water for feeding and maturation. Barton (1978) has suggested that the herring in Norton Sound are an independent stock that ranges from Norton Sound southward into the eastern Bering Sea.

Herring may mature at 2 years of age (Hart, 1973; Warner, 1981), but the majority mature between 4 and 6 years (Warner and Shafford, 1981; Wespestad and Barton, 1981). Fecundity is directly correlated with age (Hart, 1973). Dense schools of adults move into nearshore waters to spawn about the time of ice breakup. After spawning in late spring or early summer, adults may remain in nearshore waters through the summer. Parts of the adult population are found in coastal areas during fall and early winter. Although most herring are thought to overwinter in offshore regions to the south, Barton (1978) suggests that some of the herring population remains in nearshore shallow waters throughout the year.

Spawning occurs at various locations in Norton Sound (Fig. III-16). Eggs generally are laid on aquatic plants such as *Fucus distichus* (a brown alga) and *Zostera marina* (eelgrass) (Barton, 1978; Morris, 1981; Warner and Shafford, 1981), but they also have been found attached to rocks, pilings, and submerged tree branches (Hart, 1973; Reid, 1972). Development is temperature-dependent, and eggs hatch within 10 to 23 days (Hart, 1973; Musienko, 1970).

Juvenile Pacific herring may remain in coastal estuaries until fall (Lewbel, 1983). Nearshore surveys during 1977 found juveniles in most of the areas sampled, with relatively large numbers in the inner portions of the Port Clarence area (Grantley Harbor and Imuruk Basin) (Barton, 1978). Herring fry largely eat immobile prey such as diatoms (Wespestad and Barton, 1981), but take mobile prey such as copepods, euphausiids, amphipods, and fish fry as the herring get older (Hart, 1973; Morrow, 1980; Wespestad and Barton, 1981). Pacific herring and their spawn are a fundamental food source for many species of fish, mammals, and birds in the Norton Basin (Hart, 1973; Barton, 1978; Morrow, 1980; Warner, 1981) and the species is an important component of Norton Sound subsistence and commercial fisheries.

Herring populations may vary considerably in abundance from year to year, and it has been suggested that predation may be responsible for the huge fluctuations that occur in spite of apparently small changes in fishing pressure and environmental factors (Laevastu and Favorite, 1978; Wespestad and Barton, 1979). In the western Baltic Sea (Kiel Fjord), the abundance of juvenile herring has been linked inversely with abundance of a jellyfish predator, *Aurelia aurita*, whereas no obvious correlation exists between juvenile and adult herring abundance (Moller, 1984).

Other Pelagic Species: Two other relatively important pelagic species are rainbow (toothed) smelt and capelin. These species should be considered environmentally important, since they constitute a significant part of the diets of several marine birds and mammals and are important subsistence species in the Bering Strait region.

Table III-6  
 Commercial and Subsistence Salmon Catches by Species in the Nome  
 Subdistrict, Norton Sound District  
 (Numbers of Fish)

	Chinook	Sockeye	Coho	Pink	Chum	Total
<b>Commercial Catch</b>						
5-year avg. <sup>1/</sup>	15	--	626	4,404	10,753	15,798
10-year avg. <sup>2/</sup>	12	1	324	6,215	10,548	17,101
<b>Subsistence Catch</b>						
5-year avg. <sup>2/</sup>	54	--	1,663	10,434	6,210	18,400
10-year avg.	49	--	1,250	10,210	5,850	17,379
<b>Combined Catch</b>						
5-year avg.	69	41	2,289	14,839	16,964	34,198
10-year avg.	61	21	1,575	16,425	16,398	34,479

Source: ADF&G, 1986.

<sup>1/</sup> 1981-1985.

<sup>2/</sup> 1976-1985.

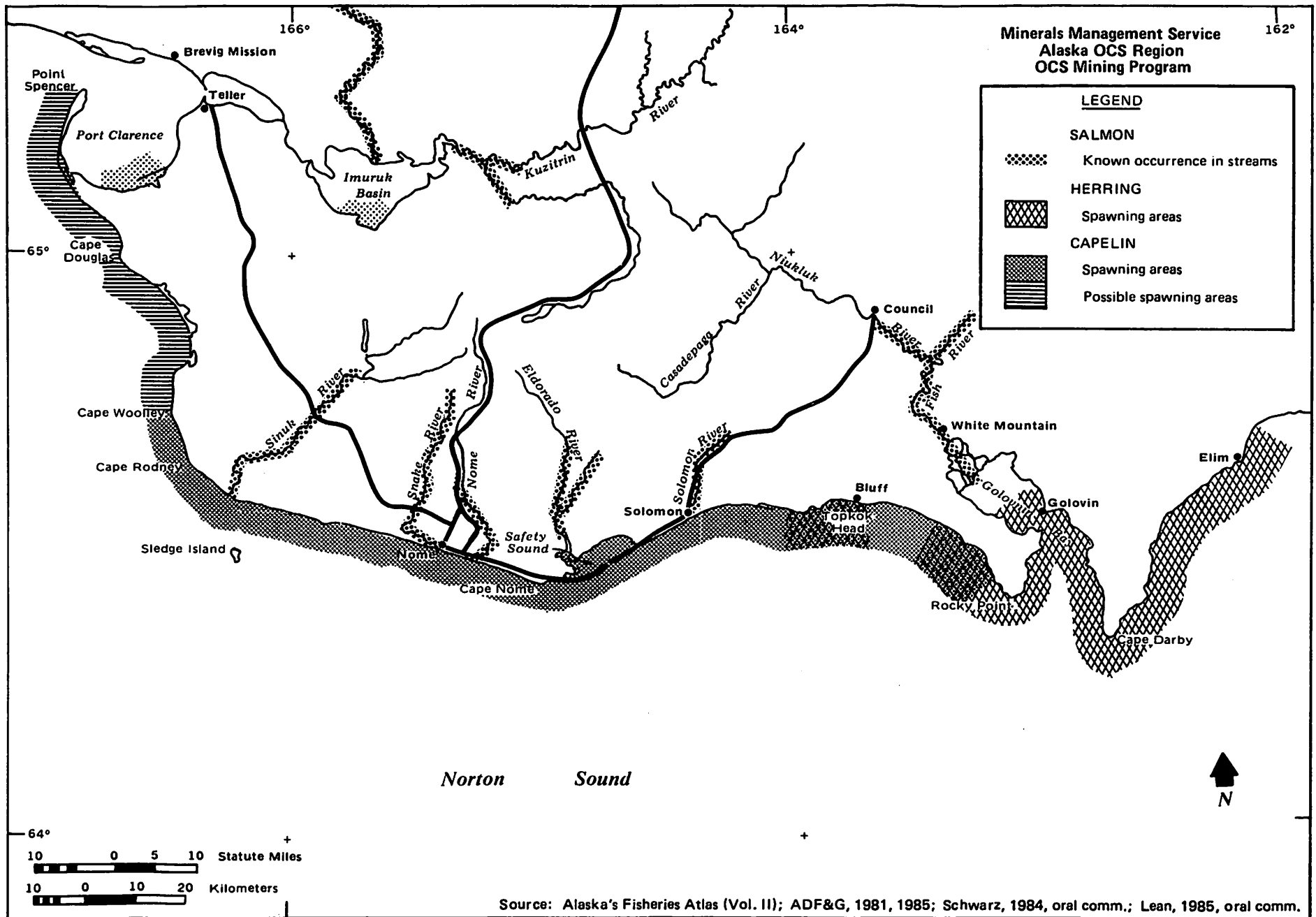


FIGURE III-16. SPAWNING AREAS OF SALMON, HERRING AND CAPELIN

Rainbow smelt is an anadromous species usually found in shallow-water areas. Although it is reputed by some to undergo an upriver spawning migration during the spring (Lewbel, 1983), a fall spawning run may occur in some areas--including the Siberian and Asian coasts (Macy et al., 1978; Warner and Shafford, 1981; Wolotira, 1984, oral comm.). Summer demersal surveys have found rainbow smelt throughout most of Norton Sound shoreward from the 25-m isobath. In nearshore surveys, smelt were found at nearly all locations sampled (Wolotira, Sample, and Morin, 1977).

Smelt are 2 to 6 years of age when they spawn. Age of females and fecundity are positively correlated (Scott and Crossman, 1973), with females producing a maximum of approximately 69,500 adhesive eggs (McKenzie, 1964). After hatching, larvae drift downstream to lakes or estuarine areas. In Norton Sound, larvae have been widely distributed in nearshore areas during August and September (Barton, 1978). Young smelt feed on mysids and amphipods; older smelt feed on cod and other small marine anadromous fishes (Macy et al., 1978). Adult smelt may be preyed on by salmon, adult cod, numerous marine mammals, and seabirds (Scott and Crossman, 1973; Macy et al., 1978) and also are used by villagers in the region.

Capelin is a marine smelt which undergoes a seasonal (spring-to-fall) migration from offshore regions to spawn in the intertidal (Lewbel, 1983; Fig. III-16). Adhesive clusters of eggs are laid on sand or very small pebbles (less than 1.5 mm diameter) (Warner and Shafford, 1981). Individuals may live for about 3 years or more (Hart, 1973) but postspawning survival and repeated spawning are thought to be negligible (Pahlke, 1985, citing Olsen, 1968, and Prokhorov, 1968). Capelin feed primarily on small crustaceans and fish and are preyed on by salmon, cod, marine mammals, and birds (Hart, 1973; Macy et al., 1978; Vesin, Leggett, and Able, 1981).

c. Other Fishes: Pacific sandlance, because of its occurrence in both offshore and nearshore regions (as well as its demersal and midwater occurrence), is discussed separately.

Pacific sandlance was the most abundant fish captured during nearshore studies of Norton Sound in 1977. Areas sampled included the Port Clarence/Grantley harbor area, Golovnin Bay/Bluff, south and east Norton Sound, and the Flat Island area of the Yukon River Delta. Areas of higher concentration were Golovnin Bay, Port Clarence, and Grantley Harbor, with highest concentrations in the Golovnin Bay/Bluff area (Fig. 68, in Barton, 1978).

During spawning, demersal, adhesive eggs are attached in clumps onto sandy substrates, and emergent yolk-sac larvae tend to bury themselves in sandy substrate until the yolk-sac is absorbed (Lewbel, 1983). Larvae then become pelagic. In Norton Sound, larvae have been found in early summer in surface waters at several offshore locations (south of Cape Nome, further offshore west and east of that area, and offshore of Cape Denbigh; Fig. 48 in Barton, 1978), suggesting that spawning occurs in late May or early June (Barton, 1978).

Diets of adult sandlance include crustaceans, barnacle larvae, copepods, and chaetognaths. In turn, sandlance are important elements in the diets of marine mammals, birds, and other fishes (Clemens and Wilby, 1949; Hart, 1973; Macy et al., 1978; Winters, 1981).

3. Marine and Coastal Birds: The proposed Norton Sound lease-sale area is near important local seabird colonies and near waterfowl and shorebird wetland-nesting habitat and includes important feeding habitat of local seabird breeding populations (Fig. III-17). The most abundant seabirds include: common murres (35,000-70,000 birds), glaucous gulls (over 20,000 birds) black-legged kittiwakes (11,500-15,000 birds), horned puffins (1,600-4,500 birds), pelagic cormorants (1,470-2,500 birds) and thick-billed murres (950-1,250 birds); small numbers of parakeet auklet, tufted puffin, and pigeon guillemot also breed in Norton Sound (Drury, Ramsdell, and French, 1980; Roseneau et al., 1982) while peregrine falcons also nest along the coast (see Sec. III.B.5). The largest seabird colony (40,000-60,000 birds) in the area is located on the Bluff Cliffs, east of Cape Nome, and two other sizeable colonies (4,000-8,000 birds) are located on Sledge Island and Square Rock (Fig. III-17). Smaller seabird colonies (1,000 birds or less) adjacent to the sale area are located at Rocky Point, Cape Darby, Safety Sound, and Topkok Head. The above seabird colonies are part of the Bering Sea Unit of the Alaska Maritime National Wildlife Refuge.

Seasonal seabird occurrence (breeding, nesting, and feeding activities) in the sale area generally is from May through September. The most abundant seabird species prey on fish during the nesting season with sand lance, cod, and prickle-back being important food items. According to bird census data, the common murre population at Norton Sound's largest bird colony--the Bluff Cliffs--declined markedly (75,000 to about 40,000 birds) from

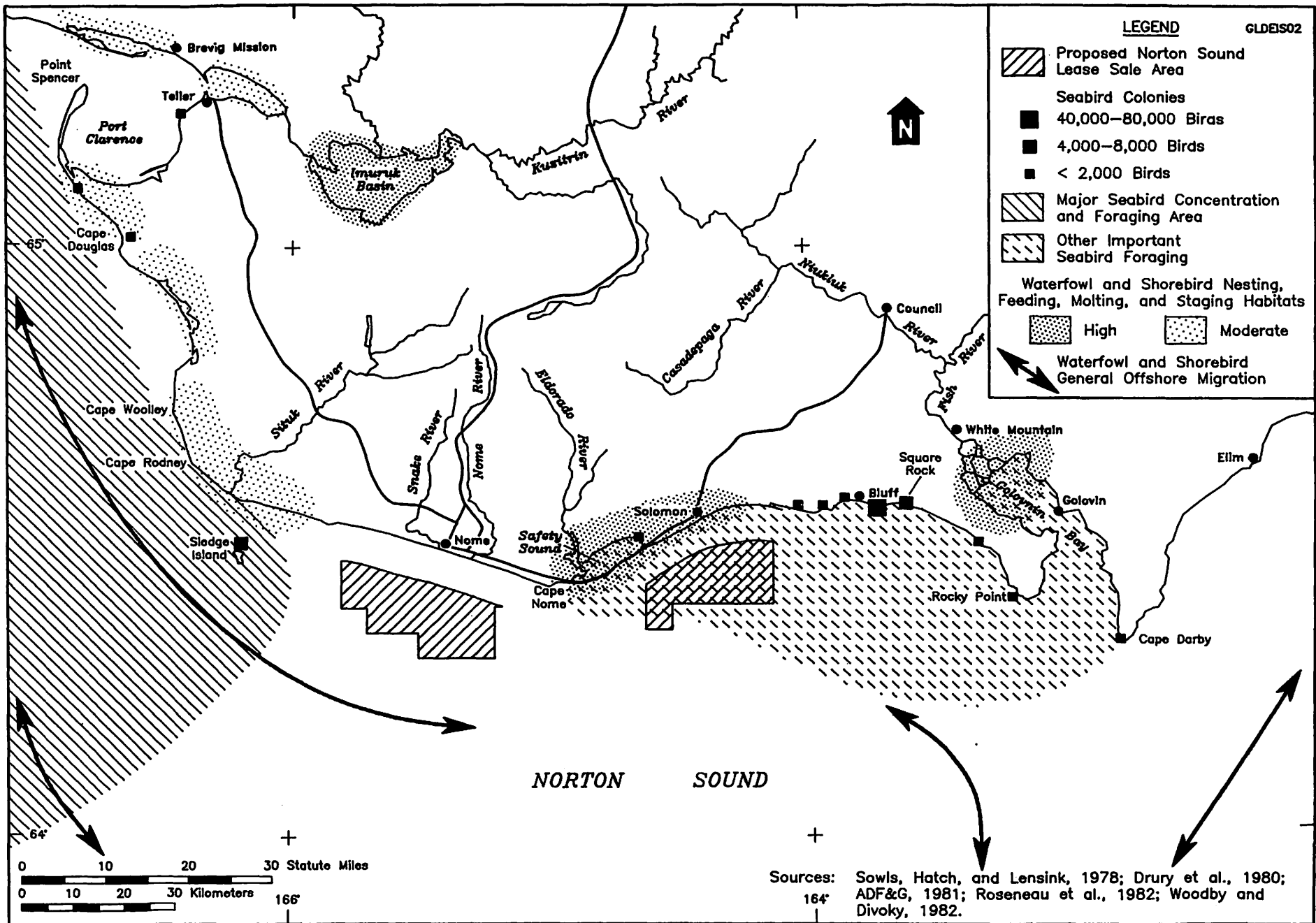


Figure III-17. Marine and Coastal Birds

the late 1970's to the present; the decline is attributed to low reproductive success in recent years and low survival in wintering areas in the southeastern Bering Sea (Murphy, Springer, and Roseneau, 1985).

The most abundant waterfowl species occurring in Norton Sound include: pintail duck (17,000; 1.4% of the eastern Bering Sea population), American wigeon (7,900; 40% of the eastern Bering Sea population), Taverner's Canada goose (6,700; 13% of the eastern Bering Sea population), greater scaup (3,600; less than 1% of the eastern Bering Sea population), Pacific brant (several thousand; less than 10% of the eastern Bering Sea population), and tundra swan (3,350; 11% of the eastern Bering Sea population) as reported in Woodby and Divoky (1982). Thirty-one species of shorebirds use coastal habitats and wetlands of Norton Sound (for feeding and/or nesting). The most abundant include semi-palmated sandpiper (over 80,000 nesting population), northern phalarope (57,000 nesting population), western sandpiper (over 15,000 post-breeding population) and dunlin (over 13,000) (Woodby and Divoky, 1982). Sandhill crane also are a common migrant species with over 20,000 occurring in Norton Sound. High-use, coastal wetland habitats adjacent to the proposed Norton Sound lease-sale area include Golovnin Bay/Fish River Delta, and Safety Sound/Taylor Lagoon (Fig. III-17). Other high-use wetlands in the Norton Sound area include Stebbins, Moses Point, Koyuk, Shaktoolik and Imuruk Basin. Moderate-use wetlands adjacent to the proposed sale area include Woolley Lagoon, Port Clarence, and Brevig Lagoon (Fig. III-17). Waterfowl use of coastal wetlands for feeding and staging reaches its peak in August and September. High use of some coastal wetlands by shorebirds for feeding occurs in May. Migrant waterfowl also concentrate at coastal wetlands in the spring (May-June).

Common birds of prey present in the proposed sale area during the spring, summer, and fall include gyrfalcon, peregrine falcon, marsh hawk, merlin, snowy owl, common raven, and short-eared owl. The golden eagle, and rough-legged hawk also are present. The above information on the biology and ecology of marine and coastal birds was summarized and incorporated by reference from the Norton Basin Oil and Gas Lease Sale 100 FEIS (USDOI, MMS 1985a).

4. Nonendangered Marine Mammals: This section (1) emphasizes species of marine mammals other than endangered whales common to the Norton Sound area and (2) briefly describes their biology and life histories relevant to potential effects of offshore mining activities in the proposed sale area. For a more comprehensive description of marine mammals found in the northern Bering Sea, see Technical Paper No. 5 (Cowles, 1981). Species discussed include: the Pacific walrus; ringed, bearded, and spotted seals; and belukha whale. Other species, such as polar bear, ribbon seal, minke and killer whales, and harbor porpoise occur infrequently and in low numbers within Norton Sound (Frost, Lowry, and Burns, 1982). Due to the relative numerical insignificance of the latter species within the proposed sale area, they are not discussed further. Summer use of northern Norton Sound habitat areas by marine mammals is shown in Figure III-18.

All marine mammals in U.S. waters are protected under the Marine Mammal Protection Act of 1972. In the Act, it is declared to be the intent of the Congress of the United States that marine mammals "be protected and encouraged to develop to the greatest extent feasible commensurate with sound policies of resource management, and that the primary objective of their management should be to maintain the health and stability of the marine ecosystem."

a. Walrus: About 80 percent of the world population of walrus (250,000-300,000) occur seasonally in the Bering Sea. Herds of migrant walrus appear on Big Diomedes, King, St. Lawrence, and the Penuk Islands in fall (October to December) during movements into the Norton Basin from the Chukchi Sea. Most data indicate that during the seasonal transition periods, walrus densities are greatest in outer Norton Sound west of 166°W. longitude. Intermittent summer use of Sledge Island, Besboro Island, and other locations in Norton Sound has been reported. King Island has been used regularly as a summer haulout area by several thousand walrus. Calves are born during the northward migration in the spring (April to June); the western part of Norton Basin could be considered an important calving area of this species.

During the summer season, more than 1,000 but less than 2,000 walrus (mostly adult males) frequent coastal haulout sites and islands near the proposed sale area (Fig. III-18). These areas include Sledge Island and Cape Darby (Frost et al., 1982). This seasonal assemblage, representing about 1 percent of the total population, utilizes benthic habitat within Norton Sound.

Walrus mainly feed on bivalve mollusks (clams) (Fay, 1982). The presence of distinct walrus-feeding excavations on the seafloor within the proposed sale area indicates that this area may be important feeding habitat for some walrus (Oliver et al., 1983a). Benthic habitats within the proposed sale area may be important locally to walrus that haul out on Sledge Island and Cape Darby during the summer season. The Pacific walrus

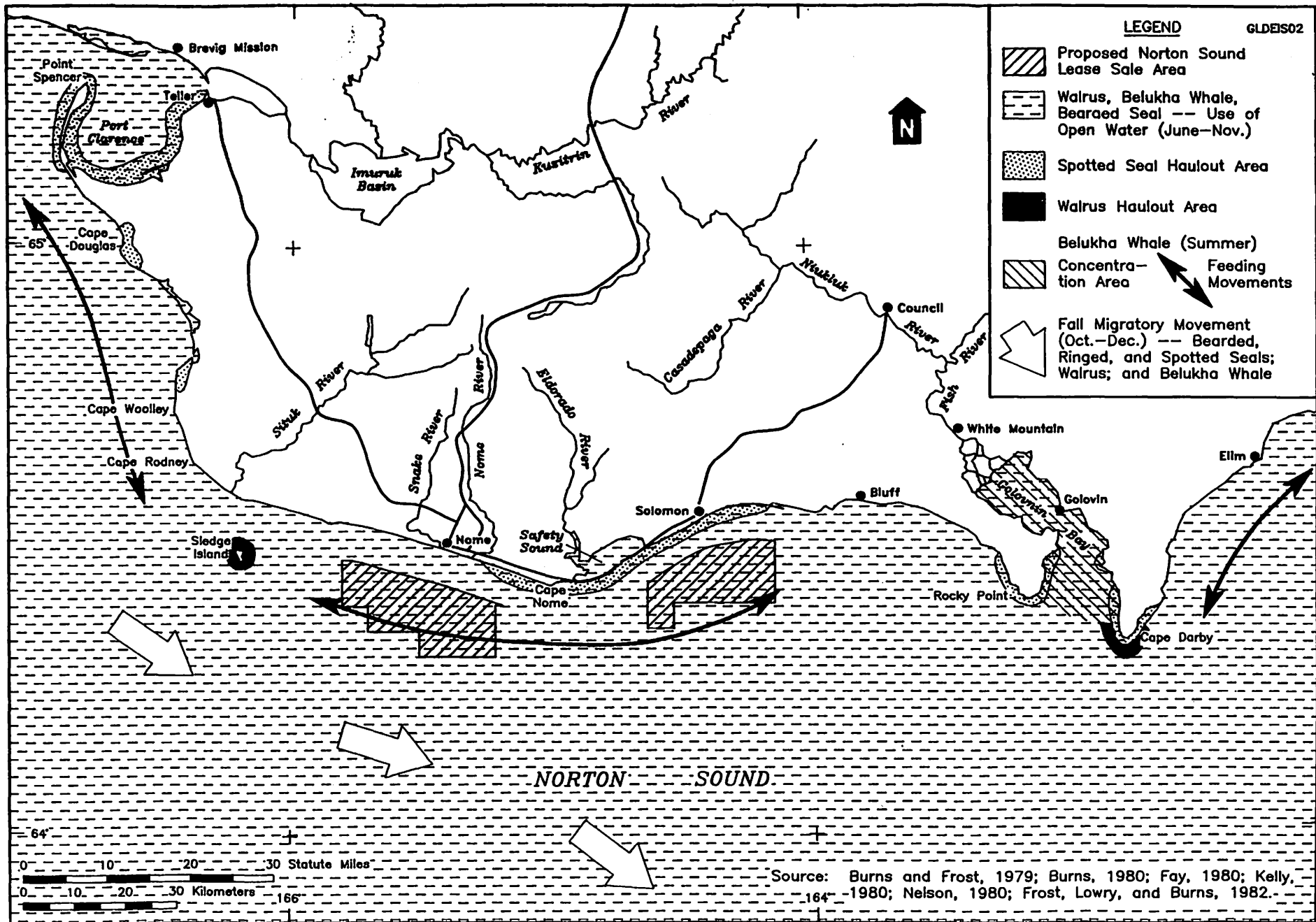


Figure III-18. Open-Water Use of Habitats in Northern Norton Sound by Nonendangered Marine Mammals



is a very important subsistence and cultural resource in the Norton Basin area (see Sec. III.C.3, Subsistence-Harvest Patterns).

b. Ringed Seal: About 1.0 to 1.5 million ringed seals probably inhabit the Bering and Chukchi Seas with less than 10 percent (100,000-150,000) occurring in the Norton Basin (Burns, 1981a). In winter, the highest densities of ringed seals occur in the stable shorefast ice which represents prime pupping and breeding habitat. The shorefast ice in Norton Sound in winter represents important breeding habitat for a portion of this population. Ringed seals also occur on drifting pack ice. A migratory species, they are present in Norton Sound primarily during fall, winter, and spring. Ringed seals migrate out of Norton Sound with the sea ice during the summer. Ringed seals are opportunistic feeders. Prey consumed depends on season and location and includes cod, amphipods, mysids, euphausiids, and small pelagic fish (Frost and Lowry, 1981). This species may account for more than 50 percent of the total seals harvested for subsistence purposes in Norton Sound (see Sec. III.C.3).

c. Bearded Seal: This species generally prefers areas where seasonal, broken-sea ice occurs over water less than 200 m in depth. Norton Sound provides good habitat for bearded seals from late November to late June. In the northeastern Bering Sea, the winter-spring population is estimated at 120,000 seals (Burns, 1981a). This species feeds primarily on benthic and epibenthic invertebrate prey, although some bottomfish are also eaten (Lowry, Frost, and Burns, 1980). Throughout the Bering Sea, spider and Tanner crab, shrimp, and clams make up the bulk of the bearded seal diet--usually more than 70 percent of the volume (Nelson, Burns, and Frost, 1984). Bearded seals generally do not haul out on land. Although this species is associated with ice habitats throughout the year, some subadult seals probably no more than 1 to 2 percent of the regional population, occur in the open water of Norton Sound and enter bays and ascend rivers during the summer season (Burns, 1981b). Pupping occurs on top of the ice from late March through May primarily in the Bering and Chukchi Seas. Bearded seals do not form herds, although loose aggregations of animals do occur. This seal is an important subsistence species and is preferred by subsistence users. Bearded seals make up about 7 to 20 percent of the total animal harvest of some villages in the Norton Basin (Stoker, 1983).

d. Spotted Seal: An estimated 20,000 to 75,000 spotted seals occur year-round in the Alaskan northern and central Bering Sea (Burns, 1981a). Major population segments migrate through outer Norton Sound during spring (April to June) and fall (late November to early January). During summer, several hundred spotted seals occur throughout the Norton Sound area, particularly in nearshore waters (Fig. III-18). Important haulouts in the Norton Sound area are located on Stuart Island, St. Michael Island, Besboro Island, Cape Denbigh, Cape Darby, Safety Sound (the latter two sites are adjacent to the proposed sale area), Port Clarence, and the Yukon River Delta (Frost, Lowry, and Burns, 1982) and are occupied during summer months. Spotted seal distribution during the summer and fall coincides with that of schooling fishes on which they feed (Lowry, 1984a). Euphausiid crustaceans are a very important food item of newly weaned pups (Kato, 1982; Bukhtiyarov, Frost, and Lowry, 1984). Breeding occurs relatively far to the south of the proposed sale area--at the seasonal ice front--in late winter. The spotted seal also is an important subsistence resource in the Nome area (see Sec. III.C.3).

e. Belukha Whale: In excess of 12,000 belukha whales migrate annually through the northern Bering Sea. In spring (late March to May), belukhas move through the Norton Basin area, with most passing through the Bering Strait. Belukha whales are common in the proposed sale area, and about 1,000 to 2,000 whales occur throughout the summer in the nearshore waters of Norton Sound (Burns et al., 1985a) (Fig. III-18). Concentrations of belukha whales in northeastern Norton Sound occur in Golovnin Bay and Norton Bay. Pods of a few to over 200 whales occur in nearshore waters off Cape Nome, and pods of up to 30 whales have been observed feeding on schools of fish near river mouths in the Nome area (Frost et al., 1982). In coastal waters of Alaska, including Norton Sound, belukhas feed on a series of sequentially abundant and highly available anadromous and coastal spawning fishes such as salmon, smelt, herring, and saffron cod (Lowry 1984b; Burns et al., 1985a). Calving is reported to occur in Norton Bay near Moses Point and probably occurs in the other major estuaries of Norton Sound. Belukhas that migrate north through the Bering Strait return to, and pass through, the northern Bering Sea in December. Belukha whales are an important subsistence species for all villages of Norton Sound.

5. Endangered and Threatened Species: The Endangered Species Act (the Act) of 1973, as amended, defines an endangered species as any species that is in danger of extinction throughout all or a significant portion of its range. The Act defines a threatened species as one that is likely to become endangered within the foreseeable future. As required in Section 7(c) of the Act, a listing of species was requested from the NMFS and USFWS, and a Biological Assessment was prepared and submitted to these agencies for their

review on April 4, 1988 (Appendix B). The following paragraphs describe the endangered and threatened species identified in the Biological Assessment that are most likely to occur in or adjacent to the proposed OCS Mining Program Norton Sound Lease Sale. These include the endangered gray whale and the threatened arctic peregrine falcon. (For further information and description of the Section 7 compliance with ESA through consultation with NMFS and FWS, see Secs. I.A.6, IV.B.7, and Appendix B).

a. Gray Whale: The gray whale is the only endangered cetacean considered to occur within or adjacent to the proposed sale area. The current eastern North Pacific stock of gray whales is estimated at 21,113 individuals (Breiwick et al., in press). Spring and Fall migrations occur annually between the coast of Baja California and Alaskan and Soviet waters. The northward migration from the Baja California coast usually begins in February (Rice and Wolman, 1971). From March through June the majority of the gray whale population enters the Bering Sea through Unimak Pass. The migration continues along the northern Alaska Peninsula and around Bristol Bay--generally within 3 kilometers of the shore. From Nunivak Island the whales appear to move offshore directly toward feeding areas, arriving near St. Lawrence Island/Chirikov Basin in May and June (Pike, 1962; Braham et al., 1977; Rugh and Braham, 1979; Braham 1984, Brueggeman et al., 1987). Summer-feeding areas in and near the Norton Basin include the Chukotsk Peninsula coast from Cape Serdtse Kamen in the Chukchi Sea to the southwestern Gulf of Anadyr, the central Chirikov Basin from St. Lawrence Island to the Bering Strait, waters near the southern capes of St. Lawrence Island, the central Chukchi Sea south of 69° N. latitude, and the Alaskan coast from Cape Prince of Wales to Barrow (Pike, 1962; Rice and Wolman, 1971). Migration from the feeding areas probably begins in October (Pike, 1962; Kuzmin and Berzin, 1975; Votrogov and Bogoslovskaya, 1980), with the peak southward migration through Unimak Pass occurring in November and December (Braham, 1984; Rugh, 1984; Brueggeman, 1987).

The St. Lawrence Island/Chirikov Basin region offshore and west of the proposed sale area is an important gray whale feeding area. Aerial surveys of gray whale use yielded estimates of 1,929 gray whales present in July 1982 and 2,653 from June through August 1981. This amounts to approximately 11 to 16 percent of the gray whale population which summers in the entire Bering Sea (Thomson and Morin, 1984). Consequently, the Chirikov Basin represents the largest known feeding aggregation of gray whales worldwide (Nelson et al., 1983). Whether a specific group of gray whales feeds in the Chirikov Basin for the entire summer period or whether individuals spend a portion of their time in other feeding areas has yet to be determined. If the latter is the case, a much larger percentage of the gray whale population may use the area for feeding. By area, feeding grounds near St. Lawrence Island and the Chirikov Basin amount to approximately 2 percent of the species' feeding range; however, the food supply is very concentrated and the area is estimated to provide 5.3 to 14.2 percent of the total biomass consumed by gray whales in the Bering Sea and Arctic Ocean (Nelson, Johnson, and Mitchell, 1983).

Gray whales have been observed feeding at the surface, in mid-water regions, and on the bottom. The three methods of feeding used are skimming, engulfing prey, and benthic suction (Nerini, 1984). On their northern summer grounds, suction feeding on bottom-dwelling organisms appears to be the primary feeding method (Ray and Schevill, 1974; Nelson et al., 1983; Nerini and Oliver, 1983; Thomson and Morin, 1984; Nerini, 1984).

Tube-dwelling amphipods of the genus *Ampelisca* are a major food source of gray whales (Tomilin, 1957; Pike, 1962; Zimushok and Lenskaya, 1970; Rice and Wolman, 1971; Nerini, Jones, and Braham, 1980; Bogoslovskaya, Votrogov, and Samenova, 1981; Lowry et al., 1982), and in the planning area the distribution of whales during the summer months appears to be closely related to areas of high amphipod biomass (Stoker, 1981; Lowry et al., 1982; Thomson and Morin, 1984; Nerini, 1984). Although ampeliscid amphipods are present over a wide area, their optimum habitat appears to consist of waters 20 to 40 m deep having a bottom composed of moderately sorted, slightly silty, very fine sand containing 80- to 90-percent sand-sized particles (Nelson, Rowland, and Stoker, 1981). In these areas, amphipods are found in concentrations ranging from 400 to 23,780 individuals per m<sup>2</sup> and 941 g/m<sup>2</sup> (Nerini, 1984); and their densely packed tubes coalesce to create extensive mats which bind the surface of the sediment (Mills, 1967; Nelson, Johnson, and Mitchell, 1983; Thomson, 1984). In the American portion of the Chirikov Basin, gray whales appear to feed selectively in areas of high amphipod biomass (Nerini, Jones, and Braham 1980; Thomson and Morin, 1984). Ampeliscid amphipods have been found to occupy about 40,000 km<sup>2</sup> of this area, but gray whale benthic-feeding features have been recorded thus far over only about 22,000 km<sup>2</sup> (Nelson, Johnson, and Mitchell, 1983). Ampeliscid amphipods are not common in Norton Sound due to its decreased salinity and sediment grain size (Nelson, Rowland, and Stoker, 1981; Nelson, Johnson, and Mitchell, 1983); and, correspondingly, the proposed sale area appears to be of low value for gray whale feeding.

Small numbers of migrating or feeding gray whales (as well as a few individual whales) may be found near or within the proposed sale area from about mid-May through November. The western boundary of the proposed

sale area lies approximately 97 km (60 miles) to the east of the major gray whale feeding and migration area within the Chirikov Basin--west of 168°W. longitude (Fig. III-19). Occasionally, gray whales have been sighted near the proposed sale area. Nerini, Jones, and Braham (1980) discussed the feeding areas of gray whales in the northern Bering Sea and summarized aerial and vessel sightings from 1975 to 1980. Sightings were uncommon in Norton Sound, although some whales were observed in July and August. Several observations of gray whales in May and July have been recorded in the nearshore waters near Nome (Frost et al., 1982; Ljungblad, 1981, 1982; Ljungblad, Moore, and VanSchoik, 1983) (Fig. III-19). None of the gray whales were observed exhibiting feeding behavior (mud plumes) which was very common in the Chirikov Basin (Appendix B, Fig. 2).

The whales begin their fall migration from the summer-feeding areas around mid-October. They return to their calving area in Baja California between December and January, generally following the same route as the spring migration, but somewhat further offshore (Brueggeman, 1987).

b. Arctic Peregrine Falcon: The threatened arctic peregrine falcon occupies coastal nesting sites near the proposed sale area generally from April to September. Nesting sites are usually associated with seabird-nesting colonies located on cliffs and bluffs, because peregrine falcons primarily prey on accessible avian populations. Consequently, most nest sites have been discovered in conjunction with seabird surveys. In a sampling of nest prey remains, Wright (1987) found a mixture of seabirds, shorebirds, and passerines. Wright (1987) conducted a limited raptor survey of the area during July 1987 and found an increase in peregrine falcon nesting activity from previous records. Six of the eleven historical nest sites along the northern shore of Norton Sound had nesting peregrine falcons. A more thorough survey in the summer of 1988 revealed additional nest sites in the Norton Sound area (Wright, 1989). Twenty active nest sites were located from Cape Prince of Wales to Unalakleet. In a survey conducted in 1989, twenty-three nest sites were located in the Norton Sound area (Ambrose, 1989). Six nest sites exist along the shoreline near the proposed sale area (Fig. III-19). Usually by September, the young have fledged and migration begins to their wintering areas in Central and South America.

Egg and nestling feather samples were collected from arctic peregrine falcons nesting in the Norton Sound and Colville River areas during 1989 for mercury analysis (see Appendix B). Three eggs were collected from three separate nest sites in Norton Sound; and 12 eggs were collected from the Colville River sites. Feather samples were taken from 12 and 8 nestlings in the Norton Sound and Colville River areas, respectively. The mean wet weight mercury level was 1.64 ppm in the Norton Sound eggs compared to a higher level of 2.55 ppm for the Colville River. Conversely, the feather sample mercury levels were higher for Norton Sound (mean wet weight of 6.383 ppm) than the Colville River (mean wet weight of 4.975 ppm).

## C. Social Systems

### 1. The Economy of Nome:

Brief History of Nome: The Nome area has been inhabited for at least 4,000 years. However, a relatively limited resource base, unfavorable sea-ice conditions, and lack of a protected harbor have made it less than desirable as a village site of traditional size or permanence. However, the surrounding areas (particularly Cape Nome and Safety Sound) were quite good. Estimates vary as to the indigenous population of the area prior to the influx of miners at the end of the last century. The population scattered along the coast between Nome and the Fish River/Golovnin Bay drainage 80 miles to the east in 1850 is estimated to have totaled approximately 900 persons. Another population estimate of the area between Safety Sound and Cape Douglas puts the 19th century population at about 320 persons, with half of these people living on either King or Sledge Island (Kevin Waring Associates, 1988).

The 1880 census identified 20 Natives living in a camp at the mouth of the Snake River and another camp of 10 living at the mouth of the Nome River. At that time, a larger traditional village of 60 inhabitants was counted at Cape Nome, one on Sledge Island numbering 50 persons, and a 100-person village on King Island (Kevin Waring Associates, 1988).

In 1898, gold was discovered on Anvil Creek, a tributary of the Snake River near Nome. Prospectors from the Yukon and Kobuk regions flocked to the Nome area. According to one estimate, 15,000 people and 600,000 tons of freight were landed at Nome in the month of June 1900 (Kevin Waring Associates, 1988). The 1900 census places the Nome population at 12,488 (see Table III-7). However, the easy pickings of the initial boom

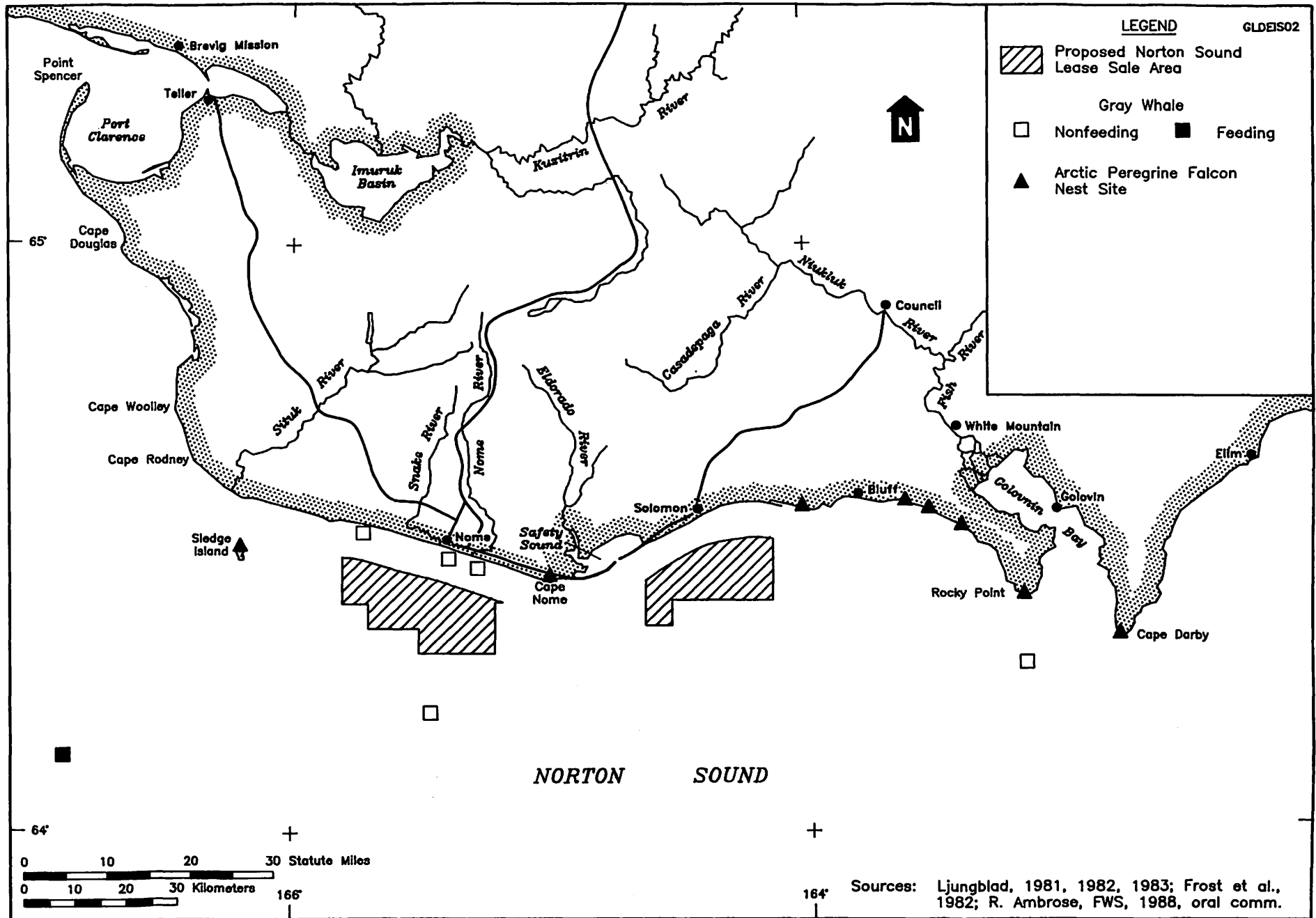


Figure III-19. Locations of Gray Whale Sightings and Arctic Peregrine Falcon Nest Sites

**Table III-7  
Nome Population Growth**

<b>Year</b>	<b>Area</b>	<b>Population</b>
1900	Nome, Town	12,488
1910	Nome, Town	2,600
1920	Nome, Town	852
1930	Nome Townsite, Inc.	1,213
1940	City of Nome	1,559
1950	City of Nome	1,876
1960	City of Nome	2,316
1970	City of Nome	2,488
1980 <sup>1/</sup>	City of Nome	3,000
1981	City of Nome	3,039
1982	City of Nome	3,430
1983	City of Nome	3,620
1984	City of Nome	3,732
1985	City of Nome	3,876
1986	City of Nome	3,876
1987	City of Nome	3,876
1988	City of Nome	4,308

Sources: Kevin Waring Associates, 1989.

<sup>1/</sup> The population survey conducted by the Census Bureau in 1980 was seriously flawed and has been discarded by planners. The population figure of 3,000 for the year 1980 is approximate and based on discussions with local officials and a review of the information collected in the 1980 Census Bureau survey.

**Table III-8  
1986 Population of Nome By Age, Sex, and Race**

	<b>0-4</b>	<b>5-14</b>	<b>15-19</b>	<b>20-34</b>	<b>35-64</b>	<b>65-</b>	<b>Total</b>
<b>Total</b>	347	758	365	1,149	1,031	226	3,876
<b>Male</b>	184	396	192	605	546	128	2,050
<b>Female</b>	163	362	173	544	485	98	1,826
<b>Native</b>	232	542	249	578	509	175	2,286
<b>Male</b>	124	286	118	312	236	93	1,169
<b>Female</b>	108	256	131	266	273	82	1,117
<b>Non-Native</b>	114	216	116	571	522	50	1,590
<b>Male</b>	59	110	74	293	310	35	881
<b>Female</b>	55	106	42	278	212	15	709

Sources: City of Nome, Office of the Clerk, Total Population as Accepted by Alaska Department of Community and Regional Affairs; 1980 Census, Tape STF2B and Community Economic and Demographic Systems Analysis of the Norton Basin Lease Sale 100, State of Alaska, ISER, October 1984, Technical Report 111, Table D-3, p. D-6.

were soon realized, and the population of Nome declined rapidly. Between 1910 and 1920, Nome's population had declined from 2,600 to 852 due to a combination of people going off to the war, a collapse of the gold industry, and a major influenza epidemic (Kevin Waring Associates, 1988).

During the years 1898 through 1906, Nome's placer deposits produced about one-third as much gold as was produced in the legendary Klondike during the same years. After 1906, production began to decline but was revived in 1915 by a shift toward larger scale operations. During World War I, shortages and high costs of labor, materials, and equipment virtually stopped gold production, which did not resume again until 1923 (Grauman, 1977).

The years between the wars saw a slight revival of Nome's mining industry. This has been attributed to technological advances that improved the efficiency of gold recovery. In addition, Nome was becoming the regional center for air transportation and government agencies. These factors contributed to a growth in population. The 1930 census placed the town's population at 1,213 and by 1940 the population had reached 1,559 (Kevin Waring Associates, 1988).

World War II created much activity for Nome. In 1941, an air base and military garrison were placed in Nome. The Alaska Territorial Guard was created and was headquartered in Nome. The ferrying of lend-lease airplanes and arms and supplies for Soviet forces were also routed through Nome. However, after the war, many defense forces in remote communities were moved to the urban centers of Anchorage and Fairbanks. The military air base was converted to a municipal airport.

Following World War I, gold mining activities declined until 1924. At that time the USSR & M Company began large-scale dredging operations. Gold operations halted again during World War II but resumed in 1946. In 1962, rising costs of production, combined with the statutory fixed price for gold, ended all gold mining other than very small operations by prospectors. Employment levels in mining in the area of Nome during this period, with the exception of the World War II period, ranged from 155 to 360 employees and averaged about 250. Following removal in 1975 of the statutory price limit of \$35 per ounce, large-scale gold operations resumed once again (Grauman, 1977).

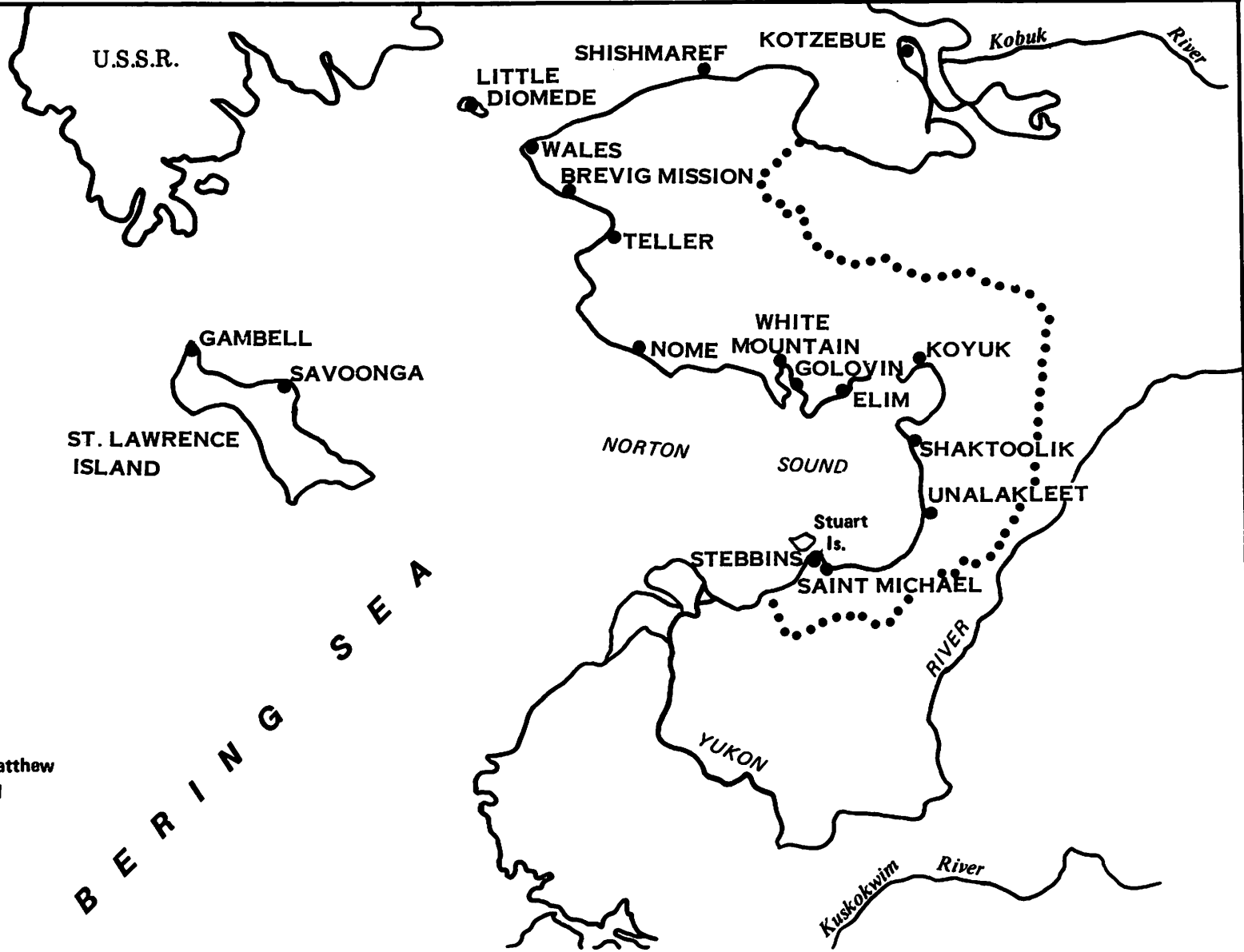
The labor demand that ensued from wartime activities attracted a large number of Natives to Nome. Many of these stayed in Nome after the war because of the services and employment opportunities available there. The 1939 census reported about 35 percent of the population as Alaskan Native. By 1960 this figure had risen to 70 percent. The census reported that the percentage of Alaskan Natives in Nome was 61 percent in 1970 and 59 percent in 1980 (Kevin Waring Associates, 1988). However, there is reason to believe that the 1980 census was seriously flawed. That year the census gave the population of Nome as 2,300. This appears to be a significant underenumeration of Nome residents. In particular, it is felt that the Native population was undercounted. The census data indicate both an absolute and percentage decline in the Native population of Nome. This trend, found in the census data, at least in absolute terms, appears to be insupportable. The 1986 population estimates are given in Table III-8.

The Nome area has long been inhabited by people to which subsistence has been an important means of support. Even though modern technology and Western industry have become commonplace in the Norton Sound area, subsistence activities are still a focal point for most of the residents of Norton Sound, including those residents of Nome. Economic activity associated with mining, the military, and government spending fluctuates according to forces outside of the region, which makes a subsistence economy a necessity for the majority of the area's residents. (For a detailed description of subsistence activities, see Sec. III.C.3.)

**Recent Economic Developments:** The more significant aspects of the economy of the City of Nome and the other areas within the Nome Census Division during the years since statehood are summarized below. As indicated in Figure III-20, the Nome Census Division includes the City of Nome plus a number of villages spread over the Seward Peninsula and around the perimeter of Norton Sound. Wage-and-salary employment totals for the Nome Census Division are shown in Table III-9. Figures for the City of Nome are shown in Table III-10. Approximately 70 percent of civilian employment in the census division is in the City of Nome. Nome has long served as the transportation and trade center for the smaller communities within the region; in recent years, Nome has become an important center of government activity.

The decade of the 1960's saw a modest increase in the number of State and local government jobs resulting from statehood. These new jobs were in the City of Nome rather than in the outlying communities. The generally

Minerals Management Service  
Alaska OCS Region  
OCS Mining Program  
Norton Sound Lease Sale



Source: U.S. Bureau of the Census

FIGURE III-20. NOME CENSUS DIVISION BOUNDARY



Table III-9  
Annual Average Wage and Salary Employment in the Nome Census Division

	1963	1973	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
<b>Wage and Salary Employment Total</b>	1,320	1,464	2,223	2,269	2,199	2,285	2,260	2,377	2,566	2,767	2,699	2,763
Mining	11	0	95	120	102	138	126	-	-	62	89	144
Contract Construction	53	63	40	41	33	40	64	88	85	54	35	30
Manufacturing	8	15	42	49	31	63	25	-	-	-	-	-
Trans./Commun./Utilities	99	179	130	145	143	175	159	172	186	201	235	307
Wholesale & Retail Trade	139	153	271	270	274	286	303	294	303	311	327	321
Finance/Insurance/Real Estate	5	41	114	100	120	53	53	79	82	103	76	73
Services	75	249	555	543	605	575	468	512	536	581	583	596
Local Government	-	-	552	592	-	-	-	793	968	1,067	987	952
State Government	-	-	168	171	-	-	-	243	243	246	242	215
State and Local Government	-	487	720	763	689	768	886	1,036	1,211	1,313	1,229	1,167
All Governments	430	-	-	-	-	-	-	1,193	1,345	1,424	1,328	1,261
Federal Government (Civilian)	-	209	191	177	161	144	132	157	134	111	99	94
Military Personnel (Active Duty)	500	58	65	61	41	43	44	39	29	31	26	31
Unclassified	0	10	0	0	0	0	0	-	-	-	-	-

Sources: Publications of the USDOC, Bureau of Economic Analysis, 1984, and State of Alaska, Dept. of Labor, 1986, supplemented by discussions with persons familiar with the Nome area.

**Table III-10  
Industry Employment for the  
City of Nome**

Industry Classification	1980	1981	1982	1983	1984	1985	1986	1987
Mining	1/	1/	1/	1/	100 <sup>2/</sup>	62	89 <sup>3/</sup>	143
Construction	22 <sup>3/</sup>	36 <sup>3/</sup>	61	75	67 <sup>3/</sup>	41	31	19
Manufacturing	1/	1/	1/	1/	1/	1/	1/	1/
Transportation, Communication, and Public Utilities	120	120	120	124	100	74	77	105
Trade	148	176	196	195 <sup>3/</sup>	200	202	221	208
Finance, Insurance, and Real Estate	30	36	37	47	45	61	41	31
Services	540	517	406	432	446	471	456	463
Government	403	411	430	454	458	471	460	418
Federal	98	89	79	88	91	98	89	90
State	172	186	213	236	236	240	236	209
Local <sup>4/</sup>	133	136	138	130	131	133	135	119
Miscellaneous	0	1/	1/	1/	1/	1/	1/	1/
<b>TOTALS</b>	<b>1,263</b>	<b>1,296</b>	<b>1,250</b>	<b>1,327</b>	<b>1,416</b>	<b>1,382</b>	<b>1,375</b>	<b>1,387</b>

Source: State of Alaska, Department of Labor, Statistical Quarterly, various issues.

- 1/ Figures withheld to comply with disclosure regulations.
- 2/ Prorated from 6 months of data.
- 3/ Prorated from 9 months of data.
- 4/ Impact Assessment, 1987.

low level of "Western" education of Native residents prevented most of them from meeting the qualifications for government jobs, which tended to be filled by non-Native immigrants to the area.

During the 1970's, job opportunities in State and local government increased at a faster rate than during the 1960's. State and local government employment jumped from 495 jobs in 1977 (annual average) to 763 in 1979, a gain of 54 percent (see Table III-9). An indirect cause of this sharp increase was a stream of income to the State of Alaska from the Prudhoe Bay oil field, which began with the completion of the Trans-Alaska Pipeline in mid-1977. The State of Alaska finances a large share of local government employment in Alaska as well as employment in State government jobs. Most of the State revenue used to finance State and local government employment is obtained from petroleum royalties, petroleum severance taxes, and oil company income taxes generated by petroleum developments that occur onshore or within 3 miles of shore. In 1982, the number of jobs in state and local government in the Nome Census Division had reached 886. Employment in this sector grew an additional 38 percent between 1982 and 1986.

The service sector of the economy provided 25 percent of all employment in Nome during 1986 (see Table III-10). Many of the jobs in this category are government-type services that were contracted to private, nonprofit corporations beginning in the 1970's. In the Nome Census Division, an expanded program of health services, as well as new adult education and job-training services, was administered by private corporations. As a result, annual average wage-and-salary employment in services increased from 263 in 1974 to 555 in 1978 (see Table III-9). Many of the new jobs in government-type services were in the City of Nome, but a significant number were in the smaller communities within the Nome Census Division.

For the Native population, both in the City of Nome and in the outlying communities within the Nome Census Division, traditional subsistence activities continue to be extremely important economic activities. By contrast, the non-Native population (chiefly Caucasian and residing in Nome) relies on wage-and-salary employment as the principal means of earning a livelihood.

Only after statehood did any significant number of Native people obtain wage-and-salary jobs, and the percentage of Native persons holding jobs continues to be substantially smaller than the percentage of non-Natives who are job-holders. The labor force participation rate in Nome for Native Alaskan males in 1980 was 50 percent and for Native Alaskan females it was 56 percent. This compares to 67 percent and 63 percent for males and females, respectively, for the Nome population as a whole (Kevin Waring Associates, 1988). For this reason, many Native residents have been forced to rely to some extent on government transfer payments to purchase heating fuel and other necessary commodities that cannot be provided by subsistence activities. Some cash income also is needed to purchase guns, boats, snowmobiles, gasoline, ammunition, and other supplies in support of subsistence hunting and fishing. Nome census area households reported spending more than \$1,400 annually in support of subsistence activities (State of Alaska, Dept. of Administration, 1985). This figure includes residents of the City of Nome who probably, on average, spend less on subsistence activities. The dollar figure spent by villages excluding Nome is not available but is expected to be higher than the \$1,400 average for the entire census area.

The 1960's also saw a steady increase in the number of tourist visitors to the Nome area. Expenditures by tourists created some new jobs in air transportation, hotels and restaurants, drinking establishments, and gift shops. Practically all of these new jobs were in the City of Nome. Some of the jobs related to tourism were filled by the Native residents of Nome. In addition, tourists purchased ivory carvings, fur garments, and other artistic and useful items produced by Native residents of the region. These Native arts-and-crafts products also began to be exported from the region.

In the 1970's and continuing into the 1980's, the number of jobs in all tourist-related activities increased at a faster rate than during the 1960's. The 1000-mile Iditarod dogsled race, which begins in Anchorage and ends in Nome, has attracted tourist visitors to Nome during the winter in recent years.

Passage of the Alaska Native Claims Settlement Act (ANCSA) by the U.S. Congress in December 1971 had two economic effects on the Nome Census Division. Beginning in 1973, sizable amounts of money were distributed from the Federal Government to special Alaska Native corporations created to administer the money and land awarded to the Native people under the terms of the land claims settlement. Creation of the Native corporations also provided new jobs, many of which were filled by Natives. Although most of these new jobs were in the City of Nome, some were in the smaller communities. Due to the creation of the Native corporations, wage-and-salary employment in the finance/insurance/real estate category increased from 41 jobs in 1973 (annual average)

to 182 jobs in 1976 within the Nome Census Division. Jobs in this category subsequently declined to only 53 in 1982 but rose again through 1987 to 73--a 38-percent increase (see Table III-9).

Two more economic developments have been of importance in the 25 years since Alaska statehood. Gold mining on a large scale was resumed in 1975 due to removal of the statutory gold price of \$35 per ounce. By 1976, gold-mining employment averaged approximately 100 wage-and-salary jobs annually (see Table III-9). The other important economic development has been a steady increase in the importance of commercial fishing within the Nome Census Division. (This topic is discussed in detail in Sec. III.C.2.)

In 1984 and 1985, the Alaska Gold Company hired between 80 and 150 people for 8 months of the year and 40 people during the winter months. In July 1986, Inspiration Gold Inc. began operation of the Bima, an offshore mining dredge. During a 40-day test period, the vessel recovered 3,000 ounces of gold. The Bima operates around the clock between mid-May and mid-November, working two shifts per day. The company employed approximately 85 people (full-time equivalent employment), 57 percent of whom are hired locally in 1988. Approximately 37 percent of those hired locally were Native. Workers are helicoptered to and from the Bima out of Nome on a daily basis. Jobs on the vessel are both for skilled (in the engine room) and unskilled (general deckhands) labor (Kosell, 1988, oral comm.). According to reports, although large, the Bima is not a particularly complicated operation.

Table C-9 in Appendix C shows the seasonal fluctuations of employment in the City of Nome. For the years 1980 through 1986, it appears that employment generally peaks in September and bottoms out in January. During this period the fluctuations have been as much as 38 percent from trough to peak and 27 percent from peak to trough during the course of a year.

Levels of Income and Costs of Living: In 1984, total personal income per capita in the Nome Census Division was \$14,265, compared to \$19,188 in Anchorage and a U.S. per capita income of \$12,772 (State of Alaska, Dept. of Labor, 1987). The Nome Census Division figure is 26 percent below the corresponding Anchorage income and 12 percent above the U.S. average income, if differences in living costs are not considered. These figures are skewed because of a higher per capita income in Nome as compared to the villages in the area. It is suspected that per capita income in most of the villages is considerably less than that presented for the district.

However, the purchasing power of a dollar of income in the Nome Census Division is much less than that of a dollar of income in Anchorage, due to higher living costs in the Nome Census Division. Even greater differences exist between living costs in the Nome area and average U.S. living costs. Consequently, the purchasing power of a dollar of income in the Nome area is a great deal less than the purchasing power of a dollar of income spent in any community with average U.S. living costs. The cost of living in the Nome district is estimated to be 33 percent above living costs in Anchorage and 47 percent above that of Seattle (State of Alaska, Department of Administration, 1985). These figures do not account for subsistence activities. According to the same report, 93 percent of all households (Native and non-Native) surveyed in the Nome district engage in subsistence activities and 64 percent obtain at least 25 percent of their food from such endeavors (see Sec. III.C.3).

## 2. Commercial Fisheries in the Nome Area:

a. King Crab: The only commercial shellfish fishery in the Nome area is for red king crab. Red king crab have been used for subsistence purposes by local residents for many years, but the commercial fishery did not exist until April 1977.

There are two distinct red king crab fisheries. The first, which occurs between November 15 and May 15, is a nearshore, through-the-ice fishery used exclusively by Nome-Norton Sound area residents for both subsistence and commercial purposes. The second, which occurs in August, is an offshore fishery used exclusively by large, out-of-region, commercial fishing vessels (ADF&G, 1986a).

Nome fishermen participate in the winter commercial crab fishery operating pots and handlines through the ice. Most of the fishing effort occurs within 5 miles of Nome. In 1986, five winter commercial fishermen reported a total harvest of 2,168 crab. The price per crab averaged \$5.40. Recent commercial and subsistence harvests from the winter crab fishery are reported in Table III-11 (ADF&G, 1986a).

In 1986, the summer crab fishing season was open for 23 days, but fishing occurred for just 13 of these days. The harvest was 479,463 pounds. The price received was approximately \$1.25 per pound, and the total value to the fishermen was about \$600,000. The number of vessels participating in the fishery has ranged from a high

Table III-11  
Commercial and Subsistence Harvests of Red King Crab  
in Norton Sound, Winter Fishery<sup>1/</sup>

Year <sup>2/</sup>	<u>Commercial</u>			<u>Subsistence</u>					
	Fisher- Men	No. Crab Harvested	Winter <sup>3/</sup>	Permits Issued	Permits Returned	Permits Fished	Total Crab Caught <sup>4/</sup>	Total Crab Harvested <sup>5/</sup>	Average Harvest/fm
1978	37	9,625	1977-78	290	206	149	<sup>6/</sup>	12,506	84
1979	1	221	1978-79	48	43	38	<sup>6/</sup>	224	6
1980	1	22	1979-80	22	14	9	<sup>6/</sup>	213	24
1981	0	0	1980-81	51	39	23	<sup>6/</sup>	360	16
1982	1	17	1981-82	101	76	54	<sup>6/</sup>	1,288	24
1983	5	549	1982-83	172	106	85	<sup>6/</sup>	10,432	123
1984	8	856	1983-84	222	183	143	15,923	11,220	78
1985	9	1,168	1984-85	203	166	132	10,757	8,377	63
1986	5	2,168	1985-86	136	133	107	10,751	7,052	66
1987	7	1,040	1986-87	138	134	98	7,406	5,772	59

Source: ADF&G, 1986a.

<sup>1/</sup> The years 1977-1984 represent finalized data; 1985 data are preliminary.

<sup>2/</sup> Prior to 1985, the winter commercial fishery occurred from January 1-April 30; as of March 1985, the winter commercial harvest may occur from November 15 through May 15.

<sup>3/</sup> The winter subsistence fishery occurs during months of 2 calendar years (as early as December through May).

<sup>4/</sup> The number of crab actually caught; some may have been returned.

<sup>5/</sup> The number of crab "harvested" is the number of crab caught and kept.

<sup>6/</sup> Data unavailable.

of 36 in 1981 to a low of 3 in 1986. In 1986 none of these vessels were from Nome; however, in 1985, one vessel from Nome participated. In 1987 three catcher/processors, one processing vessel, and six fishing vessels participated in the harvest. Recent harvests from the summer king crab fishery are reported in Table III-12 (ADF&G, 1988).

b. Salmon and Herring: The commercial salmon and herring fisheries in the area of the proposal are small relative to the Norton Sound district as a whole. The number of herring gillnet permit holders that list their residence as Nome has ranged from 12 in 1981 to a low of 2 in 1982. In 1985, there were 6 permits held by Nome residents. These fishermen caught 54,705 pounds of herring, valued at \$12,800. None of this catch was in the Nome subdistrict (USDOC, NMFS, 1988). District-wide, in 1987, approximately 564 fishermen harvested over 8 million pounds of herring, valued at \$2,600,000 (ADF&G, 1988). Table III-13 gives commercial herring fisheries information for the years 1979 through 1987.

Salmon permits held by Nome residents ranged from 20 in 1981 and 1982 to 9 in 1984. In 1987, 10 commercial fishermen harvested a total of 6,226 salmon in the Nome subdistrict, which runs from Penny River to Bluff (ADF&G, 1988). The total catch for the Norton Sound district was 136,283 fish. The value of the harvest, to the commercial fishermen, was \$504,631 (ADF&G, 1988). Commercial and subsistence salmon catches for the Nome area (subdistrict 1) are shown in Table III-13a.

### 3. Subsistence-Harvest Patterns:

a. Introduction: The OCS Mining Program Norton Sound Lease Sale area lies within Nome's subsistence-harvest area. This section describes Nome's subsistence-harvest patterns and provides general information on subsistence-harvest patterns, harvest information by resource, timing of the subsistence-harvest cycles, and harvest-area concentrations by resource. Only Nome's subsistence-harvest patterns are described because effects on subsistence harvests of other communities outside of Nome are not anticipated (see Sec. IV.B.10 for this analysis). In addition, other communities in the Norton Sound region do not harvest subsistence resources offshore of Nome in the vicinity of the proposed lease sale (ADF&G, 1986b; Magdanz, 1990, oral comm.). Effects on migratory species which may be in the proposed sale area, but harvested in other areas, also are not expected to be more than MINOR (see Sec. IV.B.10 for this analysis). Consequently, only the subsistence harvests of Nome are included in this description. Effects on subsistence harvests for the village of Solomon near Nome also are not anticipated because this community now only has a few elderly permanent residents (U.S. Census, 1980). Solomon residents participate in subsistence harvests in conjunction with their Nome relatives (see Sec. IV.B.10). Subsistence-harvest patterns in the Norton Sound region are described in the Norton Basin Sale 100 FEIS (USDOI, MMS, 1985a). This description is augmented by the Alaska Habitat Management Guide, Volume IV (ADF&G, 1986b), Magdanz and Olanna (1986), and Ellanna (1983a).

Natives (Northern and Southern Inupiat and Central and Siberian Yup'ik Inuit) in Nome participate in a way of life often referred to as "subsistence" (there are also non-Natives who have adopted this way of life--laws and State regulations regarding subsistence do not make distinction between Natives and non-Natives, although the Marine Mammal Protection Act of 1972 strictly forbids non-Natives from harvesting marine mammals). While new elements have been added to the way people live, this way of life is a continuation of centuries-old traditional patterns. Until January 1990, Alaska statutes defined "subsistence uses" as: "the non-commercial, customary and traditional uses of wild, renewable resources by a resident domiciled in a rural area of the state for personal or family consumption" (AS Sec. 16.05.940) and subsistence uses was given priority over other uses. In January 1990, as a result of McDowell v. State of Alaska this law was declared unconstitutional by the Alaska Supreme Court. However, Federal law (Title VIII of ANILCA) continues to define Alaskan subsistence and grants it priority over other uses as well. All provisions of the Alaska State law on subsistence remain in effect except for the rural provision for subsistence. The effect of the Alaska Supreme Court's decision was stayed until July 1, 1990. The State reconvened to devise a solution to the issues raised in the McDowell decision, but no solution was agreed on. The Federal Government now has jurisdiction over management of subsistence on Federal lands.

Subsistence laws recognize the importance of subsistence not only to the food supply but to a way of life. In many rural Alaska villages, subsistence pursuits structure and color all aspects of life. Residents refer to hunting as their "lifestyle," and this assertion is echoed by social scientists familiar with the Norton Sound region (MacLean, 1986; Ellanna, 1980; Wolfe, 1981; Jorgensen, 1984; Little and Robbins, 1984; Magdanz and Olanna, 1985; ADF&G, 1986; and Magdanz and Olanna, 1986). Subsistence is important to the sociocultural system through sharing of subsistence foods, the formation of task groups and crew structures, and is a core cultural value (see Sec. III.C.4 for this discussion). The importance of hunting for maintaining cultural identity is

**Table III-12**  
**Commercial Harvest of Red King Crab in Norton Sound,**  
**Summer Fishery**

Year	Legal Male Pop. Est. <sup>1/</sup>	Commercial Harvest <sup>2/</sup>	Number of Vessels	Crab/ Pot	Average Weigh	Ex-vessel Price	Fishery Value (Millions)
1976 <sup>3/4/</sup>	8.1	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1977 <sup>5/</sup>	10.0	0.52	7	36	2.7	0.75	0.229
1978 <sup>5/</sup>	11.0	2.09	8	64	3.0	0.95	1.897
1979 <sup>4/</sup>	5.4	2.93	34	28	3.0	0.75	1.878
1980	6.6	1.19	9	29	3.6	0.75	0.890
1981	4.7	1.38	36	11	3.7	0.85	1.172
1982	1.3	0.23	11	6	3.6	2.00	0.405
1983	2.1	0.37	23	12	2.8	1.50	0.537
1984	2.7	0.39	8	14	2.8	1.02	0.395
1985	2.4	0.43	6	11	2.9	1.00	0.427
1986 <sup>6/</sup>	2.8	0.48	3	38	2.9	1.25	0.600
1987 <sup>7/</sup>	2.2	0.33	9	10	3.2	1.50	0.491

Source: ADF&G, 1988b.

<sup>1/</sup> Population estimate prior to fishery in given year in millions of pounds.

<sup>2/</sup> Millions of pounds.

<sup>3/</sup> No commercial fishery in 1976.

<sup>4/</sup> Population estimate derived by NMFS.

<sup>5/</sup> Population estimate derived from catch per pot from commercial fishery.

<sup>6/</sup> Population estimate derived from 1985 ADF&G assessment survey.

<sup>7/</sup> Population estimate based on 1985 assessment-survey data and recruitment observed in season; this estimate can only be approximated due to the lack of current assessment data.



Table III-13  
Herring Biomass Estimates and Commercial  
Fisheries Data for the Norton Sound District

Year	Biomass <sup>1/</sup> (short tons)	Harvest <sup>2/</sup> (short tons)	Exploitation <sup>3/</sup> (percentage)	Roe (percentage)	Dollar Value (millions)	Number of Fishermen
1979	7,700	1,292	16.8	7.0	.6	67
1980 <sup>4/</sup>	8,400	2,452	29.2	8.1	.5	294
1981	25,100	4,371	17.3	8.8	1.5	332
1982 <sup>4/</sup>	17,400	3,933	22.6	8.8	1.0	237
1983	28,100	4,582	16.3	8.6	1.4	272
1984	23,100	3,662 <sup>5/</sup>	15.8	10.3	.9	194
1985	20,000	3,548	17.7	9.9	1.4	277
1986	28,062	5,194	18.5	9.6	2.9	323
1987	32,370	4,082	12.6 <sup>6/</sup>	8.6	2.6	564

Source: ADF&G, 1988b.

<sup>1/</sup> Methods of calculating biomass have varied over the years. Biomass estimates listed follow methods used during that year.

<sup>2/</sup> Includes both bait and sac-roe harvests.

<sup>3/</sup> Represents total District exploitation. During many years southern subdistricts are closed because exploitation of the local biomass reaches 20 percent, while northern subdistricts have remained open because little or no harvest has occurred.

<sup>4/</sup> Minimal biomass estimates due to poor survey conditions.

<sup>5/</sup> Includes an estimated 90 short tons of wastage.

<sup>6/</sup> Peak estimate made after commercial fishery; the fishery was not reopened due to the high probability of spawnouts present after 2 consecutive days of heavy spawning.

**Table III-13a**  
**Commercial and Subsistence Salmon Catches**  
**for the Nome Subdistrict (Subdistrict 1)**

Year	Commercial Total	Subsistence Total	Combined Total
1975	10,848	9,224	20,072
1976	8,989	7,399	16,388
1977	16,129	15,498	31,627
1978	31,670	17,618	49,288
1979	11,289	10,757	22,046
1980	23,937	30,515	54,452
1981	22,380	15,939	38,318
1982	33,162	25,889	59,051
1983	12,283	17,215	29,498
1984	4,571	23,949	28,520
1985	6,596	9,008	15,604
1986	8,216	17,750	25,966
1987	6,226	11,052	17,278
5-year avg. <sup>1/</sup>	12,966	18,762	31,728
10-year avg. <sup>2/</sup>	17,023	18,414	35,437

Source: ADF&G, 1988.

<sup>1/</sup> 1982-1986.

<sup>2/</sup> 1977-1986.

expected to grow in the near future as social pressures associated with development build. While subsistence is integrated into all parts of village life, this section only examines information regarding the subsistence harvests. The economic replacement value of subsistence foods is not addressed because subsistence provides more than sustenance; it also is critical to the sociocultural system (see Sec. III.C.4). In addition, there are no data on the economic replacement value of subsistence foods in Nome.

Unlike Western industrial systems, subsistence systems are built directly on naturally occurring renewable resources. The following discussion (which draws heavily on Magdanz and Olanna, 1986; Ellanna, 1980; Wolfe, 1981; Ellanna, 1983a; Sherrod, 1982; and ADF&G, 1986) focuses on the actual food hunted, fished, and gathered by local residents (see Sec. III.C.4, Sociocultural Systems). In the study area, subsistence pursuits are extremely important simply in terms of the material goods provided. While some food is imported into Nome, a vast amount is hunted and gathered locally. Even though some households may not participate in a particular subsistence harvest, these foods, will be consumed through sharing with other households. Sharing of subsistence resources occurs within Nome as well as between Nome and other villages in the region and sometimes in other areas throughout the State. Subsistence resources are the foundation of the region's mixed subsistence and cash economy. Estimates vary widely on the percentage of subsistence foods in the diet; several studies indicate that in the villages in the region subsistence may provide 70 to 80 percent of the total protein consumed within the households (see Ellanna, 1980; and Little and Robbins, 1984). Dependence on subsistence foods in Nome is most likely less; however, subsistence foods still provide a large portion of the diet--a portion that families could ill-afford to replace with imported substitutes (see Sec. III.C.1).

Besides food for people, subsistence provides dog food; and it is the only source for critical materials such as ivory needed for carving, furs for clothing, bearded seal hides for mukluk soles, and other seal skins for mukluk uppers. Lone individuals occasionally engage in certain subsistence pursuits such as duck hunting, but most subsistence activities are accomplished by groups of people working together. Often these task groups tend to be composed of related individuals, but sometimes include unrelated friends or partners. (The extreme sociocultural importance of subsistence-task organization is examined in Sec. III.C.4, Sociocultural Systems.) Fish camps call attention to four important qualities which, together, tend to characterize subsistence-based economies. First, subsistence activities are seasonal, and human economic endeavor within the study area traditionally was so strongly regulated by the migratory characteristics of major subsistence species that the form of settlement would change from one season to the next. In Nome today, however, the road system allows easy access to fish camps. Second, subsistence activities are strongly localized. Salmon fishing, for example, cannot take place just anywhere along a river; it occurs at appropriately productive and usable spots. Third, subsistence is regulated by a system of traditional, locally recognized rights, obligations, and appropriate behaviors. Who uses a particular site, how people relate to each other at the camps, how the take is divided at the site, and how it is redivided at the village are all regulated through traditional usages. The availability of each resource varies from year to year and is unpredictable, yet the variation must be planned for. Although village hunting, fishing, and gathering territories overlap, each village exists in its own niche, and village hunting patterns are fine-tuned to these local differences. In Nome, a heterogeneous community, village hunting patterns can be disrupted when outsiders unfamiliar with the traditional behaviors move into the community, begin hunting or fishing while ignoring local "rules", and finally upset the balance. Finally, the fourth factor is "opportunity." Besides the seasonal timing of the availability of the subsistence resources, "opportunistic" availability is also an important factor. For example, it may be the correct season to fish, but if the right "opportunity" is not available for harvesting them (physical conditions in the river are not right, such as high water), then the focus on a certain subsistence harvest necessarily must shift to other subsistence resources that may be "opportunistically" available at the time.

Nome is a mixture of subsistence-harvest traditions due to the variety of Natives living there (Magdanz and Olanna, 1986). The subsistence traditions Nome residents roughly follow depend on their community of birth ("natal" community), although there has been some adaptation to the Nome environment. For example, residents from Little Diomed and St. Lawrence Islands now harvest moose (Magdanz and Olanna, 1986). (A discussion of the subgroups of the Nome community is found in Sec. III.C.4) Nome residents from Teller and Brevig Mission follow the small-sea-mammal-hunting pattern; others from King Island, St. Lawrence Island, and Diomed are part of the large-sea-mammal-hunting pattern, while still others are part of the Norton Sound fishing and coastal-and inland-hunting pattern (along with Solomon, Golovin, White Mountain, Elim, Koyuk, Shaktoolik, Stebbins, St. Michael, and Unalakleet which are outside of the sale area).

Participation in harvests of subsistence resources in the Nome area varies according to a household's length of residency and place of origin. Specifically, someone who was born and raised outside of Nome--from King Island, for example--is likely to continue hunting for the resources he or she grew up harvesting and in traditional

locations, such as on or near King Island. Nome has a complex and stable round of hunting and fishing activities, a large number of species used, high volumes of output, and substantial labor investment in harvesting subsistence resources. Only a very small percentage (5%) of all Nome households (Native or non-Native) use no local resources (Ellanna, 1983a). In the Nome area, salmon is the most commonly harvested resource. In a survey conducted of a random sample of all Nome households contacted in 1982 (that included Natives and non-Natives) (see Figs. III-21a and b; Ellanna, 1983a), 83 percent of all households surveyed harvested salmon (Fig. III-21a; Ellanna, 1983a). Other fish also are harvested heavily. Moose was harvested by 63 percent of all households. Shellfish was harvested by 57 percent and ducks, geese, and cranes by about 50 percent of the households surveyed. In addition, 82 percent of all households also harvested berries, and 66 percent harvested ptarmigan (Wolfe and Ellanna, 1983).

Although these percentages are for all households in the study, percentages of households participating in harvests by birthplace is presented in Figures III-21a and b. The significance of these harvest levels is that a large percentage of Nome residents--non-Native as well as Native--participate in subsistence hunting and fishing (Ellanna, 1983a). An actual breakdown by Native and non-Native is not provided in Figures III-21a and b, however, it can be assumed that residents originating from northwest Alaska are predominantly Native and residents from outside Alaska are predominantly non-Native.

The Marine Mammal Protection Act forbids non-Natives from harvesting marine mammals. In a random sample of all Nome households contacted for a 1982 survey (Ellanna, 1983a), 22 to 29 percent of the households harvested walrus, bearded seal, and spotted seal (see Figs. III-21a and b). It is difficult to compare these harvest percentages to harvests of other resources since these exclude non-Natives.

In a subsistence mapping study of 46 households (this was a nonrandom sample of active resource users--65.2% Native [Magdanz and Olanna, 1986]), salmon was harvested by all of those people interviewed. Also harvested by more than 67 percent of the sample were freshwater and marine fish, shellfish, seals, and walrus (see Table III-14). It should be noted that statistics presented on harvests by household do not represent the number of households that consume subsistence resources through the distribution and sharing networks. Whether harvest statistics include Natives and non-Natives also needs to be considered. Statistics of household harvests also can be misleading because of the tendency for households to conduct harvests together. For example, a grandfather, his son, and his three teenage grandsons all living in the same household may go walrus hunting, but this would be represented as only one household.

b. Subsistence Resources Harvested: In the following sections, subsistence harvests in Nome are described by resource.

Fish: Fish are a primary subsistence resource for all villages in the study area (Figs. III-21a and b). Fish nets are set in the vicinity of the Nome and at fish camps located along the coast and in the drainages of major salmon streams. Salmon, particularly pink, chum, and coho, are the most important cash resource for this area and are a critical subsistence resource as well. It is not uncommon for area residents to participate in both subsistence and commercial salmon fishing at the same site during the same week (ADF&G, 1986). Salmon fishing occurs from early June to August (Fig. III-22). The Nome River is a major source of pink salmon for Nome residents. Other important rivers include the Sinuk, Penney, Cripple, Fish, Solomon, Eldorado, Flambeau, and Bonanza Rivers. The Eldorado, Flambeau, and Bonanza Rivers are the three major rivers draining into Safety Sound. Fishing also is done along the coast. Subsistence fishing in the Nome River has required a permit since 1968. Between 1972 and 1983, an average of 49 subsistence permit holders fished the Nome River. The average subsistence catch during that period consisted of 112 pink, 21 chum, and 10 coho salmon. Other rivers in the Nome area now require subsistence permits as well (see Table III-15). In 1986 the total salmon harvest in the Nome area was 17,793 fish (97% of the recent five-year average of 18,400 salmon) from 265 permits issued (see Table III-15). Arctic char and arctic grayling also are fished in the Nome River (Magdanz and Olanna, 1986).

Beach seining and gillnetting for herring also are important subsistence activities. Other fish of importance to Nome are arctic grayling, dolly varden ("trout"), ling cod, arctic cod ("blue cod"), saffron cod ("tomcod"), smelt, sculpin ("bullhead"), humpback and broad whitefish, capelin, char, halibut, pike, and flounder (Ellanna, 1983a; Magdanz and Olanna, 1986). The most commonly caught marine fish in the Nome area are saffron cod, arctic cod, and sculpin (Magdanz and Olanna, 1986). Saffron cod is harvested primarily at Safety Sound in the fall and through the shorefast ice in front of Nome during the winter (Magdanz, 1988b). Humpback and broad whitefish are caught year-round by jigging through holes in the ice in winter or with nets during open water in the summer. Whitefish are harvested primarily from mid-September through early February with occasional harvests from

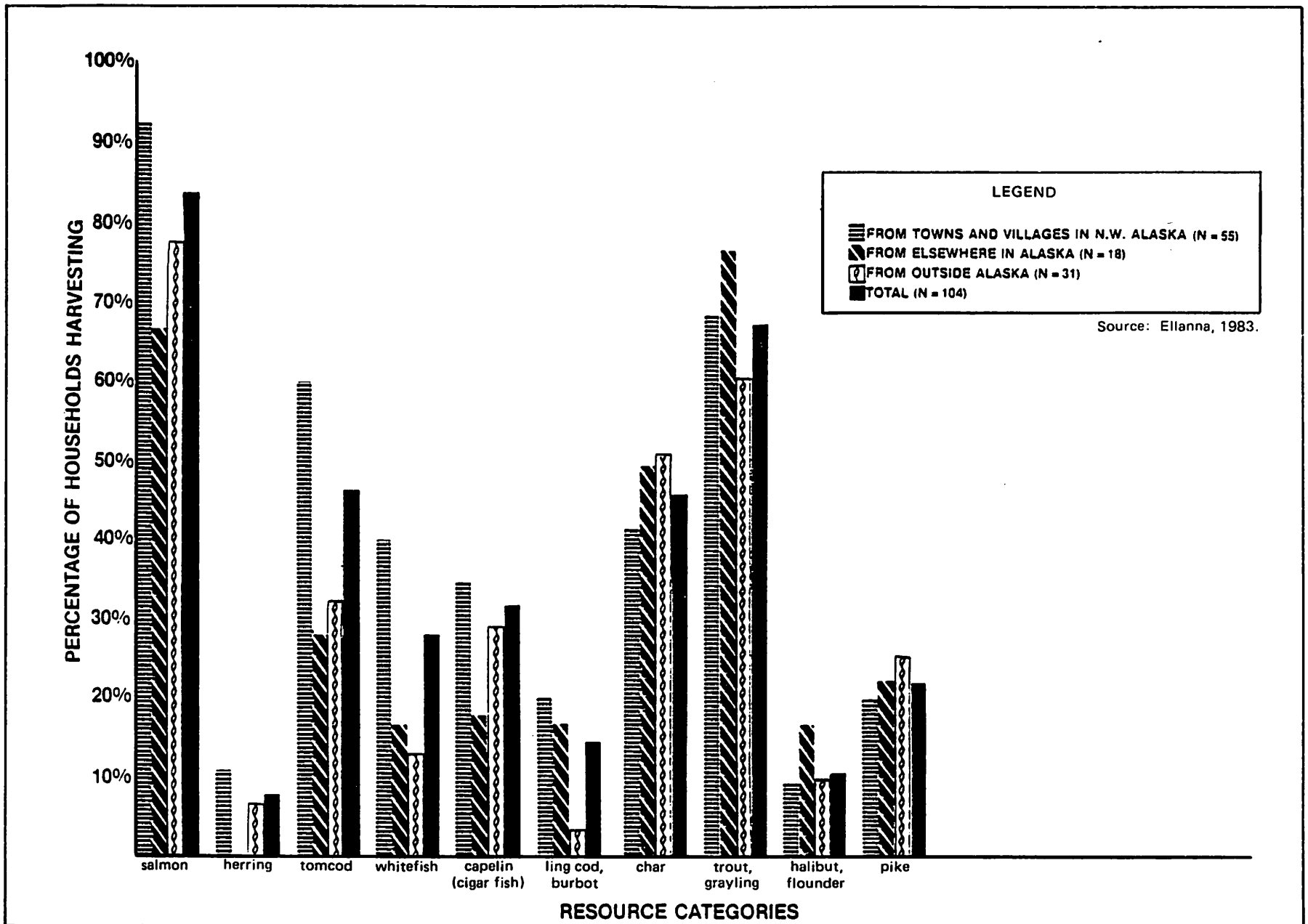


FIGURE III-21a. PERCENTAGE OF NOME HOUSEHOLDS HARVESTING SPECIFIC RESOURCES IN 1982

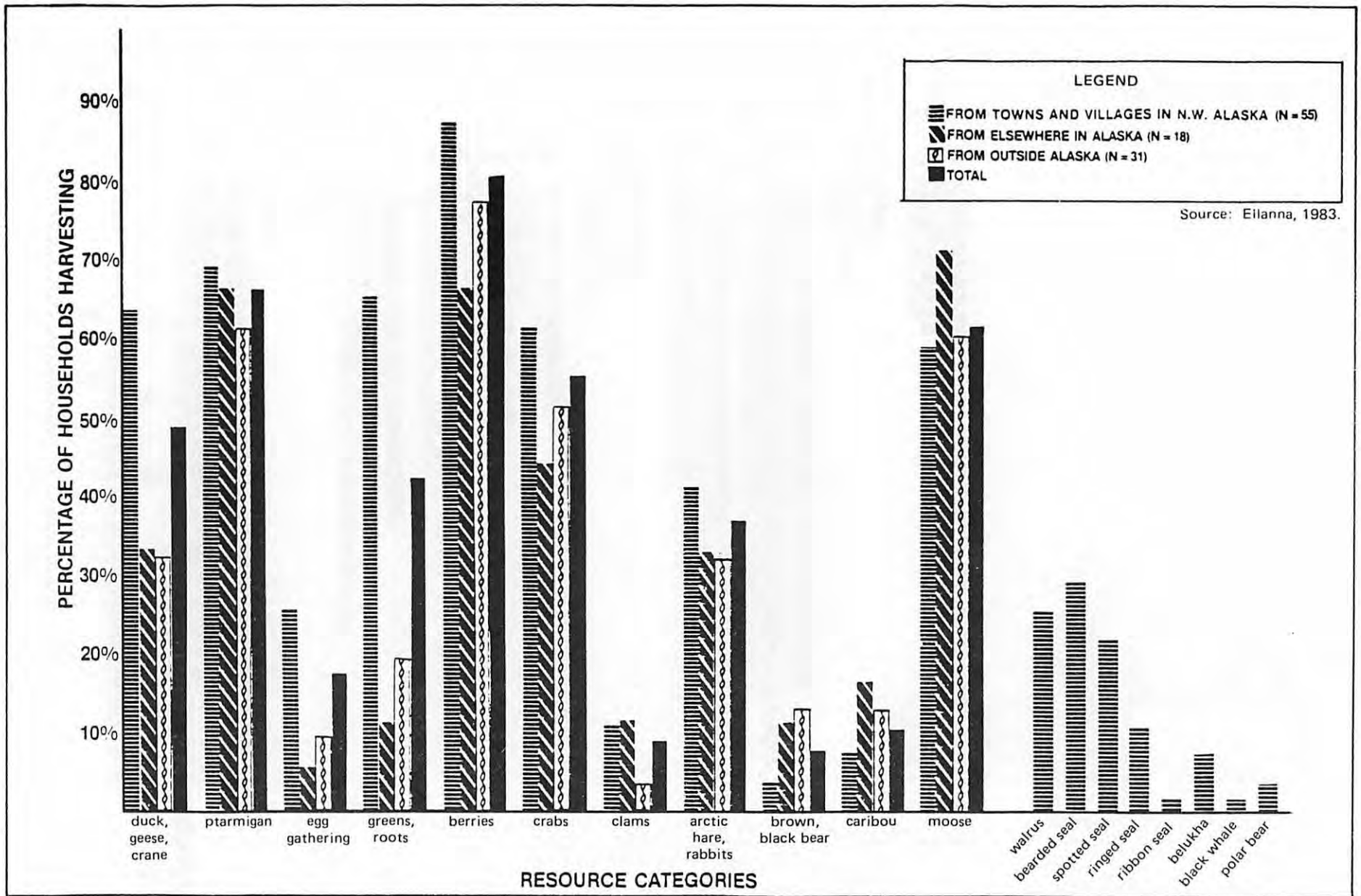


FIGURE III-21b. PERCENTAGE OF NOME HOUSEHOLDS HARVESTING SPECIFIC RESOURCES IN 1982

**Table III-14**  
**Subsistence Resources Harvested in Nome During 1985<sup>1/</sup>**

Subsistence Wild Resources Used	Number of Households	Percent of Total Sample
Salmon	46	100.00
Freshwater Fish	42	91.3
Marine Fish	36	78.3
Shellfish	37	80.4
Walrus	31	67.4
Seals	37	80.4
Moose	43	93.5
Small Mammals	32	69.6
Bear	6	13.0
Plants	43	93.5
Wood	26	56.5
Waterfowl	30	65.2

Source: Magdanz and Olanna, 1986.

<sup>1/</sup> This was not a random sample. Households were selected for their participation in subsistence harvests.



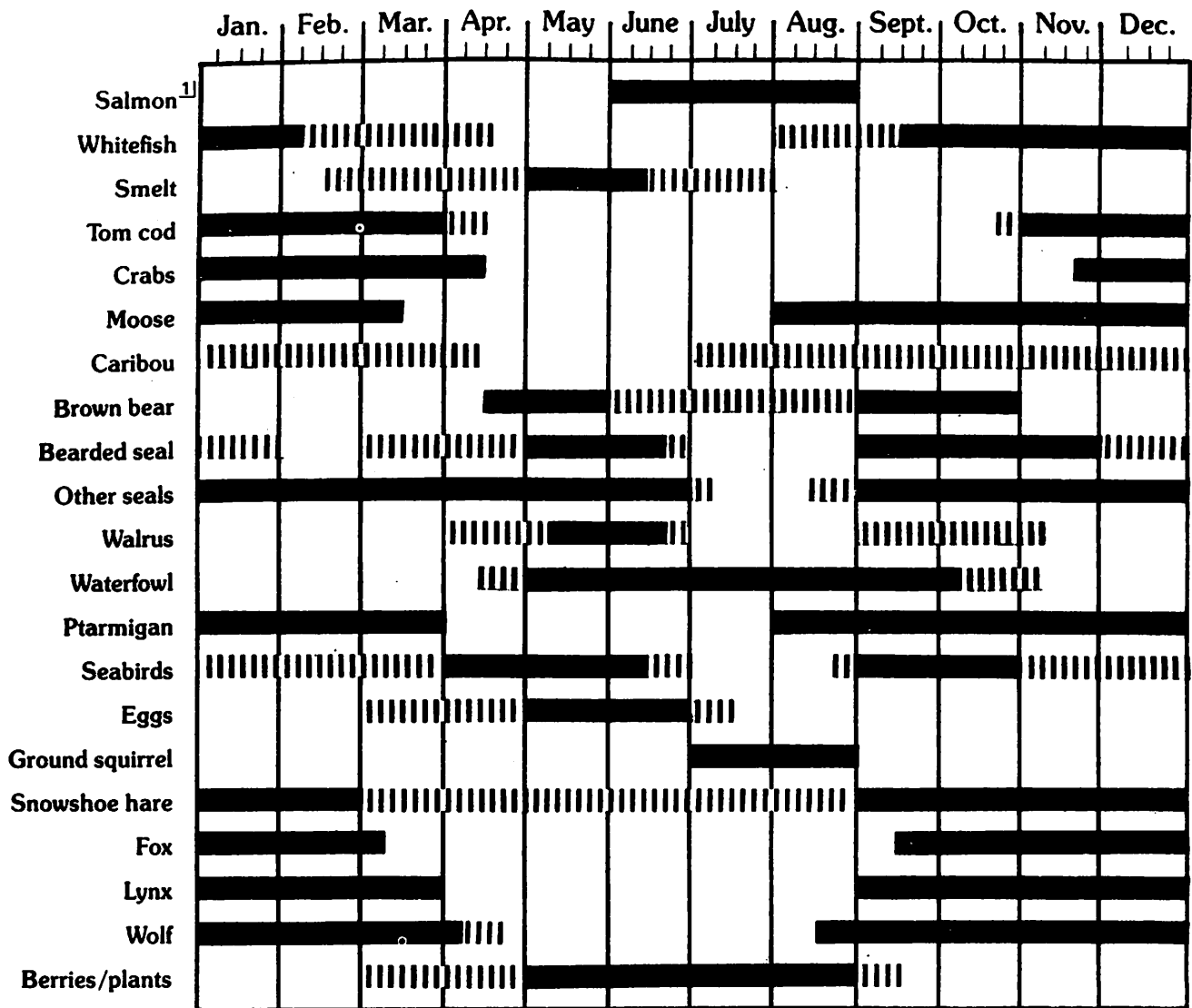


FIGURE III-22. NOME ANNUAL SUBSISTENCE CYCLE

<sup>1)</sup> Solid line indicates time when harvest usually takes place. Broken line indicates occasional harvest effort.

Source: Ellanna, 1983a.

Table III-15  
Nome Subsistence Salmon Catches for 1986

Location	Permits Issued	Permits Returned	Permits Fished	Chinook	Sockeye	Coho	Pink	Chum	Total
Nome River	92	77	55	6	0	210	4,611	847	5,674
Marine Waters	100	92	61	140	104	276	2,115	5,528	8,163
Sinuk River	6	3	2	0	1	3	91	180	275
Eldorado River	23	19	14	1	1	124	799	919	1,844
Flambeau River	12	11	6	0	1	5	571	513	1,090
Snake River	13	11	8	3	1	38	257	82	381
Penny River	2	2	1	0	0	0	97	3	100
Solomon River	9	8	3	0	0	19	1	3	23
Feather River	0	0	0	-	-	-	-	-	-
Bonanza River	7	5	3	0	0	14	207	22	243
Cripple River	1	0	0	0	0	0	0	0	0
Safety Sound	0	0	0	-	-	-	-	-	-
<b>Totals</b>	<b>265</b>	<b>228</b>	<b>153</b>	<b>150</b>	<b>108</b>	<b>689</b>	<b>8,749</b>	<b>8,097</b>	<b>17,793</b>

Source: ADF&G, Division of Commercial Fisheries, 1986.

August through mid-September and mid-February through mid-April (Fig. III-22; ADF&G, 1986). Halibut is available only in the deeper water around the Bering Strait islands. Char, trout, and pike are favorite subsistence and sports species (Ellanna, 1983a). Exactly 50 percent of Native households and 26.3 percent of non-Native households in Nome in 1982 owned boats (Ellanna, 1983a). Although this is not the current number of households owning boats, it does demonstrate the high proportion of households in Nome owning boats. Since many families are extended families living in different households, the percentage of households with access to a boat is most likely even higher.

Summer fishing occurs near the villages (Fig. III-23) and at traditional fish-camp locations along the coast, coastal lagoons, and streams. Winter fishing occurs near the villages or on outings in conjunction with other hunting activities (ADF&G, 1986).

**Shellfish:** Crabs, clams, and mussels are harvested locally by Nome residents. Red king crab is the most commonly harvested shellfish (Fig. III-24). The area immediately south of Nome between Cape Nome and Sledge Island is prime king crab winter habitat (Magdanz and Olanna, 1986), and king crab are year-round inhabitants of the proposed lease-sale area. King crab are found throughout the proposed sale area, but are most abundant in waters between Sledge Island and Cape Nome. Pot surveys have documented crab abundance of 2,000 to 3,000 crab/mi<sup>2</sup> within the proposed lease-sale area (Magdanz, 1988a, oral comm.). Crabbing occurs between January and May (peaks in March and April), although occasionally it occurs in the summer (Fig. III-22). Winter crabbing occurs from shorefast ice, which is rarely more than 3 miles offshore--outside of the proposed lease-sale area. However, the proposed lease-sale area is believed to be a critical habitat for crab which move into shallower, nearshore waters in winter and spring (Magdanz, 1988a, oral comm.). The subsistence harvest of crab has been depressed in recent years, and local residents feel it is a result of commercial crab harvests begun in 1977 (Magdanz, 1983). The total Norton Sound red king crab subsistence harvest in 1978 was 12,506, dropped to a low of 213 in 1980, went up to 11,222 by 1984, only to drop back down to 8,377 in 1985 and 7,052 in 1986. The decrease may reflect a drop in the number of permits issued and returned, but may also be due to poor ice conditions and changes in crab distribution (ADF&G, 1988a). In Nome the subsistence harvest in 1983 was 9,968 crab, an increase from 1,288 in 1982, 371 in 1981, and 213 in 1980 (see Sec. III.C.2 for commercial harvests of crab). It should be noted that harvest figures are obtained from permits; not all crabbers obtain or return permits, thus, these figures also may represent more permits being obtained and returned (Magdanz and Olanna, 1984). The poor catches in the winter of 1980-1981 may be attributed to a declining crab population. Subsistence fishing success from 1982 to 1986 may be due to a rebuilding of the crab populations and increased use of more efficient gear (pots instead of handlines) (ADF&G, 1988a).

Clamming is done by only a small portion of the population. Safety Sound and estuaries of its tributary rivers are prime clamming areas for Nome residents. There also is a clam and mussel harvest at Woolley Lagoon and along the western spit between Grantley Harbor and Port Clarence (Magdanz and Olanna, 1986).

#### Marine Mammals:

**Seals:** Seals are a critical food source for both meat and oil. Seals are harvested by residents of Nome, Solomon, Golovin, and White Mountain. The entire coastal area (Fig. III-25) is important for seal harvests. Seal and walrus are often hunted at the same time during spring. In a survey of Nome Native residents, 29 and 22 percent of the households surveyed harvested bearded and spotted seals, respectively, and 11 percent harvested ringed seals (Ellanna, 1983a). As with other subsistence harvests, through sharing, more households consume seals than harvest seals. Bearded seals (ugruk), ringed seals, and spotted seals are first, second, and third, respectively, in local preference. Spotted seals are the least desirable for human consumption and are harvested primarily for their hides and as a source of dog food. Ribbon seals also are occasionally harvested. Ringed seals commonly are available during the winter months and are hunted at breathing holes and leads in the sea ice (Fig. III-22), but also are available the rest of the year. Other seal species, including bearded seal, more commonly are associated with broken ice or the pack-ice edge during the spring (April-June) and fall (September-November). Spotted seals are especially abundant in the fall, feeding on small fish near shore and in brackish waters like Safety Sound, Grantley Harbor, and the entrance to Sinuk River. Seal harvests peak during the fall and spring migrations. The cultural and economic importance of bearded seal hunting is evident in the reported level of hunting activity. Almost all parts of the seal are utilized. The meat is eaten boiled, fried, roasted, or dried. Blubber is rendered into oil, and hides are used for garments, boot soles, ropes, gun cases,

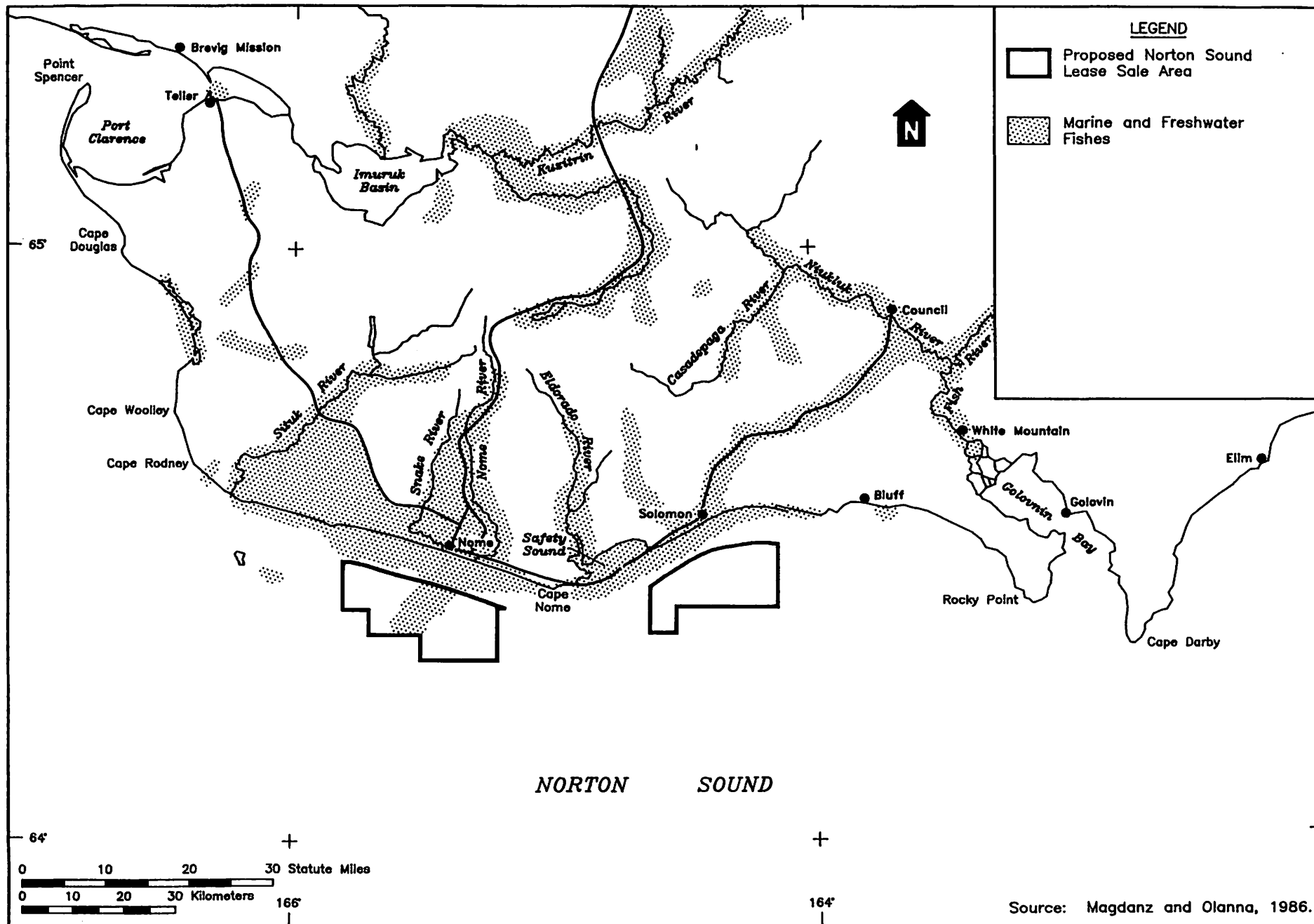


Figure III-23. Nome Subsistence-Harvest-Concentration Areas for Fishes

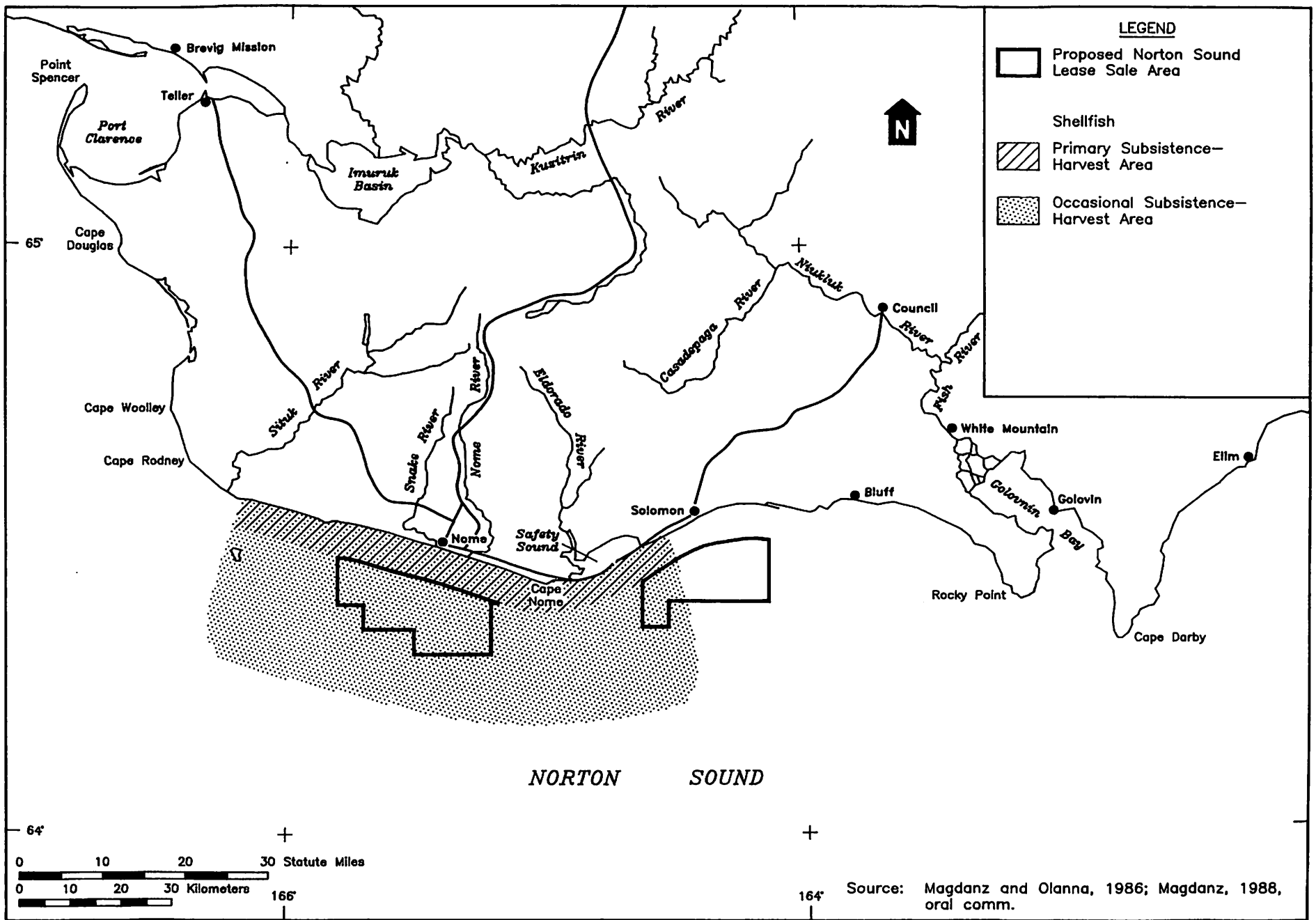


Figure III-24. Nome Subsistence-Harvest-Concentration Areas for Shellfish

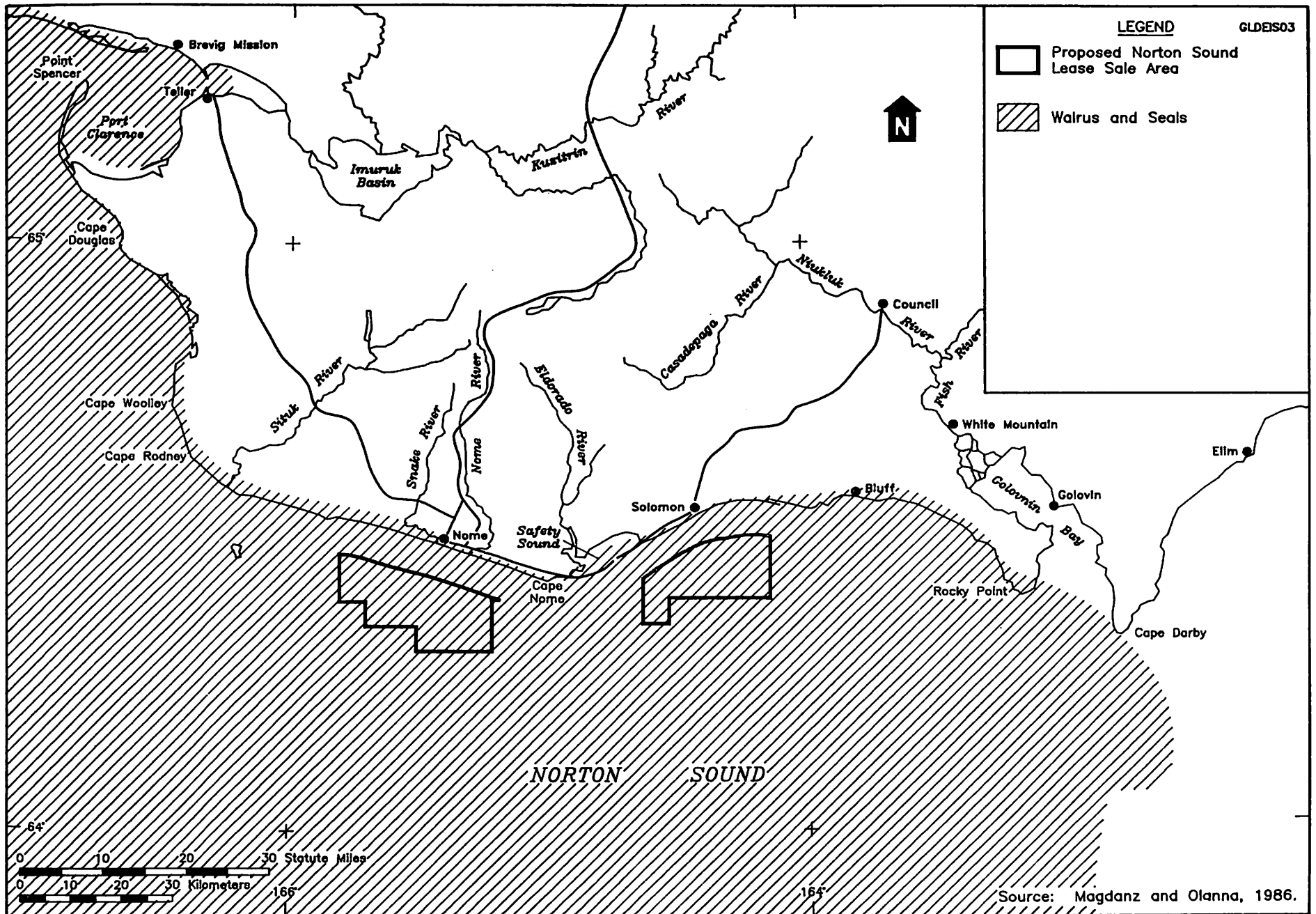


Figure III-25. Nome Subsistence-Harvest-Concentration Areas for Walrus and Seals

and packs. In the winter, seal hunters use snowmachines to travel up to 50 mi along the coast to harvest seals. In open water, in the spring, travel is done by boat from seal-camp locations along the coast. Seal skins and gut are used locally for clothing and other home uses, as well as for crafts that are sold for cash (ADF&G, 1986).

**Walrus:** Walrus are harvested by 25 percent of Nome households--all of these households are Native (Ellanna, 1983a). As with other subsistence resources, through sharing, more households consume walrus than harvest walrus. Walrus range over one of the largest territories of any subsistence species. In a study of Nome subsistence-harvest patterns, it was discovered that Nome hunters harvest walrus as far as 75 mi south of Nome. One hunter traveled as far as 125 mi southwest. However, most households hunted about 10 mi from shore to the south and west of Nome, and sometimes used Sledge Island as a base camp (Magdanz and Olanna, 1986; see Fig. III-25). Walrus also are known to congregate near Cape Nome. The use of large, wooden and aluminum boats and outboard motors has allowed residents to expand their walrus-hunting range (Ellanna, 1980). Most hunters in Nome in 1985 were using 18-foot aluminum skiffs with 50 to 90 horsepower motors. The primary Nome walrus harvest occurs from early May to late June, although harvests occasionally occur as early as April and in the last part of June and from September through November (Fig. III-22). King Islanders residing in Nome travel to King Island and harvest walrus for a somewhat longer period that begins in May and runs through the middle of July (Fig. III-26; ADF&G, 1986b). The average number of walrus harvested in Nome from 1980 to 1984 was 554; in 1985 it was 256 (Taylor, Schliebe, and Simon-Jackson, 1985).

Walrus cows and calves and later bulls and barren cows are hunted during the first part of the season, primarily in open water at ice leads or near broken ice. Bull walrus, too, are highly prized for their ivory, an important craft and cash resource in all villages in the study area. Walrus meat is frozen, dried, fermented, or stored in oil (Ahwinona, 1980). Other walrus byproducts provide rawhide line for household use and drum heads for ceremonial occasions and dancing. Walrus hunting is a cooperative effort rather than an individual activity and is done by a crew ranging from four to ten men who are directed by a boat captain (skinboats have crews of 7-10; aluminum boats, now in wide use, have crews of 4-7). Personal interrelationships, social factions, economic distribution, and well-being are all related to the boat-crew composition and the success of the hunt. Walrus products are ritually distributed among crew members, and kinship-based distribution networks provide nutritional and economic support for the entire community (Ellanna, 1980). Changes in technology, particularly the increased use of aluminum boats, have introduced some social changes (kinship ties and sharing) associated with the hunt and its distribution (Ellanna, 1980).

**Waterfowl:** Migratory waterfowl are important subsistence resources, particularly in early spring, when winter food stocks are low and fresh meat is missed. Both birds and eggs are harvested. Waterfowl complements the large, marine mammal component of the subsistence harvest. Seabird rookeries and waterfowl-nesting areas are important sources of eggs in the late spring and summer. Waterfowl are harvested throughout the spring, summer, and especially in the fall when the birds are fat (Fig. III-22; ADF&G, 1986). Nome residents harvest waterfowl primarily in Bluff, Safety Sound, and at Sledge Island. Murres and cormorants are especially abundant at Bluff and Sledge Island. The coastal areas from Topkok Head to Cape Douglas also are used by Nome residents (Fig. III-27). Cranes, Canada geese, brants, puddle or pond ducks, and eider and other sea ducks are the most hunted waterfowl (Magdanz and Olanna, 1986; Magdanz, 1988b). Eggs are gathered by residents of Nome at Bluff, Safety Sound, and Sledge Island (Magdanz, 1988b).

**Bear:** Brown and polar bears also are harvested by a few Nome residents, but are considered more of a nuisance than a food source (Magdanz and Olanna 1986). Both the meat and the hide are utilized by hunters. The polar bear hunt occurs from early December through the end of February (Fig. III-26; ADF&G, 1986). Brown bears are harvested in September, October, April, and May (Fig. III-22) and hunters must have a permit to harvest them--only 1 permit is allowed every 4 years. From 1974 through 1985, only three polar bear were harvested by Nome residents (Schliebe, 1985; Ellanna, 1983a). In 1988, King Island residents in Nome harvested 2 polar bears at Cape Woolley. In a 1985 survey in Nome, only five households reported brown bear harvests. Bears are harvested along the coast and throughout the interior (see Magdanz and Olanna, 1986 for a description of bear-harvest areas).

**Moose:** Moose have been the primary large terrestrial mammals available to hunters in the Nome area since caribou disappeared in the 19th century. Moose are harvested by Natives and non-Natives in Nome. Approximately 71 percent of residents "from elsewhere in Alaska" (generally Non-Natives) harvested moose, while approximately 64 percent of residents "from towns and villages in northwest Alaska" (generally Natives) harvest moose (see Figs. III-21a and b; Ellanna, 1983). With the exception of trout and grayling fishing, moose are the only subsistence resource which is harvested by a larger percentage of non-Natives than Natives. Moose are harvested from the beginning of August through mid-March (see Fig. III-22). Moose hunting occurs from



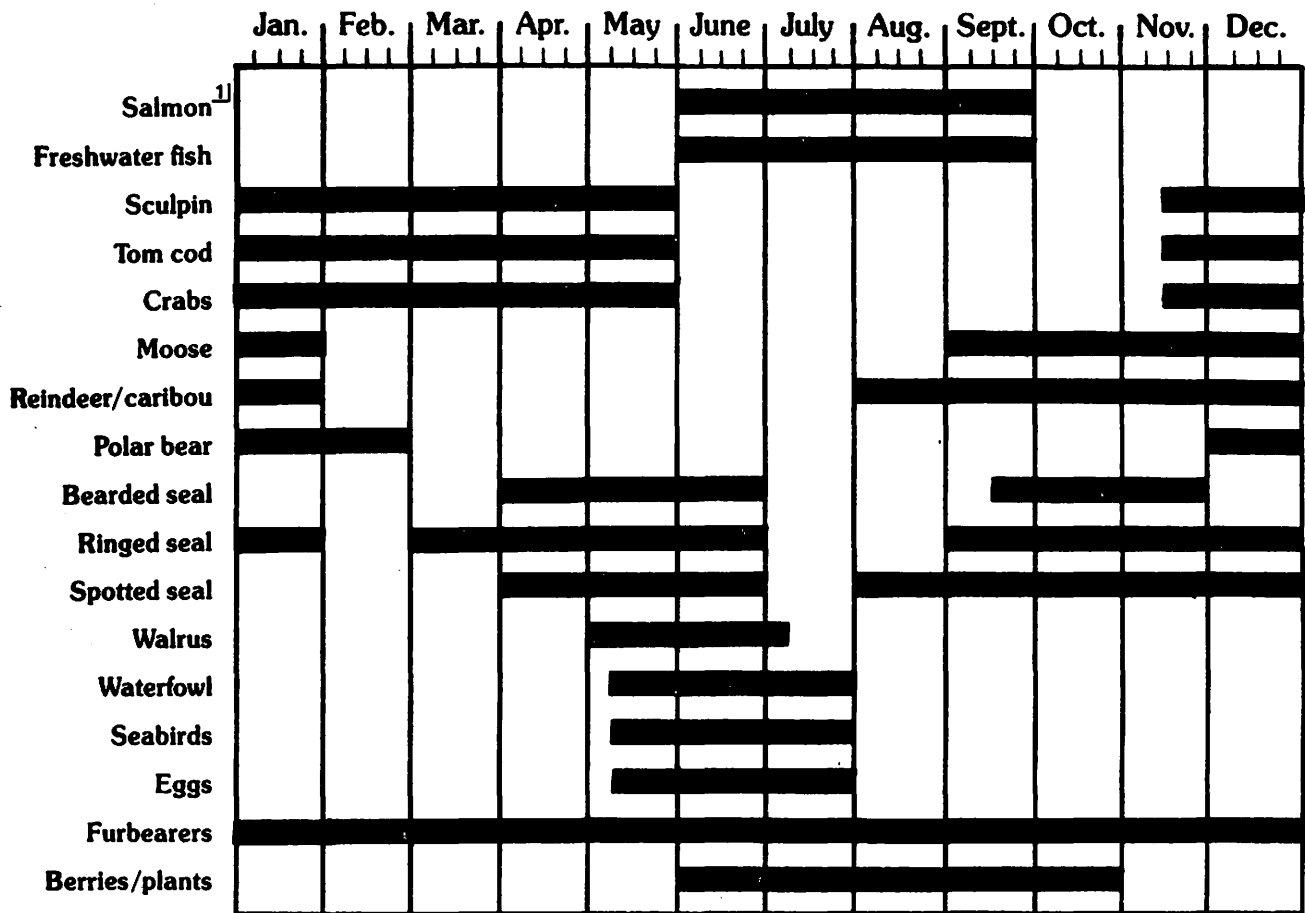


FIGURE III-26. KING ISLAND ANNUAL SUBSISTENCE CYCLE.

<sup>1)</sup> King Islanders reside in Nome and return seasonally to King Island for some of the subsistence activities depicted above.

Source: Ellanna, 1983a.

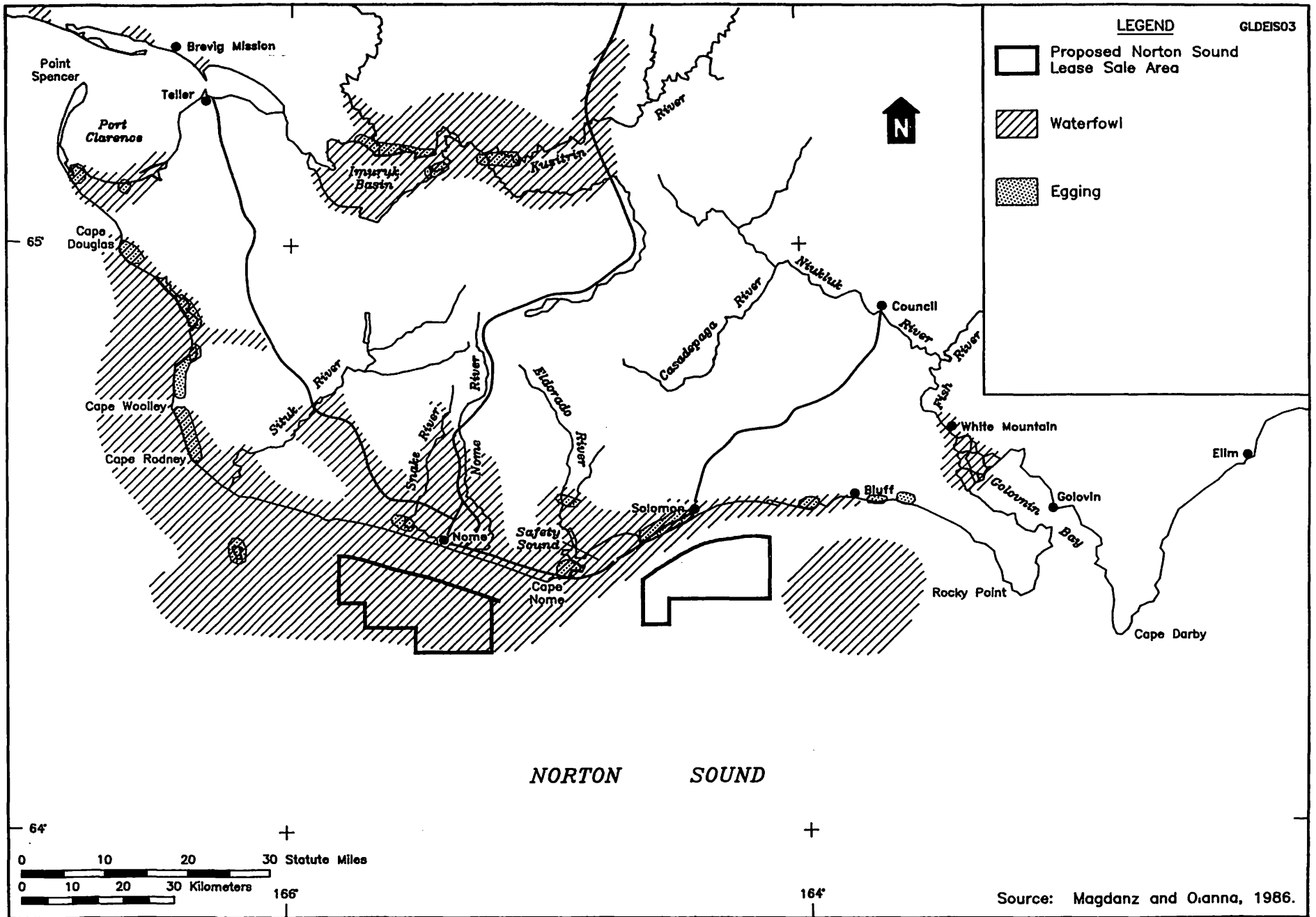


Figure III-27. Nome Subsistence-Harvest-Concentration Areas for Waterfowl and Eggling

the upper Fish River in the east to the American River in the west (see Fig. III-28), however moose harvests are concentrated along the Kougarok Road, the Teller Road, and the Council Road. Roads are used heavily for moose hunting, although some hunters fly into areas more distant from Nome. In areas near Nome the hunting season lasts only 15 days in early September. After the September hunting season, moose hunters must travel more than 50 miles to harvest moose in areas where the hunting season remains open through December or January (Magdanz and Olanna, 1986).

4. **Sociocultural Systems:** This section provides a profile of the sociocultural systems that characterize Nome, which is near the OCS Mining Program Norton Sound Lease Sale area. The topic of sociocultural systems encompasses the social organization and cultural values of the society. The ethnic, sociocultural, and socioeconomic makeup of Nome is primarily Northern and Southern Inupiat, Siberian and Central Yup'ik. Sociocultural systems of this region are described and discussed in detail in the Norton Basin Sale 100 FEIS (Sec. III.C.2; USDO, MMS, 1985a). The following summary is pertinent to the OCS Mining Program Norton Sound Lease Sale and is augmented by additional material, as cited.

a. **Introduction:** The Nome Gold Rush began at Anvil Creek (which feeds into the Snake River) in 1898. Contact with outsiders introduced new economic and social forms; it also brought new diseases to the area and led to a major population decline of Natives. A turn-of-the-century crash in the region's caribou population caused a major reorientation of the socioeconomic systems in the region. For example, the caribou hunters were forced to turn more toward marine mammals and fish; thus, altering the balance between wildlife resources. Nevertheless, profoundly important relationships exist today (as they did in the distant past) between these ecological adaptations and kinship organization, household organization, nonsubsistence-household economics, village economics, village social and political organization, and, finally, the details of habits, beliefs, ideologies, and behaviors that we call "culture."

The following discussion describes Nome, the community that may be affected by the OCS Mining Program Norton Sound Lease Sale. These community-specific descriptions discuss factors relevant to the sociocultural analysis: location of Nome in relation to the dredging activities, population, and current socioeconomic conditions. Social organization, cultural values, and other issues concerning Nome are discussed after the following descriptions. This section deals primarily with the Native sociocultural systems because it is more likely that the non-Native culture would not be affected by the proposed lease sale.

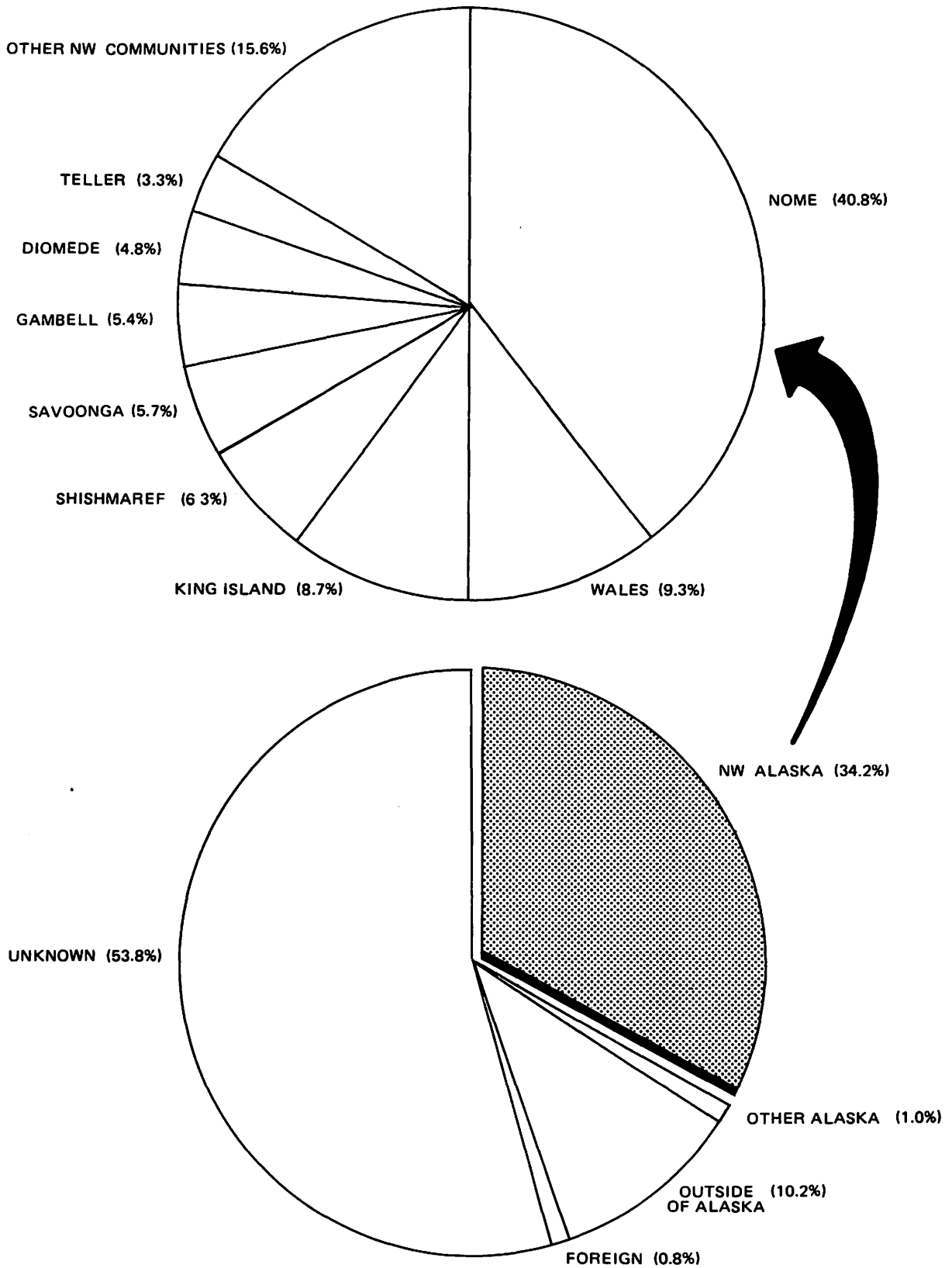
**Nome:** Historically, Nome has been the regional center of the Bering Strait region since the Nome Gold Rush began at Anvil Creek in 1898. In 1900 Nome had a population of 12,488. In 1987, Nome's population was approximately 3,872 (see Sec. III.C.1) which still made it the largest community in the region. The 1980 census determined that 39.1 percent of Nome's population was Caucasian and 58.4 percent Alaska Native (Impact Assessment, Inc., 1987). Using utility lists of occupied households, researchers for a Nome subsistence study (Magdanz and Olanna, 1986) determined that 34.2 percent of the heads of households were born in northwest Alaskan communities (including Nome); this 34.2 percent is predominantly Inupiat with residents whose natal community percentages are as follows: Nome (40.8%), Teller (3.3%), Diomedes (4.8%), Shishmaref (6.3%), King Island (8.7%), Wales (9.3%), and other northwest communities (15.6%). Residents of Nome whose natal communities are Gambell and Savoonga are Yup'ik Eskimos and represent 5.4 and 5.7 percent of the Nome population, respectively (see Fig. III-29).

Nome is the community nearest the lease-sale area (see Figs. III-23 and 24) which could be affected by the proposed lease sale because primary subsistence-harvest areas lie within the proposed sale area, local employees predominantly will be from Nome (rather than other communities in the region), and air- and marine-support will be based in Nome. Nome also will be the base of the mining operations--there will not be a base camp.

b. **Cultural Values:** Traditional Inupiat and Yup'ik values were centered on their close relationship to the land and natural resources, specifically game animals. The Inupiat and Yup'ik had a close relationship to the supernatural with specific beliefs in animal souls and beings who controlled the movements of animals (Burch, 1971; Lantis, 1959; Chance, 1966). Other values included an emphasis on the community and its needs and support of other individuals. The Inupiat and Yup'ik respected persons who were generous, cooperative, hospitable, humorous, patient, modest, and industrious (Ellanna, 1980; Lantis, 1959; Chance, 1966).

Although there have been substantial social, economic, and technological changes in the Inupiat and Yup'ik lifestyle, subsistence continues to be the central organizing value of Inupiat and Yup'ik sociocultural systems. A report entitled, "Does One Way of Life Have to Die So That Another Can Live?" eloquently states the





Source: Magdanz and Olanna, 1986.

FIGURE III-29. NATAL COMMUNITIES OF NOME RESIDENTS

NOTE: The bottom diagram depicts the birthplaces of household heads in Nome in 1985. In this survey, natal communities of non-Natives were not tabulated or some did not respond. Those born in northwest Alaska are shaded, and appear in greater detail in the top diagram.

importance of the Native's cultural survival as imbedded in the subsistence way of life and each individual's personal relationship to the land, the sea, and the resources:

"Our area is not an economically developed area. We depend on the sea for our food and clothing. There is much sharing in the catches, as we realize the needs of our brothers and they realize our needs. It is not joyful to see our children and grandchildren hungry....Everyone of us is Eskimo around here. We all have to eat our own native food, and there is no question about it. We cannot possibly go without it....Please try to fathom our great desire to survive in a way somewhat different from yours, and thus see why the hunters will continue to go out....Over long stretches of unrecorded time, Native Americans established balances with other life on the earth. They survived over the centuries by living in balance with the fish and birds and animals--in balance with the subsistence resources of the natural world....When the balance, or circle of life as it has been called, is broken, birds and fish and animals begin disappearing from the land. When they are gone, so are the people who depended upon them." (Davidson, 1974)

Today, language, culture, spiritual beliefs, customs, and respect for others and for oneself, are still tied into a view of the world which is centered on the traditional hunting, fishing, and gathering way of life. For example, the best hunters or fishermen are often traditional leaders in the community; success at the hunt or at fishing directly influences one's standing in the community. Leadership in newer organizational forms also tends to follow this form. Thus, hunting and fishing still provide the dominant structure around which the community and its people are organized. Task groups are still organized to hunt, gather, and process subsistence foods.

Subsistence is much more than an economic system. The hunt, the sharing of products of the hunt, and the beliefs surrounding the hunt tie families and communities together, connect people to their social and ecological surroundings, link them to their past, and provide meaning for the present. Generous hunters are considered good men. Good hunters are often leaders. These are but some of the ways in which subsistence and beliefs about subsistence join with sociocultural systems. The cultural value placed on kinship and family relationships is apparent in the sharing, cooperation, and subsistence activities that occur in Inupiat and Yup'ik society. However, the value of subsistence also is apparent in the patterns of residence, reciprocal activities, social interaction, adoption, political affiliations, employment, sports activities, and membership in voluntary organizations.

c. **Social Organization:** The social organization of the Inupiat and Yup'ik in Nome is strongly kinship-oriented. The family unit is the basic building block of village society and the social structure of Nome as well. Inupiat and Yup'ik households often include members beyond the simple nuclear family. Moreover, the definition of the family unit includes members not living in the household (Ellanna, 1980, 1983b). Even though Inupiat and Yup'ik family organization has changed since Western contact (see Burch, 1975), the present-day extension of the household and family unit is termed traditional since it has its roots in the earlier, precontact era (Little and Robbins, 1984; Jorgensen, 1984; Ellanna, 1980). In Nome, extended households structure sex and age roles; personal relationships; and subsistence production, sharing, and consumption. These households also are central to the organization of community social interactions, the distribution of goods and services, and the delineation of subsistence-use rights (Ellanna, 1980; Jorgensen, 1984; Little and Robbins, 1984; Wolfe, 1981). In traditional society, kinship obligations ordered and controlled individual behavior (Burch, 1975). Hence, a "stranger" in the community--a person without kin--was viewed as inherently dangerous (Bogojavlensky, 1969). Today, there are other institutions (public safety) for ordering and controlling behavior, but present-day extended households still have major social control functions, and outsiders in the community may still arouse anxiety. Fears exist that newcomers would fail to recognize subsistence-use rights based on long-standing kin relations and would trespass into subsistence territories. Tension about outsiders taking local jobs relates to this as well. The outsiders would be under no obligation to share their wealth with others in the community and, instead, would remove it from the local area. Fears about bootlegging, drug dealing, and other social disruption have similar origins.

Subsistence is important to the organization of the area's extended households and kinship systems. Subsistence plays this role in two ways. First, task groups must be organized to hunt, gather, and process subsistence foods. Whom one cooperates with is a major component of the definition of significant kin ties (Heinrick, 1963). Since tasks are, to a large extent, age and sex specific, subsistence task groups are even important to the definition of the roles of husbands and wives, children and parents, friends, etc. (Thomas, 1982; Jorgensen, 1984; Wolfe, 1981; Little and Robbins, 1984). Second, large amounts of subsistence foods are shared within the community. Whom one gives to and receives from also are major components of the definition of significant kin ties (Heinrick, 1963). Subsistence task-group formation is such a prominent part of the social landscape that it brings a cyclic

(yearly) change to village organization. In winter, people concentrate in central communities; in summer, a large number of people leave to form settlements made up of subsistence task groups at strategic fishing and hunting locations. While this process is most pronounced in other areas in rural Alaska (Wolfe, 1981), it includes the Inupiat and Yup'ik inhabitants of Nome. Cape Wolly, the summer camp for King Islanders from Nome, and Fort Davis are good examples of resettlements for fishing (Magdanz and Olanna, 1984). Thus, the "fish camp" may be seen as the organizational unit during the summer. Kinship ties help structure such things as marriage choices, subsistence pursuits, the sharing of subsistence products, and the purchase of household goods.

5. **Archaeological Resources:** Prehistoric and historic sites comprise the archaeological resources both offshore and onshore of the Norton Basin area. These resources, which include shipwrecks, represent the remains of the culture of past generations of the region's inhabitants. These resources are basic to our understanding of the knowledge, beliefs, art, customs, property systems, and other aspects of the prehistoric and historic culture. The three major categories of archaeological resources identified in the Norton Basin area are discussed in the following order: prehistoric onshore landforms and sites, offshore prehistoric landforms and sites, and historic shipwrecks. The predominant type of prehistoric resources found on the shores near the proposed Norton Basin sale area are housepits containing the household and subsistence artifacts of early people (stone lamps, sinkers, arrowheads, etc.). Historic artifacts found onshore near the proposed sale area consist of old houses, roadway inns, fish camps, mining camps, and downed World War II aircraft (See Table III-16 for National Register sites). For a more detailed analysis of archaeological resources in the Norton Sound area, see the Sale 100 FEIS (USDOI, MMS, 1985a), Alaska OCS Technical Paper No. 2 (Tornfelt, 1981), and Alaska's Cultural Resources (Leicht, 1980) (also see Fig. III-30).

Submerged prehistoric sites, if found in association with offshore landforms, would be similar to those prehistoric resources listed above. Such sites may have been scattered by tidal currents and ice gouging (Hopkins, 1967). Remote sensing surveys prior to dredge emplacement would not locate individual artifacts, as the resolution of the subbottom profiler and sidescan sonar will locate only objects 1 m or larger in size. However, both instruments have sufficient resolution to locate the landforms within which prehistoric sites are likely to be found.

Remote sensing surveys prior to dredge emplacement could locate sunken ships within the boundaries of the proposed sale area. The sidescan sonar would detect any ship remains of a meter or more in size that protruded above the seafloor, and the magnetometer could detect ferrous remains of a shipwreck at the seafloor or buried beneath the seafloor if the magnetometer sensor passed close enough to the object.

Dixon, Sharma, and Stoker (1976) suggested that landforms with associated archaeological sites could probably be found by applying similar reasoning as to why existing onshore village sites are located where they are: there must be food available that can be obtained in sufficient quantities to be stored for the winter. This would suggest locations along the shore of the Bering Sea, on the rivers and their valleys, and on the slopes of hills facing south. From studies of bathymetry, probabilities for prehistoric site occurrence were applied to all OCS lease blocks. One can find these mapped blocks in the report of Dixon, Sharma, and Stoker (1976). The MMS archaeological analysis for Norton Basin Sale 100 (Friedman, Schneider, and Bowers, 1984; Appendix E, MMS, USDOI, 1985a) discusses possible archaeological sites on the Bering Land Bridge. The 1988 archaeological update analysis done by the MMS Alaska OCS Region (see Appendix A) was done for the OCS Mining Program and verifies some of the previous report and also adds new information and interpretation.

The 1988 MMS update report states that a major paleochannel occurs within the proposed sale area (Hess, 1982). (See official Protraction Diagram Nos. 3-8, Block Nos. 586 and 587). This paleochannel may have been active when ancient hunters occupied the area at the close of the last Ice Age. This channel is a high-potential area for prehistoric-site occurrence. However, archaeological sites within this channel might have been destroyed by channel migration and thermokarst erosion of the banks during subaerial exposure. Nevertheless, the underwater landform with potential sites can be detected and is a potential resource.

The 1988 MMS update report concludes that shipwrecks within the sale area could survive the prevailing currents and storm waves. Ice gouging in northern Norton Sound, though present, is not abundant and reflects isolated encounters of pack ice. Modern depositional processes are not sufficient to bury a shipwreck. A shipwreck on the seafloor probably could be identified by sidescan sonar required for site-specific geohazard surveys. A number of shipwrecks lie on the seafloor (see Appendix A). In the early Russian period, an average of nine ships a year were sent from Russia to the Bering Sea; three of every nine were lost.

Russian losses, as well as those that occurred later, were attributed to poor marine engineering, unpredictable winds, frequent storms, general ignorance of climatic conditions, and navigational hazards in coastal areas and



Table III-16  
National Register Eligible and Listed Properties in the Vicinity  
of the Proposed OCS Mining Program Norton Sound Lease Sale Area  
that Could Be Affected by the Cumulative Case

AHRS File No.	Name	Date of Site	Date on Register
TEL 021 10/09/74	Norge Storage	1926 AD	NHR <sup>1/</sup>
TEL 025	Hillside Site	No Date	NHS12/29/62
TEL 026	Beach Site	No Date	NHS12/29/62
TEL 031	Birnirk Burial Mound	500 AD	NHS12/29/62
TEL 054	Iyapana House	No Date	NRE11/16/73
TEL 079	Kurigitavik Mound	No Date	NHS12/29/62
NOM 018 08/03/77	Sally Carrighar House	1904 AD	NHR
NOM 021 <sup>2/</sup> 12/21/65	Anvil Creek Dist. Site	1898 AD	NHR
NOM 032 <sup>2/</sup> 12/19/78	McClain Home	1900 AD	NHR
NOM 036 04/11/77	M.V. <u>Donaldson</u> (Shipwreck)	1907	NHR
NOM 038 <sup>2/</sup> 12/21/76	E.O. Lindbloom Placer Creek	1898 AD	NHR
NOM 039	Snow Creek Placer Claim	1898	NHL09/28/77
NOM 042 04/03/80	Discovery Lagoon	1901	NHR
SOLO 031 <sup>2/</sup> 03/22/79	Solomon Roadhouse	1904 AD	NHR
SOLO 069 12/12/76	Cape Nome Roadhouse	1900 AD	NHR
NOB 002	Iyatayet	5000 BC	01/20/61
UKT ---	None Listed	---	---
SMI 014	Trading Post or Redout		
	St. Michael	1833 AD	04/01/76
SMI 015	U.S. Fort St. Michael	1897 AD	04/01/76

Source: State of Alaska, DNR, Alaska Heritage Resources File, 1985.

<sup>1/</sup> Code: NHR--National Register of Historic Places and date; NHS-- National Historic Site (within NHR District) and date; NRE--Date eligible for National Register as determined by the Secretary of the Interior.

<sup>2/</sup> Within the sale area; all other entries adjacent to the sale area.

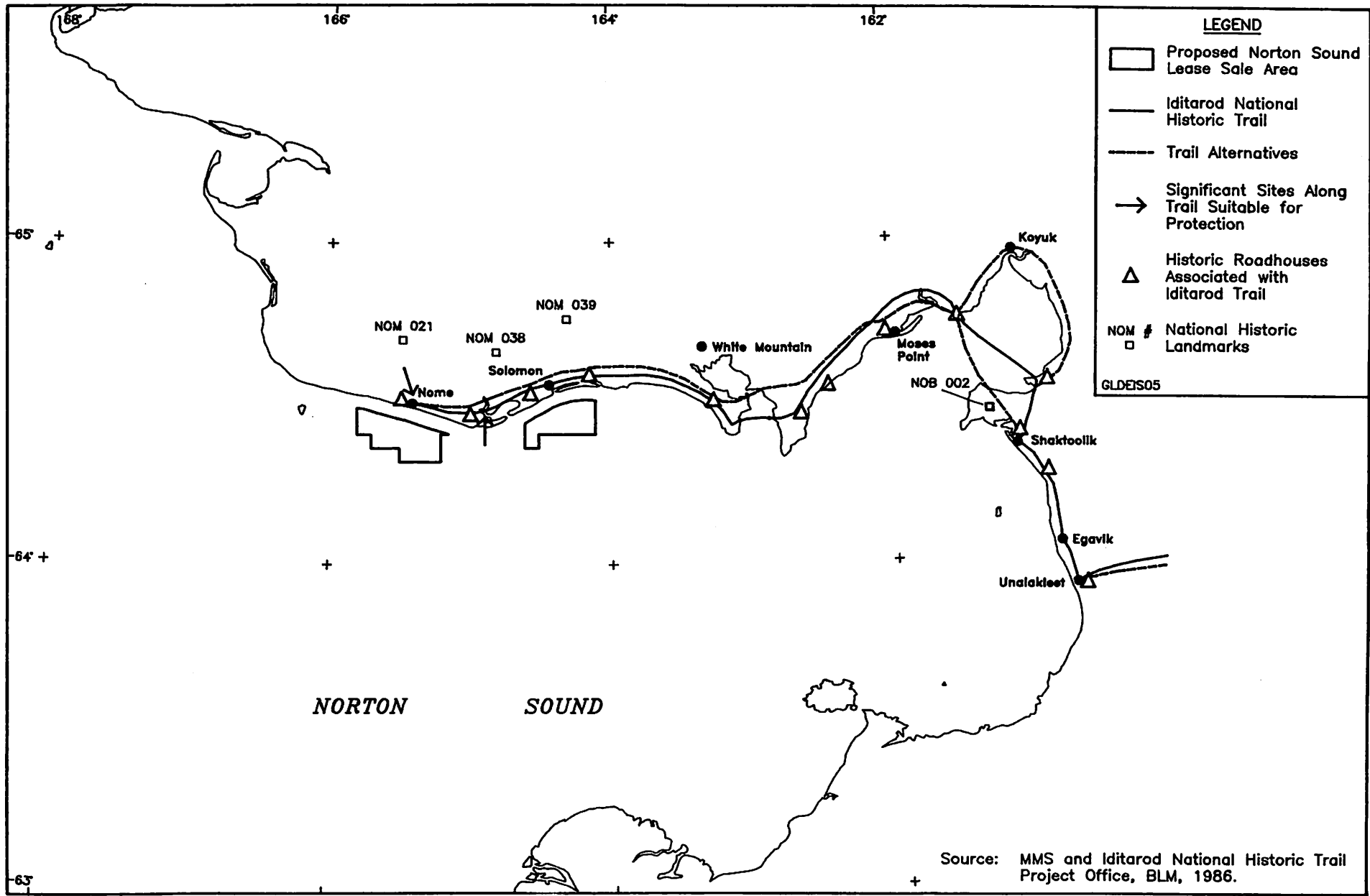


FIGURE III-30. PREHISTORIC AND HISTORIC ARCHAEOLOGICALSITES AND THE IDITAROD NATIONAL HISTORIC TRAIL

shoal waters. Often, vessels were trapped by ice in the Bering Sea and, before winter was over, many were crushed and all had to be abandoned. Tidal currents, the fast flow of water through the Bering Strait, and ice gouging may have destroyed shipwrecks in that area, but some may remain undisturbed in other areas. Approximate shipwreck locations in and near the Norton Sound area are in the shipwreck update report (Appendix A). Data from the entire Norton Basin area is included in Table 2 in the MMS publication, Shipwrecks of the Alaskan Shelf and Shore (Tornfelt, 1990). Remarkably few lives were lost in these wrecks according to the U.S. Customs records for that period. A total of approximately \$350,000 worth of ships was lost in the Norton Sound between the years 1850 and 1915 (about \$3.5 million in today's prices). About \$150,000 was lost in cargo during the same period (\$1.5 million in today's prices). Cargoes were mainly merchandise, provisions, mining tools, gold ore, whale oil, whale bone, ivory, pelts, coal, and large quantities of salt (U.S. Customs Reports, 1880-1920). Routes taken by the vessels were most frequently round trips between St. Michael and Cape Nome, San Francisco and Unalaska, St. Michael and Fort Gibbons (Tanana), St. Lawrence Island and Port Clarence, St. Michael and Dawson (up the Yukon River), St. Michael and Unalaska, and San Francisco and St. Michael. St. Michael was the departure point for Alaska gold from upriver Yukon prospects, prospects north and east of Nome, and from Unalakleet. It was in St. Michael that smaller ships loaded cargo to larger vessels going to San Francisco (Tornfelt, 1990).

6. **Recreation and Tourism Resources:** The State Division of Parks, the Joint Federal-State Land Use Planning Commission, and the Resource Allocation Section of the Alaska Department of Natural Resources have identified certain areas in the Norton Sound region which have recreation and tourism resource values (NWAP, State of Alaska, DNR, 1976, 1988; Joint Federal-State Land Use Planning Commission, 1978). These values attract visitors to the area as shown by the Alaska Department of Commerce and Economic Development study State of Alaska, Dept. of Commerce and Economic Development, 1983; State of Alaska, Division of Tourism, 1986). The Alaska "Travelers Survey and Visitor Industry Analysis" reported that of all surveyed visitors to Alaska about 2 percent visited Nome and adjacent surroundings. Therefore, of the approximately 645,960 visitors to Alaska from October 1982 to September 1983, a substantial number visited the Nome area at least once. Of these visits to Nome, about 0.4 percent spent the night. The report states that an average of 450 people in Nome were employed as a result of the visitors and brought in about \$8.23 million in total wages to the City of Nome in addition to the money left by the visitors. In the 1986 report done by the State of Alaska, Division of Tourism (1986), a summer visitors survey reported 2.2 percent, or 9,700 people, visited Nome; of these visitors 6.0 percent stayed overnight. This is a considerable increase over the previous report. No explanation is given for the increase since these two reports do not contain information for interpreting the difference. The Northwest Area Plan specifically mentions the recreational and tourism value of Safety Sound.

a. **The Kigluaik Mountains:** These mountains (inland from Nome) are visually and scenically distinctive. Some recreational areas inland from Norton Sound, and the Seward Peninsula retain wilderness qualities that attract residents of Alaska and visitors from outside Alaska. The following paragraphs give examples.

The Bering Land Bridge National Preserve (BLBNP) (inland and north by road from Nome) is a remnant of the land bridge that once connected Asia with North America more than 13,000 years ago (USDOI, NPS, 1985). The land bridge itself is now covered by the Chukchi and Bering Seas. During the glacial epoch, this was part of a migration route for people, animals, and plants whenever ocean levels fell enough to expose the land bridge. Scientists find it one of the most likely regions where prehistoric Asian hunters entered the New World. Geologic features and beach ridges in the Preserve make interesting viewing for sightseeing from aircraft. The southern part of these areas of recreation and tourism interest may also be reached by road from Nome. The road network includes three routes as part of the State highway system. These routes are between Nome and Teller (approximately 116 km) (in the southwest BLBNP), between Nome and Taylor (approximately 138 km) (in the southcentral BLBNP), and between Nome and Council (approximately 118 km) (in the southeast BLBNP) (TRA/Farr, 1983). During the winter, the roads are maintained only in the vicinity of local communities. Major improvements to the Nome/Council highway are ongoing. In 1983 a road northeast of Nome was constructed, and the highway between Mile 3 and Cape Nome was realigned and resurfaced in FY 1985. Today, Inupiat from neighboring villages pursue subsistence lifestyles and manage their reindeer herds in and around the Bering Land Bridge National Preserve. Some 112 migratory bird species may be seen here along with seals, walrus, and whales. Grizzly bears, fox, wolf, and moose and other wildlife also inhabit the Preserve. Other interesting features attracting tourists are: rimless volcanoes called maars; Serpentine Hot Springs; ancient beach ridges (showing prehistoric human occupation); and seabird colonies at Sullivan Bluffs. This area, operated by the National Park Service, is a resource with high concentration of aesthetic recreation and tourism resources.

Provisions of the Alaska National Interests Lands Conservation Act (ANILCA) do not include the creation of any wilderness units within the coastal region of Norton Sound. The Act authorized the creation of the Andreafsky Wilderness of approximately 1,300,000 acres within the Yukon Delta National Wildlife Refuge (also created by the Act). However, this area is located at least 15 mi inland from the southern coastline of the Norton Sound/Pastol Bay region. Its inland location reduces the economic effect from the income of visitors and enhances its aesthetic qualities with regard to recreation and tourism.

In addition to the important cultural values associated with subsistence activities there are also recreation values. For Nome's population, sport hunting, sport fishing and crabbing, and berry picking are also forms of recreation. These activities occur seasonally with the species or resource of interest. Refer to Section III.C.3 for a discussion of subsistence use and dependence patterns in Nome.

b. Areas near Golovin, Bluff, Solomon, White Mountain, Council, and Nome: These areas are visited most frequently by tourists because of their intrinsic cultural and recreational qualities. Evidence of man's intrusion in the area includes: (1) mine tailings along the foothills of the Kigluaik Mountains; (2) various artifacts from previous settlements and extractive operations, e.g., vessel wrecks, debris, etc.; (3) trails and routes visible in tundra and wetland environments; and (4) current maritime commerce and subsistence use of coastal areas (such as subsistence fishing sample). Although this evidence of human activity technically disqualifies much of Norton Sound and the Yukon Delta from legislative wilderness designation, it makes the area attractive for tourism and increases the property values with regard to recreation and tourism.

Not far from the present city of Nome, the first gold was discovered on Anvil Creek in the fall of 1898. This discovery brought a horde of prospectors and adventurers from all over the world. By the fall of 1900, over 12,000 people had arrived at the gold fields. By 1901, more than \$2 million in gold had been recovered from the "Golden Sands" and Anvil City became incorporated as the City of Nome. From the beach, the prospectors moved inland to pan the streams in the foothills and tundra directly north of Nome. By 1911, over \$60 million in gold had been extracted from Seward Peninsula mines. By 1905, the city was a settlement of 5,000 residents and had become the economic hub of the Seward Peninsula. What remnants remain of this gold-rush era can help recapture, to some extent, this past history.

One of the world's largest and still operating gold dredges (Dredge Number 5) has been known to recover over 20,000 ounces of gold in one summer. The countryside around Nome has many old, rustic, steam-operated engines that stopped operating when the gold fields ran out of pay dirt. A park is under development where visitors can walk among such equipment and imagine the days of the gold-rush era.

A significant recreational and tourism event in the region is the annual Iditarod Sled Dog Race in March. This race involves mushers and dog teams who travel more than 1,000 mi from Anchorage to Nome. The race commemorates the historic Iditarod Trail which was made popular by a dash to Nome with diphtheria serum. This humanitarian event caught the nations interest and made the trail famous. The trail was originally developed to support surface transportation to the Interior and Nome during the gold rush days. The diphtheria run was made on a slightly different route than is used for the present Iditarod race. The modern Iditarod Trail has been designated a National Historic Trail by Congress (16 U.S.C. 1241). A comprehensive plan is being prepared for the Iditarod National Historic Trail pursuant to this Federal statute. A draft version of the plan includes recommendations for the protection and management of the trail (USDOI, BLM, 1981d). Figure III-30 identifies the Iditarod Trail route in or near Norton Sound. Certain reaches of this route are recommended for protection from any activity or development which would alter the recreational and historic features of the trail system. The trail segments from Nome to Elim and from Unalakleet to Kaltag are the most significant in terms of historic value and are therefore valuable for tourism and recreation. Also, three sites--the City of Nome, the Cape Nome Roadhouse, and the Solomon Townsite and Roadhouse--are also valuable resources. Recent use of the trail includes the Iron Dog Race, a snowmachine race between Anchorage and Nome that occurs at about the same time as the Iditarod race, and also a race on crosscountry skis and snowshoes.

Recreation programs in Nome are organized primarily by the City of Nome and to a lesser degree by the Community Center and other local organizations. These programs include organized and intramural sports for school children, an adult softball league, a summer day-camp, an ice rink and ice skating programs, community arts and crafts classes, basketball, volleyball, bowling, cross-country skiing, and other activities. Even a golf game is played on the ice with an orange ball at the Iditarod festival. Special recreational events sponsored by business organizations include the Iditarod Sled Dog Race and the Iron Dog Race in March and the Midnight Sun Festival in June. Municipal recreational facilities generally meet or exceed the standards recommended by the National Parks and Recreation Association for a community the size of Nome (Technical Report No. 53,

USDOI, BLM, 1980). A more detailed discussion of recreational activities and facilities in the City of Nome and vicinity are contained in Technical Report No. 53. In the summer and sometimes in the winter most of these recreational programs are available to tourists.

## 7. Land Use Plans and Coastal Management Programs:

a. Land Use Plans: Several areas along the north shore of Norton Sound are included within the Alaska Maritime National Wildlife Refuge (Alaska Maritime Refuge), established in 1980 by ANILCA. Those areas include Sledge Island, Safety Sound/Barrier Island, Topkok Head, Bluff, and Cape Darby.

The major purposes for which this refuge system was established and is to be managed are: "(i) to conserve fish and wildlife populations and habitats in their natural diversity...; (ii) to fulfill the international treaty obligations of the United States with respect to fish and wildlife and their habitats; (iii) to provide, in a manner consistent with the purposes set forth in subparagraphs (i) and (ii), the opportunity for continued subsistence uses by local residents; (iv) to provide, in a manner consistent with subparagraphs (i) and (ii), a program of ... scientific research on marine resources; and (v) to ensure to the maximum extent practicable..., water quality and necessary water quantity within the refuge" (ANILCA Section 303[1][B]). Several levels of management are available to the FWS. "Intensive management" allows the most human use and is the least protective level; typically, military installations fall into this category. "Moderate management" reduces the extent of human developments allowed in the previous level and typically is used as a buffer to the military installations. "Minimal management" provides protection for fish and wildlife populations and habitats and restoration of endangered species to natural levels. The final level of management is "designated wilderness" which is similar to the minimal management category for permitted administrative and public uses but different in the use of permitted motorized equipment, oil and gas activity, commercial uses, and requirements for routing transportation or utility systems.

Section 304 of ANILCA requires that the FWS develop a Comprehensive Conservation Plan to guide the management of the Alaska Maritime Refuge. The FWS prepared an FEIS evaluating the consequences of three alternative management plans and selected a preferred alternative. The FWS must now prepare detailed management plans to identify specific actions that are necessary to implement the Comprehensive Conservation Plan and achieve its goals and objectives.

In all three alternatives assessed in the FEIS, the areas identified above in Norton Sound would be in a minimal management strategy with the exception of the roadbed in the Safety Sound/Barrier Island portion which is identified as an area for intensive management. The FEIS evaluation included several activities in the base case--mining off the coast of Nome with the Bima, mining off the coast of Bluff, monitoring seabirds near Bluff, and removing barrels of oil-product residue from Sledge Island. The analysis indicates that turbidity and an increase in concentrations of trace metals, such as mercury, are potential problems associated with the offshore dredging.

The Alaska Department of Natural Resources developed a plan to guide the management of the State's uplands, tidelands, and submerged lands in northwest Alaska. The area adjacent to this lease sale area is included in the North-west Area Plan in the Southwest Seward Peninsula Subregion. In this area, nearly all State lands will stay in public ownership and will be managed for multiple uses. Primary uses are mining, fish and wildlife habitat and harvests, reindeer grazing, subsistence, and recreation. Almost all State land will remain open for mineral entry. Exceptions to this include land disposal areas immediately prior to their sale and uplands and tidelands within one-quarter mile of six important seabird colonies, including Topkok Head and Bluff. Mining can occur within one mile of the mouths of anadromous fish streams and Safety Sound only after information has been provided to the State resource agencies that establishes that the mining and related activities will avoid significant adverse effects to anadromous fish and their habitat. All areas will remain open for coal, oil, and gas leasing (State of Alaska, DNR, 1989).

b. Coastal Management: The Federal Coastal Zone Management Act (CZMA) and the Alaska Coastal Management Act (ACMA) were enacted in 1972 and 1977, respectively. Through these acts, development and land use in coastal areas are managed to provide a balance between the use of coastal areas and the protection of valuable coastal resources. The provisions and policies of both the Federal and State Coastal Management Programs (CMP's) are described in MMS Reference Paper 83-1 (McCrea, 1983), which is summarized in the following paragraphs and incorporated by reference in this EIS. Policies of the Alaska CMP (ACMP) may be refined through local coastal programs prepared by coastal districts according to State guidelines and standards and approved by the Secretary of the U.S. Department of Commerce through the Office

of Ocean and Coastal Resource Management (OCRM). Descriptions of the district programs in the sale area follow that of the ACMP.

(1) Statewide Coastal Management Standards: The ACMP, as initially approved by OCRM includes the ACMA, guidelines and standards developed by the Coastal Policy Council (CPC), a series of maps depicting the interim boundaries of the State coastal zone, and an EIS prepared by OCRM. The statewide standards that may be relevant to activities hypothesized in this EIS are summarized in the following paragraphs under three headings: coastal habitats, coastal resources, and uses and activities.

Coastal Habitats: Eight coastal habitats were identified in the standards-- offshore; estuaries; wetlands and tidelands; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes; and important uplands. Each habitat has a policy specific to maintaining or enhancing the attributes that contribute to its capacity to support living resources (6 Alaska Administrative Code [AAC] 80.130[b] and [c]).

Activities and uses that do not conform to the standards may be permitted if there is a significant public need, no feasible prudent alternatives to meet that need, and all feasible and prudent mitigation measures are incorporated to maximize conformance. Habitat policies frequently are cited in State consistency reviews.

Coastal Resources: Two policy areas come under the heading of coastal resources: (1) air, land, and water quality, and (2) historic, prehistoric, and archaeological resources. In the first instance, the ACMP defers to the mandates and expertise of the Alaska Department of Environmental Conservation (DEC). The standards incorporate by reference all the statutes, regulations, and procedures of the DEC that pertain to protecting air, land, and water quality (6AAC 80.140). Concerns for air and water quality are cited frequently during State reviews for consistency. The policy addressing historic, prehistoric, and archaeological resources requires only identification of the "areas of the coast which are important to the study, understanding, or illustration of national, state, or local history or prehistory" (6AAC 80.150).

Uses and Activities: Nine topics are addressed under this heading: coastal development, geophysical-hazard areas, recreation, energy-facility siting, transportation and utilities, fish and seafood processing, timber harvesting and processing, mining and mineral processing, and subsistence. Uses and activities of particular relevance to the activities hypothesized for this OCS lease sale include coastal development, mining and mineral processing, and subsistence.

Both the Federal CZMA and the ACMP require that adequate consideration be given to uses that are of greater than local significance (CZMA Sec. 306[d][8] and AS 46.40.060). Among the uses of State concern are (1) large-scale industrial projects including nonfuel minerals, and (2) conservation of water quality in compliance with the Alaska Water Quality Standards (Alaska CPC Resolution No. 13).

(2) Local Coastal Management Districts: After the adoption of a district program by the Alaska Coastal Policy Council (CPC) and OCRM, a coastal management program (CMP) developed by a coastal district is fully incorporated into the ACMP. Typically, district policies supplement the Statewide standards; they replace Statewide standards only if they include all that the Statewide standard does and do so more explicitly. This section describes the CMP's of coastal districts bordering Norton Sound.

Two coastal districts border the northern shore of Norton Sound--Nome and the Bering Straits Coastal Resource Service Area (BSCRSA). Both have been fully incorporated into the ACMP. Ceñaliurrit (the Yukon Kuskokwim CRSA) is located on the southern shore of Norton Sound. Ceñaliurrit's CMP also has been fully incorporated into the ACMP.

Nome: The City of Nome, which is within the boundaries of the BSCRSA, developed a district CMP independent of the BSCRSA. The Nome CMP (NCMP) was fully incorporated into the ACMP in March 1984. The following description summarizes and incorporates by reference the description of the NCMP published in the Norton Basin Sale 100 FEIS (USDOI, MMS, 1985a). Nome's CMP is designed to facilitate development without allowing development to overwhelm local capabilities to plan and finance public facilities.

The NCMP has two sets of policies (District and City-wide), four land-use districts (General Use, Industrial, Open Space, and Resource Development), and two overlay districts (Historical and Flood Hazard). District standards address a variety of issues including construction standards and mining regulations (NCMP 20.080 et seq.). These standards are applied only in specified districts and often only to particular uses within the

district (Table III-17). City-wide standards address air, land, and water quality; transportation and utilities; recreation; community effects; and subsistence (NCMP 25.010 et seq.). City-wide standards concerning community effects are unique to Nome's program. For example, employers intending to hire or transfer into Nome a workforce equaling 5 percent of the Nome population in any one year must show that adequate housing exists and that housing vacancy rates will remain above 5 percent.

**Bering Straits Coastal Resource Service Area (BSCRSA):** The BSCRSA extends from just north of Shishmaref on the Chukchi Sea to Pastol Bay on the south shore of Norton Sound. It includes a major portion of the Seward Peninsula. The BSCRSA Board was elected in 1980 and conceptually approved its CMP (the BSCMP) in 1986. The CPC approved the program in July 1987. It was approved by OCRM in December 1989 after questions concerning BSCRSA'S inland boundary and the designation of important use areas were resolved.

Subsistence activities traditionally have been the primary and highest priority use of land and water within the BSCRSA. This premise is stated in the first policy of the BSCMP. Subsistence resources are the foundation of the region's mixed subsistence/cash economy, and subsistence continues to play a vital role in the continued survival of the region's cultures and lifestyles. The BSCMP focuses on promoting development that is in balance with the region's mixed subsistence/cash economy.

Air, land, and water quality policies incorporate the statewide standards of the ACMP. Among the topics specifically noted is the handling of hazardous substances. Public involvement and effectiveness of the technology for handling the wastes are emphasized in these policies.

Several topics included in the BSCMP relate specifically to activities onshore and have only peripheral relevance for this EIS. Of the remaining policies, three developed to regulate offshore mining are of direct relevance. First, extraction activities must avoid significant negative impacts to "important and essential habitats, commercial fishing activities, subsistence harvest activities, and navigation" (Policy G-8.1). Second, unless it is more harmful, dredged and processed materials must be discharged in the area from which they were extracted (Policy G-8.3). Last, the discharge or resuspension of toxic substances in the processing effluent may neither exceed State or Federal water quality criteria nor "contribute to additional bioaccumulation of toxic substances in marine organisms or fish" (Policy G-8.4).

The BSCMP also contains policies that are directed toward "important use areas." The intent of classifying important use areas was to develop a limited number of specific policies that provide guidance for activities taking place within areas so classified. By identifying these areas, the BSCMP provides notice that these areas are of particular concern to the residents and presents information on each site that should be used when complying with the policies of the BSCMP. Safety Sound, the Nome River drainage, and the area between Rocky Point and Topkok Head are among the sites designated. Policies directed toward important use areas with respect to habitat, subsistence, mining, and historic sites would apply to Safety Sound. Policies for important use areas related to habitat, subsistence, and recreation would apply to the Nome River drainage. The Rocky Point to Topkok Head area would be subject to important-use-area policies related to habitat, subsistence, and historic sites. Two subsistence policies (BSCMP A-4 and A-5) specifically reference the designated "important use areas."

Twelve areas also were nominated as "areas which merit special attention" (AMSA's). These areas will be presented to the CPC for AMSA designations when management schemes specific to each area are completed. Three of the areas nominated are near the lease sale area: Safety Sound, Cape Nome, and Nome River. No specific management schemes have been prepared as yet.

**Ceñaliulriit:** In 1979 the CRSA was established and the CRSA Board elected. The program was fully incorporated into the ACMP in March 1985. The Ceñaliulriit boundary coincides with the coastal boundaries of the Calista Corporation and extends from Pastol Bay north of the Yukon Delta in Norton Sound to Hagemester Strait at the entrance to Bristol Bay. The city of Bethel, which is within these boundaries, developed a CMP independent of Ceñaliulriit. This area is quite distant from the lease-sale area, and as a result, only policies that address far-ranging species are described.

Ceñaliulriit's program reflects the hunter-gatherer culture of the region, the residents' dependence on the land and the renewable resources of the region, and the residents' preference for retaining their indigenous culture. The goals, objectives, and standards of the Ceñaliulriit CMP are arranged under 14 issues.

Table III-17  
Application of Standards in the Nome  
Coastal Management Program

Standards	Districts			
	Industrial <sup>1/</sup>	Open Space <sup>2/</sup>	Resource Development <sup>3/</sup>	General Use <sup>4/</sup>
<b><u>District Standards</u></b>				
Dredge and Fill (20.080)	XL <sup>5/</sup>	X	XL <sup>5/</sup>	
Mining (20.110)	L		L	
Petroleum Products and Toxic Substances Storage (20.150)	L		L	
Piers, Docks, and Related Shoreland Construction (20.160)	L	L	L	
Residential Uses in Resource Development District (20.190)			L	
Shoreline Setbacks (20.200)	X	X		
Stream Protection (20.220)			X	
Water Dependency (20.240)	X	X	X	
<b><u>City-Wide Standards</u></b>				
All standards under this category (25.010-20.050)	X	X	X	X

Source: MMS, Alaska OCS Region, 1988.

X -- Applies to all uses and activities permitted in the district.

L -- Specifically identified as applying to a particular use permitted in the district.

<sup>1/</sup> The new port facility and upland areas adjacent to the port are within this district.

<sup>2/</sup> Most shoreline areas and the waters of the Snake River are included in the Open-Space district.

<sup>3/</sup> This district includes all the offshore area and most of the land outside the port district, townsite, and two airports. Mining and transportation uses are priority uses. All others must be reviewed for compatibility.

<sup>4/</sup> This district includes the townsite, the two airports, and several isolated areas. Mining and industrial uses are not included among the permitted uses.

<sup>5/</sup> Although the dredge and fill policy applies to all uses and activities in the district, the policy also is identified as a specific limitation to particular uses or activities.



The first issue establishes the standards for compliance and the ground rules that Cenāliulriit will follow. The standard for this issue applies the concept of reasonable balance. Assuming that the public benefit outweighs the problems, that the action is consistent with sound engineering practices, and that the noncomplying aspects are limited, development may occur despite problems if the sponsor of the action, the government agency making the determination, and Cenāliulriit work together to solve the problems. Of the remaining issues, Issues 2 and 5 are the most relevant; they relate directly to protecting subsistence uses that may include far-ranging species.

The standard for Issue 2 requires that the government agency making the consistency determination be sensitive to the implications of the action on the Yup'ik culture and obtain adequate information about the culture, local subsistence economy, and ecosystem before deliberation takes place concerning new development.

Most of the standards under Issue 5 relate to habitat within the Yukon-Kuskokwim Delta and not the offshore area. However, the first two standards are broad and therefore, could have some application. First, government agencies making the consistency determination must analyze "possible adverse impacts of the action on subsistence use" and provide safeguards "to assure subsistence use" (Cenāliulriit CMP, 5.1). Second, the action must not "curtail the age-old hunter-gatherer culture of the Yupik" (Cenāliulriit CMP, 5.2).

#### **D. Human Health**

Previously reported elevated levels of mercury in the water column (see Sec. III.A) and elevated mercury and arsenic levels in soils in the Nome area have raised concerns about mercury and arsenic as a health issues. However, a recently conducted MMS study on methylmercury-hair levels in Nome women of childbearing age indicate that methylmercury levels are low in the population (Crecelius, Apts and Lasorsa 1990). Other trace metals (see Sec. III.A) were not considered a human health concern because they do not bioaccumulate in the food chain. This section provides a description of background mercury and arsenic levels as they relate to the human health of Nome residents.

1. **Mercury Levels in other Areas in Alaska and Canada:** The only published research on mercury-hair levels in humans conducted in Alaska has been a study done on Alaskan Yupik mothers with infants (Galster, 1976). A comparison was done of mercury levels in umbilical cord blood, placenta, maternal blood, hair, and milk of 38 maternal-infant pairs from Anchorage and the Yukon-Kuskokwim Delta. The average red blood cell (RBC) and placental mercury levels were two to four times higher in both mothers and infants from the Yukon-Kuskokwim Delta than from Anchorage (see Table III-18). Additional increases of average mercury levels of RBC from mother and infants appeared in comparisons of the respective levels from the interior and coastal villages on the Delta. The average mercury levels in placental tissue from women eating seal meat or fish every day were four to five times greater than those from women who ate marine food less frequently. The fetus appeared to concentrate the mercury from its mother; the RBC mercury level of coastal infants was nearly two times greater than that of the mothers (Table III-18). Mothers who ate seal oil twice a day and seal meat or fish from the Yukon-Kuskokwim coast every day, had an estimated average of 22.7 and 49.3 ppb of mercury in maternal and fetal whole blood, respectively (equivalent to 5.6 and 12.3 ppm of hair). Maximal levels of mercury in maternal and fetal whole blood were 37.5 and 73.8 ppb, respectively (equivalent to 9.4 and 18.5 ppm in hair) (Galster, 1976). The equivalent ppm in hair to blood ppb have been calculated based on a ratio of 1 to 250 (Marsh, as cited in MMS, 1989). Mean hair levels of mercury in women from Anchorage, the Yukon-Kuskokwim coast and the interior were reported in Galster (1976). These levels showed slight differences between the three study groups, and the hair levels did not correspond to the blood levels according to the hair to blood ratio of 250. Since the mean ratio of hair to blood of 250 has been demonstrated (Marsh, as cited in MMS, 1989), it is unclear which numbers in the Galster study are in error--the hair or blood levels. Equivalent hair levels were calculated from the mean RBC levels reported by Galster (1976) on Table III-18. It is expected that coastal residents would have the highest mercury levels (because they are expected to consume more seafood), interior residents somewhat lower levels, and Anchorage residents the lowest levels, as are reflected in the RBC mercury levels, and in the equivalent hair-mercury levels in Table III-18; then it is most likely that the blood levels reported in this study are accurate and the hair levels are not.

Comparable average mercury blood and hair levels of interior Yukon-Kuskokwim Delta villages were found in people living in the Northwest Territories, Canada, while higher mean blood and hair levels of methylmercury were found in people living in northwestern Ontario and northwestern Quebec (Table III-19). The Yukon-Kuskokwim Delta coastal methylmercury blood level is above the 20 ppb safety level established by U.S. health experts (Federal Register, 44 FR 3990, 1979) while the mean Interior Alaska village mercury blood level and the

Table III-18

Mercury in Maternal-Infant Pairs from Coastal and  
Interior Yukon-Kuskokwim Delta and Anchorage (Urban)

	Coastal	Interior	Urban
<b>Maternal Hg Levels</b>	<b>Mean</b>	<b>Mean</b>	<b>Mean</b>
Plasma	5.8 ppb	5.0 ppb	2.6 ppb
RBC Hg	33.5 ppb	22.6 ppb	8.9 ppb
Milk	7.6 ppb	3.2 ppb	3.3 ppb
Placenta	38.3 ppb	30.7 ppb	11.6 ppb
Hair Equivalent <sup>1/</sup>	8.4 ppm	5.7 ppm	2.2 ppm
Reported Hair Level <sup>2/</sup>	4.4 ppm	3.6 ppm	4.0 ppm
<b>Infant parameters</b>			
Plasma Hg	4.5 ppb	5.0 ppb	3.3 ppb
RBC Hg	60.2 ppb	32.5 ppb	10.8 ppb
Hair Equivalent <sup>1/</sup>	15.0 ppm	8.1 ppm	2.7 ppm

Source: Galster, 1976.

<sup>1/</sup> RBC Hg Level x 250.

<sup>2/</sup> Mercury-hair level reported in Galster, 1976.

**Table III-19**  
**Canadian Surveys of Blood and Hair Levels of Methylmercury**

Region	Date	Sample	Mean Levels		Highest Levels	
			Blood (ppb)	Hair (ppm) <sup>1/</sup>	Blood (ppb)	Hair (ppm)
Northwest Territories	(1972-3)	176	22.1	5.5	119.2	29.8
Yukon Territories	(1972)	104	8.1	2.0	21.0	5.3
British Columbia	(1970)	350	7.3	1.8	34.8	8.7
Alberta	(1972)	144	9.95	2.5	50	12.5
Saskatchewan	(1972)	679	6.7	1.6	16	4.0
Manitoba	(1973)	385	19.7	4.9		
			22.3	5.6	120	30
<u>Northwestern Ontario</u>						
Grassy Narrows (GN)	1970	35	46.4	11.6	159	39.8
	1972	64	52	13.0	289	72.3
White Dog (WD)	1970	61	77.4	19.4	385	96.3
	1972	49	62.5	15.6	222	55.6
GN and WD	1975	11	136	34.0	---	---
<u>Northwestern Quebec</u>						
Matagami	1971	76	44	11.0	306	76.5
Miquelon	1971	146	21.5	5.4	148	37.0
Mistassini	1971	198	36.7	9.2	155	38.8

Source: This information was taken from several unpublished reports from Health and Welfare Canada as cited by Charlebois (1977).

<sup>1/</sup> Mean Blood Level x 250.



Northwest Territories mean blood level are slightly above this level. High mercury blood levels (such as 100 ppb or greater) found in Canada are sufficient to cause chromosome and fetal damage.

2. **Background Mercury Levels in the Nome Environment:** It is expected that the blood and hair levels of mercury of Nome residents would be comparable to levels found in the Yukon-Kuskokwim study (Galster, 1976) because both populations have diets dependent on seafood, particularly seal. However, there are other factors which could raise or lower these mercury levels. First, it is possible that consumption of seafood in Nome is less than consumption in the Yukon-Kuskokwim area--there is no consumption information available to determine the diets of Nome residents. It is known that Nome residents harvest marine mammals, fish, and shellfish (see Sec. III.C.3 for a description of subsistence-harvest patterns). Second, there is evidence that elevated levels of mercury and arsenic are present in soils in the Nome environment. Three sites were studied in Nome for the ADEC (Tryck, Nyman, and Hayes, 1986) for mercury contamination: the new Gold House, Dry Creek, and Alaska Gold dredges 5 and 6. The soil directly beneath the outfalls of the Gold House ranged from 21.6 to 484,600 ppm total mercury (the latter sample came from a sediment pile associated with the gold house). Because of the high levels, it was suggested that further study be done on the original gold house site in Nome (the present day playground). Concentrations of total mercury in Dry Creek ranged from 0.09 to 1,300 ppm. There was no elevation in mercury levels below the apparent area of entry of waste streams from the Gold House to the creek, or in the channeled drainage tributary to Dry Creek at the Gold House site. Even so, the very high mercury levels in the soil around the Gold House are of concern because of recreational and subsistence-fishing use of the Snake River, 1 mi downstream from the site. Where the Snake River is joined by Dry Creek is a harbor area under tidal influence from Norton Sound. If mercury were accumulating in the sediments of the harbor, a potential pathway would exist for the bioaccumulation of mercury in fish tissues and the eventual accumulation in humans. Dredges 5 and 6 also showed elevated levels of mercury. Sampling of the active Alaska Gold dredge Number 6 revealed mercury concentrations up to 195 ppb in the dredge effluent discharge and 250 ppm in sediments below the effluent outfall. This dredge is located within one-half mile of coastal beaches approximately 2 mi west of Nome. Tailings sampled near the active Alaska Gold dredge Number 5 location revealed mercury concentrations of 144 ppm. Dredge Number 5 is situated 3 to 4 mi north/northeast of Nome-Front street along Dry Creek.

Subsequent studies were done on the previous site of past Alaska Gold Company retort operations on Steadman Field, the playground in Nome. The USEPA (1987) found that mercury concentrations at the ballpark approached 85 ppm and the highest arsenic concentration in the soil was 33,400 ppm. The EPA estimated that older children (above 6) playing within the contaminated areas of Steadman Field (mercury concentrations of 10-85 ppm) ingested 200 mg of soil each day, and that these children may have consumed from 2 to 17 ppm of mercury daily and from 54 to 2,000 ppm of arsenic daily. The subchronic and chronic Average Daily Intake (ADI) established for the ingestion of mixed alkyl and inorganic mercury compounds is 20 ppm/day; therefore, the elevated concentrations of mercury detected at Steadman Field appeared to pose an elevated risk to the health of these children. The EPA carcinogen potency factor for arsenic exposure via ingestion is 15,000 ppm/day. The mercury is generally believed to be elemental (Environmental Toxicology International, Inc. [ETII], 1987), which poses a far less serious risk to humans. Most of the elemental mercury when ingested is excreted in the urine. Children who had played at the playground were given urinalysis to test levels of elemental mercury and arsenic; these levels were considered normal, indicating no significant exposure to elemental mercury or arsenic (ETII, 1987). These children did not have blood or hair analyses which would have determined levels of methylmercury. Elevated mercury levels also were detected in ambient air at various locations within the Nome city limits (USEPA, 1986a); however, further research in Steadman Field showed that this source of mercury contamination was confined to Steadman Field (America North, Inc. and Harding Lawson Associates, 1987).

3. **Mercury Levels of Nome Women of Childbearing Age:** A recently conducted MMS study on methylmercury hair levels in Nome women of childbearing age indicated that methylmercury hair levels are about 1 ppm average (Creelius, Apts, and Lasorsa, 1990). This value is at least 4 to 8 times less than the level found in Native women from the Yukon-Kuskokwim Delta and 2 to 4 times less than the level from Anchorage (Table III-18). This unexpected difference probably is due to more than one factor. First, Nome women probably eat less seafood than women on the Delta. Second, mercury levels in marine organisms in Norton Sound probably are low even though inorganic mercury is present in the Nome area as discussed above (probably due to low bioavailability and a low rate of conversion of the mercury to organic or methylated forms). Third, the year that hair samples were collected was a poor year for salmon and marine mammal harvests in the Nome area; thus, less seafood was consumed during the time when methylmercury in the hair was measured. However, these factors do not explain why higher mercury levels were found in Native women from Anchorage (Galster, 1976). The Native women sampled from Anchorage by Galster (1976) may have been temporarily residents who



came to give birth to their babies; their permanent residences may have been in the villages. This is only speculation since Galster did not give any details on specific resident times of the women sampled.

A followup MMS study to sample that portion of the population of Nome women of childbearing age known to consume high levels of seafood (that would include a segmental analysis of the hair samples to measure seasonal variation in mercury exposure) was conducted in October 1990 to verify and accurately determine the baseline exposure of prenatal and natal life to methylmercury. The final report should be available in the spring of 1991, but could not be incorporated into this FEIS. However, the results will be used for determining baseline monitoring. If there are any high levels of methylmercury reported, a detailed dietary survey of the daily and weekly amounts of seafood consumed by these women may be necessary in order to compare methylmercury exposure with seafood consumption. Nome women that might have hair-mercury levels above the 10 ppm level (a level at which there is some risk of neural damage to the fetuses and newborn) should be advised to reduce their seafood consumption somewhat during pregnancy and during breast feeding of the infant in order to minimize any methylmercury risk to the child.

4. Arsenic Levels of Nome Women of Childbearing Age: The arsenic levels in Nome women in the MMS study were usually below the limit of detection, with only 42 of the 200 samples containing arsenic (Crecelius, Apts, and Lasorsa, 1990). The concentrations of arsenic that were detected by these investigators ranged from 0.03 to 0.80 ppm with a mean of 0.26 ppm. These levels are all below the level (1ppm) of concern for human health. The arsenic levels found in the Nome hair samples indicate that there is no arsenic contamination in the food or water of the Nome women tested (Crecelius, Apts, and Lasorsa, 1990).<sup>13</sup>

**SECTION IV**

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**ENVIRONMENTAL  
CONSEQUENCES**



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## IV. ENVIRONMENTAL CONSEQUENCES

### A. Basic Assumptions for Effects Assessment

This section quantifies effects that could result from the proposed OCS Mining Program Norton Sound Lease Sale. All figures are relative to the base-case recoverable resource estimate (530,000 troy ounces of gold) since this case is used for quantification of probable levels of developmental activity (Sec. II.A). There are, however, many areas in which it is difficult to quantify effects due to the variable factors that affect any potential development.

For each effects analysis, all pertinent U.S. laws and Federal regulations, specifically the OCS Lands Act (OCSLA) and any implementing regulations, are assumed to be in effect. Departmental regulations of 30 CFR 251 and 282 for leasing and operations for minerals other than oil, gas, and sulphur are incorporated in the EIS analysis. Mitigating measures identified in Section II.G.2 are included in the analysis of effects in Section IV.B.

For this EIS analysis, a primary term of 20 years is assumed. The lease may continue beyond the specified primary term for as long thereafter as leased OCS minerals are being produced in accordance with an approved mining operation or the lessee is otherwise in compliance with provisions of the lease and the regulations under which a lessee can earn continuance of the OCS mineral lease in effect.

The discussion of cumulative effects contained in each effects section is based on the interrelationship of this proposed action with other major current and proposed projects. The projects considered in preparing the cumulative-effects assessment are discussed later in this section.

Potentially affected communities should not use this EIS as a "local planning document." Site-specific planning cannot yet be done, and it would be several years before such specific projections could be made. The facility locations and scenarios described in this document are only representative of the locations and scenarios that seem likely at this time, and they serve simply as a basis for identifying characteristic activities and resulting effects for this EIS. These locations and scenarios do not represent an MMS recommendation, preference, or endorsement of facility sites or development schemes.

The basic assumptions used in assessing the effects of the Norton Sound Lease Sale are summarized in Table IV-1. The activities associated with projected exploration and production of mineral placers are described in more detail in Section II.A of this EIS. Several key assumptions to keep in mind are:

- any discharge of processed material, such as dredge tailings, in Federal waters would be subject to EPA NPDES permit requirements;
- no mercury would be used onboard the vessel in processing the gold concentrate;
- the dredging operation would occur from a dredge similar to the Bima;
- one 3,500-bbl diesel-fuel spill would occur over the life of the proposal; and
- mitigating measures addressed in Section II.F.2 are assumed to be in place for the analyses in Section IV; of particular importance are the monitoring and operations control measures (Stipulation Nos. 1-4) which are part of the proposed action and deferral alternatives.

The level of activities is based on the base-case resource estimate for the Norton Sound Lease Sale (Table II-1). Resource estimates also are provided for the high case (Table II-2). The high-case estimate (1,060,000 troy ounces of gold) represents a quantity of gold that is twice that of the base case but less likely to be discovered. Because the estimate is preliminary, as noted in Section II.A.2, it is assumed that the level of mining activities associated with the high case would be two times that of the base case (see Sec. IV.I for an analysis of the high case).

1. The Role of Monitoring and Operations Management to Achieve Mitigation: Monitoring (Stipulation Nos. 1 and 3 described in Sec. II.F.2) is part of the base-case proposal and the deferral alternatives and is important to understanding the analysis of the effects of the proposed mining activity on the marine environment. The following will help the reader understand the processes by which the monitoring programs for the marine environment and human health will be managed.



**Table IV-1  
Summary of Basic Scenario Assumptions Regarding  
OCS Mining Activities in the Norton Sound Lease-Sale Area**

	<u>Base Case</u> (Alternatives I, IV, V) Number or Amount	<u>TimeFrame</u> Base Case and High Case	<u>High Case</u> Number or Amount
<b>Proposed Sale Area</b>			
Area – acres	147,050		147,050
<b>Operating Season</b>		Late May or Early June to Late October or Early November	
No. of Days	120-150		120-150
Operating Days (80% of Operating Season)	100-120		100-120
<b>Exploration (Prospecting)</b>			
<b>Seismic Surveys</b>			
Exploration (Testing)			
Line Kilometers	4,200	1991-1993	8,400
No. of Survey Vessels	1		2
No. of Vessel Operating Days	135		270
Prospect Assessment			
Line Kilometers	8,200	1995-2008	16,400
No. of Survey Vessels	1		2
No. of Vessel Operating Days	260		520
<b>Sampling</b>			
Exploration			
No. of Cores	3,240	1992-1994	6,480
No. of Vessels	1		2
No. of Vessel Operating Days	270		540
Prospect Assessment			
No. of Cores	14,040	1995-2008	28,080
No. of Vessels	1		2
No. of Vessel Operating Days	1,170		2,340
<b>Production (Placer Mining)</b>			
Mining Vessel (Dredges)	1	1995-2008	2
<b>Gold Production</b>			
Total—Troy Ounces	530,000	1995-2008 (14 years)	1,060,000
Yearly Total (Average)			
–Troy Ounces	40,000	1996-2007	80,000
–Troy Ounces	25,000	1995&2008	50,000
<b>Dredging (Excavated Volume)</b>			
Total –m <sup>3</sup>	20,000,000	1995-2008	40,000,000
Daily (Average)—m <sup>3</sup>	12,500-15,000		25,000-30,000
<b>Area Dredged (Excavated)</b>			
Total—Acres	1,300		2,600
Yearly (Average)			
–Acres	100	1996-2007	200
–Acres	50	1995-2008	100
Depth (Average)—m <sup>3</sup>	3.6		3.6
<b>Seawater-Intake Volume</b>			
Gallons/cubic meter mined	3,750-4,500		7,500-9,000
Total—billion gallons	75-90	1995-2008	150-180
Yearly (Average)			
–billion gallons	5.80-6.96	1995-2008	11.60-13.92
Daily (Average)			
–million gallons	58.0		116.0
<b>Solids-Discharge Volume</b>			
Total—m <sup>3</sup>	20,000,000	1995-2008	40,000,000
Daily (Average)—m <sup>3</sup>	12,500-15,000		25,000-30,000
<b>Seawater-Discharge Volume</b>			
Total—billion gallons	75-90	1995-2008	150-180
Daily (Average)			
–million gallons	58.0		116.0
<b>Support Activities</b>			
Vessels (Anchor Handling and Supply)	1	1995-2008	2
Total No. of Vessel Operating Days	1,680-2,100		3,360-4,200
No. of Days/Dredge/Season	120-150		120-150
Helicopter Flights (Round Trips)			
Total	5,040-6,300	1995-2008	10,080-12,600
Yearly	360-450		720-900
Daily/Dredge	3		3
Fuel-Oil Spill (3,500 bbls)	1		1

Source: MMS, Alaska OCS Region.

The monitoring programs, designed to detect and identify potential effects of the mining operation with respect to EPA and FDA criteria as appropriate, would be approved by the RS/FO in coordination with the appropriate State and Federal agencies. The MMS is developing a postlease review process which will involve coordinating and consulting with appropriate State and Federal agencies and others to develop the monitoring program. The postlease review process will be developed prior to the publication of the Final Leasing Notice. This postlease review team will advise the RS/FO of issues associated with mining such as what to monitor, how to monitor, and also would provide technical review of studies to assure that the monitoring is done with the best scientific methodologies and technologies. Postlease review will ensure that the lessee --under the direction of MMS--will conduct a satisfactory monitoring program. After background studies are completed to establish the levels of trace metals in marine waters and selected organisms of Norton Sound and the delineation of selected habitat (i.e., for the red king crab), monitoring would be conducted to track habitat/organism changes attributable to the mining program. Sampling would be accomplished both upstream and downstream of the mining operation. Sampling would be frequent enough to ensure that variations in discharges would be measured (i.e., from daily to whenever a change in placer deposits is encountered). In the unlikely event that an effect or signal from the mining activity should occur in the marine environment, it is expected that this would be detected in the water column associated with the potential repartitioning of trace metals in the sediments. The monitoring of local representative marine food chain resources also would be conducted to identify if potential effects or signals occurring in the water column or sediments were carrying over into the food chain.

In the unlikely event that a signal was detected in the water, sediments, or food chain (indicating a possible situation adverse to human health), the RS/FO would require modification of the operation and/or shutdown. If continuing operations indicate that the bioaccumulation of trace metals is occurring at an ever increasing rate, the RS/FO would request the lessee to submit a plan to monitor the human health of the Nome population. The lessee would coordinate the preparation of this plan with the appropriate State and Federal health agencies. When this human health monitoring is initiated the results would be used by the RS/FO in coordination with the appropriate public health agencies to determine the necessary actions to protect human health. The major decision points throughout this entire process would be decided by the RS/FO in consultation with the appropriate agencies and would be based on the magnitude of an effect and/or by the identification of time trends of the specific abiotic and biotic parameters.

2. **Definitions Assumed For Effects Assessment:** The definitions shown in Table IV-2 were developed to help determine the relative extent of effect. The words MAJOR, MODERATE, MINOR, and NEGLIGIBLE, which are defined in the Table IV-2, appear in capital letters throughout this EIS. These words are capitalized to designate their precise application in this context, rather than to emphasize the level of effect.

3. **Major Projects Considered in Cumulative-Effects Assessment:**

a. **Guidance on Cumulative-Effects Assessment:** The regulations for implementing the procedural provisions of NEPA define cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7). In the case of migrating species, effects also can occur outside the lease-sale area.

Projects described in this section fall along a continuum ranging from those likely to occur in the near future to those which may occur at some point in the more distant future. This scale is reflected in the differences in the information and assumptions available for various projects--from those that are well defined to those that are largely conjectural.

b. **Projects Included in the Cumulative Case:**

**Offshore Mining:** Offshore exploration for minerals or mining in State waters requires a prospecting permit or a mining lease from the State of Alaska through the Department of Natural Resources, Division of Mining. If data are available indicating the presence of minerals, the State can hold a competitive lease sale. If data are not available, the State can issue an offshore prospecting permit granting exclusive exploration rights through a noncompetitive permit system. Permits are issued for a single term of 10 years and are not renewable. If the permittee finds deposits of locatable minerals that can be successfully mined, the permit can be converted to a renewable offshore-mining lease with a 20-year term. Before the State can issue a permit, it must provide public

**Table IV-2**  
**Definitions Assumed in Effects Assessment**

NEGLIGIBLE	MINOR	MODERATE	MAJOR
<b>Resource Category</b>			
<b>Air Quality</b>			
Emissions cause measurable increases in concentrations of criteria pollutants (e.g. SO <sub>2</sub> , CO, NO <sub>2</sub> , O <sub>3</sub> , and PM <sub>10</sub> ) over one localized portion of a Federal attainment area, resulting in the consumption of less than 5 percent of the available Prevention of Significant Deterioration (PSD) increment for NO <sub>2</sub> , SO <sub>2</sub> , or TSP or 5 percent of the available National Ambient Air Quality Standards <sup>1/</sup> (NAAQS) concentration for NO <sub>2</sub> , PM <sub>10</sub> , CO, or O <sub>3</sub> ; no observed adverse effects on human health or vegetation; and/or no significant decrease in onshore visibility. <sup>2/</sup>	Emissions cause measurable increases in concentrations of criteria pollutants over more than a localized portion of a Federal attainment area; resulting in the consumption of at least 5 percent but less than 20 percent of the available PSD increment for NO <sub>2</sub> , SO <sub>2</sub> , or TSP or 5 percent of the available NAAQS concentration for SO <sub>2</sub> , PM <sub>10</sub> , CO, or O <sub>3</sub> ; no observed adverse effects on human health or vegetation; and/or significant decrease in onshore visibility.	Emissions cause measurable increases in concentrations of criteria pollutants over more than half of a Federal attainment area (regional effect), resulting in the consumption of at least 20 percent but less than 50 percent of the available PSD increment for NO <sub>2</sub> , SO <sub>2</sub> , or TSP or 5 percent of the available NAAQS concentration for SO <sub>2</sub> , PM <sub>10</sub> , CO, or O <sub>3</sub> ; small but measurable short-term adverse effects on human health or vegetation; and/or significant decrease in onshore visibility.	Emissions cause measurable increases in concentrations of criteria pollutants over more than half of a Federal attainment area (regional effect), resulting in the consumption of at least 50 percent of the available PSD or NAAQS concentration increments; readily identifiable adverse long-term effects on human health or vegetation; and/or significant decrease in onshore visibility.
<b>Water Quality<sup>3/</sup></b>			
	LOCAL—changes in water quality from one or more sources, extending beyond the edge of a mixing zone (100-m perimeter about the dredge footprint), but affecting less than 180 km <sup>2</sup> (30% of the sale area) about each discharge.		
	REGIONAL—changes in water quality over an area of at least 180 km <sup>2</sup> or larger about a discharge source.		
No regulated contaminant (such as mercury or other trace metal) is discharged into the water column, or some amount is discharged, but the resulting concentration of contaminant does not exceed the chronic State standard or EPA criterion.	A regulated contaminant (such as mercury or other trace metal) is discharged into the water column and the resulting concentration of contaminant occasionally exceeds but does not increase the average beyond the chronic State standard or EPA criterion.	A regular contaminant (such as mercury or other trace metal) is discharged into the water column and the resulting concentration of contaminant averages (sampling period set by permit) more than the chronic State standard and EPA criterion, but does not exceed acute (toxic) State Standards and EPA criteria and does not exceed 7,500 ppm suspended-sediment concentration.	A regulated contaminant (such as mercury or other trace metal) is discharged into the water column and the resulting concentration of contaminant is above the acute (toxic) State standard or EPA criterion. Turbidity exceeds 7,500 ppm suspended sediment concentration.
<b>Biological Resources (Lower-Trophic-Level Organisms, Fishes, Marine and Coastal Birds, Nonendangered Marine Mammals)</b>			
No measurable short-term or long-term change in numbers or distribution of individuals occurs in a population.	A specific group of individuals of a population in a localized area and/or over a short time period (one generation or less) is affected; the regional population is not affected.	A portion of a population in the region changes in abundance and/or distribution over more than one generation, but the change is unlikely to affect the regional population.	A population or species in the region declines in abundance and/or distribution beyond which recruitment would not return it to its former level within several generations.
<b>Endangered and Threatened Species</b>			
No measurable change occurs.	A specific group of individuals of a population in a localized area is affected over a short time period (less than one breeding cycle).	A portion of a regional population declines in abundance and/or distribution, and recovery requires more than one breeding cycle <sup>4/</sup> but less than one generation.	A regional population or species declines substantially in abundance and/or distribution, and recovery requires at least one generation. <sup>5/</sup>
<b>Economy of NOME</b>			
Economic effects occur which have no measurable effects on governmental policies, planning, or budgeting, or no measurable effect on the economic well-being of residents of the area.	Economic effects occur which may require slight marginal changes in governmental policies, planning, or budgeting, or may marginally affect the economic well-being of residents of the area.	Economic effects occur which will require some but not major modification of governmental policies, planning, or budgeting, or may create problems such as an increased rate of price inflation or housing shortages, or may substantially affect the economic well-being of residents of the area.	Economic effects occur which will require major changes in governmental policies, planning, or budgeting, or which have the potential to create major problems or to cause important and sweeping changes in the economic well-being of residents of the area.

**Table IV-2**  
**Definitions Assumed in Effects Assessment**  
(Continued)

NEGLIGIBLE	MINOR	MODERATE	MAJOR
<b>Resource Category</b>			
<b>Commercial Fishing</b>			
Conflicts are rare. One-year losses to important commercial fisheries do not exceed 1 percent.	Minor conflicts develop. Losses of 1 to 3 percent, for periods of 1 or more years, occur in important commercial fisheries.	Minor conflicts are frequent or significant conflicts occur occasionally. Losses of 3 to 10 percent, for periods of 1 or more years, occur in important commercial fisheries.	Major disruptions to fishing occur. Conflicts are frequent and significantly affected fishing. Losses exceed 10 percent, for periods of 1 or more years, in important commercial fisheries.
<b>Subsistence-Harvest Patterns</b>			
Subsistence resources could be affected but with no apparent effects on subsistence harvests.	Subsistence resources would be affected for a period of less than 1 year, but no resource would become unavailable.	One or more subsistence resources would become locally unavailable for a period of time not exceeding 1 year.	One or more important subsistence resources would become locally unavailable for a period of time exceeding 1 year.
<b>Sociocultural Systems</b>			
Periodic disruption of local sociocultural systems occurs without apparent effects.	Short-term disruption of local sociocultural systems without a tendency toward the displacement of existing institutions.	Long-term (5 years or more), chronic disruption of local sociocultural systems occurs without a tendency toward the displacement of existing institutions.	Long-term (5 years or more), chronic disruption of local sociocultural systems occurs with a tendency toward the displacement of existing institutions.
<b>Archaeological Resources</b>			
No detectable archaeological resources (including landforms and sites) are expected to be present and disturbed.	Few archaeological resources (including landforms and sites) are expected to be present and disturbed.	Some archaeological resources (including landforms and sites) are expected to be present and disturbed.	Many archaeological resources (including landforms and sites) are expected to be present and disturbed.
<b>Recreation and Tourism Resources</b>			
Barely detectable reduction in recreation and tourism aesthetic qualities and economic expenditures.	Slight reduction in recreation and tourism aesthetic qualities and economic expenditures over one-fourth of the area lasting approximately 1 year.	Some reduced recreation and tourism aesthetic qualities and economic expenditures over one-half of the area lasting for approximately 2 years.	Much reduced recreation and tourism aesthetic qualities and economic expenditures over the whole area for approximately 3 to 4 years or longer.
<b>Land Use Plans and Coastal Management Programs<sup>6/</sup></b>			
Proposed activities generally conform with existing land use and have negligible effects on protected coastal resources and uses.	Proposed activities infringe on an existing land use, or create minor effects on protected coastal resources or uses.	Proposed activities alter a preferred land use, or create moderate effects on one or more protected coastal resources or uses.	Proposed activities are incompatible with or displace a preferred land use, or create major effects on one or more protected coastal resources or uses.
<b>Human Health</b>			
No change to the hair-mercury levels of any of the Nome population.	Hair-mercury levels of some of the general population residing in Nome would approach but not exceed recommended levels set for the general adult population. Any changes in hair-mercury levels of pregnant women do not reach 6 ppm. <sup>7/</sup>	Hair-mercury levels of one or more women of child-bearing age (because of potential effects to the developing fetus) residing in Nome would be elevated but would not exceed recommended levels set for pregnant women. <sup>8/</sup>	Hair-mercury levels of one or more women of child-bearing age (because of potential effects to the developing fetus) residing in Nome would exceed recommended levels set for pregnant women. <sup>9/</sup>

**Table IV-2**  
**Definitions Assumed in Effects Assessment**  
**(Continued)**

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Source: MMS, Alaska OCS Region.

- ' NAAQS are based on the protection of human health. Numerical standards for each pollutant are given in Table III-2. PSD increments are supplements to the NAAQS protecting existing high air-quality areas. Regional refers to effects on areas that are as large as, or larger than, about one-half the area of the North Slope of Alaska. Local refers to effects limited to tens of miles near the shoreline. Short term refers to hours, days, or weeks; long term refers to seasons or years.
- ' Visibility criteria are applied only to PSD Class I areas; significance is determined by EPA visibility-analysis guidelines. Long term refers to seasons or years. Short term refers to hours, days, or weeks.
- '
  - a. The State standard and EPA chronic criterion for mercury are both 0.025 ppb.
  - b. The acute State standard and EPA criterion for mercury are both 2.1 ppb.
  - c. State standards and EPA criteria allow exceedence of trace-metal limits once per 3-years on the average.
  - d. For water turbidity, the State standard is 25 NTU and EPA criterion is a 10-percent decrease from seasonally averaged compensation depth.
- ' A breeding cycle is the average time period between the births of successive offspring.
- ' A generation is the average time period between the birth of the parents and birth of their offspring.
- ' Definitions reflect inconsistencies between the proposal and land and water regulatory regimes, not effects of the proposal on the regulations.
- ' The WHO environmental health criteria in 1976 established 200 ppb mercury in blood or 60 ppm in hair as the level where effects from methylmercury exposure begin to be seen in adults.
- ' "Elevated" is defined as 6-10 ppm in hair.
- ' The new World Health Organization (WHO) environmental health criteria document (to be published in 1990) will state that the occasional psychomotor retardation effects from prenatal exposure to methylmercury can be seen in infants and children whose mothers had mercury hair levels between 10 and 20 ppm (Clarkson, 1989, oral comm.)

notice and prepare a "best interest finding" for the disposal of a State interest in public lands as required by AS 38.05.035(e).

In August 1989, the State of Alaska found it in the State's best interest to approve offshore prospecting permits (OPP's) for 97,000 acres of the 185,000 that were included in the area under consideration--the area between the Sinuk and Solomon Rivers. This award included 34 of the applications for OPP's and 19 tracts that had not been under application.

Applications for OPP's within Safety Sound were rejected. The Final Best Interest Finding and Coastal Consistency Determination for the area south and east of Safety Sound and around Sledge Island (approximately 62,700 acres) were deferred. The deferred areas are in a Special Use Area identified in the Bering Straits CMP. Seventeen stipulations were attached to the OPP's. These stipulations cover area closures such as a 1-mi buffer at the mouths of the Sinuk River and Cripple Creek and lesser buffers to protect herring spawning (effective between May 15 and August 15), capelin spawning (between May 15 and August 15), and important resources near Cape Nome (between June 1 and September 30). Other stipulations are designed to protect subsistence; water quality; biological, cultural, and archaeological resources; public access and navigation; and adjacent uses and users. The State specifically reserved the right to require pre- and post-mining studies on the effects of exploration and mining activities on subsistence resources and uses and to require the applicant to design and carry out an environmental monitoring program. No prohibition on the use of mercury offshore is included in the stipulations. These stipulations are enforced through the plans of operation that are submitted annually by operators. These plans of operation for exploration are subject to consistency determinations to ensure activities are consistent with the statewide standards and district policies of the Alaska Coastal Management Program. A decision on the deferred areas is expected in 1990 (State of Alaska, DNR, 1989).

Two offshore areas along the northern shore of Norton Sound have valid mining leases--the area adjacent to the city of Nome and a small area off the coast near Bluff (Fig. IV-1). Western Gold Exploration and Mining Co., Limited Partnership (WestGold) is mining for gold on the first site--an area of 21,750 acres (8,802 hectares) that extend from about 1.6 km east of Nome to about 16 km west of Nome. The leases extend approximately 4 km offshore (see Sec. II.A).

The following paragraphs are based on information contained in the 1987 Annual Report (Rusanowski, Gardner, and Jewett, 1988) and updated with information from the 1988 mining season. WestGold uses the Bima, the largest bucketline offshore-mining vessel currently active. The bucket ladder is 87.8 m long and contains 137 buckets, each with a 0.85 m<sup>3</sup> capacity. Maximum speed is 40 buckets/min. Minimum digging depth is 9 m; maximum digging depth is 45 m. Although the dredge is capable of recovering about 46,000 m<sup>3</sup>/day, these ideal conditions are seldom approached. In 1986, the dredge footprint covered an area of approximately 9.33 hectares (23.05 acres). Following improvements to the dredge during the winter of 1986-87, the dredge footprint for the 1987 season more than doubled that of 1986 and covered an area of approximately 22 hectares (54.36 acres). The area dredged more than doubled again in the 1988 season, when 58 hectares (143.32 acres) were dredged. Of the 148 operating days during the 1987 dredging season, the dredge was unable to operate 34 percent of the time. In 1988 the percentage of downtime dropped to 24 percent of the 170 days it operated. Nineteen percent of the downtime in 1987 was attributable to weather conditions. This was less significant than the previous year. During 1987, digging conditions were difficult--heavy boulders, some the size of small cars, were encountered throughout the season. Benthic material consisted mainly of various mixtures of glacial till, marine clay, sand, and gravel. The typical dredge workforce during the mining season is 88 people--15 to 20 were employed in the office, including the geologists and engineers; 44 people (22 per shift) were employed on the dredge, and the remainder worked on the drilling program. Of the total workforce, 50 persons (or 57 percent) were residents within the Seward Peninsula area. Of the local residents, 18 (or 37 percent) were Alaska Natives. Nonresidents of the Bima workforce occupied about 30 rental units in Nome during the 1987 season (May-December). Although during peak mining season there are an estimated 88 people employed, FTE employment is approximately 62 (these figures account for the reduction of labor force by WestGold during the 1989 season).

Almost 50 people began work in February 1988 to prepare the Bima for the 1988 season. Other winter work included drilling several hundred holes through the ice. The number of holes drilled reflected the ice and weather conditions. During the summer of 1988, almost 900 holes were drilled. Depending on the results of the winter drilling program, WestGold will determine the economic feasibility of obtaining a shallow-water dredge (Prescott, 1988, oral comm; Garnett, 1988, oral comm.).

During the 1989 mining season, WestGold evaluated two other methods of dredging (Jewett et al., 1990). A single shallow-water barge that was capable of processing the dredged material provided a platform for dredge

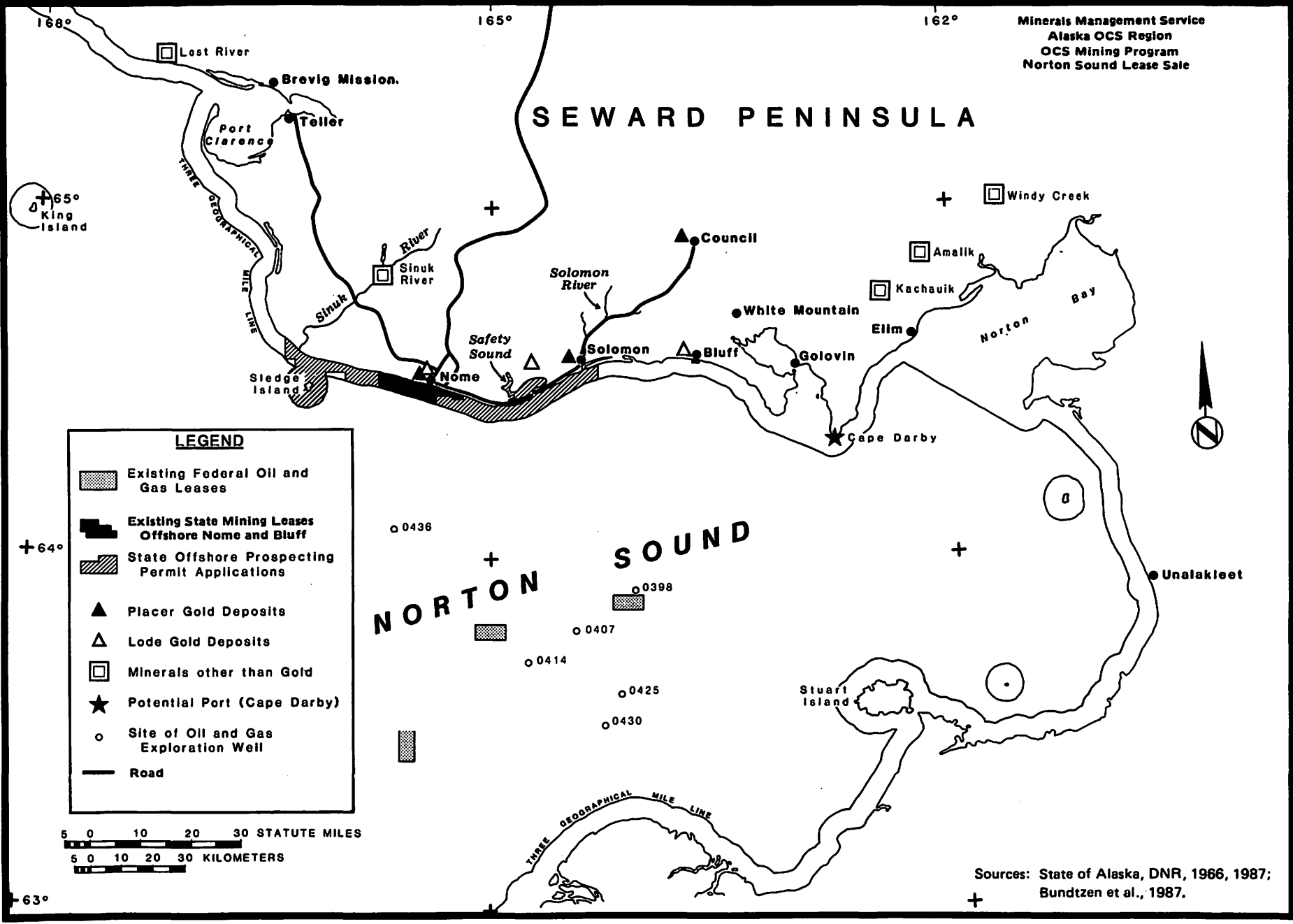


FIGURE IV-1. ACTIVITIES AND SIGNIFICANT MINERAL DEPOSITS IN THE NOME AREA THAT ARE INCLUDED IN THE CUMULATIVE CASE



systems to be tested. The two methods were a bucket wheel that was attached to a ladder structure and mounted on a large crane and a remotely controlled, unmanned suction system called a tramrod. Neither system worked well, neither system will be brought back for the 1990 mining season, and WestGold would have to redesign either system prior to commercial use.

Industry monitoring data (Rusanowski, Gardner, and Jewett, 1988; Jewett, Gardner, and Athey, 1989; Jewett et al., 1990) for the current gold dredging in State waters report downcurrent turbidity in excess of State marine standards or EPA permit restrictions (USEPA, 1986a,b; 1988a,b). Measurements made downcurrent of the Bima by an MMS contractor (Creelius, Apts, and Lasora, 1990) on three dates during the 1989 mining season observed copper concentrations in excess of the EPA acute criterion and average lead and nickel concentrations in excess of the EPA chronic criteria.

Future mining activities are assumed to increase (see Table IV-2a). Increased activity assumes the use of shallow-water dredges. Two other dredges in addition to the Bima--one to mine the leases held by WestGold and the other to mine the leases off Bluff or other areas leased by the State of Alaska in 1989 will be used. Acreage assumed to be mined by these dredges reflects the greater areal extent mined by WestGold in recent operations. Two of the dredges are assumed to mine 120 acres per season. The third dredge is assumed to have less capability and to dredge only 60 acres per season. Approximately 11,364 l (3,000 gal) of fuel per day can be consumed by the Bima (Harris, 1987). This would be the maximum amount consumed by any of the dredging operations on a daily basis. The smaller dredge is assumed to use half that amount. Therefore, daily fuel consumption of the dredging activities is assumed to be about 28,000 l (or 7,500 gal).

The use of mercury during these operations is uncertain. The State has no categorical exclusion on the use of mercury offshore and the proposed stipulations for the new offshore prospecting permits do not include such a prohibition. However, the Bima has mined successfully without the use of mercury and this practice is assumed to continue.

Some additional offshore prospecting permits are assumed to be offered by the State. Coring operations on this acreage plus that already leased are assumed to increase the number of cores drilled annually to 1,000.

Onshore Mining: Mining potential on the Seward Peninsula is related primarily to gold, tin, lead, zinc, fluorite, beryllium, and tungsten (Fig. IV-1). Of the non-gold prospects, the Lost River Mine is of greatest potential. Permits were received to mine and process 1,750,000 tons (T) of ore/year (fluorite, tin, and tungsten) for at least 16 years with possible expansion to 2,800,000 T. At the lower production rate and using arctic-class bulk-ore carriers, approximately 50 round trips between the mine and market per year would be required for the low-end production and 80 trips for the high end. The mine is located 25 mi west of Teller and would require a large investment in infrastructure, including processing facilities, a marine terminal, an airport, and a surface-transportation system. Action on the mine is tied up in law suits and bankruptcy proceedings. If these issues are resolved, the Bering Straits Native Corporation, owners of the land, anticipates that production of the ore will proceed. Since the time limit of the U.S. Army Corps of Engineers permit has lapsed, new permit applications would have to be filed.

Gold mining is the prevalent form of mining on the Seward Peninsula--more than 3,000 placer claims exist (USDOI, BLM, 1988). However, most are small operations. In the vicinity of Nome, 64 acres were disturbed as a result of gold mining during the 1988 season. Of these, 59 acres were mined by three operators, all of whom were mining on land owned by Alaska Gold Company (Smith, 1990, oral comm.). Alaska Gold Company controls about 17,000 acres (6,880 hectares) of patented mining claims around Nome and has proven reserves of about 50 million m<sup>3</sup> of ore. In 1988 the company began winter operations to remove overburden in preparation for summer placer operations. About 12 to 15 people are employed for winter operations. This practice is expected to continue. During the summers of 1988 and 1989, Alaska Gold ran two dredges, each with a crew of 17; about 25 additional people work the thaw field. At the peak of the summer season about 120 people were employed. Extra people are housed in a camp facility located north of town; however, Alaska Gold plans to phase out the camp facility (Harris, 1987; Fisher, 1990, oral comm.).

In recent years, two other major operators have worked land near Nome owned by Alaska Gold Company--Windfall Mining Company and Anvil Mining Company. Both firms employed about 35 persons and worked from early April through early November. Although Windfall Mining Company has no plans to resume mining in 1990, another firm is expected to take over. Ore from operations on Third Beach, an ancient beach line lying to the north of the city, is processed using a closed-water system (Saunders, 1988, oral comm.).

**Table IV-2a  
Assumptions Included in the Cumulative Case**

Activity	Assumptions
<b><u>Offshore Mining:</u></b>	
<b><u>State Leases</u></b>	
Dredges (3)	
Shallow-Water Dredge	60 acres/season
Shallow-Water Dredge	120 acres/season
<u>Bima</u>	120 acres/season
Fuel Consumption	28,000 l/day (assuming 3 dredges)
Cores	1,000/year
<b><u>Onshore Mining:</u></b>	
Placer Gold Mining	75 acres disturbed/year
Lode Gold Mining	
Exploration Drilling (1989-1991)	15-20 holes/year
Operations (1991-future) <sup>1/</sup>	80-100 acres disturbed
Lost River Mine (after 2000) <sup>1/</sup>	Approx. 2 million T/year with extensive development of transportation systems, mining facilities, and community infrastructure
<b><u>Offshore Oil and Gas</u></b>	
Sale 57	1 exploration well
Sale 120	Postponed
<b><u>Maintenance Harbor Dredging</u></b>	
Snake River	13,000 yd <sup>3</sup> dredged per year; deposited about 1.5 mi E. of mouth of Snake River

<sup>1/</sup> These projects fall outside the scope of projects normally included in an assessment of cumulative effects. No permits have been issued to develop lode gold operations and the permit issued by the COE in 1976 for the Lost River Mine has expired and a new proposal could be modified substantially from that originally proposed.

Several companies are exploring for lode gold; although none is in production at this time, one--the Big Hurrah gold mine--may come into production in 1991. Approximately 27,000 ounces of gold were mined from the Big Hurrah during three previous operations (Burton, 1990). The mine is 40 mi east of Nome on a tributary about 15 km up the Solomon River. Over a 5-year life, the mine is expected to produce at least 250 T/day with an 8:1 stripping ratio. The mine is being designed as an open-pit mine.

In the Rock Creek area, about 8 mi north of Nome, Placer Dome U.S., Inc. and Aspen Exploration are conducting a joint venture to explore for a mother lode (or primary sources) for the placer gold that has been mined over the decades. Exploration costs for this hard-rock operation exceeded \$500,000 during the 1987 field season, and Placer Dome spent about \$900,000 during the 1989 field season (Aspen Exploration Corp., 1987). Another firm is expected to take the place of Placer Dome for the 1990 season. An agreement with Alaska Gold, Sitnasauk Native Corporation and Bering Straits Native Corporation provides the necessary access to explore the coastal plain of Nome. If sufficient concentration and field size are defined, a large processing plant would be required. Planning for such a facility depends upon the results of the exploration; development and production likely would take from 5 to 10 years to bring on line (Carpenter, 1988, oral comm.).

BHP Utah Minerals International is expected to return in 1990 for more exploratory work near Bluff and in the Mt. Distun area about 35 km north of Nome. Exploration near Bluff is on lands selected by the White Mountain Village Corporation for surface rights and the Bering Straits Native Corporation for subsurface rights. These lands lie both in and outside of the Bluff Unit of the Alaska Maritime Refuge. An impregnated zone along the sea cliffs in this area was identified during initial exploration at the turn of the century (Collier et al., 1908) and the area remains of interest. Approximately 10 persons are employed in the drilling operation. Workers are housed in a camp located at the site. Assuming results are favorable, exploration could continue for several more years. Following a decision to develop, 2 to 3 years would be required to develop a small underground mine capable of processing about 1,000 t/day. BHP Utah also has explored on Third Beach in the Nome area. This work will be resumed by another firm in 1990.

Activity levels have increased over those noted in the Sale 100 FEIS. In addition to the mining described previously, the Bering Straits Native Corporation is looking into joint ventures with Soviet mining interests to spur production from the Seward Peninsula. The viability of the conclusion reached by Louis Berger and Associates (1981) and the COE (USDOD, COE, 1988) that new large-scale mining operations are not expected onshore in the vicinity of Nome prior to the 21st century would be modified slightly if the Big Hurrah begins operating in 1991. However, it is unlikely Soviet/BSNA joint ventures could produce ore within the near future (Table IV-2a).

**Previous OCS Lease Sales:** No leases are currently active in Norton Sound. All 59 leases awarded in Sale 57 have been relinquished. Sale 100 was canceled due to lack of industry interest. Six wells were drilled on these leases, three in 1984 and three in 1985. No discoveries were announced. Although wide-ranging species, such as marine mammals, could be affected by activities in other lease-sale areas, any relevant effects will be discussed in the cumulative assessment for that resource.

**Other Norton Sound Oil and Gas Lease Sale Activity:** Sale 120 was the next sale scheduled for Norton Sound. Two requests for interest have been issued--the last in January 1989. Industry indicated little interest in response to either the first or the second request. A sale in Norton Sound may be included in the next 5-year schedule for the OCS oil and gas leasing program. However, the fact that all Sale 57 leases have been relinquished and subsequent sales were not held, indicates that any presumption of development and production would appear to be highly speculative.

**Other Dredging and Disposal Activities:** The mouth of the Snake River near the entrance jetties is dredged annually by the COE as part of a routine maintenance program. Historically, about 13,000 yd<sup>3</sup> of material has been removed each year and deposited 1/2 mile east of the jetty. Since the construction of the causeway, the amount of material to be dredged has dropped to about 5,000 cubic yards. Once the system comes to an equilibrium, the amount to be dredged is expected to return to 13,000 yd<sup>3</sup>. Recent data have led the EPA and COE to review the decision to allow disposal of this material at the offshore site. This year the dredged material will be placed on the uplands. Future sites for deposition will depend on the results of a sediments analysis--if the material is contaminated, upland disposal will be continued. The turning basin in the Snake River is dredged every 4 to 5 years. This material, too, will be tested to determine if the sediments are contaminated. If they are, they will be deposited on the uplands.

4. **Constraints and Technology:** This section discusses those environmental features that are considered hazards to the exploitation of mineral resources of the OCS Mining Program Norton Sound Lease Sale area. The environmental features identified as potential hazards include sea ice, storm surges, earthquakes, winds, and superstructure icing.

The potential severity of these hazards is related to the type of activity and, thus, measures can be taken to reduce or eliminate the effects. These measures include (1) scheduling activities so as to minimize exposure; (2) conducting surveys to locate potentially hazardous areas and locating facilities away from known hazards; and (3) designing facilities to withstand the hazardous conditions.

Sea ice is the major environmental factor affecting mining of the placer minerals in the sale area. However, the offshore gold mining operation presently being conducted by Westgold with the Bima in State of Alaska waters off Nome occurs during the time when the ice is absent and thus not a threat. For the foreseeable future, it is anticipated that mining operations in the sale area also will be conducted during the ice-free season because of considerations relating to (1) existing technology, (2) the availability of dredges built to mine deposits in other offshore areas, and (3) the increase cost of building vessels that will withstand sea-ice forces.

The BOM estimates that it would be about 3 times more expensive to construct a new dredge than it would be to purchase a used dredge (USDOI, BOM, 1987). Most of the mining of the world's offshore mineral deposits occurs in areas where sea ice is not a threat. Thus, nearly or almost all of the dredges that potentially might be available for use in the sale area are not constructed to operate in the presence of sea ice. The Bima was constructed to mine offshore deposits of tin in Malaysia. The dredge was commissioned in 1978 and cost \$33 million dollars to build; it has been refurbished to mine the gold placers (Rusanowski, Gardner, and Jewett, 1987).

The design, construction, and operation of facilities for use in the northern Bering Sea will be more expensive than in regions not affected by sea ice. Although it may not be directly applicable, some indication of the increased expense involved in operating year-round in the northern Bering Sea might be derived by comparing the capital and operating costs of ice-strengthened tankers and conventional tankers. Han-Padron Associates (1984) estimates that the capital cost of a Class 4 ice-strengthened (100-200 DWT) tanker would be about 60-percent greater than that of a comparable conventional tanker and the operating costs about 30- to 60-percent more.

The major constraint during the ice-free operating period is storms. The sale area is exposed to winds and large waves prevailing from the south and southwest in the summer and fall. Storm/wind stress on the water causes a rise in the sea level in coastal areas; low barometric pressure associated with the low pressure field of a storm also causes a rise in the sea level. During storms, wind-driven current velocities and wave heights increase. The dredges used to mine the offshore areas are relatively large structures and thus will be able to operate during some storms. The Bima, one of the world's largest offshore bucket-ladder dredges, weighs about 15,000 T. Some storms may be severe enough to halt operations; during the period from 1988 through 1989, the amount of downtime due to weather conditions ranged from 13 to 33 percent of the operation operation. When storm conditions are anticipated to become severe, the dredges could be moved to areas--on the leeward side of a terrestrial feature such as a cape, peninsula, or island--where they are protected from the full force of winds and waves that accompany a storm. However, in the Nome area other than the lee side of Sledge Island there are no such land forms that are close enough for the dredge to move to that offer protection from storms. Because of the exposed location of the sale area, the dredges may be equipped with a system to protect the bucket ladder that will absorb some of the shock produced when wave action causes the ladder to be thrust into the seafloor.

Superstructure icing caused by sea spray is the most frequent and most important form of icing at sea (Labelle et al., 1983). Ice buildup on a vessel's superstructure has both operational and safety implications. Buildup of ice may affect operations of equipment on deck and may pose a danger to personnel. Massive ice buildup may significantly affect the vessel's free-board and center of gravity, with a corresponding reduction in vessel stability. These effects are of particular concern with regard to small vessels. The conditions necessary to cause significant accumulations of superstructure icing are: (1) air temperature less than the freezing point of seawater (-1.7 to -1.9°C, depending on the salinity of water down to about -30°C); (2) windspeed of 10 m/sec or more; and (3) seawater temperature colder than 8°C.

Earthquakes, biogenic gas, and current scouring were not considered to be hazards for any of the floating units associated with offshore oil and gas exploration (Zimmerman, 1982) and would not be hazards to the dredges.



## IV.B. ALTERNATIVE I - PROPOSAL

### 1. Effect on Air Quality:

a. Effect on Air Quality Relative to Standards: Federal and State statutes and regulations define air-quality standards in terms of maximum allowable concentrations of specific pollutants for various averaging periods (see Table III-1). These concentration maxima are designed to protect human health and welfare. However, an exceedence of a maximum of one per year is allowed except for standards that use an annual averaging period to define the maximum concentration allowable (an exceedence is not allowed for particulate matter less than 10 microns in aerodynamic diameter (PM10) and ozone). The standards also include Prevention of Significant Deterioration (PSD) concentration increments for nitrogen dioxide (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), and total suspended particulates (TSP) to limit deterioration of existing air quality that is better than required by the standards. There are three classes of PSD areas. Class I allows the least degradation and also restricts degradation of visibility. However, the nearest Class I area is St. Matthew Island which will not be affected by the proposal because the island is approximately 580 km away. The northern coast of Norton Sound is classified as Class II by the State of Alaska (State of Alaska, DEC, 1982), although baseline-ambient concentrations for PSD analysis for the area have yet to be established. Air-quality standards do not directly address all other potential effects such as acidification of freshwater bodies and precipitation or effects on nonagronomic plant species.

With the recent enactment of the Clean Air Act Amendments of 1990, the U.S. Environmental Protection Agency (USEPA) has been given jurisdiction over blocks to be leased under this lease sale, for air quality. The amendments require that for sources located within 25 mi of the seaward boundary of such states, such requirements shall be the same as would be applicable if the source were located in the corresponding onshore area, and shall include, but not be limited to, state and local requirements for emission controls, emission limitations, offsets, permitting, monitoring, testing, and reporting. The State of Alaska shall have air-quality jurisdiction over the blocks to be leased, once the State of Alaska has promulgated, and the USEPA Administrator has confirmed adequacy of regulations to implement and enforce the requirements of Section 328, Title III. There will not be a significant difference in the requirements to be to be complied with by the lease operators since there are no onshore nonattainment areas and the State of Alaska has adopted the national air-quality standards and PSD regulations as the State standards and PSD regulations.

If an air-quality analysis of air pollution for the OCS Mining Program Norton Sound Lease Sale is required, the USEPA approved Offshore and Coastal Dispersion (OCD) Model would be used to calculate impacts of pollutant emissions due to the Norton Sound Lease Sale on onshore air quality.

Base Case: Under the base case for the proposal, one offshore dredge would operate for 150 days each year with 20-percent of this time representing downtime (not dredging). It is possible that the dredge could operate as close as 5 km from shore, and it is likely that it would be further away. Estimated uncontrolled annual base-case emissions for the dredge and support activities, including exploration activities for the peak year of mining activity, are summarized in Table IV-3. Estimated NO<sub>x</sub> annual uncontrolled emissions are 248 tons per year. Should maximum uncontrolled NO<sub>x</sub> emissions exceed 250 tons per year, under the Federal and State of Alaska PSD regulations, the lessee would be required to reduce emissions through application of Best Available Control Technology (BACT). An analysis performed using the OCD model for air pollutants emitted in the base case due to the Norton Sound Lease Sale, showed that maximum NO<sub>x</sub> concentration, averaged over a year, would be 0.27 μ/m<sup>3</sup> at the nearest shoreline which is only 1.1 percentiles of the available PSD-Class-II increment for NO<sub>x</sub> (Table IV-4). There are no onshore air-quality-monitoring data in the Nome area to establish baseline NO<sub>x</sub> ambient concentrations. Because of the limited sources of emissions, it is expected that the ambient concentration would be near the lower limit of detectability, except perhaps in the City of Nome. In any event, neither the air-quality standard nor the PSD limitation for NO<sub>x</sub> would be approached (Table IV-4).

b. Effect of Air Quality Not Addressed by Standards: Effects of air pollution from OCS activities and other sources on the environment, as distinct from those specifically addressed by air-quality standards, include the possibility of damage to vegetation and acidification of coastal tundra, as discussed in Sections III.D.7 and IV.G.7 of the Diapir Field Lease Offering (Sale 87) FEIS (USDOI, MMS, 1984f) and in Olson (1982). Effects may be short term (hours, days, or weeks), long term (seasons or years), regional (on the scale of the southern half of the Seward Peninsula) or local (near the shoreline only). This information is incorporated by reference, and a summary pertinent to this proposed lease sale follows.

**Table IV-3**  
**Estimated Uncontrolled Emissions and USDOJ Exemption Levels for**  
**Offshore Mining in the Norton Sound Lease-Sale Area**  
**(metric tons per year)**

	Pollutant <sup>1/</sup>				
	CO	NO <sub>x</sub>	TSP <sup>2/</sup>	SO <sub>2</sub>	VOC
<b>Base-Case Mining Activity<sup>3/</sup></b>	63	248	23	28	7
<b>Exemption Levels at 5 kilometers<sup>4/</sup></b>	6,415	90.6	90.6	90.6	90.6

Source: MMS, Alaska OCS Region.

- <sup>1/</sup> CO = Carbon Monoxide.  
NO<sub>x</sub> = Nitrogen Oxides (assumed to be predominately NO<sub>2</sub>).  
TSP = Total Suspended Particulates  
SO<sub>2</sub> = Sulfur Dioxide.  
VOC = Volatile Organic Compounds (excluding nonreactive compounds such as methane and ethane).
- <sup>2/</sup> Includes most particulate matter less than 10 micrometers in aerodynamic diameter (PM<sub>10</sub>).
- <sup>3/</sup> Assumes one dredge of approximately 7,000 HP each operating 150 days per year with 20-percent downtime (open-water season) plus support-boat emissions and exploration activity emissions. Computed from scenarios and emission factors in Form and Substance and Jacobs Engineering Group, Inc. (1983).
- <sup>4/</sup> Exemption levels based on USDOJ exemption criteria accounting for distance from shore (30 CFR 250.45 and 30 CFR 282.28).

**Table IV-4**  
**Comparison of Modeled Air-Pollutant Concentrations with Regulatory Limitations for**  
**the Base and Cumulative Cases**  
**(measured in micrograms per cubic meter)**

Averaging Times	PSD Class II Increment <sup>1/</sup>	USDOJ Significance Increment <sup>2/</sup>	Maximum Modeled Concentration Over Land <sup>3/</sup>	Air-Quality Standards
<b>Base Case NO<sub>x</sub></b>				
annual	25	1	0.27	100 <sup>4/</sup>
24-hour	--- <sup>5/</sup>	---	---	---
8-hour	---	---	---	---
3-hour	---	---	---	---
1-hour	---	---	---	---
<b>Cumulative Case NO<sub>x</sub> State and OCS Waters</b>				
annual	25	NA	5.78	100 <sup>4/</sup>
24-hour	---	---	---	---
8-hour	---	---	---	---
3-hour	---	---	---	---
1-hour	---	---	---	---
<b>Cumulative Case NO<sub>x</sub> State Waters Only</b>				
annual	25	NA	5.68	100 <sup>4/</sup>
24-hour	---	---	---	---
8-hour	---	---	---	---
3-hour	---	---	---	---
1-hour	---	---	---	---
<b>Cumulative Case SO<sub>2</sub> State and OCS Waters</b>				
annual	20	NA	0.82	80 <sup>4/</sup>
24-hour	91	NA	17.54	365
8-hour	---	---	---	---
3-hour	512	NA	67.44	1,300
1-hour	---	---	---	---
<b>Cumulative Case SO<sub>2</sub> State Waters Only</b>				
annual	20	NA	0.80	80 <sup>4/</sup>
24-hour	91	NA	17.54	365
8-hour	---	---	---	---
3-hour	512	NA	67.44	1,300
1-hour	---	---	---	---

Source: MMS, Alaska OCS Region.

NA - Not Applicable (applicable to Federal OCS waters only)

<sup>1/</sup> Increment above ambient concentration allowed in a designated PSD area. Ambient-baseline concentration for PSD not established for this area.

<sup>2/</sup> Increases in concentration above significance level by Federal OCS sources require reduction of emissions by application of Best Available Control Technology.

<sup>3/</sup> Projected concentrations attributable to the proposal as modeled by the Offshore and Coastal Dispersion Model.

<sup>4/</sup> Annual arithmetic mean.

<sup>5/</sup> No value has been established, not to exceed maximum allowable PSD increment.



Olson (1982) reviews the body of knowledge that demonstrates the known high susceptibility of fruticose lichen, an important component of the tundra ecosystem, to sulfurous pollutants. There is evidence that SO<sub>2</sub> concentrations as low as 12.0 (μ/m<sup>3</sup>) for short periods of time can depress photosynthesis in several lichen species. Also, the sensitivity of lichen to sulfate is increased in the presence of humidity or moisture--conditions which are common to coastal tundra. However, the maximum SO<sub>2</sub> concentrations calculated by the OCD model, for the base or high case, are 0.03 and 1.91 μ/m<sup>3</sup> annually and for 3-hour averaging periods, respectively. In combination with minimal background-ambient concentrations, these concentrations are much less than the threshold for short-term or permanent effects on lichen.

A sulfur budget has not been compiled for the Arctic tundra ecosystem. Such a budget is necessary to determine potential contributions to tundra acidification from acid deposition of pollutants. However, Rahn (1982) estimated a total input of 14 kilograms per square kilometer over the Arctic Ocean, with a factor of three uncertainty. A rough approximation of maximum deposition from SO<sub>2</sub> annual emissions, for the maximum emissions evaluated in this EIS, can be made from OCD Model calculations of maximum concentrations assuming a constant rate of deposition. The result is an annual deposition of 0.093 kg/km<sup>2</sup>/year. This is more than two orders of magnitude less than the estimated existing sulfur budget and four orders of magnitude less than the 670 kg/km<sup>2</sup>/year associated with damage such as fish kills, lower ecosystem productivity, and die-off of plant species, in susceptible areas. In addition, the sulfur-deposition estimate for the proposed sale assumes a constant rate of deposition over the coastal area, an assumption that overestimates the deposition. The maximum concentration of SO<sub>2</sub> decreases rapidly from the maximum at the shoreline and varies through time. The concentrations and deposition of sulfurous pollutants would be well below the known level of damage to lichen (and of less sensitive plants) or of significant acidification of the tundra even on a local basis for any of the cases considered by this EIS.

Effects of Accidental Emissions: It is likely that one major spill of diesel fuel oil would occur near or at the shore during the life of the offshore mining project (Sec. IV.B.2). The spill size is assumed to be 3,500 bbl (bbl), which is a median fuel load for a large dredge. The amount evaporated would vary depending on wind and temperature. In the event of a 3,500-barrel spill, within 3 days, approximately 537 to 572 bbl of fuel oil, 71 to 75 metric tons (t) of gaseous hydrocarbons, and 7.1 to 7.3 t of VOC could evaporate and be lost to the atmosphere (calculations are for summer and fall Nome area conditions, respectively, based on Redding and Kirstein [1985]). Evaporation would cease within approximately 122 hours (about 5 days). The motion of the oil slick would help disperse the emissions over a larger area than the slick itself, resulting in lower concentrations of air pollutants.

Diesel fuel spills may catch fire either accidentally, or set on fire intentionally as a possible cleanup and control technique. If a fuel spill is ignited immediately after spillage, the burning can combust the fuel that would otherwise evaporate. In the case of fuel oil, more than two-thirds of the initial mass of the slick may eventually evaporate. Because the chemical composition of fuel oil consists of fewer of the high-molecular-weight components than does crude oil, the amount of TSP emitted would be less than from a crude oil burn. A discussion of the emissions from example crude oil burns is given in the Chukchi Sea Sale 109 FEIS (USDOI, MMS, 1987) and is incorporated herein by reference. The discussion is summarized in the following paragraphs.

Incomplete combustion of oil injects about 10 percent of burned crude oil as oily soot plus minor quantities of other pollutants into the air. Clouds of black smoke from a 360,000-bbl tanker fire 75 km off the coast of South Africa deposited oily residue in a rain 50 to 80 km inland. Later the same day, clean rain washed away most of the residue and allayed fears of permanent damage.

Based on qualitative information, burns that are two or three orders of magnitude smaller do not appear to cause noticeable fallout problems. Along the Trans-Alaska Pipeline, 500 bbl of a spill were burned over a 2-hour period "apparently without long-lasting effects" (Schulze et al., 1982). The smaller-volume Tier II burns of Prudhoe Bay had no visible fallout downwind of the burn pit (Industry Task Group, 1983).

Coating portions of the ecosystem in oily residue is the major, but not the only, potential air-quality risk. Oily residue in smoke plumes from crude oil is mutagenic, but not highly so (Sheppard and Georghiou, 1981; Evans et al., 1987). The Expert Committee of the World Health Organization considers daily average smoke concentrations of more than 250 μ/m<sup>3</sup> to be a health hazard for sufferers of bronchitis.

It is expected that one spill of 3,500 bbl of fuel oil would occur during the life of the offshore mining project. The spill would consist of diesel fuel oil which, if burned, would emit less soot and other particulate matter than

would burning crude oil. Also, modeling of emissions (including TSP) from hypothetical dredges demonstrates that there would be small concentrations of pollutants onshore, even during summer periods of onshore winds. Once deposited, soot from a fire would clump and wash off of vegetation in subsequent rains, limiting any effect on vegetation and human health in the short term.

**SUMMARY:** Impacts from air emissions due to the Norton Sound Lease Sale on onshore air quality are expected to be less than 5 percent of the maximum allowable PSD-Class-II increments and would not make the concentrations of criteria pollutants in the onshore ambient air approach the air-quality standards. Therefore, the effects of air emissions due to the Norton Sound Lease Sale on onshore air quality are expected to be NEGLIGIBLE.

**CONCLUSION (Effect on Air Quality):** The overall effect of the proposed sale on onshore air quality with respect to standards and with respect to effects of air quality not addressed by standards is expected to be NEGLIGIBLE.

**CUMULATIVE EFFECTS:** Additional emissions of air pollutants may occur from activities onshore and in State waters, from mining, oil- and gas-related, and other activities. These must be considered together to define emissions in the cumulative case. The cumulative case under the proposal includes one large mining dredge 5 km offshore in Federal waters, and one large and two small dredges in State waters. All of the Norton Sound Sale 57 oil and gas leases now have been relinquished and would not contribute to effects on air quality in the cumulative case.

The total estimated emissions for OCS and State waters are given in Table IV-5. The majority of the pollutant concentration would be from emissions in State waters. This is apparent from comparison of the modeled concentrations for the cumulative case considering first, sources in both OCS and State waters and second, sources in State waters only (Table IV-4). The OCD Model was applied to simulate total emissions from all dredges and for dredges in State waters only (Table IV-4). The results indicate that uncontrolled emissions of the dredge in OCS waters, in addition to those in State waters, would increase annual mean 1-hour  $\text{NO}_x$  and  $\text{SO}_2$  concentrations at the shoreline from  $5.68 \mu/\text{m}^3$  to  $5.78 \mu/\text{m}^3$ , and from  $0.80 \mu/\text{m}^3$  to  $0.82 \mu/\text{m}^3$ , respectively. The maximum hourly  $\text{SO}_2$  concentrations averaged over 3-hour and 8-hour periods would remain  $67.44 \mu/\text{m}^3$  and  $17.54 \mu/\text{m}^3$ , respectively. These concentrations are likely to be conservative (high) because the dredges probably would not be located as close together as in the model simulation.

The background ambient concentrations of  $\text{NO}_2$  and  $\text{SO}_2$  in the area are very small. Additional consumption of PSD increments due to a dredge in Federal OCS waters would be  $0.1 \mu/\text{m}^3$  of  $\text{NO}_x$  as an annual hourly average; and  $0.02$  and  $0 \mu/\text{m}^3$  of  $\text{SO}_2$  maximum averages for 24-hour and 3-hour periods, respectively. In each case, the added pollutant concentrations would be less than 0.5 percent of the allowable PSD-Class-II increments. Consequently, concentrations from the OCS activities under the proposal--when added to existing amounts--would not approach the PSD-Class-II increments or the ambient air-quality standards. Air-pollutant emissions in the cumulative case, with or without a dredge in Federal waters, would not approach maximum concentrations allowed by ambient or incremental (PSD) air-quality standards.

Emissions could be reduced from those facilities on land or in Federal and State waters which would be subject to EPA and State regulations. The regulations require application of BACT to all major facilities, in addition to staying within the limitations of ambient air-quality standards and PSD-Class-II concentration-increment limitations. If the State of Alaska concluded that dredges in Federal or State waters were major sources, application of BACT would be required to reduce emissions. The methods available for the reduction of  $\text{NO}_x$  emissions from diesel engines include retarding fuel-injection timing and the selection of engines with more efficient combustion characteristics. There are also more experimental procedures. Discussion of current  $\text{NO}_x$  BACT for diesel engines in Alaska can be found in State of Alaska air-quality-permit analyses (State of Alaska, DEC, 1987). For diesel engines, BACT for  $\text{SO}_2$  usually includes use of fuel oil with a limited sulfur content (see, for example, State of Alaska, DEC, 1987).

The modeled maximum concentration of  $\text{SO}_2$  for the cumulative case ( $0.82$  and  $67.44 \mu/\text{m}^3$  for annual and 3-hour averaging periods, respectively) indicate that photosynthesis of lichen could be reduced in a localized area (within a few hundred meters of shore) at the shoreline for short periods of time (hours or days). The  $\text{SO}_2$  concentrations would decrease rapidly inland from the shore. If deposition from  $\text{SO}_2$  at a constant rate and at a concentration of  $0.14 (\mu/\text{m}^3)$  is assumed,  $3.23 \text{ kg}/\text{km}^2$  each year would be deposited on the tundra near the shore. This estimate is conservatively high, but is still much less than Rahn's (1982) background-sulfur-input

**Table IV-5**  
**Cumulative Estimated Uncontrolled Emissions in the Sale Area**  
**and Adjacent State Waters**  
**(metric tons per year)**

	Pollutant <sup>1/</sup>				
	CO	NO <sub>x</sub>	TSP <sup>2/</sup>	SO <sub>2</sub>	VOC
Offshore Mining <sup>3/</sup>	217.7	852.7	80.2	95.2	20.8

Source: MMS, Alaska OCS Region.

- <sup>1/</sup> CO = Carbon Monoxide.  
NO<sub>x</sub> = Nitrogen Oxides.  
TSP = Total Suspended Particulates.  
SO<sub>2</sub> = Sulfur Dioxide.  
VOC = Volatile Organic Compounds.

<sup>2/</sup> Includes PM 10.

<sup>3/</sup> Based on one large dredge in Federal waters and one large and two small dredges in State waters, plus support-boat activities and emissions from exploration activities, all located off Nome. Estimates computed from air-pollutant-emission scenarios in Form and Substance and Jacobs Engineering Group, Inc. (1983).

estimate of 14 kg/km<sup>2</sup>/year for the Arctic Ocean. Consequently, significant acidification of the tundra and surface water is not expected. The effects of air quality on the environment (other than those addressed by standards) would be short term and localized.

**Conclusion:** Because effects from air-pollutant emissions from OCS sources on onshore air quality PSD-Class-II increments or national ambient air-quality standards for a criteria air pollutant, and effects of air quality not addressed by standards would be short-term and localized, the effect on onshore air quality under the cumulative case is expected to be MINOR.

2. **Effect on Water Quality:** Offshore dredging and tailings discharge are agents which will have a combined effect on water quality in the sale area. The aspects of water quality most likely to be affected are turbidity, trace-metal content, and oxygen levels. A fuel spill during a major accident or during fuel transfers could also contaminate area waters.

a. **Effect of Offshore Mining on Turbidity:** Offshore dredging and tailings discharge and their generic effects are described and discussed in Section IV.E.5.a of the Sale 100 FEIS (USDOI, MMS, 1985a); this discussion is summarized below and is incorporated in total by reference.

(1) **Extent of Turbidity:** Experiences with actual dredging or dumping operations elsewhere offshore of Alaska and in other U.S. waters show a decrease in the concentration of suspended sediments with time (2-3 hr) and distance (1-3 km) downcurrent from the discharge. Similarly, in the dredging operations associated with artificial island construction and harbor improvement in mostly sandy sediments of the Canadian Beaufort Sea, the turbidity plume generally extended a few hundred meters to a few kilometers but tended to disappear within hours after operations ceased (Pessah, 1982).

Offshore mineral extraction by dredges, however, may cause higher and more persistent turbidity than these other, more common dredging activities. Mining dredges process sediments continuously and use additional volumes of water to deliberately destroy sediment cohesiveness, resulting in greater dispersal of sediment fines. Dredging of alluvial tin deposits in 30 to 40 m of water off of Thailand resulted in significant turbidity up to 5 km downcurrent (Limpsaichol and Poopetch, 1984), a 70-percent greater distance than reported for nonmining dredging.

The Norton Sound environment appears to be less effective in dispersing fine sediments than is expected from experience with other marine waters. In a Norton Sound study of drilling-mud discharges in 12 to 13 m of water, ECOMAR Marine Consulting (1983) found a three-to-four-orders-of-magnitude decline in suspended-solid concentrations within 10 minutes of ceasing a 1,000-barrels (bbl)-per-hour discharge of drilling mud. Although this rate is sufficient to rapidly dilute discharged drilling mud, it was slower than had been observed in discharge studies in other waters. ECOMAR Marine Consulting thought that a greater wave-induced turbulence in the Norton Sound study might have slowed settling of the drilling mud.

Industry monitoring of current gold-mining activity in Norton Sound has also found less dispersion of discharged sediments than expected. Gold dredging and tailings discharge in inshore State waters have resulted in greater turbidity than projected in the Offshore Discharge Criteria Evaluation (ODCE) modeling (Northern Technical Services, 1985) at the furthest distance measured (500-600 m in 1986-89), and have exceeded EPA permit restrictions (USEPA, 1986b, 1988a,b; Jewett et al., 1990). The greater turbidity than expected is attributable at least in part both to greater silt content in dredged materials than had been projected and to technical difficulties in maintaining the optimum configuration for the tailings-discharge system on the dredge. In 1989, turbidity 600 m downcurrent of the Bima averaged 52 nephelometric-turbidity units (NTU, a measure of light-scattering ability), increasing ambient turbidity by about 40 NTU (Jewett et al., 1990).

WestGold received a second dredging permit for a new project in 1989, the Nome Expansion Project (NEP), with planned dredging using a variety of equipment in very shallow, nearshore waters. This project was allowed a larger, 1-km mixing zone to meet the turbidity standard of 25 NTU. No turbidity data were collected for the NEP in 1989 because the equipment tested was unable to effectively dredge nearshore sediments and did not obtain planned rates of discharge. Modeling data for the Bima indicate that with a larger, 1-km mixing zone, the State turbidity standard would have only been occasionally rather than usually exceeded (as was the case in 1986-89). However, the State of Alaska and EPA to date have not indicated any willingness to permit a similar 1-km mixing zone in the deeper waters where the Bima operates.

(2) Turbidity Standards and Criteria: Suspended sediments have very low direct toxicity for sensitive species, with expected toxicity somewhere between that of a clay such as bentonite ( $LC_{50}$  = concentration at which half of the test organisms die within a set time [usually 4 days] greater than 7,500 ppm for the eastern oyster) and that of calcium carbonate ( $LC_{50}$  greater than 100,000 ppm for the sailfin molly) (see National Research Council, 1983). These are very low toxicities, falling into the ranges generally described as slightly toxic to nontoxic. Direct toxicity from suspended sediments, therefore, has not been considered a regulatory issue and toxic or acute marine standards have not been formulated by either the State of Alaska or EPA.

For the purpose of analysis, this EIS will use 7,500 ppm suspended solids as an unofficial, acute (toxic) criterion for water quality. This value is the lowest (most toxic)  $LC_{50}$  for a clay or calcium carbonate reported in the National Research Council (1983) assessment of drilling fluids in the marine environment.

The State of Alaska standard and Federal criterion for marine waters are considered a chronic standard and a chronic criterion in this analysis. Both the State standard and Federal criterion are directed toward protecting biota from chronic stresses rather than from acute toxicity, but the two limits are very different in formulation. The State standard used in permitting the Bima in 1989 is a limit of 25 NTU, but the only Federal criterion is a 10-percent decrease in the seasonally averaged compensation depth for photosynthetic activity. The State criterion and the Federal criterion are not directly comparable. (The State does have a standard similar to the Federal criterion, but it was not considered as stringent a requirement and was not referenced on the Bima NPDES permit).

(3) Mining Experience in State Waters: This EIS assumes that saltwater throughput and tailings-discharge rates per dredge will be similar to that for the Bima dredge in inshore State waters (Rusanowski, Gardner, and Jewett, 1988). The [chronic] State turbidity standard of 25 NTU was not met by the turbidity plume from the Bima on 44, 81, and 61 percent of dates in 1986, 1987, and 1988, respectively. Unaveraged frequency data were not tabulated in the annual report for the 1989 Bima operations, but an average turbidity of 52 NTU--versus the 25 NTU standard--at 0.6 km downcurrent from the dredge (0.1 km beyond the edge of the mixing zone) was reported (Jewett et al., 1990).

The continued high turbidity at 0.5 km and further from the discharge is of particular concern because studies of drilling-mud disposal in Norton Sound and elsewhere have indicated that the most rapid (time and distance) dilution occurs within 0.1 km of the discharge; at greater distances, plume concentrations decrease much more slowly (ECOMAR Marine Consulting, 1983). Rusanowski, Gardner, and Jewett (1988) suggest that this high turbidity may be indicative of resuspension of dredged sediments from tailings piles rather than of direct discharge from the dredge.

Whether exceeding the State (chronic) standard would translate into exceeding the Federal (chronic) criterion cannot be estimated from the data. Because the Federal criterion must be met closer, at a distance of 0.1 km from the discharge, rather than the State requirement of a distance of 0.5 km, it is likely that the Federal criterion for turbidity could be exceeded. Because turbidity plumes can extend up to 5 km from point of origin, it is also possible that dredging turbidity above State standards would extend into State waters from dredging within the sale area.

The (chronic) turbidity standard has been exceeded by the Bima despite non-settleable solid concentrations in the effluent far below that maximum allowed by its NPDES permit. The NPDES permit for the Bima currently permits discharges of 60,000  $yd^3/day$  with maximum nonsettleable matter discharge limited to a concentration of 20,000 ppm (Table IV-6). Based on an EPA estimate of 35-fold dilution of effluent within 100 m, nonsettleable solid concentrations at 100 m would be limited to 570 ppm. Monthly nonsettleable solids, however, averaged from 730 to 1,700 ppm in the Bima effluent in 1988 (Jewett, Gardner, and Athey 1989), or--assuming 35-fold dilution--an incremental 21 to 48 ppm at 100 m--an order of magnitude lower than the NPDES permit maximum limit. Thus, the data indicate that the NPDES permit limit for nonsettleable solids is set at least one order of magnitude too high to insure meeting the State (chronic) standard. Based on these same data, direct toxicity from suspended solids has not occurred from the Bima operation and would not be expected to occur in a similar Federal operation. The reported effluent concentrations of 114 to 221 ppm nonsettleable suspended solids are thirty- to sixtyfold lower than the toxic level prior to dilution within the mixing zone.

(4) Methods of Decreasing Turbidity: Several ways of possibly decreasing turbidity at the edge of the State mixing zone have been considered for the Bima operation (Engineering Hydraulics, 1988). Reducing both water flow and amount of sediment dredged reduces modeled turbidity at

Table IV-6  
Effluent Limitations and Monitoring Requirements  
for the Bima

	Discharge Limitations		Monitoring Requirements		
	4-Day (Chronic) Average (ppb)	(Acute) Maximum (ppb)	Measurement Frequency	Sample Type/Method <sup>1/</sup>	Reported Values
Flow Rate	None	47.8 mg/d <sup>2/</sup>	hourly	instan- taneous	monthly max. & monthly ave.
Total Solids	None	60,000 yd <sup>3</sup> /day	hourly	grab monthly ave.	monthly max. &
Nonsettleable Matter	None	20,000 ppm	daily	grab	monthly max.
Arsenic (total recoverable)	1,260	2,420	each operating day for 15 days, weekly thereafter	24-hr composite	all daily & weekly values
Chromium (total recoverable)	1,750	38,500	each operating day for 15 days, weekly thereafter	24-hr composite	all daily & weekly value
Mercury (total recoverable)	0.875	73.5 <sup>3/</sup>	each operating day for 15 days, weekly thereafter	24-hr composite	all daily & weekly values
Lead (total recoverable)	196	4,900 <sup>4/</sup>	each operating day for 15 days, weekly thereafter	24-hr composite	all daily & weekly values
Zinc (total recoverable)	2,030	5,950	each operating day for 15 days, weekly thereafter	24-hr composite	all daily & weekly values
Cadmium (total recoverable)	326	1,510 <sup>5/</sup>	each operating day for 15 days, weekly thereafter	24-hr composite	all daily & weekly values
Copper (total recoverable)	None	102	each operating day for 15 days, weekly thereafter	24-hr composite	all daily & weekly values
Nickel (total recoverable)	249	4,900 <sup>6/</sup>	each operating day for 15 days, weekly thereafter	24-hr composite	all daily & weekly values

Source: USEPA, 1986b.

<sup>1/</sup> Only nonsettleable trace metals monitored in discharge.

<sup>2/</sup> mg/d = million gallons per day.

<sup>3/</sup> Maximum discharge in excess of 3.5 ppb mercury will exceed 4-Day Average discharge limitation.

<sup>4/</sup> Maximum discharge in excess of 784 ppb lead will exceed 4-Day Average discharge limitation.

<sup>5/</sup> Maximum discharge in excess of 1304 ppb cadmium will exceed 4-Day Average discharge limitation.

<sup>6/</sup> Maximum discharge in excess of 996 ppb nickel will exceed 4-Day Average discharge limitation.

the edge of the mixing zone, but this reduction might not occur with the real discharge because of increased entrainment of air in the discharge at lower water-flow rates. The air entrainment increases turbulence and adds buoyancy to the discharge plume, making the plume rise rather than sink. The effects of air entrainment and plume buoyancy were not included in the modeling evaluation of turbidity. Turbidity levels, although still frequently exceeding the State standard, were much lower in 1988 than in 1987. This change has been attributed to reduced air entrainment in the discharge. Reducing the solids content of the discharge would also reduce turbidity, but that is not considered economically viable (Northern Technical Services, 1986a). Modeling an increase in the number of discharge ports for the Bima projected an increase rather than decrease in turbidity.

Near-surface discharge in shallow waters (10 m) and near-surface or mid-depth discharge in deeper waters (18 m) rather than bottom discharge would also lessen bottom turbidity at the edge of the State mixing zone according to the model. The model did not evaluate turbidity elsewhere in the water column. This approach appears to be unlikely to reduce turbidity in all levels of the water column sufficiently to meet either the (chronic) State standard or the Federal criterion for a similar operation in Federal waters. First, during much of 1987, discharge from the Bima was already near surface (Engineering Hydraulics, 1988; USEPA, 1988b), and the State turbidity standard was usually exceeded in bottom waters. Second, the Federal standard is in terms of compensation depth, a measurement made from the water surface downward. Near-surface discharge will increase surface turbidity and would make the operation less likely to meet the Federal standard than deeper discharge. Third, the model also shows that higher current velocities increase turbidity at the edge of the State mixing zone. ECOMAR Marine Consulting (1983) reported near-surface (1 m) currents of 1.5 knots and bottom currents fivefold lower at 0.3 knots in a study of drilling-mud dispersion in 13-m-deep waters southeast of Nome. Thus, the higher current velocities in near-surface waters than in bottom waters could result in increased rather than decreased turbidity at the edge of the mixing zone with surface discharge.

The use of flocculants to reduce turbidity from the Bima was also evaluated and rejected by Engineering Hydraulics, based on difficulty of applying flocculants in a continuous, open-water operation, the large quantities of flocculants that would be discharged to the environment, and the high cost involved. Dredge curtains--a sort of boom around the dredging operation--are not applicable to open-water dredging (Sec. II.A.2.e).

The model used by Engineering Hydraulics also shows that the same discharge would have lower turbidity in bottom waters at the edge of the State mixing zone if the discharge were in deeper (18 m) rather than in shallower (10 m) waters. However, the applicability of this model conclusion to the marine environment off of Nome is highly questionable. The modeled effect that deeper water has on lessening turbidity is more than counteracted by the modeled effect of the known, higher silt-plus-clay content in sediments at most locations offshore of Nome.

(5) Effect of Sediment Silt Content: Turbidity greatly increases with increasing amounts (percentage) of silt and finer particulates present in the dredged sediments. Rusanowski, Gardner, and Jewett (1988) report silt-plus-clay on the order of 2 percent or less in sands and gravels of 1986 and 1987 dredge areas and levels on the order of 0.5 percent in cores from below the surface sediment layer. However, it is not clear whether these concentrations represent the range of substrates in the mined area--including sand/silt, or just represent typical "sand" or typical "gravel" environments. That is, the amount of silt in the dredged sediments that caused the turbidity problem in 1986 and 1987 dredging could have been higher than this 0.5 to 2 percent. Hood et al. (1974) report more than twofold higher concentrations (5 percent, n=6 [n=number of samples]) of silt-plus-clay in surface sediments off of Nome at similar water depths (8-15 m).

More importantly, the Hood et al. (1974) data indicate increasing silt-plus-clay in sediments in deeper waters, with an average of 12-percent silt-plus-clay (n=13) in surface sediments in 16 to 22 m of water, and an average of 42-percent silt-plus-clay (n=4) in surface sediments in 23 to 27 m of water. The data of Hood et al. also show that silt and clay content is highly variable within each depth range, with the coefficient of variation being 0.82-0.90 of the mean content of silt-plus-clay in each water-depth range. The Hood et al. data--silt and clay content, variability, and apparent depth dependence--are consistent with data for the sale area and other inshore waters collated from various studies by Roberts (1976). Dredging in deeper waters, a category which would include the sale area, would be less likely to meet turbidity standards than the past 1986-89 gold dredging operation in shallower State waters which only infrequently met the State standard for turbidity.

(6) The Proposed Action: Once tailings are discharged, the extent, duration, and concentration of turbidity depend on the grain-size composition of the discharge, the rate, depth, and duration of the discharge, the turbulence in the water column, and the current regime. The sale area contains gravel-, sand-, and silt-plus-clay-sized sediments with gold potential and overburden with high silt-plus-clay content.



Dredging discharge--unlike drilling-mud discharge in other OCS operations--is continuous. Extremely high turbidity values have been observed at least 0.5 km from the Bima, indicating low rates of settling in this environment adjoining the sale area. Turbidity, therefore, is typically expected to extend to the high end of commonly observed values for dredging plumes in the literature, or a 3-km distance from the dredging and discharge activities.

The specific locations of high turbidity resulting from the dredging and tailings discharge would change with season and year as the dredge progressed or changed locations. Because a dredge would move very slowly (on the order of 0.5 km per season), because it would discharge continuously over many tidal current reversals (Pearson, Mofjeld, and Tripp, 1981), because of frequent, short-term, nontidal fluctuations in current direction in northwestern Norton Sound (Muench, Tripp, and Cline, 1981), and because of changes in current direction with water depth as the plume sinks in the water column (Muench, Tripp, and Cline, 1981; ECOMAR Marine Consulting, 1983), the area affected by the turbidity plume in the base case for the proposal would be 28 km<sup>2</sup> on any one day (area of circle with 3-km radius about the dredge).

In a full season of dredging, the area affected by turbidity about a dredge would be an ellipse of 3-km distance around the dredged area. Assuming that the area actually dredged is a square collapses this ellipse into a circle and eases calculation of the area affected by turbidity without significantly changing the estimated area. In a complete season a dredge would move over an area of about 0.4 km<sup>2</sup>, equivalent to a square with 0.6-km sides. The 1989 mixing zone for turbidity for the Bima is then calculated as the area of a circle with a diam equal to the side of the dredged square plus 2 km, or 5.3 km<sup>2</sup>. The area affected by turbidity is calculated as the area of a circle with a diameter equal to the side of the dredged square plus 6 km. The area affected by a short-term (a few days to several months during one dredging season) increase in turbidity in the water column thus would be limited to 34 km<sup>2</sup> about the dredge, or to 29 km<sup>2</sup> excluding the area contained within the mixing zone.

Based on the monitoring data for the Bima, turbidity levels over at least some of this 34 km<sup>2</sup> would average greater than the (chronic) State standards and/or EPA criteria. The EPA (USEPA, 1990a) has recently reissued an NPDES for the WestGold Bima which provides a larger mixing zone for (only) turbidity of 1000 m, which should reduce the frequency with which the State standard for turbidity would be exceeded in State waters. The State standard for turbidity specifically allows such a change in the size of the mixing zone. However, note that WestGold's plume-modeling studies have indicated that a 1,400-m mixing zone would be necessary to insure compliance of the Bima with State turbidity standards (USEPA, 1990a). Further complicating the issue is the fact that the EPA water-quality criteria do not allow a similar expansion of the (100-m) mixing zone in the Federal waters. The compensation-depth criterion for Federal waters would still have to be met at 100 m, regardless of the size of the mixing zone for turbidity established in adjoining State waters.

The requirement for monitoring discharges from mining operations that result from this proposal--particularly the requirement for timely notification of RS/FO of violations of water-quality criteria or permits (Stipulation No. 1)--will allow the RS/FO to order modification of operations to preclude continuous violation. For example, discharge modifications could be required that would limit discharges within 1.4 km of State waters, the latter distance being that considered necessary by WestGold to insure compliance with State turbidity criteria (USEPA, 1990a). No directly toxic levels of suspended solids are anticipated outside of the mixing zone. Thus, based on the monitoring history for the Bima, but taking into account the additional protection offered by Stipulation No. 1, the LOCAL effect of turbidity on water quality would be expected to be MINOR. A NEGLIGIBLE effect of turbidity on water quality would be expected on a REGIONAL basis.

b. Effect of Offshore Mining on Trace Metals: Offshore mining can increase trace-metal concentrations in the water column (1) by discharging metals dissolved in interstitial waters of the sediment, (2) by washing loosely bound metals off of the dredged tailings and into solution, (3) through resuspension of particulate-trace metals, and (4) by placing metalliferous placer deposits at the sediment surface, in contact with the water column (with consequent, possible, long-term dissolution, desorption, and resuspension of trace metals). Metals of interest in the sale area are those of most concern, as denoted by their presence on the original (Gold Book) EPA priority list of metals (USEPA, 1986a). Mercury is addressed first in a separate subsection in the following discussion because of concerns identified during public scoping and because of the strong tendency of mercury levels to biomagnify through the marine food chain.

This EIS will commonly refer to the eight metals on the original EPA priority list as "trace metals." There is some carelessness in the common use of the terms "trace metals," "heavy metals," and "heavy minerals." A "trace metal" is a metal expected to be found in low, "trace" amounts. Generally, in sediment chemistry, "trace" would be a metal which would be measured in ppm of dry weight and in water chemistry a metal which would be

measured in parts per billion (ppb). A "heavy metal" is a metal with specific gravity greater than 5. Specific gravity is a dimensional ratio of density of a material to the density of water. Trace metals may or may not be heavy metals. Aluminum is a water trace metal which is not a heavy metal. Arsenic, one of the trace metals of concern in this EIS, has metal forms with specific gravities both greater than and less than 5. "Heavy minerals" are minerals with specific gravity greater than 2.9.

Of the eight trace metals of concern in this analysis, arsenic, chromium, and lead accumulate in the sediments of northwestern Norton Sound predominately as heavy minerals (Sec. III.A.8) and are expected to be concentrated along with gold in offshore placers. Zinc, cadmium, and copper are not present as heavy minerals and would not be expected to be concentrated in offshore placers. There is some concentration of mercury and nickel in placer deposits (Jewett et al., 1990), but the data for mercury and nickel are insufficient to identify whether these two metals are present predominately in heavy-mineral form.

(1) Summary of Existing Data: Reliable data for ambient concentrations of trace metals in the water column are limited to three dates in June and September 1989. The ambient data were summarized in Table III-2. These data are insufficient to detect seasonal and interannual variations, or the effect of storms on trace-metal concentrations (Hood, 1989). Such information is important in predicting the likelihood or frequency of exceeding water-quality criteria.

This analysis assumes that these measured trace-metal concentrations in the water represent the true mean concentrations and that seasonal or interannual variations are small relative to the EPA criteria for each trace metal. The validity of these assumptions would be verified during postlease monitoring of water quality. In addition, the seasonal and interannual water-quality data from the monitoring program--rather than sale EIS assumptions--would be used by the RS/FO to interpret and regulate mining activities to insure protection of LOCAL and REGIONAL water quality.

The amounts of trace metals released during dredging are correlated with and can be predicted from particulate and interstitial concentrations of metals in the sediment and from the amounts of metal released in elutriate tests (Brannon, Plumb, and Smith, 1980; Engler, 1980; and Lindberg, Andren, and Harriss, 1975).

Total trace metals in surficial sediment, usually only within the upper few centimeters, have been measured at a few sites in the sale area and at several inshore sites. The data indicate that locally elevated levels of arsenic, chromium, lead, zinc, cadmium, copper, and nickel exist in the vicinity of the sale area and that very high anomalies of arsenic, mercury, lead, zinc, copper, and nickel are possible (Table III-3). Elutriate data are sparse, totaling five surficial sediment samples, with only two samples analyzed for four metals from the sale area. These data are summarized in Table IV-7. Sediments with anomalous, higher concentrations of trace metals have been identified nearshore along the coastline in northeastern Norton Sound (Table III-3), but have not been reported in the sale area or inshore sediments dredged by the Bima.

Prediction of trace-metal release to the water requires data for the entire sediment column to be dredged and not just data for surficial sediment (Wright, 1989). No such data are available for the entire (3.6-m) sediment column subject to dredging in the sale area.

This analysis assumes that the surficial sediment measurements of total trace metals and elutriate metals adequately represent the trace-metal content of the entire gold-bearing substrate subject to potential dredging. The rationale for this assumption is based on four lines of reasoning. First, there is a limited metal data set from eight deep (2- to 7-m) sediment samples at one dredge site in State waters (Table E-6 in Jewett et al., 1990). The mean concentrations of seven metals (mercury, arsenic, chromium, lead, zinc, copper, and nickel) in these deeper sediments were not significantly different ( $p = 0.05$ ) than the mean of all (pre) dredge-site samples ( $n=50$ , including the eight deeper samples). The eighth metal, cadmium, was significantly (fivefold) lower in concentration in the deeper sediment.

The second line of reasoning supporting the EIS approach is the similarity of trace-metal chemistry for surface tailings and predredging surface sediments in State waters (Tables E-6 and E-7 in Jewett et al., 1990). In line with what was found for surface versus deeper sediments, only the cadmium concentrations differed between the two data sets; this time being almost sixfold lower in the surface tailings than in the undisturbed surface sediments.

The third line of reasoning is that an MMS technical advisory workshop did not consider it feasible to attempt a complete trace-metal characterization of deeper sediment in the sale area, given the suspected inhomogeneity

Table IV-7  
Examination of Results of Elutriate Testing of Sediments  
Inshore of and in the Norton Sound Lease Sale Area<sup>1/</sup>

	Arsenic	Chromium	Mercury <sup>2/</sup>	Lead	Zinc	Cadmium	Copper	Nickel
<b>Northern Technical Services (n=2)</b>								
Sediment Metal Content (ppm dry wt.)	22-83	59-101	0.006-0.009	13-39	65-252	<5.4-<6.3	17-41	42-58
Elutriate Test <sup>3/</sup> (ppb water)	15-23	<500 <sup>4/</sup>	<20 <sup>5/</sup>	<50 <sup>4/5/</sup>	<25-28	<7 <sup>5/</sup>	<12 <sup>4/</sup>	<30 <sup>4/</sup>
<b>Crecelius, Apts, and Lasorsa (n=3)<sup>6/</sup></b>								
Sediment Metal Content (ppm dry wt.)	12-67	-- <sup>7/</sup>	0.016-0.065	--	--	--	20-32	28-37
Elutriate Test (ppb water)	5-18	--	0.3-0.4	--	--	--	0.3-0.6 <sup>8/</sup>	0.8- <u>18.8</u>
<b>EPA Marine Criteria</b>								
Chronic (ppb water)	36	50	25	5.6	86	9.3	NONE	8.3
Acute (ppb water)	69	1,100	2,100	140	95	43	2.9	75

Source: Northern Technical Services, Inc. 1985a; Crecelius, Apts, and Lasorsa, 1990; USEPA, 1986a; Federal Register 1986, 1987.

<sup>1/</sup> Underlined values denote tests with relatively high metal release (in comparison to EPA marine criteria).

<sup>2/</sup> Elutriate Test and Criteria Concentrations in parts per trillion (ppt).

<sup>3/</sup> 1-hour seawater extraction at pH 8.0.

<sup>4/</sup> Note that limit of detection is greater than EPA marine criterion.

<sup>5/</sup> Initial concentrations of this metal in tested sediments were low and test results may underestimate potential for metal release from area sediments which range much higher in metal content.

<sup>6/</sup> Includes two sediments from sale area.

<sup>7/</sup> Denotes no data.

<sup>8/</sup> Sediments sorbed copper from Norton Sound seawater.

of sediment (Hood, in press). Instead, the workshop recommended that postlease monitoring be done to verify nondegradation of water and sediment quality.

The fourth line of reasoning is that the incorporation of the monitoring program as part of the proposed sale (Stipulation No. 1) would enable MMS to carry out the workshop recommendation and verify whether effects are at the level projected in the EIS. The monitoring results would be used by the RS/FO to interpret and regulate mining activities to insure protection of water quality.

(2) Federal Water-Quality Criteria: The responsibility for maintaining the quality of OCS waters lies with EPA. Acute and chronic Federal criteria for trace metals in marine waters have been developed by EPA (USEPA, 1986a), based on toxicity of individual trace metals, their degree of bioaccumulation in the food chain, and their threat to human health via marine foods. In setting these criteria, the EPA collated and statistically evaluated the available laboratory and empirical field data on toxicity of, relative bioaccumulation of, relative abundances of, and transformations between the various elemental phases and ionic forms of individual trace metals. This information in USEPA (1986a) is incorporated by reference herein and is only summarized here. These criteria do not take into account the synergistic (increased toxicity) and antagonistic (decreased toxicity) effects some trace metals have on the toxicity of other metals. The trace-metal soup in the environment is too complex, understanding of the biochemical mechanisms involved too weak, and results of toxicity experiments on multiple-trace-metal mixtures too variable, too species-specific, and too few for antagonism or synergism to be incorporated into the water-quality criteria. Synergistic and antagonistic complications can also occur through interactions with dissolved or colloidal organic compounds in the water; for example, through complexation of metal with organic, which can either increase or decrease biological and physicochemical availability of the metal, depending upon the exact circumstances and specific metal, organics, and biota involved.

All chemical forms of individual trace metals are not equally toxic or equally likely to bioaccumulate. The EPA did consider the possibility of producing separate standards for different forms of the same trace metal, and for chromium (trivalent and hexavalent) and arsenic (trivalent), EPA has developed cation-specific standards. The EPA examined the analytical techniques available to measure chemical speciation of trace metals and concluded that the state-of-the-art was insufficient to establish an EPA-approved, standardized and reproducible procedure for quantifying trace-metal speciation in natural waters. The EPA, therefore, developed criteria in terms of acid-soluble concentration of each trace metal within marine waters, taking into account the expected speciation of individual trace metals when setting the criteria concentrations for each trace metal.

However, EPA has been unable to develop an approved method for acid-soluble metals and continues to require that trace metals be analyzed with the harsher, total recoverable method, a strong, hot, oxidizing acid extraction. This procedure is harsher than current state-of-the-art oceanographic methods for total metals in marine waters and is a more conservative estimate of total metal content than of some smaller, more available metal pool. Whether the total recoverable procedure significantly overestimates biologically available metals--the combined total of dissolved trace metals plus those trace metals readily and rapidly solubilized (generally sorbed ionic or organic forms) by the internal or external digestive activities of marine biota--has not been demonstrated and is an impossible problem for present science.

This analytical procedure also does not distinguish between trivalent and hexavalent chromium or between trivalent and pentavalent arsenic. If the total recoverable procedure is used to monitor chromium, the measured metal concentrations are compared for the more toxic form, hexavalent chromium. Ambient arsenic in marine waters is mostly pentavalent arsenic, but there are no EPA marine water-quality criteria for arsenic with this valence state. Thus, measured arsenic concentrations are compared to the criteria for trivalent arsenic. Trivalent arsenic is more acutely toxic than pentavalent arsenic. However, pentavalent arsenic does affect some saltwater plants at concentrations as low as 13 ppb--less than the chronic criterion of 36 ppb for trivalent arsenic, but chronic effects of pentavalent arsenic have been studied on too few saltwater plants (and no saltwater animals) for EPA to set water-quality criteria for pentavalent arsenic.

The EPA acute criteria for trace metals are maximum 1-hour average concentrations not to be exceeded more than once in 3 years on the average (Table IV-8). The chronic criteria are 4-day averages not to be exceeded more than once in 3 years on the average. If either acute or chronic criteria are exceeded, marine organisms and their use may be unacceptably affected, with ecosystem recovery taking more than 3 years.

(3) Mercury: Mercury is the most toxic trace metal regulated by the EPA. Its toxicity is of the same order of magnitude as that of several pesticides, and a hundredfold more toxic than the

Table IV-8  
Observed Increases in Trace Metal Concentrations, in Plume downcurrent of the  
Bima at the Edge of the (100-m) Mixing Zone<sup>1/</sup>

	Arsenic	Chromium	Mercury	Lead	Zinc	Cadmium	Copper	Nickel
<b>Average Increase</b>								
ppb	+11.0	-- <sup>2/</sup>	+0.4 <sup>3/</sup>	+6.7	+16	+0.055	+33	+35
Percent	730	--	30	2,600	1,800	79	2,200	1,400
Significant <sup>4/</sup> at P =	0.1	--	NS <sup>5/</sup>	0.1	0.05	0.01	0.05	0.1
<b>Highest Downcurrent Concentration (ppb)</b>								
	23.2	--	1.4 <sup>3/</sup>	13.3	29	0.230	51.3	68
<b>EPA Marine Criteria</b>								
Chronic (ppb)	36	50	25 <sup>3/</sup>	5.6	86	9.3	NONE	8.3
Acute (ppb)	69	1,100	2,100 <sup>3/</sup>	140	95	43	2.9	75
<b>Percent of Plume Observations Above EPA Criteria:</b>								
Chronic (%)	0	--	0	33	0	0	NA <sup>6/</sup>	100
Acute (%)	0	--	0	0	0	0	100	0

Source: Calculated from Crecelius, Apts, and Lasorsa 1990; USEPA, 1986a; Federal Register 1986, 1987.

<sup>1/</sup> Relative to bottom-water concentrations 2 km upcurrent, June and September, 1989. The EPA criteria are in terms of total-recoverable metals; observed values are reported as total metals as measured by state-of-the-art oceanographic techniques. The difference in methods does not affect comparisons made with the criteria (see Crecelius, Apts, and Lasorsa, 1990).

<sup>2/</sup> Denotes no data.

<sup>3/</sup> In ppt.

<sup>4/</sup> Paired t-test, n = 3.

<sup>5/</sup> Nonsignificant.

<sup>6/</sup> Not applicable.

other trace metals of concern. Mercury (and also arsenic) are unique among toxic metals in that they are the only metals with demonstrated biomagnification within the aquatic food chain (Lindberg et al., 1987; Mance, 1987). The concentration of mercury increases in organisms at higher-trophic levels of the food chain. The EPA, therefore, sets its chronic marine criterion for mercury a hundredfold lower than those for other trace metals (see Table IV-7). The chronic criterion for mercury is set at the level which should ensure that direct uptake of mercury from the water by a commercial marine species will not result in a methylmercury concentration in that species above the Federal Drug Administration (FDA) action level of 1 ppm wet weight. There is no safety factor nor consideration of additional mercury uptake through food ingestion assumed in this calculation. The acute criterion for mercury is based on the assumption that mercury is present as the mercuric ion and not as methylmercury. Methylmercury is much more toxic than the mercuric ion, but is taken up so quickly by biota that it is usually not detected in water samples.

The chronic criterion for mercury of 0.025 ppb is based on bioaccumulation data for methylmercury which constitutes only a small fraction of the total mercury in the water. However, had the criterion been based on the prevalent form of mercury in the water, the mercuric ion, the criterion would have been no more than fourfold higher (0.1 ppb). Levels of mercury higher than this criterion do not necessarily indicate anthropogenic pollution or necessarily atypically high concentrations, but rather that sub-ppb-or-greater concentrations of mercury are high enough to pose bioaccumulation and health risks to marine food chains (USEPA, 1986a). Analytical techniques to measure such low (a few hundredths of a ppb) concentration of mercury are readily available but must be conducted by experienced marine chemists under extremely clean conditions to avoid contamination (Hood, 1989; USEPA, 1988b; Olafsson, 1982).

Mercury concentrations were a concern in the sale area because of prior high, but suspect, measurements of mercury levels in sale-area waters; continued (1986-1989) measurements of mercury concentrations above EPA and State chronic criterion and standard in NPDES monitoring of the Bima in inshore State waters; historical mercury pollution (Sec. III.A.8); likely release of mercury from dredged sediments during processing and discharge; resuspension of tailings; and because both high-mercury and high-gold concentrations in the sediments are associated with offshore placer deposits.

The measurements of mercury for Nome-area waters reported by Crecelius, Apts, and Lasorsa (1990) are considered by MMS to be the only valid (uncontaminated) data set for mercury in the sale area and inshore waters. The low ambient and relatively constant concentrations of about 1 part per trillion (ppt) found for mercury in June and September 1989 suggest that seasonal or interannual variation would probably be small in magnitude relative to the EPA criteria values of 25 and 2,100 ppt. The concentrations of mercury above EPA criteria reported in the NPDES monitoring for the Bima operations in 1989 and earlier years are considered by WestGold to represent sample contamination (Montoya-Nelson, 1988; Jewett et al., 1990). In parallel sampling in 1989, samples collected by WestGold with WestGold sampling equipment and analyzed by Battelle Northwest exceeded the EPA chronic criterion for mercury, whereas samples collected at the same time by Battelle Northwest using Battelle equipment and then analyzed by Battelle Northwest had an order of magnitude less mercury than the chronic criterion.

The state-of-the-art measurements of total mercury in the sale area and inshore waters made for MMS (Crecelius, Apts, and Lasorsa, 1990) found levels of mercury of 1.0 ppt (1.1 ppt, dates x stations = 16 excluding the inshore samples)--an order of magnitude less than the Federal chronic criterion for mercury. There was no statistically significant seasonal difference in mercury (June vs. September) evident in the limited data.

Dredging experiments indicate immediate release of mercury dissolved in the interstitial waters within the sediments, desorption and/or dissolution of additional mercury within a few minutes to a couple of hours, and recapture of most of the released mercury by sediments within 4 hours (Lindberg, Andren, and Harriss, 1975; Lindberg and Harriss, 1977; Brannon, Plumb, and Smith, 1980). Contact time of tailings and discharge waters is within the range of a few minutes to a couple of hours for a Bima-type dredge; less than the 4 hours necessary for recapture of the initial spike of dissolved mercury. Thus, the mercury spike would be expected to be remain in the discharged water phase.

Brannon, Plumb, and Smith (1980) found that interstitial and elutriate concentrations of mercury--measures of short-term release--accounted for 86 percent of the variance in total releases of mercury from a wide assortment of sediments. Elutriate tests measure the concentration of dissolved trace metals resulting from shaking a 4:1 volumetric (seawater:sediment) mixture for 1 hour. The dilution ratio of sediment in this test is the same order of magnitude as that which would occur for dredged sediments in wash water during offshore gold dredging. The data in this study indicated that long-term release of mercury did not occur from undisturbed dredge spoils.

Based on the above studies, only the release of mercury during active dredging is anticipated; no long-term release of mercury is likely from undisturbed tailings after dredging, unless by resuspension and reworking of tailings piles by currents and waves. However, such reworking of the tailings is slower than and less in magnitude than the initial dredging.

In the analysis in this EIS, short-term release of mercury to the wash water during dredging is estimated in three ways: direct measurement of mercury concentrations observed downcurrent of the Bima in three MMS samplings, extrapolation of dissolved-mercury release during elutriate tests, and extrapolation from sediment total mercury measurements.

The direct measurements, paired up, and downcurrent measurements of total mercury concentrations around the Bima did not detect a statistically significant increase in mercury at the edge of the mixing zone (Table IV-8), with the downcurrent concentrations, remaining an order of magnitude less than the EPA chronic criterion of 0.025 ppb.

The limited elutriate tests conducted in 1989 for MMS (Table IV-7) support this finding of low mercury release. Elutriate tests have been performed on two sediment samples from the sale area and on one sample from near the Bima. The percentage of mercury released to seawater in dissolved form from these three elutriate tests has been estimated from the test values at about 0.003 percent of total sediment mercury.

This is a very low solubilization, lower than has been reported elsewhere on the OCS offshore of Alaska. The best data for comparison are those of Burrell (1978), who reported data for dissolved mercury release from 27 sediments with mixing (6:1 seawater:sediment, 1-hr mixing time) from the northeastern Gulf of Alaska. An average of  $1.4 \pm 1.5$  percent ( $p=0.05$ ) of sediment mercury was released. The wide confidence interval about the mean value for dissolved-mercury release is indicative of the wide range in response of individual sediments in tests and from release of less than 0.01 percent to as much as 19.5 percent of the total mercury present. Elsewhere in Alaskan OCS waters, for the Beaufort and Chukchi Seas, Atlas (1978) summarized unpublished data and reported that less than 5 percent of sediment mercury from these areas could be solubilized within 1 hour of mixing.

The low but sale-area-specific estimate of 0.003 percent solubilization for mercury in sediments can be used to project dissolved mercury discharges during gold dredging, including discharges that could occur if high mercury concentrations were encountered in dredged sediments. These latter projections are important because the EPA criteria are meant to protect marine water quality from relatively rare events--those with a frequency greater than once in 3 years, not just from average discharges.

This analysis assumes an average of 0.035 ppm mercury in the sediments and 0.410 ppm mercury as the highest concentration expected in dredged sediments. Mercury concentrations in undisturbed surface sediments offshore of Nome have averaged between 0.032-0.038 ppm in three sediment studies (Nelson, in Bronson, 1988; Jewett, Gardner, and Athey, 1989; and Naidu et al., 1989). Despite the similar averages, data from the three studies cannot be compiled into a single mean because of unexplained, but statistically significant, differences in sample variances among data sets (Bronson, 1988). The 0.410 ppm is the highest concentration of sediment mercury observed in 3 years of dredging by the Bima, measured in the tailings downcurrent (Jewett, Gardner, and Athey, 1989). Higher anomalies of mercury, up to 1.3 ppm have been observed locally in shoreline beaches (Table III-3) and concentrations of a similarly high magnitude in the sale area are possible but are not anticipated.

There is also the necessary assumption that these surface data (top 0.1 to 0.2 m) represent mercury concentrations in the top few meters of sediment that would be dredged. No data are available to quantify concentrations in deeper sediments. Measurements in surface tailings downcurrent of the Bima have averaged 0.041 ppm mercury versus 0.033 ppm mercury in undisturbed surface sediments upcurrent (Jewett, Gardner, and Athey, 1989), but the difference between the two values is not statistically significant (t-test).

About 25,000 dry t of sediments per day would be discharged by one dredge. In the base case, the average daily release of dissolved mercury (0.003 percent of the mercury in the processed sediment) would be 0.025 grams (g), but would reach 0.3 g once during a 3-year period. The discharged tailings and released, dissolved mercury are both diluted with the large volumes of seawater used in processing. The release of these amounts of dissolved mercury into the  $1.8 \times 10^5 \text{ m}^3$  of daily effluent would increase effluent concentrations by an average 0.1 ppt of dissolved mercury and once by a 2-ppt increment--depending upon the mercury content of the sediments dredged and assuming a constant percentage of dissolved-mercury release. In the unlikely event of mercury



concentrations of 1.3 ppm in the dredged sediment, the calculated dissolved mercury increment in the effluent would be 6 ppt.

This analysis assumes a 35-fold dilution factor for trace metals from the discharge source to the edge of the (100-m) mixing zone. In setting discharge limitations for the Bima, EPA modeled effluent dilution with distance from the dredge for bottom discharge and estimated dilution at this magnitude over the first 100-m distance--the distance of most rapid dilution. Subsequent modeling by WestGold contractors (Demlow et al., 1989) for various other discharge configurations in deep water (18 m) estimated dilution factors over 100 m of 20-fold to 29-fold for low-ambient currents (0.39 knots) and 25-fold to 50-fold for high-ambient currents (0.78 knots), a range bracketing the estimate of EPA. An additional point to note is that Demlow et al. (1989) found that discharge could not be configured to simultaneously minimize both turbidity and trace-metal concentrations.

Based on the dilution factor of 35-fold within the mixing zone, the average expected increase of 0.1 ppt at the discharge should be reduced to a 0.004-ppt increase in dissolved mercury at 100 m and the highest expected increase of 2 ppt should be reduced to an 0.05-ppt increase at 100 m. In the unlikely event that sediments of 1.3 ppm mercury were encountered, the dissolved mercury increment could increase to 0.2 ppt. None of these increments when added to ambient mercury levels (1 ppt) would result in mercury concentrations at the edge of the mixing zone in excess of EPA criteria for total recoverable mercury.

Most of any mercury release during dredging would be as part of the suspended solids load. Monthly nonsettleable solids averaged 730 to 1,700 ppm in the Bima effluent (Jewett, Gardner, and Athey 1989), or--assuming 35-fold dilution--an incremental 21 to 48 ppm at 100 m. As a first approximation, concentrations of mercury in suspended finer tailings can be assumed similar to the concentration in the parent sediment. The average sediment content of 0.035 ppm mercury would result in a 0.7- to 1.7-ppt increase in total mercury at 100 m, the expected high sediment content of 0.41 ppm mercury would result in an 8.6- to 20-ppt increase in total mercury, and the unlikely occurrence of sediment with 1.3 ppm mercury would result in a 27- to 62-ppt increase in total mercury. The expected range in mercury concentrations in mined sediment would not increase ambient-mercury levels to above the EPA criteria for total recoverable mercury. If anomalous, high levels of mercury occur (>0.5 ppm) in dredged sediments, the EPA chronic criteria of 25 ppt for mercury could be exceeded at the edge of the mixing zone. Such concentrations are possible in the area but have not been reported in available measurements from the sale area or in the vicinity of the Bima operations, and, therefore, are not anticipated. This premise would be further evaluated during MMS and EPA (NPDES) monitoring of any mining activities resulting from the proposed sale.

All three of these subanalyses--based on measured downcurrent concentrations, elutriate test results, and total mercury levels--project that neither the Federal chronic nor acute criterion for mercury should be exceeded at the edge of the mixing zone by the proposed action. Therefore, the effect of mercury discharge from the sale is estimated as a NEGLIGIBLE effect on both LOCAL and REGIONAL water quality.

(4) Other Trace Metals: Water-column increases in other trace metals such as arsenic, chromium, lead, zinc, cadmium, copper, and nickel are also possible and require evaluation (Table IV-9).

Arsenic: Discharge of arsenious sediments during dredging for the proposal may present a pollutant risk. Arsenic is the only trace metal, other than mercury, known to biomagnify through marine food chains (Mance, 1987). That arsenic released from mined sediments could be contaminating marine waters offshore of Nome was raised as an issue by EPA in 1987 (USEPA, 1987b). Arsenic concentrations were increased downcurrent of the Bima at the edge of the 100-m mixing zone by an average of 11 ppb on three dates sampled by an MMS contractor (Table IV-8). The peak concentration of arsenic observed at the edge of the mixing zone was 23.2 ppb. Long-term release of arsenic does not usually occur from dredged sediments once dredging has stopped (Table IV-9).

Ambient concentrations of arsenic in sale area and inshore waters, averaging 0.8 ppb, are low (see Table III-2). Most arsenic in the water column is pentavalent arsenic (Creelius, Apts, and Lasorsa, 1990), as expected for oxygenated marine waters, rather than the more toxic trivalent form.

Concentrations of arsenic in the sediments range relatively high, up to 140 ppm. Gold in the Nome area, both onshore and offshore, is commonly found in association with arsenopyrite (see Jewett et al., 1990; Green, Bundtzen, and Hansen, 1988; America North 1988; Environmental Toxicology International, 1987; American North and Harding Lawson Associates, 1987; USEPA, 1987b). Arsenic is concentrated 600 times over

Table IV-9  
Matrix of Trace-Metal Parameters<sup>1/</sup>

Parameter	Trace Metal							
	Arsenic	Chromium	Mercury	Lead	Zinc	Cadmium	Copper	Nickel
Current Offshore Mining Has Exceeded Water-Quality Criteria <sup>2/</sup>	N	N <sup>3/</sup>	N	Y <sup>(c)</sup>	N	N	Y <sup>(a)</sup>	Y <sup>(c)</sup>
High Concentrations in Sediments <sup>4/</sup>	Y	Y	N	Y	Y	Y	Y	Y
Nearby, Anomalous, Much Higher Concentrations <sup>4/</sup>	Y	N	Y	Y	Y	N	Y	N
Enriched in Offshore Gold Placers <sup>4/</sup>	Y	Y	Y	Y	N	N	N	I
High Elutriate Test Results on Local Sediments <sup>5/</sup>	Y	I	N	I	Y	Y	N	Y
Long-Term Release Likely in Most Sediments <sup>6/</sup>	N	I	N	N	Y	N	Y	I

<sup>1/</sup> Individual trace metals pose risk (Y), do not pose risk (N) to water quality if the sale occurred, or for which data are inconclusive or insufficient (I).

<sup>2/</sup> Crecelius, Apts, and Lasorsa (1990) (3 samplings) compared to the acute (a) and chronic (c) EPA criteria.

<sup>3/</sup> Reported 1986-8 monitoring data in Runsanowski, Gardner, and Jewett (1988) and Jewett, Gardner, and Athey (1989).

<sup>4/</sup> See Section III.A.8.b. Note that "high" sediment classification not made on basis overlying water concentrations.

<sup>5/</sup> See Table IV-8.

<sup>6/</sup> Based on findings of Brannon, Plumb, and Smith (1980); and Ellis and Taylor (1988).

background sediment concentrations in gold concentrate from the Bima (Jewett et al., 1990). Concentrations of arsenic are thus expected to be enriched in gold placers, possibly leading to greater release of arsenic during gold dredging than would be expected on the basis of bulk-sediment composition. Arsenic concentrations in the vicinity of the Bima operations average 61 ppm in the sediment (Jewett, Gardner, and Athey, 1989), sixfold higher than a regional average for Norton Sound (Robertson and Abel, 1979). Anomalous, and an order of magnitude higher, concentrations of arsenic (up to 3,000 ppm) occur locally in northwestern Norton Sound and could exist in the sale area.

Elutriate tests of sale area and inshore sediments released both trivalent (70%) and pentavalent arsenic. The total dissolved arsenic solubilization in elutriate tests was proportionate to the total arsenic content of the sediment (correlation coefficient  $[r] = 0.9097$ , number of tests  $[n] = 5$ , significant at probability  $[p] = 0.05$ ). Thus, arsenic solubilization as a result of dredging can readily be estimated from arsenic levels in the dredged materials. Dredging sediments with the Bima average of 61 ppm arsenic could result in effluent concentrations of 18 ppb dissolved arsenic; the peak expected arsenic concentration of 140 ppm arsenic in the sediment could result in an effluent containing 35 ppb dissolved arsenic, and an anomalous sediment with 3,000 ppm could result in an effluent containing 670 ppb dissolved arsenic. Interstitial water concentrations of surface-oxidized and reduced sediments in the sale area average 87 ppb arsenic (Naidu et al., 1989)--in agreement with the relatively high dissolved arsenic concentrations found in the elutriate tests.

Because the ambient, water concentration of total arsenic averages only 0.8 ppb, resultant concentrations of dissolved arsenic at the edge of the mixing zone would not be expected to approach the EPA chronic criterion for arsenic of 36 ppb. After initial mixing, concentrations at the edge of the mixing zone would be increased by the dissolved arsenic concentrations at 100 m downcurrent by about 0.5, 1, or 19 ppb, respectively, depending upon the sediment concentration.

Most of any arsenic release during dredging would be as part of the suspended solids load. Monthly nonsettleable solids averaged 730 to 1,700 ppm in the Bima effluent (Jewett, Gardner, and Athey 1989), or--assuming 35-fold dilution--an incremental 21 to 48 ppm at 100 m. Because arsenic is not being added to the discharge within the mining process, concentrations of arsenic in the nonsettleable solids would, as a first approximation, be similar to the concentration in the parent sediment. Based on the suspended-solids loading of 21 to 48 ppm at 100 m downcurrent of the dredge, the average sediment content of 61 ppm arsenic would project a 1.3- to 2.9-ppb increase in total arsenic at 100 m, the expected high sediment content of 140 ppm arsenic would project a 2.9- to 6.7-ppb increase in total arsenic, and the unlikely occurrence of sediment with 3,000 ppm arsenic would project a 63- to 140-ppb increase in total arsenic.

The average arsenic concentration observed by Creelius, Apts, and Lasorsa (1990) 100 m downcurrent of the Bima was 4 to 8 times as great as the value extrapolated from the average sediment concentration of total arsenic. This difference may imply a 4-to-8-fold enrichment in the nonsettleable fraction relative to the 61-ppm arsenic content of bulk sediments. Trace-metal enrichment of this magnitude is often found in sediment fines. Such enrichment is the most likely reason for the difference between observed and extrapolated arsenic concentrations.

Note that a 4-to-8-fold enrichment of arsenic in the nonsettleable sediments could result in occasionally exceeding the chronic criterion for arsenic, when bulk sediment concentrations exceed 90 ppm arsenic. Such arsenic enrichment, however, would not increase the expected range in plume concentrations of arsenic at the edge of the mixing zone to above the EPA acute criterion of 69 ppb.

If anomalous high levels of arsenic occur (>410 ppm) in dredged sediments, the EPA acute criterion arsenic could be exceeded at the edge of the mixing zone. Such concentrations can occur in northwestern Norton Sound, but have not been reported in available measurements from the sale area or in the vicinity of the Bima operations, and, therefore, are not anticipated. This premise would be further evaluated during MMS and EPA (NPDES) monitoring of any mining activities resulting from the proposed sale.

In any case, note that although occasional exceeding of the arsenic chronic criterion is possible, none of the three 1989 MMS samplings downcurrent of the Bima found total arsenic concentrations as high as the chronic criterion. Because released arsenic is in mostly particulate form, the area affected by any arsenic concentrations above the chronic criterion would be limited to the area covered by the dredge plume, estimated at 34 km<sup>2</sup> in Section IV.B.2.b. This is the area that may be affected occasionally during active dredging.

In addition, the arsenic criteria are technically only for the trivalent form of arsenic, although this valence distinction cannot be made with the total recoverable analytical procedure required by EPA. Total trivalent arsenic data could be collected which would allow estimation of the concentration of total recoverable, trivalent arsenic. This correction would allow permitted discharge of total recoverable arsenic to be increased by some presently unknown amount.

The Stipulation No. 1 requirement for monitoring discharges from mining operations that result from this proposal--particularly the requirement for timely notification of the RS/FO of violations of water-quality criteria or permits--would be in place and would provide impetus to keep arsenic concentrations below criteria and permit restrictions. The stipulation will enable the RS/FO to order modification of operations to preclude arsenic concentrations from continuing above the EPA chronic criterion once it was exceeded. No directly toxic (acute) levels of arsenic are anticipated outside of the mixing zone. Thus, based on extrapolation from sediment concentrations of arsenic and this EIS analysis, the chronic criterion for arsenic may occasionally be exceeded by the arsenious-sediment discharge for one, Bima-like dredge in the proposal for a MINOR effect on LOCAL water quality. A NEGLIGIBLE effect from arsenious-sediment discharge is expected for REGIONAL water quality.

The EPA (USEPA, 1990a) recently reissued an NPDES permit for the WestGold dredge Bima which provides a reduced chronic discharge limitation of 234 ppb for arsenic. Although not stated in the permit, the EPA (USEPA, 1990d) has indicated to the MMS that this limit applies only to that fraction of the discharge which is estimated to remain suspended at the 100-m mixing zone- boundary under worst-case conditions of minimal (18:1) dilution and not to the total discharge. Based on this dilution ratio, the EPA considers this limitation to be protective of the chronic criterion of 36 ppb total recoverable arsenic.

If permit limitations on trace-metal discharge similar to those on the reissued Bima NPDES permit were applied for the proposed dredging activity in Federal waters, whereby the chronic criterion level of 36 ppb total recoverable arsenic were not exceeded at 100 m from the discharge, NEGLIGIBLE effects for both LOCAL and REGIONAL water quality would be expected. Based on extrapolation from measured high concentrations of arsenic in sale area and inshore sediments, this criterion is unlikely to be consistently met on State or proposed Federal leases offshore of Nome by a Bima-like dredge. Whether a mining operation in Federal waters could ensure that the 36-ppb criterion would be met would depend upon the site-specific sediment chemistry and the exact type, configuration, and operating procedures of the dredge. The EPA (1990b) believes that operating conditions for the proposed action in Federal waters can be maintained that would, in the future "reduce trace metal concentrations to acceptable levels at the edge of the mixing zone."

Chromium: The database for chromium is the weakest of that for any of the trace metals of concern (Table IV-9). The 1989, MMS survey did not examine chromium concentrations in area waters. However, chromium is the only EPA priority metal monitored for the Bima operation in 1986-89 that has never been reported--despite continued contamination problems with other metals--as exceeding either permit restrictions or EPA water-quality criteria. Limited data from elsewhere in Norton Basin and other marine waters suggest that ambient total chromium concentrations in the sale area should be less than 1 ppb. Long-term release of chromium was not evaluated in the available literature, and is assumed not to occur.

Chromium concentrations do range high in the sediments, and chromium would be expected to covary with gold in the sediment. On the other hand, chromium concentrations in the vicinity of the Bima operations average 21 ppm in the sediment (Jewett, Gardner, and Athey, 1989), fourfold lower than a regional average for Norton Sound (Robertson and Abel, 1979). Concentrations as high as 101 ppm chromium have been observed in northwestern Norton Sound, but higher, anomalous concentrations of chromium have not been locally observed (see Table III-3).

Greater chromium concentrations, up to 140 ppm dry weight solids have been observed in suspended sediments in central Norton Sound during a storm (Table III-4). This latter observation indicates that chromium is enriched in the finer, nonsettleable fraction of the sediments. Thus, as a first approximation, concentrations of chromium in suspended finer tailings can be taken as equal to concentration in the storm-suspended fines, or 140 ppm chromium.

Available elutriate tests are inconclusive because of high limits of detection in the tests. Interstitial water concentrations of surface-oxidized and reduced sediments in the sale area do not exceed the chronic criteria (Naidu et al., 1989), which suggests that further elutriate tests for chromium would not show high concentrations in test filtrates.

Most of any chromium release during dredging would be as part of the suspended solids load. Monthly nonsettleable solids averaged 730 to 1,700 ppm in the Bima effluent (Jewett, Gardner, and Athey 1989), or--assuming 35-fold dilution--an incremental 21 to 48 ppm at 100 m. The nonsettleable solid content of 140 ppb chromium would result in a 2.9- to 6.7-ppb increase in total chromium at the edge of the (100-m) mixing zone, an order of magnitude less than the EPA chronic criterion for chromium of 50 ppb.

Thus, neither projected discharge of total chromium from the proposed sale nor reported concentrations of chromium downcurrent of current mining operations in State waters are large enough to exceed EPA criteria at the edge of the mixing zone. Therefore, the effect of chromium discharges on both LOCAL and REGIONAL water quality is expected to be NEGLIGIBLE.

Lead: Discharge of plumbeous sediments during dredging for the proposal may present a pollutant risk. Both ambient lead (0.1 ppb) and lead released from dredging, as expected, are almost entirely in particulate form in northwestern Norton Sound (Crecelius, Apts, and Lasorsa, 1990). Lead concentrations were increased downcurrent of the Bima by an average of 6.7 ppb--more than the chronic criterion for lead (5.6 ppb)--on three dates sampled by an MMS contractor (Table IV-8). The peak concentration of lead observed at the edge of the mixing zone was 13.3 ppb. Long-term release of lead does not usually occur from dredged sediments once dredging has stopped (Table IV-9).

Total lead concentrations in sediments and tailings near the Bima average 12 ppm, but range relatively high, up to 92 ppm (Jewett, Gardner, and Athey, 1989). Anomalous, higher concentrations of lead up to 500 ppm occur locally in northwestern Norton Sound and could exist in the sale area (see Table III-3). Lead is present as a heavy mineral and is concentrated in gold placer deposits, possibly leading to greater release of lead during dredging than would be expected on the basis of bulk-sediment composition. Available elutriate tests are inconclusive because of high limits of detection in the tests (Table IV-7).

Because lead is not being added to the discharge within the mining process, concentrations of lead in the nonsettleable solids would, as a first approximation, be similar to the concentration in the parent material. Monthly nonsettleable solids averaged 730 to 1,700 ppm in the Bima effluent (Jewett, Gardner, and Athey 1989), or--assuming 35-fold dilution--an incremental 21 to 48 ppm at 100 m. Based on the suspended-solids loading of 21 to 48 ppm at 100 m downcurrent of the dredge, the average sediment content of 12 ppm lead would result in a 0.3- to 0.6-ppb increase in total lead at 100 m, the expected high sediment content of 92 ppm lead would result in a 1.9- to 4.4-ppb increase in total lead, and the unlikely occurrence of sediment with 500 ppm lead would result in an 11- to 24-ppb increase in total lead.

The average lead concentration observed by Crecelius, Apts, and Lasorsa (1990) 100 m downcurrent of the Bima was 10 to 20 times as great as the value extrapolated from the average sediment concentration of total lead. This difference may imply a 10- to 20-fold enrichment of lead in the nonsettleable fraction relative to the 12-ppm lead content of bulk sediments. Such enrichment appears to be the case for arsenic and chromium as discussed earlier, and similar enrichment of sediment fines in lead is the most likely explanation for the difference between observed and extrapolated concentrations of lead at the edge of the mixing zone. Note, however, that even a 20-fold increase in the maximum expected lead concentration in the nonsettleable solids to 1,800 ppm lead per dry weight solids would not increase calculated plume concentrations of lead to above the EPA acute criterion of 140 ppb at the edge of the mixing zone.

If anomalous, high levels of lead (as high 500 ppm) occur in the bulk sediments being dredged, the EPA acute criterion for lead could be exceeded at the edge of the mixing zone, if sediment fines were 10 to 20 times enriched in lead as suggested in the above paragraph. However, such anomalous lead concentrations have not been observed in either monitoring for current mining in State waters or in limited sampling of sale-area sediments, and, therefore, such concentrations are not anticipated to be dredged as a result of the proposal. This premise would be further evaluated during MMS and EPA (NPDES) monitoring of any mining activities resulting from the proposed sale.

In any case, note that mining operations increased the average lead concentration at the edge of the mixing zone to above the EPA and State chronic criterion and standard for lead in the three 1989 MMS samplings downcurrent of the Bima. Because released lead is in particulate form, the area affected by high lead concentrations would be limited to the area covered by the turbid dredge plume, estimated at 34 km<sup>2</sup> in Section IV.B.2.b.

The Stipulation No. 1 requirement for monitoring discharges from mining operations that result from this proposal--particularly the requirement for timely notification of the RS/FO of violations of water-quality criteria or permits--will be in place and will provide impetus to keep lead concentrations below criteria and permit restrictions. The stipulation will enable the RS/FO to order modification of operations to preclude continuing lead concentrations above the EPA chronic criterion that would otherwise be expected to occur. For example, the highest observed lead concentration of 13.3 ppb downcurrent of the Bima would likely have been decreased to less than the chronic criterion of 5.6 ppb if the dredging rate had been decreased by 30 percent and water throughput increased by a similar percentage. No directly toxic (acute) levels of lead would be anticipated outside of the mixing zone. Thus, based on the monitoring data for the Bima and likely effectiveness of Stipulation No. 1, the chronic criterion for lead is expected to occasionally exceeded by the plumbeous-sediment discharge for one, Bima-like dredge in the proposal, for a MINOR effect on LOCAL water quality. A NEGLIGIBLE effect of lead discharge on water quality would be expected on a REGIONAL basis.

The EPA (USEPA, 1990a) recently reissued an NPDES permit for the WestGold dredge Bima which provides a reduced chronic discharge limitation of 100.8 ppb for lead. Although not stated in the permit, the EPA (USEPA, 1990d) has indicated to MMS that this limit applies only to that fraction of the discharge which is estimated to remain suspended at the 100-m mixing-zone boundary under worst-case conditions of minimal (18:1) dilution and not to the total discharge. Based on this dilution ratio, the EPA considers this limitation to be protective of the chronic criterion of 5.6 ppb total recoverable lead.

If permit limitation on trace-metal discharge similar to those on the reissued Bima NPDES permit were applied for the proposed dredging activity in Federal waters, whereby the chronic criterion level of 5.6 ppb total recoverable lead were not exceeded at 100 m from the discharge, NEGLIGIBLE effects for both LOCAL and REGIONAL water quality would be expected. Based on the lead concentrations observed by Crecelius, Apts, and Lasorsa (1990) and extrapolation from sediment concentrations of lead, additional fine-tuning of discharge limitations and initial dredging operations would be necessary to insure that the 5.6 ppb chronic criterion would be consistently met. This fine-tuning would be based on site-specific sediment chemistry and the exact type, configuration, and operating procedures of the dredge. The EPA (1990b) believes that operating conditions for the proposed action in Federal waters can be maintained that would, in the future "reduce trace metals concentrations to acceptable levels at the edge of the mixing zone."

Zinc: Both long-term and short-term releases of zinc occur from dredged sediments (Table IV-9); however, the highest concentrations of zinc in the water would be expected while mining discharges were occurring. Industry gold dredging in State waters significantly increases the ambient zinc concentration (<0.65 ppb) by an average 16 ppb at the edge of the mixing zone, but resulting concentrations have met the Federal criteria for zinc in limited measurements (Table IV-8). Elutriate tests did not indicate a high release of zinc from dredged tailings (Table IV-7), suggesting that the observed increase in downcurrent total zinc concentrations can be attributed to increases in particulate rather dissolved zinc.

Concentrations of zinc in the sediment near industry operations in State waters have averaged 72 ppm (Jewett, Gardner, and Athey, 1989; Sharma, 1974) and have ranged relatively high, up to 400 ppm in other northwestern Norton Sound measurements (see Table III-3). Anomalous, higher concentrations of zinc ranging up to 1,000 ppm occur locally and could exist in the sale area. Zinc concentrations and gold concentrations do not covary; there is no potential for increasing zinc exposure by focusing mining on high-gold sediments.

Zinc concentrations average 220 ppm dry weight in suspended solids in waters of central Norton Sound (Table III-4), threefold higher than the average bulk sediment concentration. This observation suggests that zinc is enriched in the finer, nonsettleable fraction of the sediments. That zinc concentrations in sediments offshore of Nome are correlated with organic content also supports this premise (Sharma, 1974). As a first approximation, concentrations of zinc in suspended finer tailings are assumed to be threefold higher than the bulk sediment concentration.

Based on the suspended-solids loading of 21 to 48 ppm at 100 m downcurrent of the dredge, an average nonsettleable solid content of 220 ppm zinc would result in a 4.6- to 11-ppb increase in total zinc at 100 m, still somewhat less than the average observed 16-ppb increase downcurrent of the dredge (Table IV-8), supporting the assumption of zinc-enriched fines in the bulk sediment. The expected high nonsettleable solid content of 1,200 ppm zinc would result in 25-to 58-ppb increase in total zinc, and the unlikely occurrence of nonsettleable solid content of 3,000 ppm zinc would result in a 63- to 140-ppb increase in total zinc. The expected range in zinc concentrations in mined sediment would not increase ambient-zinc levels to above EPA criteria for total recoverable zinc.

If anomalous, high levels of zinc greater than 600 ppm occur in dredged sediments, the EPA chronic criteria of 86 ppb for zinc could be exceeded at the edge of the mixing zone during periods of higher discharge of nonsettleable solids. The EPA acute criteria of 95 ppb for zinc could be exceeded if zinc concentrations exceeded 700 ppm in dredged sediments. Such concentrations can occur in the area but have not been reported in available measurements from the sale area or in the vicinity of the Bima operations, and, therefore, are not anticipated. This premise would be further evaluated during MMS and EPA (NPDES) monitoring of any mining activities resulting from the proposed sale.

Thus, neither projected discharges of zinc from the proposed sale nor reported concentrations of total zinc downcurrent of current mining operations in State waters are large enough to exceed EPA criteria at the edge of the mixing zone. Therefore, the effect of zinc discharges on both LOCAL and REGIONAL water quality is expected to be NEGLIGIBLE.

Cadmium: Long-term release of cadmium does not usually occur from dredged sediments once dredging has stopped (Table IV-9); however, release of cadmium does occur during gold dredging of marine sediments in inshore State waters. Cadmium concentrations were increased downcurrent of the Bima by an average of 0.055 ppb--versus the chronic criterion for cadmium of 9.3 ppb--on three dates sampled by an MMS contractor (Table IV-8). The peak concentration of cadmium observed at the edge of the mixing zone in the three samplings was 0.23 ppb (Table IV-8), versus an ambient average concentration in area waters of 0.06 ppb (Table III-2).

Concentrations of cadmium in the sediment average 2.6 ppm near gold mining operations in State waters, but range very high, up to 39 ppm (Jewett, Gardner, and Athey, 1989). The 39 ppm cadmium is the highest value reported for all of Norton Basin (see Table III-3) and in an industrial setting would be taken as a priori evidence of pollution. Cadmium in soils and oxidized sediments is usually present as exchangeable or humic-complex forms, and, thus, highly available to biota (Asami, 1984). On the other hand, cadmium concentrations and gold concentrations do not covary; there is no potential for increasing cadmium release by focusing mining on high-gold sediments. Available elutriate test results are inconclusive because of the atypically low cadmium concentration of tested sediments (Table IV-7). However, interstitial water concentrations of surface-oxidized and reduced sediments in the sale area average 2.3 ppb cadmium (Naidu et al., 1989), tenfold higher than the water column values reported by Crecelius, Apts, and Lasorsa (1990).

The expected variation in total cadmium discharge can be estimated from the observed sediment concentrations of cadmium. Monthly nonsettleable solids averaged 730 to 1,700 ppm in the Bima effluent (Jewett, Gardner, and Athey 1989), or--assuming 35-fold dilution--an incremental 21 to 48 ppm at 100 m. As a first approximation, concentrations of cadmium in suspended finer tailings can be assumed similar to the concentration in the parent sediment. The average sediment content of 2.6 ppm cadmium would result in a 0.05- to 0.12-ppb increase in total cadmium at 100 m, and the highest observed sediment content of 39 ppm cadmium would result a 0.8- to 1.9-ppb increase in total cadmium. These calculated values are consistent with the magnitude of increases observed downcurrent of the Bima. The expected range in cadmium concentrations in mined sediment would not increase calculated cadmium levels to above the EPA criteria for total recoverable cadmium at the edge of the mixing zone.

Neither projected discharges of cadmium from the proposed sale nor reported concentrations of total cadmium downcurrent of current mining operations in State waters are large enough to exceed EPA criteria at the edge of the mixing zone. Therefore, the effect of cadmium discharges on both LOCAL and REGIONAL water quality is expected to be NEGLIGIBLE.

Copper: Discharge of cupreous sediments during dredging for the proposal may present a pollutant risk. Available data indicate that both long-term and short-term releases of copper can be expected from dredge operations and resulting tailings (Table IV-9). However, the highest concentrations of copper in the water column would be expected in the turbid plumes during active mining. These dredge plumes rapidly dissipate with distance and with the additional mixing during the frequent seasonal storms in Norton Sound.

Such storms also resuspend some trace metals and sediment from eroding tailings, particularly along open coasts (e.g., Ellis and Popham, 1983). Tailings generally retain sufficient trace metals to be a source of pollution (Fimreite et al., 1971; Hoff, Thompson, and Wong, 1982). Copper release from marine tailings, in particular, has been observed. Tailings from two tailings-line breaks along an open shore "resulted in slight copper bioaccumulation by intertidal clams 20 km away over 4 years" (Ellis and Popham, 1983). In the case of the proposal, however, the tailings are dredged sediments which are not enriched in copper relative to the original



surface sediment, and any secondary solubilization or resuspension of copper would not be expected to result in long-term concentration increases in the water column.

Copper concentrations 100 m downcurrent of the Bima have been found to increase by an average of 33 ppb above the ambient level of 1 ppb (Table IV-8). The peak concentration of copper observed at the edge of the mixing zone was 51.3 ppb. Elutriate tests (Table IV-7) had shown that discharge of sediments into the water column should decrease dissolved copper concentrations (presumably through adsorption) and the 1989 sampling up- and downcurrent of the Bima (Crecelius, Apts, and Lasorsa, 1990) confirmed a decrease in dissolved copper concentrations within the dredge plume. Thus, the observed increase in copper downcurrent of the dredge was the result of very high particulate loading and not the result of solubilization.

Total copper concentrations in sediments and tailings in State waters near the Bima average 24 ppm, with a maximum observed concentration of 60 ppm (Jewett, Gardner, and Athey, 1989; Table III-3). Copper concentrations and gold concentrations do not covary; there is no potential for increasing copper release by focusing dredging on high gold sediments. Anomalous, higher concentrations of copper up to 700 ppm occur locally in northwestern Norton Sound and could exist in the sale area.

Because copper is not being added to the discharge within the mining process, concentrations of copper in the suspended fines would, as a first approximation, be similar to the concentration in the parent sediment. Based on the suspended-solids loading of 21 to 48 ppm at 100 m downcurrent of the dredge, the plume would increase copper concentrations 0.5 to 1.1 ppb for sediments of average copper content and 1.3 to 2.9 ppb for sediments of high (60 ppm) copper content. The unlikely occurrence of sediment with 700 ppm copper would result in a 14- to 32-ppb increase in total copper within the plume at 100 m.

The average copper concentration observed by Crecelius, Apts, and Lasorsa (1990) 100 m downcurrent of the Bima was more than 30 times as great as the value extrapolated from sediment concentrations of total copper. This difference may imply a 30-fold enrichment of copper in sediment fines relative to the 24-ppm copper content of bulk sediments. Apparent, but lesser-magnitude enrichments were also calculated for lead and chromium concentrations in sediment fines earlier in this analysis. The apparent enrichment of sediment fines in trace metals would be further addressed by the baseline monitoring recommended for the proposed sale in the recent workshop held by MMS (Hood, 1989).

In any case, note that all three 1989 MMS samplings downcurrent of the Bima found that mining operations were increasing total copper concentrations at the edge of the mixing zone to above the EPA and State acute criterion and standard for copper. Because the copper discharged in dredging is in particulate form, the area affected by high copper concentrations would be limited to the area covered by the turbid dredge plume, estimated at 34 km<sup>2</sup> in Section IV.B.2.b. Dissolved copper was found to actually decrease within the plume downcurrent of the Bima.

The Stipulation No. 1 requirement for monitoring discharges from mining operations that result from this proposal--particularly the requirement for timely notification of the RS/FO of violations of water-quality criteria or permits--would be in place and would provide impetus to reduce copper discharges. However, MMS has not identified a modification of dredging activities at this time that would consistently reduce the concentration of total recoverable copper to below the acute criterion. Thus, based on the monitoring data for the Bima and this EIS analysis, the acute criterion for copper is expected to be occasionally exceeded by the cupreous sediment discharge for the one, Bima-like dredge in the proposal, for a MAJOR effect on LOCAL water quality. A NEGLIGIBLE effect from copper discharge on water quality is expected on a REGIONAL basis. The MMS notes that the absence of major biological effects from the high concentration of total-recoverable copper in the discharge from the Bima--as evidenced in the Bima monitoring program and the following Section IV analyses in this EIS--indicates that the total recoverable criterion for copper is overly protective in this environment and situation. The EPA (USEPA, 1990d) also considers that, in this case, an occasional exceeding of the acute criterion for copper at 100 m by total recoverable, but not dissolved, copper would have negligible effect on LOCAL water quality.

The EPA (USEPA, 1990a) recently reissued an NPDES permit for the WestGold dredge Bima which provides a reduced discharge limitation of 52.2 ppb for copper. Although not stated in the permit, the EPA (1990d) has indicated to MMS that this limit applies only to that fraction of the discharge which is estimated to remain suspended at the 100-m mixing-zone boundary under worst-case conditions of minimal (18:1) dilution and not to the total discharge. Based on this dilution ratio, the EPA considers this limitation to be protective of the acute

criterion of 2.9 ppb total recoverable copper in marine waters. The EPA has required WestGold to measure both total recoverable and total dissolved concentrations of copper to establish the relationship between these measurements for this discharge in this environment.

If a similar NPDES permit limitation on trace-metal discharge were applied for the proposed dredging activity in Federal waters, whereby the acute criterion level of 2.9 ppb total recoverable copper were not exceeded at 100 m from the discharge, NEGLIGIBLE effects for both LOCAL and REGIONAL water quality would be expected. Based on the copper concentrations observed by Crecelius, Apts, and Lasorsa (1990), it does not appear that this criterion can be consistently met by the Bima on State leases. Whether a mining operation in Federal waters would be more successful than the Bima in State waters in meeting the 2.9 ppb criterion would depend upon the site-specific sediment chemistry and the exact type, configuration, and operating procedures of the dredge. The EPA (1990b) believes that operating conditions for the proposed action in Federal waters can be maintained that would, in the future "reduce trace metal concentrations to acceptable levels at the edge of the mixing zone."

Nickel: Discharge of nickeliferous sediments during dredging for the proposal may present a pollutant risk. Ambient-nickel concentrations in the sale area and in inshore waters averaging 1.7 ppb are mostly dissolved nickel and are relatively high compared to typical oceanic concentrations (see Table III-2). Nickel concentrations were increased downcurrent of the Bima by an average of 35 ppb--more than the chronic criterion for nickel (8.3 ppb)--on the three dates sampled by an MMS contractor (Table IV-8). The highest concentration of nickel observed at the edge of the mixing zone was 68 ppb, slightly less than the acute criterion of 75 ppb.

The MMS has no data as to whether long-term release of nickel can be expected from dredge tailings. Concentrations of nickel resulting from long-term release, however, would be expected to be less than those reached during active dredging.

Total nickel concentrations in sediments and tailings near the Bima averaged 35 ppm, but ranged relatively high, up to 93 ppm (Jewett, Gardner, and Athey, 1989). Anomalous, high concentrations of nickel have been reported as existing locally in northwestern Norton Sound, but the magnitude of the high values were not identified (see Table III-3). It is not known whether nickel and gold concentrations covary and, therefore, whether there is potential for increasing nickel release by focusing mining on high-gold sediments.

Elutriate tests conducted for MMS (Table IV-7) had variable results: two of the tests removed about 1 ppb dissolved nickel from the water phase, while the third--on the one freshly collected sediment and the only sediment collected from an active dredging site--released 17 ppb dissolved nickel to the water phase. This latter sample contained exactly the average sediment concentration of nickel, 35 ppm. A 17-ppb release of dissolved nickel in the dredge effluent would be diluted 35 times to 0.5 ppb at 100 m and would account for about 1 percent of the total nickel increase observed at that distance. Thus, nickel released during dredging must be almost all in the particulate rather than the dissolved phase.

Because nickel is not being added to the discharge within the mining process, concentrations of nickel in the nonsettleable solids would, as a first approximation, be similar to the concentration in the parent material. Monthly nonsettleable solids averaged 730 to 1,700 ppm in the Bima effluent (Jewett, Gardner, and Athey, 1989), or--assuming 35-fold dilution--an incremental 21 to 48 ppm at 100 m. Based on this suspended-solids loading downcurrent of the dredge, the average sediment content of 35 ppm nickel would result in a 0.7- to 1.7-ppb increase in total nickel at 100 m; the expected high sediment content of 93 ppm nickel would result in 2.0- to 4.4-ppb increase in total nickel.

The average nickel concentration observed by Crecelius, Apts, and Lasorsa (1990) 100 m downcurrent of the Bima was 20 to 50 times as great as the value extrapolated from sediment concentrations of total nickel. This difference may imply a 20- to 50-fold enrichment of nickel in sediment fines relative to the 35 ppm nickel in bulk sediments. This level of enrichment is similar to that postulated for copper. This apparent enrichment of sediment fines in trace metals would be further addressed by the baseline monitoring recommended for the proposed sale in the recent workshop held by MMS (Hood, 1989).

In any case, note that all three 1989 MMS samplings downcurrent of the Bima found that mining operations were increasing total nickel concentrations at the edge of the mixing zone to above the EPA and State chronic criterion and standard for nickel. The nickel concentrations downcurrent of the dredge are high enough that either a twofold increase in sediment-nickel content above average or a twofold increase in the tailings-discharge rate would increase nickel concentrations at the edge of the mixing zone to above the acute criterion. Because released nickel is in particulate form, the area affected by high nickel concentrations would be limited to the area

covered by the turbid dredge plume, estimated at 34 km<sup>2</sup> in Section IV.B.2.b. This is the area that could be affected during active dredging.

The Stipulation No. 1 requirement for monitoring discharges from mining operations that result from this proposal--particularly the requirement for timely notification of the RS/FO of violations of water-quality criteria or permits--would be in place and would provide impetus to keep nickel concentrations below criteria and permit restrictions. This requirement would allow the RS/FO to order modification of dredging operations to preclude the occasional exceeding of the EPA acute criterion and to lessen the frequency or at least the magnitude by which the EPA chronic criterion for nickel would otherwise be exceeded. No potential modifications of operations identified by MMS to date would be sufficient under the assumed mining scenario (Table II-3) to consistently reduce nickel concentrations fourfold--the amount necessary, on the average, to meet the chronic criterion at the edge of the mixing zone. Thus, based on the monitoring data for the Bima and this EIS analysis, the chronic criterion for nickel is expected to be exceeded on the average by the nickeliferous-sediment discharge for the one, Bima-like dredge in the proposal, for a MODERATE effect on LOCAL water quality. A NEGLIGIBLE effect of nickel discharge on water quality would be expected on a REGIONAL basis.

The EPA (USEPA, 1990a) recently reissued an NPDES permit for the WestGold dredge Bima which provides a reduced discharge limitation of 149.4 ppb for nickel. Although not stated in the permit, the EPA (1990d) has indicated to MMS that this limit applies only to that fraction of the discharge which is estimated to remain suspended at the 100-m mixing-zone boundary under worst-case conditions of minimal (18:1) dilution and not to the total discharge. Based on this dilution ratio, the EPA considers this limitation to be protective of the chronic criterion of 8.3 ppb total recoverable nickel in marine waters. The EPA has required WestGold to measure both total recoverable and total dissolved concentrations of nickel to establish the relationship between these measurements for this discharge in this environment.

If a similar NPDES permit limitation on trace-metal discharge were applied for the proposed dredging activity in Federal waters, whereby the chronic criterion level of 8.3 ppb total recoverable nickel were not exceeded at 100 m from the discharge, NEGLIGIBLE effects for both LOCAL and REGIONAL water quality would be expected. Based on the nickel concentrations observed by Crecelius, Apts, and Lasorsa (1990), it does not appear that this criterion can be met by the Bima on State leases. Whether a mining operation in Federal waters would be more successful than the Bima in State waters in meeting the 8.3 ppb criterion would depend upon the site-specific sediment chemistry and the exact type, configuration, and operating procedures of the dredge. The EPA (1990b) believes that operating conditions for the proposed action in Federal waters can be maintained that would, in the future "reduce trace metal concentrations to acceptable levels at the edge of the mixing zone."

c. Effect of Offshore Mining on Dissolved Oxygen: Dissolved- oxygen concentrations are a concern because of the potential increased oxygen demand in the water from dredge discharges of tailings and relatively small volumes of sewage. An increase in oxygen demand can be biological and/or chemical depending on whether increased microbial respiration or chemical oxidation is using up the oxygen supply. Usually the two mechanisms of oxygen depletion are considered together, rather than separately, under the category of biochemical oxygen demand (BOD).

The EPA criteria for oxygen exist for freshwater only and are based on life- cycle stresses rather than direct toxicity. For the purpose of analysis, this EIS has adapted these criteria as chronic marine criteria. Anoxia, or zero oxygen concentration in the water, is assumed as a toxic criterion.

Dissolved-oxygen concentrations were monitored during the 1986 and 1987 gold dredging operation of the Bima (Rusanowski, Gardner, and Jewett, 1987, 1988). The data indicate very little oxygen depletion within the 0.5-km mixing zone about the dredge--on the order of 0.4 ppm or less out of a total dissolved oxygen content of 10 ppm. The high oxygen concentrations in the effluent in 1986 and 1987 were at least partially attributable to high entrainment of air in the discharge. Early in the 1988 season, the discharge pipe was redesigned to eliminate this air entrainment which had interfered with discharge operations. A biologically significant decrease in dissolved oxygen content of effluent waters as a result of this discharge modification was not observed in the 1988 monitoring program, if it occurs. Oxygen depletion would have to be at least fivefold greater to be a concern, based on comparison with (chronic) Federal criteria for freshwater (USEPA, 1986a).

Continued BOD, while effluent waters move further from the dredge site could continue to decrease oxygen concentrations. This effect is unlikely to significantly reduce oxygen concentrations at greater distances from the dredge because of the relative shallowness and weak stratification of sale- area waters--allowing for greater mixing of atmospheric oxygen into the water column. This factor cannot be evaluated directly for the Bima

operation. The single BOD determination for the Bima was made in October 1988. This determination found very low BOD of 0.042 ml/l/day (Naidu et al., 1989). However, BOD values would be expected to be higher by an unknown amount in warmer, midsummer waters.

Significant depletion of oxygen concentrations are unlikely to occur outside the smaller 0.1-km mixing zone allowed in Federal waters around any dredge, and oxygen depletion at the dredge site would cease when the dredge moved elsewhere. Thus, the effect of the proposal on oxygen concentrations in the water would be short term and only within the mixing zone, or NEGLIGIBLE for both LOCAL and REGIONAL water quality.

d. Effect of a Fuel Spill during Offshore Mining: Small quantities of fuel could be spilled during fuel transfers and larger quantities--up to the 6,000 barrels (bbl), stored fuel capacity of a dredge--could be spilled in a major accident.

Water-column concentrations of hydrocarbons following spills are difficult to compare to existing State standards and Federal water-quality criteria because of ambiguities. Applicable ambient-water-quality standards for marine waters of the State of Alaska are the lower of 15 ppb ( $\mu\text{g/l}$ ) total hydrocarbons and 10 ppb (10  $\mu\text{g/l}$ ) aromatic hydrocarbons or 0.01 of applicable  $\text{LC}_{50}$ 's for critical lifestages of important local species. Federal standards are set at 0.01 of the applicable  $\text{LC}_{50}$ ; no absolute Federal concentration standard exists for hydrocarbons. The State of Alaska criteria of a maximum of 15 ppb of total hydrocarbons in marine waters--about fifteenthfold background concentration--provide the readiest comparison and are used in this discussion of water quality. This analysis will consider 15 ppb to be a chronic criterion and 1,500 ppb--a hundredfold higher level--as an acute criterion.

Potential trajectories of oil spills; fate and behavior of oil spills; likelihood, extent, and persistence of oiled shoreline; potential oil-spill contingency measures, and toxicity of oil in the marine environment of Norton Basin have been discussed in detail in Section IV.A of the Sale 100 FEIS (USDOJ, MMS, 1985a). The effects that spilled oil, including fuel, would have on water quality of Norton Basin have been discussed in Section IV.J.5 of the same FEIS. This information is only summarized here; it is incorporated in total by reference.

Spills of a 1,000 bbl or more are usually associated with major marine accidents. Spills smaller than a 1,000 bbl are usually much smaller than a 1,000 bbl. For example, 1 percent of the oil industry spills on the U.S. OCS are larger than 1,000 bbl in size, 1 percent are between 10 to 1,000 bbl, and 98 percent are less than 10 bbl in size (Anderson and LaBelle, 1990). Such small spills have a NEGLIGIBLE effect on the water quality (USDOJ, MMS, 1985).

There is a possibility that a major fuel spill could result from the proposal. Offshore gold dredging in northwestern Norton Sound, particularly in fall, has been shown to be very hazardous. The dredge in the most recent offshore gold mining attempt in northwestern Norton Sound, prior to the arrival of the Bima, was lost in a sudden storm (State of Alaska, 1983a,b) and all onboard fuel was lost. A dredging attempt prior to 1983 resulted in the grounding and loss of a dredge and the accompanying tug and the loss of most of the fuel onboard (State of Alaska, 1970). In the latter accident, 7 percent of the fuel was recovered from the wrecked tug by locals, but no recovery was attempted by the spiller. In neither of these two sinkings was any fuel that was spilled into the water recovered.

These data are insufficient to quantify the likelihood of a major spill occurring in the base case. Such a spill could occur on a lease or on inshore waters as a result of grounding. For the purposes of analysis, one major spill of 3,500 bbl is assumed to occur. A 3,500-bbl spill would be equivalent to losing the average, onboard-fuel load of a Bima-sized dredge. The location of occurrence--on a lease or at a nearshore grounding--assumed in effects analysis for an individual resource is that which causes the greater effect.

Table IV-10 provides examples of weathering of a spill of 3,500 bbl of light diesel fuel in the sale area. Diesel fuel is missing both the lightest and heaviest ends of the petroleum spectrum. Diesel fuel, therefore, will initially evaporate more slowly than crude oil, but more will eventually evaporate. In addition, diesel fuel does not form a water-in-oil emulsion, keeping the viscosity of the slick low. Because of the lower viscosity, diesel will more readily disperse into the water column than will crude oil. In the sale area during open water, about 4 times more spilled diesel would disperse into the water than would evaporate.

If the spill grounded on the shoreline, the diesel fuel would not be mechanically abraded and dispersed in the same manner as weathered crude; instead, it would remain within the original, contaminated shoreline beaches

**Table IV-10**  
**Examples of Spill Weathering for a Light Diesel Fuel in the Sale Area<sup>1/</sup>**

	Spill of 3,500 Barrels
	<u>Time After Spill</u> 3 Days
<b>Spill in June, Water Temperature 5°C, Winds 10 knots</b>	
Oil Remaining (%) <sup>2/</sup>	22
Thickness (mm)	0.3
Area of Slick (km <sup>2</sup> ) <sup>3/</sup>	0.4
Discontinuous Area (km <sup>2</sup> ) <sup>4/</sup>	40
Hydrocarbons in the Water (ppb) <sup>5/</sup>	400
<b>Spill in September Storm, Water Temperature 9°C, Winds 21 knots for 16 hr, then 12 knots</b>	
Oil Remaining (%) <sup>6/</sup>	15
Thickness (mm)	0.3
Area of Slick (km <sup>2</sup> ) <sup>3/</sup>	0.3
Discontinuous Area (km <sup>2</sup> ) <sup>4/</sup>	60
Hydrocarbons in the Water (ppb) <sup>5/</sup>	300

<sup>1/</sup> Calculations based on the oil-weathering model of Payne et al. (1984), as modified for variable winds by Redding and Kirstein (1985). The model does not include slick losses to shoreline stranding.

<sup>2/</sup> Slick dissipated by sixth day.

<sup>3/</sup> This is the area of oiled surface.

<sup>4/</sup> Calculated from Equation 6 of Table 2 in Ford (1985), based on average weather conditions in June and September, including 0.5 m waves in June and 1 m waves in September (Brower, Baldwin, and Williams, 1988). This is the discontinuous area of a continuing spill or the area swept by instantaneous spill of the given volume.

<sup>5/</sup> Average concentration of dispersed and dissolved hydrocarbons beneath discontinuous slick.

<sup>6/</sup> Slick dissipated by fifth day.

for several months (McLaren, 1985). Diesel would be released from the beach predominately during ebbing tides, with little natural cleansing by wave action.

While weathering, remaining spilled diesel in the sale area would be expected to maintain a viscosity below 2,000 centistokes for about the first 2 days after a 3,500-bbl spill. Most standard oil-spill-response measures are generally ineffective at higher viscosities. However, by the time such higher viscosities were reached, about 75 percent of the slick would have dispersed into the water column or evaporated. A fuel spill of this size in a sudden storm would cover a larger area but could dissipate more rapidly than a spill in calmer weather (Table IV-10).

Some degradation of water quality would occur from a major fuel spill of 3,500 bbl. Diesel concentrations within the water column on the first day of the spill could exceed 1,000 ppb over 10 to 20 km<sup>2</sup> for a MINOR effect on LOCAL water quality. A plume of dispersed and dissolved diesel--300 ppb to 400 ppb over 40 to 60 km<sup>2</sup> after 3 days--could be detectable over the low-background levels of hydrocarbons (0.7 ppb) in Norton Sound and over the chronic standard of 15 ppb. Over several days to weeks, the plume could spread over a few hundred square kilometers, for a MINOR effect on REGIONAL water quality.

**SUMMARY:** The area affected by increased turbidity and arsenic, lead, copper, and nickel concentrations in the water column would be limited to 34 km<sup>2</sup> about the one dredge in the proposal. Potential modifications identified to date by MMS for a Bima-like dredge would be insufficient to insure that copper concentrations at the edge of the mixing zone would be less than the acute criterion, for a MAJOR effect on LOCAL water quality. A NEGLIGIBLE effect from turbidity and metalliferous-sediment discharges is expected on a REGIONAL basis. The EPA (USEPA, 1990d) considers that in this case and under projected NPDES discharge limitations (USEPA, 1990a), an occasional exceeding of the acute criterion for copper at 100 m by total recoverable--but not dissolved--copper concentrations would have negligible effect on LOCAL and REGIONAL water quality.

Oxygen depletion is expected to have a NEGLIGIBLE effect on both LOCAL and REGIONAL water quality. Diesel concentrations within a few kilometers of a spill could reach 1,000 ppb within a day of a spill for a MINOR effect on LOCAL water quality. Concentrations of the diesel above the chronic standard of 15 ppb could persist for days to weeks over a few hundred square kilometers, for a MINOR effect on REGIONAL water quality. The overall effect of all contaminants is MAJOR on LOCAL water quality and MINOR on REGIONAL water quality.

**CONCLUSION (Effect on Water Quality):** The effect of offshore mining on marine-water quality in the base case would be MAJOR for LOCAL water quality and MINOR for REGIONAL water quality.

**CUMULATIVE EFFECTS:** In addition to the proposal, past, present, and reasonably foreseeable future actions, such as offshore placer mining in State waters, onshore mining and mineral processing on the north side of Norton Sound (past, present, and future), local harbor dredging, and non-oil-industry spillages of petroleum products in northwest Alaskan rivers and coastal communities will have a combined effect on water quality in the sale area. Ambient water quality in Northwestern Norton Sound, away from current offshore placer mining, meets EPA criteria for all parameters tested.

The proposed action could occasionally cause local increases, over about 34 km<sup>2</sup>, of turbidity and trace metals to levels above EPA chronic criteria, a MAJOR effect on local water quality.

Losses of mercury used for amalgamation in historical sluicing operations since 1898 in the Nome mining district may be on the order of the amount of gold recovered, or about 120 metric tons (see Wise, 1966; Ealey et al., 1983; McCredie, 1983). The mercury concentration in soil downslope of a Nome gold-processing facility, within the Snake River watershed and only a few miles from the river mouth, was measured at 92,300 ppm in very limited sampling. Mercury concentrations in sediments of the Snake River Estuary average about sixfold higher than offshore sediments. Mercury used in mineral processing, natural mercury, lead, arsenic, and chromium discarded in mining wastes (Environmental Toxicology International, 1987); Collier et al., 1908; Green, Bundtzen, and Hansen, 1988; USDOD, COE, 1990), and other minerals mined such as tin are likely washing or leaching into northern Norton Sound from mining activities going back almost a century. These trace-metal loads would be in addition to, but not necessarily as large as, that occurring from natural erosion of local mineralized soils (which already results in locally elevated levels of several trace metals in Norton Sound sediments [See Sec. III.A.8.b]).

Because of the known mercury contamination of the Snake River watershed by mercury-amalgamation dredging and processing of gold into 1985 (Crevensten, 1987; USEPA, 1987a,b; Tryck, Nyman, and Hayes, Science Applications International Corporation, and Shannon and Wilson, 1986), and high arsenic concentrations within the turning basin, also attributed to past gold processing (USDOD, COE, 1990), the annual Nome Harbor dredging and offshore discharge of spoils of 5,000 yd<sup>3</sup>/year by the U.S. Army Corps of Engineers may add some additional risk of pollution, but only in years when the turning basin is dredged (USDOD, COE, 1990). The USDOD, COE (1990) has stated that dredging of the turning basin and accompanying disposal of spoils will not be conducted until further sediment testing is accomplished. The channel--the part of the harbor usually dredged and with lower trace-metal levels--has sediment composition similar to that of the offshore disposal area for dredge spoils (USDOD, COE, 1989, 1990).

Monitoring data for the Bima in State waters reported downcurrent concentrations of turbidity, lead, and nickel in excess of Federal and State marine-chronic criteria and standards, and concentrations of copper in excess of the acute criterion and standard (Hood, 1989; Crecelius, Apts, and Lasorsa, 1990); the latter having been a MAJOR effect on LOCAL water quality. Nickel and lead concentrations exceeded the chronic criterion for a MODERATE effect on LOCAL water quality during active dredging. The Bima had a NEGLIGIBLE effect on REGIONAL water quality.

In the future, two large gold dredges and one small gold dredge are projected for State waters in the cumulative case. Future mining activity will be required to more closely control mining discharges. The EPA (USEPA, 1990a) recently reissued an NPDES permit for the WestGold dredge Bima which provides for a twofold-reduced discharge limitation for trace metals. The EPA (USEPA, 1990b,d) believes that similar permit restrictions for future dredges would reduce the effects of turbidity and metal discharges to below those estimated from past Bima monitoring. The EPA (1990b) believes that operating conditions for the proposed action in Federal waters can be maintained that would, in the future "reduce trace metal concentrations to acceptable levels at the edge of the mixing zone." However, based on the trace-metal concentrations observed by Crecelius, Apts, and Lasorsa (1990), as analyzed for the proposal, this EIS still projects that each of these three dredges would continue to exceed trace-metal and turbidity criteria, and, in particular, the acute copper criterion, for a MAJOR effect on the surrounding, LOCAL water quality. Cumulatively, these three dredges would have a NEGLIGIBLE effect on REGIONAL water quality.

Offshore placer mining in State waters poses some risk of fuel spillage (State of Alaska, DEC, 1983a,b; 1970). On September 26, 1983, several vessels mobilizing for a gold dredging operation in State waters ran aground in a storm. About 30 to 100 bbl of fuel and hydraulic oil--all that was onboard a wrecked dredge 60 m offshore--were spilled without recovery. In the fall of 1969, another offshore gold dredging operation failed when the dredge barge and accompanying tug went aground, with the tug losing over 300 bbl--93 percent of its fuel. About 7 percent of the fuel was recovered from the tug by locals over winter; no spill response was conducted by the spiller. The slick froze into the ice and was still present the following May. Based on MMS oil-weathering and spreading models (see citations in Table IV-10), these past marine-dredging spills likely originally had a MINOR LOCAL effect on water quality within about 10 km<sup>2</sup> of the point of spillage but a NEGLIGIBLE REGIONAL effect. Future small spills are likely to have a similar level of effect on water quality. One larger spill of 3,500 bbl of diesel is assumed to occur in the cumulative case for offshore mining, either from the proposed activity in Federal waters or from one of the dredges in State waters. As analyzed for the proposal, such a spill would have a MINOR effect on both LOCAL and REGIONAL water quality.

Non-oil-industry spills of petroleum products of a few to a few hundred barrels are relatively common in western Alaska (USDOI, MMS, 1985a). For example, the Alakanuk fuel-tank spill of 1978, the Pilot Station fuel-tank spills of 1984 and 1985, the Anvik fuel-tank spill of 1985, and the Nulato fuel-tank spill of 1985 into the Yukon River totaled about 1,000 bbl. Two-thirds of a 140 bbl diesel spill were not recovered from the shoreline and waters of the Snake River estuary in 1977 (Allen, 1978). A cleanup of a mysterious, underground fuel spill in Nome recovered 1,200 bbl of fuel in 1985. Based on MMS oil-weathering and spreading models, these historic spills likely had a MINOR LOCAL effect on water quality within a few tens of kilometers of the spill sites but also a NEGLIGIBLE REGIONAL effect.

**Conclusion:** In the cumulative case with the proposal, the dominating (MAJOR) effect is that of metalliferous-sediment discharge on the LOCAL water quality around each mining dredge in State and Federal waters, with a MINOR effect on REGIONAL water quality from an assumed major offshore fuel spill.

3. **Effect on Marine Plants and Invertebrates (Including Red King Crab):** Offshore dredging and materials discharge have the potential to affect marine plants and invertebrates (including red king crab).



via the effects of habitat alteration, including turbidity; entrainment of organisms; exposure to trace metals; noise and disturbance; and a fuel spill.

To aid in the interpretation of the following effects discussion, an explanation for some of the terms in the definitions presented in Table IV-2 follows. The "region" is considered to be the Norton Sound area, and a "population" is a group of interbreeding individuals. A "portion of a population" consists of a subset of the individuals in the population, as in a group of clams in a localized area, not representing the entire breeding stock.

a. Effect of Offshore Mining on Habitat Alteration: Under the scenario, marine plants and invertebrates are expected to be affected by sediment coring during exploration and dredging activities during development. During exploration, approximately 17,280 sediment cores will be taken. These represent very small-scale disturbances that will result in the death and injury of some plants and invertebrates, but populations are not expected to be affected. A far more significant activity is the actual dredging of bottom sediments. Dredging activities associated with this lease sale are projected to excavate the sea bottom and associated flora and fauna to a depth of 3.6 m (12 feet), process this material, and discharge the processed material and organisms. In the base case, one dredge is assumed to be operating, excavating 100 acres of bottom terrain per year, with a total area excavated over the life of the lease of 1,300 acres. Bathymetric surveys associated with Bima operations have indicated that the area affected by mining may be at least 1.5-1.8 times larger than the excavated area (for coarse-grained material); the affected area includes the excavated area as well as the area in which the material processed on the dredge is discharged (Sec. II.A.2.d.(4)). Thus, in the base case, 1,950 to 2,340 acres would be affected directly, by changes in bathymetry. A greater areal extent will be affected by sedimentation of resuspended materials (see Sec. II.A.2.d.(4) and Sec. IV.B.2.a). Based on modelling results presented in Sec. II.A.2.d.(4), up to approximately 22,792 acres or 15.5 percent of the proposed sale area could be affected by sedimentation of 1 cm or greater. Although dredge size and dredging depth may vary, the preceding numbers are based on the assumption that dredging in the OCS will closely resemble the Bima operation in State waters. If the dredging depth were to decrease or the number of dredges operating to increase, the areal extent of bottom (benthic) habitat affected would increase.

The above activities would result in the death of a number of organisms through the mechanical action of the dredging, via processing procedures, or via the disposal of dredged material. Both lethal and sublethal effects to organisms would occur. Dredging would result in major alteration of the habitat and death of many or most of the associated benthic inhabitants. According to data from the Bima operation in State waters, 85 to 90 percent of the benthic organisms die (Rusanowski, 1988, oral comm.). Those animals and plants that survive the dredging process may also die if they are buried by spoils and cannot dig themselves out or if they require a different kind of substrate that no longer exists.

The habitat would be greatly altered by the excavation of 3.6-m depths of sea bottom, the mixing of all the various substrates within those 3.6 m during processing, and the discharge of that mixed material. Fine materials and organic matter that may have been on top would be mixed up with other materials. Cobbles and boulders, which can be abundant (see Rusanowski, Gardner, and Jewett, 1987) may be buried (see Table IV-11), with subsequent loss of the epilithic flora and fauna, as well as organisms more loosely associated with the rocks. This mixing and upheaval of substrates will result in the death of more organisms, who, although they may have survived the excavating and processing, may end up in or on unsuitable substrates.

Change or alteration of the substrate type has important implications for recovery of the disturbed area. Many larvae use sediment cues, or combined sediment and organic cues to trigger settlement and/or metamorphosis. If surficial sediments are greatly altered, which is quite likely, then recolonization through larval settlement/recruitment may be slowed and those species settling may be different than those that predominated prior to disturbance. Recolonization then may be most dependent on immigration of mobile animals from nearby undisturbed or less-disturbed areas. Again, substrate differences between dredged and nondredged areas and lack of fauna (or presence of many dead animals) may limit which species move into the area and/or how long they stay. The presence of many dead animals in dredged areas immediately following dredging may stimulate occupation of the areas by scavengers; this occupation may be temporary and could, if the feeding habits or ecological roles of the species were not well defined or noted, suggest that recolonization or recovery were taking place, when in fact a temporary movement into the area to exploit an enhanced food source was all that was occurring. Recovery of the community, meaning a return to its previous species composition and relative abundance of species, may not occur, or may take many years. When substrates are altered, larval recruitment can be affected, as well as immigration of species. Opportunistic species (e.g., scavengers, or species that recruit abundantly from the plankton and/or have different or nonstrict settlement cues) may come to predominate.

Table IV-11  
Substrate Composition  
Before and After Dredging by the Bima

Substrate Type	1986 Dredge Area (R-6) (Percentage)		1987 Dredge Area (R-7) (Percentage)	
	Before Mining	After Mining	Before Mining	After Mining
Sand/silt	41	70	28	77
Sand/gravel	44	30	23	18
Cobble	11	0	45	3
Sand waves	4	0	4	2

Source: Rusanowski, 1988, written comm.

The replacement of these species through time (succession) will be dependent on how the colonizing species interact with other species that attempt to immigrate or recruit into the area, and how alteration and continued disturbance of the environment affects the entrance of species into the area.

In addition to effects within the dredged area, effects to a much broader area may occur because of settlement of particulates from the water column. The factors affecting water-column turbidity resulting from dredging and spoils discharge are discussed in Section IV.B.2.a. Based on calculations in that section, in the base case, over one-half of the sale area could be affected by a short-term increase in turbidity at some point during the 14 years of production. The concern for the benthos is that extensive areas could become covered by fine sediments settling out from turbid waters. The differential settlement of particles of different sizes (see Sec. III.A.3) will lead to a much larger area being covered by silts than sands, and a larger area covered by sands than gravel. The persistence of these substrates also depends on particle size and the dynamics of the oceanographic regime; since this is a natural environment for sand deposition and reworking, sand newly deposited as a result of dredging would be a relatively permanent addition to the environment. Silts, on the other hand, would be expected to be moved more readily by fall storms. Thus, the effects of habitat alteration due to dredging would be expected to vary with the type and extent of sediment deposition. The extent of the potential problem would be exacerbated if high turbidity in bottom waters downcurrent of the dredge is due to resuspension of sediments from easily eroded tailings (Rusanowski, Gardner, and Jewett, 1988). Heavy siltation has occurred outside the dredged areas. Fine sand and flocculents to a depth of 6 in have been observed outside the actual dredged area. At one site adjacent to an area dredged 1.5 years ago, boulders were partially covered by 6 in of sand, and barnacles low on the rocks had smothered (Lean, 1988, oral comm.). Thus, the potential exists for extremely wide-ranging and significant effects to the benthos that would far exceed the actual dredged area.

Some indication of the potential for recovery of these disturbed (at least the directly-dredged) benthic communities may be gleaned by studies of areas dredged by the Bima in 1986 and 1987. The study site dredged in 1986 (R6) was a sandy station, whereas the study site first dredged in 1987 (R7) and subsequently dredged in 1988 and 1989 was dominated by cobbles. The physical character of both sites changed following dredging, but the previously cobble-dominated site changed more drastically, becoming dominated by sands and silt (Table IV-11). When R6, the sandy site dredged in 1986, was sampled in 1987, the substrate was siltier, with a concomitant increase in the amount of interstitial water present. Also, the bottom profile had changes ranging from +15 ft (+4.6 m) to -5 ft (-1.5 m) of its previous level.

The amount of cobble habitat in the dredge footprints of both R6 and R7 (as depicted in Table IV-11) has declined greatly. However, if data cited as also being from 1987 (Table 3.1-2; Jewett, Gardner, and Athey, 1989) are compared to the pre-dredging substrate compositions, at R6 there appears to be no change in amount of cobble following dredging, and at R7, there is about a 24-percent drop. These numbers are hard to reconcile, therefore, it is difficult to know how to interpret the approximately 30-percent increase in cobble substrate reported in dredged areas (both R6 and R7) from 1987 to 1988. Was the amount of cobble formerly within the actual dredged area (now the footprint) dumped in the surrounding area (still part of the "dredged" areas), leading to an overall apparent increase in the amount of cobble? Presumably, the amount of cobble has increased because the subsurface dredged material contained significant amounts of cobble, which have "surfaced" as finer materials initially covering cobble have been swept away by currents.

Data from the 1989 field season now indicate a decrease in the percentage of cobble at R6 and R7 from 1988 to 1989 (Table 2-1, Jewett et al., 1990). Does this mean that fine sediments are now covering cobble? At site R6, even though there is a decline in the amount of cobble from 1988 to 1989, the overall change from 1987 to 1989 is for an almost 18-percent increase. One difficulty for interpreting changes is that there are no predredging data for either R6 or R7, so we cannot relate changes back to some predredged state.

Dredging also changes the nature of the cobble substrate; before dredging, cobbles are more consolidated or compacted than afterwards, when they can be loose and unstable (Prentki, 1989, oral comm.). In some areas, cobbles or mixed substrates are quite consolidated (Jewett, 1990, oral comm.; and Kaufman and Hopkins, 1989), and the increasing discreteness (instability) of these substrates following dredging could greatly affect the successful recruitment of biota. This increasing instability could be the mechanism that has kept the observed recruitment of benthic invertebrates to cobble very low (Sousa, 1979).

The major differences at R6 in 1987 were in the faunal (animal) characteristics. In fact, in 1987, approximately 8 months after dredging, station R6 was the most dissimilar of all the intermediate and deep stations examined; all other sandy and cobble stations were more similar to each other faunistically than was R6 to any of them. At station R6, the number of taxa, density, biomass, and average weight per individual were all much lower than

at the other sandy stations (see Table 3.2-18, Rusanowski, Gardner, and Jewett, 1988). Species composition also changed. Although there was a general paucity of animals at R6, cumaceans and amphipods (both crustacean groups) became relatively very abundant, compared to predominance by polychaetes at nondredged stations. Also, the percent of mobile taxa was much greater at R6. In 1988, the two dredged sites, R6 and R7, were resampled to look for recolonization patterns. Benthic invertebrates sampled in the sand habitat at R6, now 2 years after dredging, showed increases in the average number of taxa, density, and biomass (see Table 3.2-2; Jewett, Gardner, and Athey, 1989). These changes apparently represent increased recolonization of the sand habitat. There was also a shift (in terms of abundance) in the predominant invertebrate group. In 1987, R6 was dominated by crustaceans (primarily cumaceans and amphipods). In 1988, polychaetes had increased in abundance, from 20 percent in 1987 to about 75 percent. Additional analyses (k-dominance curves using abundance and biomass data), however, suggest that the community still appears disturbed. Tremendous variability in some of the control areas suggests that it will be difficult to use control data to help assess changes occurring in dredged areas.

Another major result of 1988 recolonization studies was the low recruitment of benthic invertebrates to cobble substrate in both R6 and R7. The 1988 sampling was two years after dredging at R6 and one year at R7. Both showed low average densities and extremely low average biomasses (see Table 3.2-2; Jewett, Gardner, and Athey, 1989). Thus, although recolonization appeared to be occurring within 2 years in the sand habitat, cobble habitats showed little recolonization at that point.

Data from the 1989 field season suggest that recolonization in the sand habitat of R6 has stabilized to some degree. The number of taxa and average density of individuals are similar to 1988 figures, but biomass has increased (Table 5-2 in Jewett et al., 1990). One big change was an increase in the percentage of mollusks at R6 (from 9.0% in 1988 to 41.5% in 1989). The 41.5-percent value is much greater than for any other sand station, either dredged or control. Also, the percentage of annelids is lower than at all other stations except R7 (which was dredged in 1987, 1988, and 1989).

In 1989, data for recolonization of cobble substrates are available only for R6. Some recolonization has occurred at R6; in 1989, there were increases in the number of taxa, density, and biomass (Table 5-2 in Jewett et al., 1990). These values are still lower than for control stations. Also, the percent density of taxonomic groups is different for R6 versus control stations. R6 has a larger percentage of mollusks and crustaceans and a lower percentage of annelids than the control stations.

Based on the data gathered through 1989, it appears that recolonization in sand habitats has been occurring and some parameters have stabilized, although compositional differences exist between R6 and the other stations. In cobble habitat, recolonization has been much slower, and only more recently has it increased. There are still large differences between dredged cobble sites and control sites. As mentioned earlier, these may be related to the increased instability of cobble substrates following dredging. Based on the differences observed, it is not yet possible to say if or when recovery of dredged communities would take place. As Jewett, Gardner, and Athey (1989), in a discussion of the current Bima monitoring results concur: "Drastic changes induced by dredging may alter these [ecological] pathways, and the resulting community may never return to the pre-dredging structure and internal integrity, although abundance levels may return to pre-dredging levels" (McCauley et al., 1977).

As discussed above, marine plants and invertebrates in the proposed sale area (and some beyond) may be affected directly by dredging, processing and spoils discharge, and more indirectly through habitat alteration. Of concern are the distribution of habitat types and their associated communities, the effects of alteration on these habitats and communities, and the rate and process of recolonization and recovery. In the proposed sale area, we have only spotty information about the composition of benthic communities (Stoker, 1981) and the distribution of habitats. There is no information on the dynamics of community change or how communities would be affected by dredging. The most detailed and most pertinent information comes from studies associated with the Bima monitoring program. From this program we have learned that there is a greater diversity of substrates (in State waters adjoining the proposed sale area) than we had anticipated based on Stoker's work, and that recolonization and the potential for recovery appear to differ dramatically between sand- and cobble-dominated habitats (i.e., recovery of cobble-associated communities has not occurred and recolonization has been slow).

The proposal includes a monitoring program that is intended to avert or mitigate the degree of effects from dredging activities. The specific program could include an assessment of the distribution of habitats in the proposed sale area, the relationship between habitat type and community structure, and an understanding of recolonization and recovery rates for disturbed communities. The monitoring program should be able to identify

any unique or more limited habitats and communities and allow restriction of dredging activities in them. It should also be able to restrict or limit dredging in habitats where recovery of communities is slow or negligible (e.g., possibly cobble habitat). The MMS has already expressed its concern for an area of high density red king crab habitat by deleting six blocks that were previously to be part of the lease sale.

Some indication of what the habitat and communities may be like in the proposed sale area may be gleaned from/suggested by information from the Bima program in 1988. In that year, Bima activities extended to just outside (shoreward) of the proposed sale area. In these deeper waters, communities on cobble substrates were more diverse (had more species) and also contained greater biomass than cobble communities in shallower water (Jewett, Gardner, and Athey, 1989). Less disturbance (e.g., ice gouging, wave action, turbidity) in deeper waters (those deeper than 20 m) may account for the differences. At present, the extent of cobble habitat in Norton Sound is not known. Therefore, it is not possible to say with surety what the distributions of cobble-associated animals and plants may be. If there are species of plants or invertebrates that are limited to rocky substrates, and if a great percentage of these substrates occurs within the proposed sale area, then effects to these organisms as a result of habitat alteration could be MAJOR. However, the monitoring program should be able to identify any unique or more limited habitats and communities and allow restriction of dredging activities in them. This would enable the effects on marine plants and invertebrates from habitat alteration to be minimized. Most marine plants and invertebrates in the proposed sale area are thought to have broad distributions, far exceeding the limits of the sale area. Habitat alteration is expected to affect only a portion of these populations in rather localized areas for an, as yet, indeterminate time, but probably exceeding one generation. Without monitoring, the effect on marine plants and invertebrates (excluding red king crab) from dredging activities is likely to be MODERATE. However, if information on habitat types and recolonization and recovery rates of the communities, as determined by the monitoring program included in the proposal, is used to determine the location and extent of dredging activities (i.e., dredging is limited or restricted in unique areas or where recovery of the communities would take multiple generations), then potential effects to marine plants and invertebrates (excluding red king crab) could be reduced from MODERATE to MINOR. However, the knowledge necessary to make these judgment calls may require more time than is likely to be available for the scale of the project. Also, if the sale area or the western part of the sale area were largely dominated by cobble or rocky substrates, then it is not too probable that dredging would be restricted from the entire area. This pragmatic view would likely result in a MODERATE effect on marine plants and invertebrates.

Under the terms of the proposal, which includes a monitoring program, the most likely effect of habitat alteration on marine plants and invertebrates (excluding red king crab) will be MODERATE.

Red King Crab: Alteration of habitat due to dredging activities also has ramifications for the red king crab population in Norton Sound. Of prime concern is loss or alteration of cobble habitat that is potentially critical habitat for juveniles and possibly females, and that may also be preferred habitat for red king crabs in general (Lean, 1988, oral comm.; Rice and Babcock, 1989). Dredging activities associated with the proposal also could affect the zone from 5 to 10 mi offshore, which is considered permanent habitat for red king crabs; this is a transitional zone in which the density of crabs varies with the season and the movements of the crabs (Lean, 1988, oral comm.). As described earlier in Section III.B.1, adult male red king crabs in Norton Sound are found in the winter in the nearshore under the ice (Schwarz, 1984, oral comm.), but in the summer, males move seaward in a southwesterly direction and presumably return northeastward in the fall (Powell et al., 1988).

The proposed sale area also includes about one-third of a 30-m deep trench that runs parallel to the Seward peninsula from south of Safety Sound to southwest of Sledge Island. High concentrations of juvenile red king crabs, and occasionally older crabs, are found near this trench, but the importance of this feature for red king crabs is not known or understood. The trench may be prime red king crab habitat because of substrate types (possibly more gravel and cobble), oceanographic regime (possibly more active currents, thus more food and perhaps less siltation, thus better epifaunal growth on rocks or cobbles), or for some other reasons.

Based on the very high densities of red king crabs observed near this trench in what would have been the eastern-most part of the western half of the lease area, MMS decided in December 1989 to delete six blocks that were originally to be part of the lease offering. This decision removed an area that we assume is critical habitat for red king crabs, thus reducing the potential effect of dredging on the population. This deletion, coupled with the information that may be forthcoming from the monitoring program regarding the distribution of habitats in the lease area and the rates of recolonization and recovery of communities following dredging, should result in a lessening of potential effects on red king crabs. In particular, as delineated below, the monitoring program should be sensitive to the distribution and abundance of cobble-based communities and the rate of their recovery following dredging.

Several types of substrates may be found in the proposed lease area, including sand, cobble, gravel, and a partially-consolidated gravel and cobble. Cobble, boulder, or gravel substrates are known to be important to juvenile king crabs. Studies in other areas indicate that the distribution of young-of-the-year red king crab is generally limited to coarse substrates such as boulders, gravel, cobble, and shell debris with attached epifauna (Jewett and Onuf, 1988, citing: Powell and Nickerson, 1965b; Tsalkina, 1969; Sundberg and Clausen, 1977; and McMurray et al., 1984). Young crabs are dependent on an environment which provides both adequate food and refuge from predators such as demersal fishes. Females and juveniles show a clumped distribution, while males, especially the larger ones, migrate both in- and offshore farther than females and thus have a broader pattern of distribution (Lean, 1988, oral comm.). The more clumped distributions of juveniles and females may be related to the distribution of cobble habitat. Rocks may provide important protection to females while they are soft following molting and during subsequent mating. Recently molted crabs, in general, are more vulnerable to predators, and are readily taken by walrus (Fay, no date, pers. comm. to R. Highsmith).

King crab habitat could be altered directly in dredged areas, as has been described above for station R7 and also through extensive sedimentation outside of the actual dredged area (see previous observation by Lean). There have been conflicting reports of the effect that dredging has had on the use of areas by red king crab. Winter-fishing commercial crabbers in 1988 reported that they caught few crabs in a dredged area that previously had been a good area for crabs (Tobin, 1988). On the other hand, in 1987 crab pots were set out by the Bima monitoring program in both dredged and non-dredged areas, with no significant difference in catch among the areas reported (Jewett, Gardner, and Athey, 1989). More recent pot studies by the Bima monitoring program showed no clear trend in 1988 (one control area had a significantly greater catch than the other three sites, two dredged and one control), but in 1989, there was a significantly smaller catch at a dredged site (R6) than at either control site (Jewett et al., 1990). No definite trend is apparent yet. It is possible that effects of dredging on male crabs differs from those on females and juveniles, and that catch of crabs (primarily the more mobile males) in previously dredged areas will not reflect the true effects of dredging on the population, since alteration of habitat is the important issue for females and juveniles. In dredged areas in State waters, investigators studying the effects of dredging have sometimes observed a pile of boulders in the midst of a dredged area, with no life apparent on the boulders (Jewett, 1988, oral comm.). Data in Table IV-11 indicate that dredging has at least initially greatly reduced the amount of cobble substrate in areas dredged in 1986 and 1987. In addition to cobbles or boulders being partially buried by sedimentation or overturned by dredging, they may be completely buried by many feet of finer sediments and thus lost as part of the habitat. Since increased sedimentation resulting from dredging activities could cover an extensive area (potentially an area one-half the size of the sale area in the base case), both king crab habitat and other benthic and epibenthic organisms (including king crab prey) could be affected. The degree and persistence of the effect depends on the depth and type of sediment deposited; as described earlier, sand deposition could become a relatively permanent alteration of the habitat. The extent of sand deposition is expected to be much less than that of silts, but the effects are expected to be more severe, lasting perhaps for many years. It is not possible to say if or when recovery of communities affected by sand deposition would take place. It is not known to what extent cobble habitat represents critical king crab habitat (although it appears to be critical for very young king crabs), nor what the effects of the scale of sediment deposition anticipated are on this and other types of habitat. The extent of habitats of different types in the proposed lease sale area also is not known. The monitoring program included in the proposal could address these issues.

Information from the Bima monitoring program suggests that cobble habitat may, at least initially, increase in dredged areas, however the long-term fate of dredged cobbles remains to be seen (see discussion earlier in this section). It may be that finer sediments that initially covered the ejected cobbles have been washing away, leaving more coarse substrates exposed. Notwithstanding this, recruitment of organisms to cobbles has been very low, perhaps due to instability of the cobbles. The effects of cobble instability on the quality of habitat that the rock represents for red king crab is not known. Reductions in settlement and growth of benthic organisms on cobbles (especially bryozoans and hydroids, [Rice and Babcock, 1989]) could significantly reduce the quality of the habitat for recruits or juveniles, and instability of the rocks could lead to increased mortality of crabs.

This analysis assumes that the red king crabs in Norton Sound are a discrete population; that the alteration of benthic habitat is likely to last for a number of years in some areas; that a high proportion of cobble or boulder habitat that is directly dredged would be reduced in quality; and that gravel, cobble, or boulder habitat is critical for the survival of young-of-the-year red king crabs. Cobble and boulder habitat may also be preferred by older juvenile red king crabs and by females. Habitat alteration from dredging activities could affect the red king crab population for more than one generation and could affect subsequent recruitment or the success of juveniles. It is for these reasons that a monitoring program is included as part of the proposal. An assessment of the

distribution of habitats in the proposed sale area (with special attention to the trench area) is needed, as well as an understanding of the relationship among habitat, community types, and successful recruitment of juvenile red king crabs. This knowledge could lead to the limitation of dredging in prime red king crab habitat and could allow the amount of area to be dredged to be based on recovery rates of the communities. The level of effect on red king crabs will be directly related to the extent of dredging that occurs in prime red king crab habitat. Effects on red king crab could range from MINOR to MAJOR. Given that it will take some time to be able to define the communities and understand the dynamics involved, it is likely that a portion of what we think is prime red king crab habitat may be adversely affected by dredging for a number of years (greater than one generation of the crabs). This would result in a MODERATE effect on the red king crab population.

b. Effect of Turbidity: Turbidity is an expression of habitat alteration in the water column. Degree and extent of water-column turbidity are described in Section IV.B.2.a (Effect on Water Quality). Any organisms located in or feeding in the water column could potentially be affected by the increased turbidity projected as a result of dredging and disposal operations. Potential effects on phytoplankton, zooplankton, and benthic invertebrates are described below.

Phytoplankton and zooplankton are expected to be affected locally, in regions of higher turbidity. Turbidity and suspended matter in the water column can both inhibit and stimulate primary production by phytoplankton (Odum and Wilson, 1962, as cited by Stern and Stickle, 1978). The turbidity can decrease light penetration and hence, light available for photosynthesis, while inorganic nutrients associated with suspended particles or released in the discharge of dredge spoils could stimulate photosynthesis. Decrease of light by turbidity can have a stronger effect on photosynthesis than the release of nutrients, as evidenced by the decrease in photosynthesis when turbidity increases (Stern and Stickle, 1978). Also, there may be some abrasion of phytoplankton by suspended particles, but the combined effects of turbidity on phytoplankton are expected to be local and MINOR.

Similarly, zooplankton may be negatively affected by turbidity through abrasion, clogging of filtering apparatus, reduction of feeding activity, diminution of nutrient intake through uptake of less-nutrient-rich sediment versus organics, effects on reproduction, etc. The development of larval forms of invertebrates also may be affected (Stern and Stickle, 1978). Effects of turbidity are expected to be MINOR for zooplankton due to localized effects.

Filter-feeding benthic invertebrates may also be affected by turbidity in many of the same ways as zooplankton. For those benthic invertebrates in the dredged area, habitat alteration would be much more devastating than any effects of increased turbidity. For organisms outside of the actual dredged area, increased sedimentation and possible burial could be more significant than increased turbidity in the water column, although where sedimentation rates are great, turbidity also should be high. In areas where sedimentation rates are low, turbidity in the water column may still affect feeding, reproduction, etc. The most likely effect of turbidity on these organisms will be MINOR.

Red King Crab: Turbidity is likely to have negative effects on the various life stages of red king crab. Larval stages, which spend 3 to 4.5 months in the plankton (Jewett and Onuf, 1988, citing: Marukawa, 1933; Kurata, 1960, 1961a,b; Weber, 1967; and Armstrong et al., 1981) may be negatively affected by turbidity as they move and feed in the water column. The larvae feed on both phytoplankton and zooplankton (Bright, 1967, as cited by Jewett and Onuf, 1988) and could be affected by the abrasion and feeding effects described above for other zooplankton, a MINOR effect.

Turbidity and sedimentation effects could cause benthic crabs of various ages to move around more due to irritation, reductions in food or habitat quality, etc. Increased movements, especially for juvenile crabs and newly-molted crabs could lead to increased predation, resulting in a MINOR effect to the crab population.

In general, due to the expected localized nature of increased turbidity, its effect on marine plants and invertebrates (including red king crabs) is expected to be MINOR.

c. Effect of Entrainment: During the processing of sediments, large volumes of seawater (quantitatively described in Sec. II.A.2.d) will be used; for the single dredge projected in the base case, the total volume of water used per season is estimated to be 4.78 to 5.74 billion gallons. The seasonal estimates of volume are the most useful for assessing potential effects, due to the seasonal nature of dredging, the short life spans of many planktonic organisms, the seasonal abundance of particular life-history phases in the water column, and the spatial transiency of organisms.



Marine plants and invertebrates in the water column likely to be affected by entrainment include phytoplankton and zooplankton. Although some of the small organisms in the water may survive their trip through the processing apparatus, many of the entrained organisms will probably die or be injured and then be more susceptible to predation. For those organisms with short generation times and broad-scale abundance in the waters of Norton Sound (most phytoplankton and zooplankton species), effects are most likely to be MINOR, since localized effects will occur that may be ameliorated by dispersion and reproduction of other members of the same species. At greater risk are larval or young juvenile stages of invertebrates. These may occur in clumped distributions (rendering whole cohorts more susceptible) and may represent the year's reproductive output of a group of adults. The dredge operates in the open-water season when many larval forms are in the water column. Our lack of knowledge about the distribution and abundance of such groups makes it difficult to assess risk to populations, however, we know their distribution is often patchy. Since mortality of planktonic larval forms is often very great under natural conditions, death due to entrainment may not significantly affect populations. In general, because of the broad distributions of adults giving rise to planktonic larvae, entrainment should affect only some portion of the larval output of a species in the area. For the above-mentioned reasons, the effect of entrainment on marine plants and invertebrates is expected to be MINOR.

**Red King Crab:** Effects of entrainment on red king crab larvae, which spend 3 to 4.5 months in the plankton (see references in Jewett and Onuf, 1988), are expected to be MINOR, as for other planktonic invertebrates. To some extent, possible effects on a cohort of red king crab larvae will be lessened because the time of hatch within a region is not necessarily synchronous and larval assemblages are simultaneously composed of individuals at various stages of development (Jewett and Onuf, 1988, citing Armstrong et al., 1981).

The effect of entrainment on marine plants and invertebrates, including red king crab, is expected to be MINOR.

d. **Effect of Trace Metals:** Organisms may be exposed to trace metals during the process of dredging and disposal of dredge spoils and from continued release of metals with time. Details of the processes involved and concentrations found in the Bima dredging operation in State waters and during other studies in Norton Sound can be found in Section IV.B.2.b (Effect on Water Quality); Rusanowski, Gardner, and Jewett (1987, 1988); and Jewett, Gardner, and Athey (1989).

During the process of offshore mining, trace-metal concentrations in the water column may be increased (1) through the release of metals dissolved in interstitial waters, (2) by washing metals off of dredged tailings, (3) through the resuspension of particulate trace metals, and (4) by exposing previously buried placer deposits with high-metal content to the water column.

Metals of interest in the sale area include arsenic, mercury, lead, copper, nickel, chromium, zinc, and cadmium. Based on concentrations observed in the water column, or other concerns, the following metals will be discussed: arsenic, mercury, lead, copper, and nickel. Of particular concern are copper, because of the elevated concentrations associated with Bima dredging activities; and arsenic and mercury, which could biomagnify through the food web (Mance, 1987; Eisler, 1987).

(1) **Arsenic:** Aquatic organisms have shown adverse effects to arsenic compounds at concentrations of 19 to 48 ppb in water, 120 milligrams per kilogram in diets, and 1.3 to 5 mg/kg fresh weight in tissues. Early life stages are the most sensitive, and even among closely related species there may be large interspecies differences (Eisler, 1988). The most sensitive marine species tested (as reviewed by Eisler, 1988) were three species of marine algae, which showed reduced growth when exposed to 19 to 22 ppb As<sup>+3</sup>. Not all phytoplankton species are similarly affected, however. Mass cultures of natural phytoplankton assemblages exposed, in chronic studies, to low levels of arsenate (1.0-15.2 ppb) demonstrated that various species were affected differentially, leading to marked changes in species composition, succession, and predator-prey relationships. How these changes affect carbon transfer between trophic levels is not known (Eisler, 1988, citing: Sanders and Cibik, 1985; Sanders, 1986).

The degree of toxic and other effects of arsenical compounds to aquatic organisms can be affected by numerous biotic and abiotic factors (Eisler, 1988). These include water temperature, pH, eH, organic content, suspended solids, presence of other substances (including other trace metals), duration of exposure, etc. Inorganic arsenic compounds are generally more toxic than organic compounds, and trivalent species are usually more toxic than pentavalent species. A preferred detoxification mechanism for absorbed inorganic arsenicals is by biomethylation. Methylated arsenicals generally clear from tissues within a few days. Algae are a route of methylation. Arsenic is bioconcentrated by organisms, but opinion as to whether it biomagnifies is mixed. Eisler (1988) states that arsenic is not biomagnified in food chains (citing: Woolson, 1975; NAS, 1977; NRCC, 1978; Hallacher

et al., 1985; Hood, 1985). On the other hand, Mance (1987) cites two instances where arsenic concentration increased as one moved up the food chain. He also cites Forstner and Wittman (1979) as concluding that arsenic and mercury were most likely to demonstrate biomagnification because of their high affinity to organic substances.

Arsenic levels measured 100 m downcurrent of the Bima dredge operating in State waters are elevated an average of 11.0 ppb over upcurrent concentrations, and the highest downcurrent concentration equals 23.2 ppb (see Table IV-8). These values do not exceed either the EPA chronic or acute criteria. Some effects on marine phytoplankton might occur at the higher observed concentrations, but these are expected to be occasional and very transient since the phytoplankton assemblages would be moving past the dredging operations. Little to no effect on marine invertebrates is expected. The level of effect on marine plants and invertebrates based on the concentrations of arsenic released by the Bima would be expected to be NEGLIGIBLE.

The EPA (USEPA, 1990a) has recently developed new NPDES permit restrictions for future Bima mining activities (see Sec. IV.B.2, Effect on Water Quality). These more restrictive effluent limitations should, among other things, reduce the level of total-recoverable metal discharges. Thus, arsenic levels would be expected to be lower under the new permit. Since effects at the higher concentrations were already judged to be NEGLIGIBLE, there is no expected change in level of effect under the new permit.

The most likely effect on marine plants and invertebrates from the release of arsenic by dredging activities is NEGLIGIBLE.

(2) Mercury: Mercury can occur in several forms, the most toxic of which is methylmercury (USEPA, 1986a). Greater attention has been paid to methylmercury rather than inorganic mercury in part because the intestinal absorption of methylmercury approaches 100 percent, whereas inorganic mercury absorption is only a few percent of the ingested dose (Scheuhammer, 1987, citing Berglund and Berlin, 1969). Inorganic mercury may be converted to the more toxic methylmercury by bacteria in the environment (Jensen and Jernelov, 1969; and Rowland, Davies, and Grasso, 1977, citing Matsumura et al., 1972) or possibly by bacteria living in the digestive systems of animals (as occurs in rats; Rowland, Davies, and Grasso, 1977). Conversion of inorganic mercury to methylmercury may occur within hours (bacteria in rat digestive system: Rowland, Davies, and Grasso, 1977) or a few days (Jensen and Jernelov, 1969). Depuration of mercury can also occur. Methylmercury also has been demonstrated to bioaccumulate in food webs (Gardner et al., 1978; Swartz and Lee, 1980, citing Young and Mearns, 1979).

Mercury contamination may persist for years. Mercury or cinnabar (mercuric sulfide) tailings released during mining activities at a freshwater lake in Canada were still an important source of contamination 25 years later (Fimreite et al., 1971). Information from Sweden suggests that mercury contamination may last for 10 to 100 years unless the mercury is made biologically inactive, which, given current technology, is not likely (Lofroth, 1969, as cited by Fimreite et al., 1971).

Mercury or related compounds can affect species, as well as individuals within a species, differentially (Fimreite et al., 1971; and Hannerz, 1967). Also, different tissues or organs can be affected. Acute toxic levels cause death of the organism, but a variety of potentially sublethal effects can also occur. Viarengo (1985) has reviewed the biochemical responses of aquatic organisms to zinc, cadmium, copper, mercury, and silver. These effects include reductions in the rate of protein synthesis, effects on ATP synthesis, etc. Acute toxic values of mercuric chloride to marine organisms (29 genera, including annelids, mollusks, crustaceans, echinoderms, and fishes) can range from 3.5 ppb for a mysid to 1,678 ppb for the winter flounder (USEPA, 1986a). Mercury (II) is acutely toxic at lower levels for mollusks and crustaceans than it is for fishes (i.e., the fish are more resistant).

Sublethal effects of mercury can include effects on growth, reproduction, productivity, shell growth, etc. The growth and photosynthetic activity of marine plants (one diatom and 6 species of brown algae) were affected by mercury concentrations ranging from 10 to 160 ppb (USEPA, 1986a). Concentrations of mercury salts lethal to phytoplankton have ranged from 0.9 to 60 ppm of mercury (Hueper, 1960, as cited by Nuzzi, 1972). Growth and reproduction of Chlamydomonas sp. (phytoplankton) were found to be inhibited by mercuric chloride concentrations of about 8 ppb. Two other phytoplankton species, Phaeodactylum tricoratum and Chlorella sp., were also inhibited by mercuric chloride and sustained morphological abnormalities in the presence of sublethal concentrations of mercury. There was an increased incidence of abnormalities as the mercury concentration increased (Nuzzi, 1972). Trace metals, including mercury (II), may be strongly adsorbed on the cell surfaces of algae, fungi, and bacteria (see citations in Greene et al., 1986).

In life-cycle tests with a mysid species, exposure to mercury (II) concentrations of 1.6 ppb significantly affected both the time of first spawn and productivity of the animals (USEPA, 1986a). For the oyster, Crassostrea virginica, exposure to 10 ppb of mercury reduced shell growth (Rubinstein, D'Asaro, and Sommers, 1980, citing Cunningham, 1976). Significant sublethal effects on various aquatic species have been observed at water concentrations ranging from 0.03 to 0.1 ppb (Eisler, 1987).

Methylmercury, as mentioned earlier, has been demonstrated to biomagnify in food webs. Mercury may enter organisms via their food, or through contact with contaminated sediments or water (e.g., transport through membranes). Gardner et al. (1978), in an examination of methylmercury in a salt marsh ecosystem contaminated by inorganic mercury, found that methylmercury levels were low in sediments and plants but accounted for most of the mercury found in tissues of higher-trophic-level organisms. Methylmercury became concentrated in tissues of higher-trophic-level organisms and was rather clearly related to diet. The form of metal consumed (e.g., mercury vs. methylmercury) was important to the accumulation by animals, since primarily herbivorous animals (the cotton rat and the fish, Brevoortia tyrannus) had lower concentrations of mercury than their predaceous counterparts. Results similar to this have been reported for different trophic levels of freshwater fishes (Gardner et al., 1978, citing Bainbridge et al., 1974), marine fishes (Fimreite et al., 1971) and marine food webs (Young and Mearns, 1979, as cited by Swartz and Lee, 1980). After examining the factors involved in the extensive mercury poisoning at Minimata Bay, Japan, Nishimura and Kumagai (1983, as cited by Eisler, 1987) believe that the conversion of inorganic mercury to methylmercury occurred primarily in zooplankton. In this case, as in the other cases cited above, diet of the various consumers strongly influenced mercury levels.

Even though methylmercury is usually only a small percentage (less than 0.01) of total mercury in sediments (Andren and Harriss, 1973, as cited by Gardner et al., 1978), and is rarely found in natural waters (Chau and Saitoh, 1973, as cited by Gardner et al., 1978), it can accumulate in organisms and become concentrated in higher-trophic-level organisms. The differential concentration of methylmercury versus inorganic mercury may be due to its much greater absorption in the intestines of animals. Scheuhammer (1987) reports that adult mammals absorb only about 1 to 3 percent of orally-ingested inorganic mercury, while absorption of methylmercury is close to 100 percent. A similar relationship has been demonstrated for marine fish and their prey. Pentreath (1976a,b) has found, in examining the transfer of radio-labelled mercury from polychaetes (Nereis diversicolor) to their predators, that thornback rays and plaice retained a much larger proportion (about 90%) of organic mercury than inorganic mercury (less than 15%).

Biomagnification of mercury, especially the more toxic and readily absorbed methylmercury (Scheuhammer, 1987) has important and potentially serious implications for food webs, most notably for the higher-trophic-level organisms, including humans. The regular consumption of contaminated fish and shellfish by humans can pose severe health risks (Fujiki, 1980b), with the daily consumption of fish containing 5 to 6 ppm of mercury posing a lethal threat to humans (Birke et al., 1967, as cited by Fimreite et al., 1971).

Mercury concentrations measured downcurrent of the Bima using state-of-the-art methodology show an average increase of 0.0004 ppb, with the highest downcurrent concentration reading 0.0014 ppb (Table IV-8). These numbers are considerably less than other measurements that have been made (see discussion in Sec.IV.B.2). These new, low numbers are below the EPA chronic criterion of 0.025 ppb, and, based on the setting of that criterion, plus the literature reviewed above, suggest that this amount of elevation of mercury should pose little threat to marine plants and invertebrates.

In monitoring studies conducted in association with the Bima dredging operations in State waters, analyses of trace-metal concentrations in a variety of invertebrates (with emphasis on red king crab) and fishes were made (Rusanowski, Gardner, and Jewett, 1987, 1988). Red king crab is the species of greatest immediate concern because it is fished both commercially and for subsistence purposes. Except for one crab sampled in 1985, the muscle tissue of all crabs has been below FDA action levels, which are 1.0 ppm methylmercury or 0.5 mg of methylmercury/kg wet weight. In general, the 1985 and 1986 values were higher than the 1987 or 1988 values, possibly because the analyses were done at different labs (Smith and Rusanowski, 1988, oral comm.).

Mercury levels in red king crab were slightly higher in the hepatopancreas versus muscle tissue in 1986, 1987, and 1988. However, all of these values are below the FDA action levels for fish and shellfish. Values for other invertebrates (prey of red king crabs) and fishes (Rusanowski, Gardner, and Jewett, 1987, 1988) were also below the FDA action levels, but often very few tissue samples were analyzed (only 1 to 3 per location; Table 3.3-10, Rusanowski, Gardner, and Jewett, 1988). Several samples in 1986 had tissue-mercury values greater than 1.5 times background-sediment values, indicating potential bioaccumulation effects according to Rusanowski, Gardner, and Jewett, 1987. These included least cisco liver samples (mean of nine values equalled 0.12 ppm,

and one value equalled 0.24 ppm) and one sample from the polychaete worm, Travisia spp. (one value equalled 0.22 ppm, mean of four samples equalled 0.075 ppm). Other mercury-tissue values for invertebrates and fishes in 1986 ranged from 0.004 ppm to 0.100 ppm (Rusanowski, Gardner, and Jewett, 1987). There should be greater emphasis put on looking at the ranges of values, in addition to the mean values; the median value, which is often portrayed in Bima monitoring reports, is not as meaningful as the mean and upper range values, and tends to be lower than the mean. High values (termed in the above report "aberrant" values) may be extremely meaningful as an indication of the levels of concentration that can be present. More recent (1988) data obtained in the Bima monitoring program indicate a slight but insignificant increase in the mean level of mercury found in white muscle of red king crabs in 1988 versus 1987 (.007 ppm versus 0.005 ppm in 1987). Of greater interest is that there was much greater variability in the numbers obtained in 1988, with the high value (0.019 ppm wet weight) almost four times the high value sampled in 1987. Hepatopancreas-mercury values declined somewhat from 1987 to 1988. Therefore, no clear trends in mercury concentrations in crabs are evident.

As described above, mercury concentrations in red king crab are low--well below FDA action levels. The values reported to date do not indicate mercury concentrations that might pose a threat to the red king crab population nor do they suggest that red king crabs have accumulated levels to be of concern to other organisms. Other invertebrates may more readily bioaccumulate mercury, such as predatory snails like Neptunea and bivalve mollusks. Studies by Burrell (1978) found that Neptunea snails from the southern Bering Sea had very high concentrations of cadmium, copper, and zinc in their tissues, especially in the digestive gland and reproductive organ, and that these high values could not be explained by sediment incorporation. Mercury levels were not examined. Since neptunid snails are possible bioaccumulators of trace metals and do not have planktonic larvae, but rather larvae which crawl away from their egg cases after hatching, they may be good candidates for studies of localized effects of trace-metal contamination. Bivalve mollusks are also good candidates for studies of bioaccumulation of trace metals (Eisler, 1988, oral comm.). Unfortunately, crustaceans, including the red king crab that has been extensively sampled in the Bima monitoring program, are not, since they have reduced the mercury in tissues by concentrating it in their exoskeletons, which they shed when they molt (Eisler, 1988, oral comm.).

Based on the latest measurements of mercury released by dredging activities in State waters and reviews of potential effects, the effect of such a mercury release on marine plants and invertebrates would be expected to be NEGLIGIBLE.

The EPA (USEPA, 1990a) has recently developed new NPDES permit restrictions for future Bima mining activities (see Sec. IV.B.2, Effect on Water Quality). These more restrictive effluent limitations should, among other things, reduce the level of total-recoverable metal discharges. Thus, mercury levels would be expected to be lower under the new permit. Since effects at the higher concentrations were already judged to be NEGLIGIBLE, there is no expected change in level of effect under the new permit.

The most likely effect on marine plants and invertebrates from the release of mercury by dredging activities is NEGLIGIBLE.

(3) Lead: Lead concentrations downcurrent of the Bima are an average of 6.7 ppb higher than ambient concentrations, and the highest downcurrent concentration was 13.3 ppb. One of the three samples exceeded the EPA chronic criterion of 5.6 ppb (Table IV-8). Comparisons of filtered and unfiltered samples indicate that almost all of the lead released during dredging is in the particulate rather than in the dissolved phase (Sec. IV.B.2). According to Wong et al. (1978), as cited by Eisler (1988), only soluble waterborne lead is toxic to aquatic biota, and free cationic forms are more toxic than complexed forms.

Lead has been shown to have adverse effects on marine organisms at concentrations as low as 5.1 ppb. Growth of the marine diatom, Skeletonema costatum, was inhibited by 50 percent at that concentration. Lead concentrations as low as 1 ppb (for 140 days) have resulted in high bioconcentration factors for the American oyster, Crassostrea virginica (Eisler, 1988). A chronic toxicity test conducted with a mysid indicated adverse effects at 37 ppb but not at 17 ppb. Acute toxicity tests for 13 marine organisms produced a range of lethal values from 315 ppb lead for the mummichog to 27,000 ppb for the soft shell clam (USEPA, 1986a). Very few of the toxicity tests conducted with lead have used concentrations as low as those measured near the Bima dredging operation. In Eisler's review (1988), tests with only a few organisms used concentrations of lead less than 20 ppb.

No significant biomagnification of lead in aquatic food chains is thought to occur (Eisler, 1988, citing: Boggess, 1977; Rolfe and Reinbold, 1977; Branica and Konrad, 1980; Demayo et al., 1982; and Flegal, 1985), since lead

concentrations are usually highest in algae and benthic organisms, and lowest in upper trophic level predators. Within a species, younger, more immature organisms (eggs, larvae, and juveniles) are more susceptible to adverse effects from lead exposure.

The increase in lead levels associated with the dredging activities of the Bima can represent a low-level threat to marine organisms. The exceedence, at least periodically, of the EPA chronic criterion suggests that sublethal effects to marine organisms are likely. Acute effects are not likely. Therefore, the effect of increased lead levels on marine plants and invertebrates from dredging activities like those of the Bima would be expected to be NEGLIGIBLE.

The EPA (USEPA, 1990a) has recently developed new NPDES permit restrictions for future Bima mining activities (see Sec. IV.B.2, Effect on Water Quality). These more restrictive effluent limitations should, among other things, reduce the level of total-recoverable metal discharges. Thus, lead levels would be expected to be lower under the new permit. Since effects at the higher concentrations were already judged to be NEGLIGIBLE, there is no expected change in level of effect under the new permit.

The most likely effect on marine plants and invertebrates from the release of lead by dredging activities is NEGLIGIBLE.

(4) Copper: Copper concentrations downcurrent of the Bima have been measured to increase by an average of 33 ppb over ambient levels. The highest downcurrent concentration was 51.3 ppb (Table IV-8). Comparisons of filtered and unfiltered samples indicate that almost all of the copper released during dredging is in the particulate rather than the dissolved phase (Sec. IV.B.2). All the values measured downcurrent exceed the EPA acute criterion (2.9 ug/l) for copper. Thus, elevated copper levels pose the greatest direct risk to marine organisms of any of the trace metals measured.

Acute values of copper for marine organisms range from 5.8 ppb for the blue mussel to 600 ppb for the green crab (USEPA, 1986a). In studies reviewed by Hodson et al. (1979), acute values ranged from 14 to 109,000 ppb, with euphausiids, ctenophores, and medusae being the most sensitive (LC-50's ranging from 14-33 ppb). Adverse sublethal effects to marine invertebrates occurred at concentrations ranging from 5 to 250 ppb (Hodson et al., 1979). Several marine algae showed adverse effects to exposures from 5 to 100 ppb. In a chronic life-cycle test with a mysid, adverse effects were produced by exposure to 38 ppb, but not to 77 ppb. Some organisms bioaccumulate copper to a high degree; oysters can concentrate copper by a factor of 28,200 and not show any significant mortality. On the other hand, in long-term exposures, the bay scallop was killed at 5 ppb copper.

The elevated copper levels associated with dredging by the Bima are likely to lead to the deaths of some marine organisms within the area affected by the discharge plume. In addition, a variety of sublethal effects are possible. Therefore, the most likely effect of increased copper concentrations on marine plants and invertebrates from such dredging activities is MINOR, if dredging activities were unmitigated. If, as specified by Stipulation 1, dredging activities were modified or stopped by the RS/FO in response to elevated copper levels, then some deaths would still be likely to occur (a MINOR effect), but the extent of effect would be reduced.

The EPA (USEPA, 1990a) has recently developed new NPDES permit restrictions for future Bima mining activities (see Sec. IV.B.2, Effect on Water Quality). The more restrictive limitation on copper discharge, 52.2 ppb total-recoverable copper in the effluent, would reduce the likelihood that the copper criterion would be exceeded at the edge of the mixing zone. Thus, the effect of copper discharges on marine plants and invertebrates would become NEGLIGIBLE.

(5) Nickel: Nickel concentrations downcurrent of the Bima have been measured to increase by an average of 35 ppb, which exceeds the EPA chronic criterion for nickel (8.3 ppb; see Table IV-8). Only three dates were sampled by the MMS contractor and the highest concentration sampled at the edge of the mixing zone was 68.0 ppb. Comparisons of filtered and unfiltered samples indicate that almost all of the nickel released during dredging is in the particulate rather than in the dissolved phase (Sec. IV.B.2).

In laboratory studies of toxicity, the acute values of nickel for marine plants and invertebrates ranged from 152 ppb for a mysid shrimp (Heteromysis formosa) to 320,000 ppb for the softshell clam (Mya arenaria). In a chronic toxicity test conducted with the mysid shrimp, Mysidopsis bahia, adverse effects were observed at concentrations of 141 ppb and above. However, there were no significant differences between the control and treatments of 30 ppb and 61 ppb. In algal species (Macrocyctis pyrifera and Phaeodactylum tricornutum, one a large brown alga and the other a phytoplankter), reductions in growth and photosynthesis occurred at

concentrations ranging from 1,000 to 2,000 ppb. Several mollusks (the mussel, Mytilus edulis, and the oyster, Crassostrea virginica) were relatively good accumulators of nickel, revealing bioconcentration factors ranging from 299 to 416 ppb. Other effects on invertebrates include delayed embryonic development, suppressed reproduction, and inhibition of larval growth in a bivalve mollusk, polychaete worm, and sea urchin, respectively, but these occurred at nickel concentrations ranging from 58 to 17,000 ppb (USEPA, 1980).

Even though the data for nickel concentrations near the Bima dredging operation indicate that the EPA chronic criterion is being exceeded, the results of the laboratory tests discussed by the EPA only show effects at levels higher than those observed near the Bima. In addition, since the nickel released in association with dredging is Xprimarily particulate, lesser effects on marine plants and invertebrates would be anticipated. Therefore, it is most likely that effects on marine plants and invertebrates from elevated nickel concentrations associated with dredging activities like the Bima would be sublethal, and therefore NEGLIGIBLE.

The EPA (USEPA, 1990a) has recently developed new NPDES permit restrictions for future Bima mining activities (see Sec. IV.B.2, Effect on Water Quality). These more restrictive effluent limitations should, among other things, reduce the level of total-recoverable metal discharges. Thus, nickel concentrations would be expected to be lower under the new permit. Since effects at the higher concentrations were already judged to be NEGLIGIBLE, there is no expected change in level of effect under the new permit.

The most likely effect on marine plants and invertebrates from the release of nickel by dredging activities is NEGLIGIBLE.

In summary, exposure to trace metals in the sale area is expected to cause some sublethal effects to marine plants and invertebrates, but the effects are expected to be localized and relatively short term. Thus, the effect of trace metals on marine plants and invertebrates, including red king crab, is expected to be NEGLIGIBLE.

e. Effect of Noise and Disturbance: Seismic surveys conducted during exploration and for prospect assessment during production will generate frequencies varying from several hundred cycles per second to several thousand cycles per second. These energies are less than those generated by airguns, which are typically used in petroleum exploration. See Section II.A.2.c. for details of the extent, timing, and type of surveys to be done.

The effects of seismic surveys used for petroleum exploration have been discussed in the Proposed Beaufort Sea Oil and Gas Lease Sale 97 FEIS (USDOJ, MMS, 1987) and this information is incorporated by reference. The use of airguns was expected to have NEGLIGIBLE effects on marine plants and invertebrates. In part, this was because most algae do not contain critical gas chambers, and thus would not be susceptible to injury, making NEGLIGIBLE effects most likely. In general, even high explosives (e.g., dynamite) have relatively little effect on marine invertebrates, presumably due to lack of air-containing chambers, such as the swim bladder of fish (Falk and Lawrence, 1973). Airguns, which are much more innocuous for fish than explosives, were shown to have no effect on caged oysters placed close to the airgun (Gaidry, unpublished, cited by Falk and Lawrence, 1973). Effects of seismic exploration associated with the dredging scenario should have a lesser effect. Thus, effects on marine plants and invertebrates, including red king crab, are expected to be NEGLIGIBLE.

f. Effect of a Fuel Spill: Offshore-dredging activities are attended by the risk of a fuel spill. A dredge the size of the Bima carries about 6,000 bbl of diesel fuel. Although smaller spills are more likely during refueling, a spill of up to 6,000 bbl also is possible. For the purpose of analysis, a spill of 3,500 bbl is assumed. This amount is equivalent to the average, onboard fuel load of a Bima-sized dredge. The effects of small spills have been evaluated in the Sale 100 FEIS (USDOJ, MMS, 1985a) and MINOR effects to marine plants and invertebrates were anticipated. A large spill would be most likely to occur during fall storms (see Table IV-10 for details of the area and weathering of such a spill). Diesel fuel lacks both the lightest and heaviest fractions of petroleum components, and will initially evaporate more slowly than crude oil. Eventually, however, more will evaporate (see Sec.IV.B.2). The effects of spilled oil on marine plants and invertebrates in the Norton Basin area have been considered in the Sale 100 FEIS (USDOJ, MMS, 1985a), and that information is herein incorporated by reference.

If a fuel spill occurred during a storm, the fuel slick would be expected to be dissipated by the fifth day (Table IV-10). The 4 to 5 days of its existence could allow time for some fuel to be dispersed onto the beach bordering Safety Sound or over the sand barrier and into the Sound (with storm waves). If fuel did contact this region, it would be expected to cause more problems than crude oil would. Some invertebrates and plants would be expected to die, but it is most likely that only a portion of Safety Sound would be affected. This could result in

a MODERATE effect on marine plants and invertebrates, since a portion of the populations could be affected for more than one generation.

In general, the widespread distributions of marine plant and invertebrate resources in the Norton Sound area generally make them less vulnerable to effects from spilled oil. An oil spill is likely to cause lethal effects to some marine plants and invertebrates, with eggs and larval stages being more susceptible, but is unlikely to affect regional populations. An oil spill is less likely to contact marine plants and invertebrates in a restricted environment like Safety Sound than to contact them in other environments. Thus, a fuel spill is most likely to cause a MINOR effect on marine plants and invertebrates, including red king crab.

**SUMMARY:** Offshore dredging and spoils discharge have the potential to affect marine plants and invertebrates (including red king crab) via the effects of habitat alteration, including turbidity; entrainment of organisms; exposure to trace metals; noise and disturbance; and a fuel spill. Of greatest concern is habitat alteration, which is likely to lead to a MODERATE effect on red king crabs due to potential loss of critical habitat for juveniles and perhaps females. Other marine plants and invertebrates are likely to incur a MODERATE effect from habitat alteration. Another area of concern is the absorption and possible biomagnification of trace metals. Effects on marine plants and invertebrates are expected to be NEGLIGIBLE, but consequences may be more severe for higher trophic-level organisms. Effects of turbidity, entrainment, and a fuel spill are each expected to be MINOR.

**CONCLUSION (Effects on Marine Plants and Invertebrates and Red King Crab):** The effect of the proposal on marine plants and invertebrates, including red king crab, is expected to be MODERATE.

**CUMULATIVE EFFECTS:** Effects on marine plants and invertebrates in the Norton Sound area may derive from: Federal offshore mining (this proposal), State offshore mining, past and future Federal OCS oil and gas lease sales in Norton Sound, onshore mining projects in the Norton Sound area, harbor dredging in Nome, and fishing activities, both commercial and subsistence. The scope of these activities has been described in greater detail in Section IV.A.2 (Major Projects Considered in Cumulative-Effects Assessment) and are presented in condensed form in Table IV-2a. Although some of these activities (State offshore mining, onshore mining, harbor dredging, and fishing) have reached the development stage, the probability of other similar activities reaching the development stage is not known.

**Effect of Offshore Mining and Harbor Dredging:** Offshore-mining effects to marine plants and invertebrates may come from both Federal (this proposal) and State offshore-leasing activities. Of most concern are habitat alteration and absorption and possible bioaccumulation of trace metals. Habitat alteration includes not only the physical effects to the benthic environment from dredging, but effects on prey, and other changes in the interactions of organisms with each other and with the environment. Under the scenario for the proposed Federal offshore mining (see Sec. II.A.2), 1,300 acres of the benthos will be dredged over the life of the lease. In State waters, assuming a 20-year activity period for a lease and the number of acres dredged per season given in Table IV-2a (300 acres total by 3 dredges), a total of 6,000 acres is likely to be dredged. Other potential mining activities could increase the area affected, but the probable extent of these activities is not known. The actual area affected by dredging is going to be much larger than the 7,300 acres that may be dredged in the cumulative case, since settling particulates from the turbidity plume, and possibly from eroding tailings, will affect a larger area. In the base case under the proposal, increased sedimentation resulting from dredging activities was estimated to cover an area perhaps one-half the size of the sale area (Sec. IV.B.2.a). The potential effects of such sedimentation have not been assessed in the current offshore-mining operation. As described in Section IV.B.3.a, habitat alteration from proposed Federal offshore-mining activities is likely to have a MODERATE effect on marine plants and invertebrates, including red king crab, with a monitoring program reducing effects on red king crab. The addition of other offshore-mining activities, especially in nearshore waters, and particularly near Nome and Sledge Island, is expected to increase the magnitude of effect on marine plants and invertebrates (not including red king crabs) to MODERATE. However, the level of effect on red king crabs is expected to remain MODERATE, since the purportedly prime red king crab habitat is in offshore waters.

In addition to effects on habitat, dredging activities may increase the levels of trace metals in the water column, surficial sediments, and in organisms. Of particular concern have been elevated levels of copper associated with Bima dredging, and the potential biomagnification of mercury and arsenic through the food web (see Sec. IV.B.3.d, Effect of Trace Metals on Marine Plants and Invertebrates). Data from current offshore-dredging activities in State waters suggest that mercury concentrations in the water column are elevated, but state-of-the-art analysis from a Federal study suggests that that is not the case (see Sec. IV.B.2). These latter data do suggest that water concentrations of nickel, lead and copper can exceed Federal water-quality standards. The



EPA (USEPA, 1990a) has recently developed new NPDES permit restrictions for future Bima mining activities (see Sec. IV.B.2, Effect on Water Quality). These more restrictive effluent limitations should, among other things, reduce the level of total-recoverable metal discharges, leading to an expected NEGLIGIBLE effect on marine plants and invertebrates. The addition of other offshore-dredging operations to the current operation in State waters could lead to areas being exposed to elevated trace-metal levels. This could increase the possibility of biomagnification effects, especially for wide-ranging foragers, most notably higher-trophic-level organisms (see appropriate sections for effects on birds, marine mammals, endangered species, and humans). Harbor dredging in the mouth of the Snake River, next to Nome, is not expected to affect benthic organisms to any great degree but, due to the possible contamination of sediments with mercury from previous gold-processing activities, could result in the release of additional mercury into the environment. Each year 13,000 yd<sup>3</sup> of sediments are projected to be dredged (Table IV-2a). Trace-metal concentrations from waters in the Snake River estuary (see Table III-2) indicate that arsenic, mercury, lead, and zinc concentrations are higher there (about 4 times) than in offshore waters. Sediment concentrations show high values for arsenic, chromium and lead (Table III-3).

NEGLIGIBLE effects on marine plants and invertebrates from exposure to trace metals were concluded to be expected under the proposal, but MINOR effects are likely under the cumulative case. Offshore mining, in total, is expected to have a MODERATE effect on marine plants and invertebrates (including red king crab).

Effects of Onshore Mining: Onshore-mining activities, as detailed in Section IV.A.2.b and Table IV-2a, may have effects on marine plants and invertebrates by increasing the concentration of mercury in the marine environment. Onshore placer-gold mining (in the Nome area) has resulted in the discharge of a considerable amount of mercury into streams, onto the ground around dredges, and around gold-processing houses. Water runoff via streams and from coastal land may carry dissolved mercury and contaminated sediments into the marine environment. Although much of the mercury coming into the marine environment may be in the metallic or inorganic forms, it may be converted to more toxic and absorbable forms (e.g., methylmercury) by organisms in the marine environment (see preceding discussion in Sec. IV.B.3.d). It is not possible to say how much of the mercury in offshore sediments originated from terrestrial runoff, but the addition of mercury from terrestrial environs is not expected to increase the level of effect of trace metals on marine plants and invertebrates above that likely for the proposal, MINOR.

Effect of Federal OCS Oil and Gas Activities: Oil spills are more likely to cause widespread negative effects to marine plants and invertebrates than are other activities or events associated with exploration, development, and production of oil and gas resources in Norton Sound. At present, the only foreseeable effects could come from actions associated with future Norton Sound oil and gas lease sales. If an oil spill were to occur, the most likely effect on marine plants and invertebrates would be MINOR.

SUMMARY: The greatest concern for marine plants and invertebrates under the cumulative case rests with alteration of the habitat by offshore-dredging activities. Habitat alteration is likely to lead to a MODERATE effect on benthic invertebrates, including red king crab, which supports both commercial and subsistence fisheries. The release and resuspension of trace metals as a result of dredging is expected to have a MINOR effect on marine plants and invertebrates. Activities related to Federal offshore oil and gas activities are also expected to have a MINOR effect on these organisms.

Conclusion: Under the cumulative-case scenario, the effects on red king crab, as well as other marine plants and invertebrates, are likely to be MODERATE, due mainly to alteration of benthic habitat.

4. Effect on Fishes: Offshore dredging and spoils discharge have the potential to affect fishes via the effects of habitat alteration, including turbidity; entrainment of organisms; exposure to trace metals; noise and disturbance; and a fuel spill.

To aid in the interpretation of the following effects discussion, an explanation for some of the terms used in the definitions presented in Table IV-2 follows. The "region" is considered to be the Norton Sound area, and a "population" is a group of interbreeding individuals. A "portion of the population" consists of a subset of the individuals in the population, as in a group of herring in a localized area, not representing the entire breeding stock.

a. Effect of Offshore Mining on Habitat Alteration: Under the scenario, dredging activities associated with this lease sale are projected to excavate the sea bottom and associated flora and fauna to a depth of 3.6 m (12 ft), process this material, and discharge the rejected material and organisms. In the base case, one dredge is assumed to be operating, excavating 100 acres of bottom terrain per year, with a total area

excavated over the life of the lease of 1,300 acres. Bathymetric surveys associated with Bima operations have indicated that the area affected by mining may be at least 1.5-1.8 times larger than the excavated area, for coarse-grained material; the affected area includes the excavated area as well as the area in which the material processed on the dredge is discharged (Sec. II.A.2.d(3)). Thus, in the base case, 1,950 to 2,340 acres would be affected directly, by changes in bathymetry. This represents about 1 to 2 percent of the sale area. A greater areal extent will be affected by sedimentation of resuspended materials (see Sec. II.A.2.d(3), Sec. IV.B.2.a, and following discussion). Although dredge size and dredging depth may vary, the preceding numbers are based on the assumption that dredging in the OCS will closely resemble the Bima operation in State waters. If the dredging depth were to decrease, or the number of dredges operating to increase, the areal extent of bottom (benthic) habitat affected would increase.

Alteration of habitat would affect fish directly or indirectly, with indirect effects coming from changes in composition of benthic communities, reduction in prey, etc. Effects on marine plants and invertebrates are presented in Section IV.B.3. Dredging would result in major alteration of the habitat and death of many or most of the associated benthic inhabitants.

The habitat would be greatly altered by the excavation of 3.6-m depths of sea bottom, the mixing of all the various substrates within those 3.6 m, and the discharge of that mixed material. Fine materials and organic matter which may have been on top would be mixed up with other materials. Cobbles and boulders, which can be abundant (see Rusanowski, Gardner, and Jewett, 1987) may be buried (see Table IV-11), with subsequent loss of the epilithic flora and fauna, as well as organisms more loosely associated with the rocks. Change or alteration of the substrate type may affect the recruitment of benthic invertebrates and the potential for recovery of the disturbed area. Recolonization, at least initially, may be most dependent on immigration of mobile animals from nearby undisturbed or less-disturbed areas.

In addition to effects within the dredged area, effects to a much broader area may occur because of settlement of particulates from the water column. The factors affecting water-column turbidity resulting from dredging and spoils discharge are discussed in Section IV.B.2.a. Based on calculations in that section, in the base case, over one-half of the sale area could be affected by a short-term increase in turbidity at some point during the 14 years of production. The concern for the benthos is that extensive areas could become covered by fine sediments settling out from turbid waters. The effects of habitat alteration due to dredging would be expected to vary with the type and extent of sediment deposition (see more detailed discussion in Sec. IV.B.3.a). The extent of the potential problem would be exacerbated if high turbidity in bottom sediments downcurrent of the dredge is due to resuspension of sediments from easily eroded tailings (Rusanowski, Gardner, and Jewett, 1988).

Fish may be affected by the habitat alteration processes described above, although their mobility may lead to avoidance of current dredging activities resulting in a lesser chance of direct mortality. Pelagic adult fish are expected to be little affected. It is expected that they will avoid the area, be delayed in their movements, or suffer slight effects as they pass through the area. Demersal fish have some chance of being affected directly, as well as indirectly through reductions in prey. Possibly, some fish mortality will occur in the actual dredging and depositional processes, but the numbers are not expected to be great (see following discussion in Effects of Entrainment). At greater risk are demersal eggs of fishes. These are likely to suffer mortality via deposition of dredge spoils. Also, settlement of particulates from the turbid plume could also bury or affect the survival of demersal eggs in an extensive area outside the actual dredged area. In the base case, the area affected by increased sedimentation over the life of the lease could equal one-half the size of the sale area (see previous discussion and Sec. IV.B.2.a.). Species with demersal eggs include: Pacific sandlance, shorthorn sculpin, herring, saffron cod, and capelin. Herring and capelin eggs are laid right along the coast and therefore, would not be jeopardized by dredging activities associated with this proposal.

Benthic prey of fishes are also likely to be affected by dredging, spoils deposition, and the broader-ranging settlement of particulates (see previous discussion on Effects of Habitat Alteration on Marine Plants and Invertebrates, Sec. IV.B.3.a). Even with local depressions in the invertebrate fauna, benthic-feeding fishes may not be greatly affected, due to their mobility and opportunistic or generalized diets (Feder and Jewett, 1981; Jewett and Feder, 1980). Only if food is limiting to benthic-feeding fishes would local reductions in invertebrate populations be expected to affect fish populations. Reductions in prey could make some habitat inferior and could alter use of that habitat by benthic-feeding fishes. Dredging could have short-term positive effects on fishes by making available numerous benthic invertebrates, both dead and alive. Viosca (1958), as cited by Stern and Stickle (1978), observed congregations of fishes near dredges in Louisiana, and attributed it to the stirring up of food and nutrients.

The general effect of habitat alteration on fishes is expected to be MINOR, due to effects on demersal eggs and possible mortality of some adult fishes.

b. Effect of Turbidity: Turbidity is an expression of habitat alteration in the water column. Degree and extent of water-column turbidity are described in Section IV.B.2.a (Effect on Water Quality). Pelagic fishes in the water column could potentially be affected by the increased turbidity projected as a result of dredging and disposal operations. Fishes may suffer both lethal and sublethal effects from increased turbidity (Stern and Stickle, 1978), although they are most likely to avoid highly turbid areas and thus, avoid directly-related ill effects. A study by Sherk et al. (1974), as cited by Stern and Stickle, 1978) found that fish were apparently more sensitive to suspended solids than were any of the invertebrates tested. A number of studies of fishes in estuarine areas where dredging was taking place have found no ill effects (Stern and Stickle, 1978, citing: Ingle, 1952; Ingle et al., 1955; Ritchie, 1970; Stickney, 1972; and Flemer et al., 1968), although fish in more enclosed areas can suffer mortality through clogging of the gills (Stern and Stickle, 1978, citing: Ingle et al., 1955; plus numerous freshwater studies). Thus, fish may suffer some displacement due to turbidity, or alter normal migration movements (e.g., salmon) but the effects are not expected to be great. Juvenile fishes are more sensitive to turbidity (Stern and Stickle, 1978) and, depending on their state of development and ability to avoid the highly turbid areas, could suffer some mortality. Larval fish in the plankton may be negatively affected by turbidity through abrasion, reduction of feeding activity and effects from reduced energy intake. Mortality of some of these fishes is possible, but identifiable effects on recruitment would be difficult to discern given the high natural mortality of larvae and the unpredictability of recruitment for pelagic fishes from year to year. The most likely effect on fishes from turbidity associated with dredging is MINOR.

c. Effect of Entrainment: During the processing of sediments, large volumes of seawater (quantitatively described in Sec. II.A.2.d) will be used; for the single dredge projected in the base case, the total volume of water used per season is estimated to be 4.78 to 5.74 billion gallons. The seasonal estimates of volume are the most useful for assessing potential effects, due to the seasonal nature of dredging, the short life spans of many planktonic organisms, the seasonal abundance of particular life-history phases in the water column, and the spatial transiency of organisms.

Larval and juvenile fish in the water column are more likely to be affected by entrainment than are adult fish. Adult fish are expected to avoid the area, possibly because of noise or turbidity. Although some of the small fish in the water may survive their trip through the processing apparatus, many of the entrained organisms will probably die or be injured and then be more susceptible to predation. Larval or young juvenile stages of fishes may occur in clumped distributions (rendering whole cohorts more susceptible to effects) and may represent the year's reproductive output of a group of adults. The dredge operates in the open-water season when many larval forms are in the water column. Our lack of knowledge about the distribution and abundance of larvae and juveniles in the plankton makes it difficult to assess risk to populations. Since mortality of planktonic larval forms is often very great under natural conditions, death due to entrainment may not significantly affect populations. In general, because of the broad distributions of adults giving rise to pelagic larvae, entrainment should affect only some portion of the larval output of a species in the area. For the above-mentioned reasons, the effect of entrainment on fishes is expected to be MINOR.

d. Effect of Trace Metals: Fish may be exposed to trace metals during the process of dredging and disposal of dredge spoils and from continued release of metals with time. Details of the processes involved and concentrations found in the Bima dredging operation in State waters and during other studies in Norton Sound can be found in Section IV.B.2.b (Effect on Water Quality); Rusanowski, Gardner, and Jewett (1987, 1988); Jewett, Gardner, and Athey (1989); and Jewett et al. (1990).

During the process of offshore mining, trace-metal concentrations in the water column may be increased (1) through the release of metals dissolved in interstitial waters, (2) by washing metals off of dredged tailings, (3) through the resuspension of particulate trace metals, and (4) by exposing previously buried placer deposits with high-metal content to the water column.

Metals of interest in the sale area include arsenic, mercury, lead, copper, nickel, chromium, zinc and cadmium. Based on concentrations observed in the water column, or other concerns, the following metals will be discussed: arsenic, mercury, lead, copper, and nickel. Of particular concern are copper, because of the elevated concentrations associated with Bima dredging activities, and arsenic and mercury, which could biomagnify through the food web (Mance, 1987; Eisler, 1987).

(1) Arsenic: Marine fishes have suffered lethal effects from concentrations of arsenic ranging from 3,800 ppb to 28,500 ppb. No effects were observed for pink salmon exposed to 2,500 ppb for 10 days, while exposure to 3,800 ppb for 10 days led to the deaths of 54 percent of the individuals, and exposure to 7,200 ppb for 7 days resulted in the death of all the salmon.

The degree of toxic and other effects of arsenical compounds to aquatic organisms can be affected by numerous biotic and abiotic factors (Eisler, 1988). These include water temperature, pH, eH, organic content, suspended solids, presence of other substances (including other trace metals), duration of exposure, etc. Inorganic arsenic compounds are generally more toxic than organic compounds, and trivalent species are usually more toxic than pentavalent species. A preferred detoxification mechanism for absorbed inorganic arsenicals is by biomethylation. Methylated arsenicals generally clear from tissues within a few days. Early life stages are the most sensitive, and even among closely related species there may be large interspecies differences (Eisler, 1988).

Arsenic is bioconcentrated by organisms, but opinion as to whether it biomagnifies is mixed. Eisler (1988) states that arsenic is not biomagnified in food chains (citing: Woolson, 1975; NAS, 1977; NRCC, 1978; Hallacher et al., 1985; Hood, 1985). On the other hand, Mance (1987) cites two instances where arsenic concentration increased as one moved up the food chain. He also cites Forstner and Wittman as concluding that arsenic and mercury were most likely to demonstrate biomagnification because of their high affinity for organic substances.

Arsenic levels measured 100 m downcurrent of the Bima dredge operating in State waters are elevated an average of 11.0 ppb over upcurrent concentrations, and the highest downcurrent concentration equals 23.2 ppb (see Table IV-8). These values do not exceed either the EPA chronic or acute criteria. The analysis of water quality (Sec.IV.B.2) projects an occasional exceedence of the chronic arsenic criterion within 3 km. The measured values suggest that arsenic would have little to no apparent effect on fishes. Thus, the most likely effect on fishes from the release of arsenic by such dredging activities is NEGLIGIBLE.

The EPA (USEPA, 1990a) has recently developed new NPDES permit restrictions for future Bima mining activities (see Sec. IV.B.2, Effect on Water Quality). These more restrictive effluent limitations should, among other things, reduce the level of total-recoverable metal discharges. Thus, arsenic levels would be expected to be lower under the new permit. Since effects at the higher concentrations were already judged to be NEGLIGIBLE, there is no expected change in level of effect under the new permit.

The most likely effect on fishes from the release of arsenic by dredging activities is NEGLIGIBLE.

(2) Mercury: Mercury can occur in several forms, the most toxic of which is methylmercury (USEPA, 1986a). Greater attention has been paid to methylmercury rather than inorganic mercury in part because the intestinal absorption of methylmercury approaches 100 percent, whereas inorganic mercury absorption is only a few percent of the ingested dose (Scheuhammer, 1987, citing Berglund and Berlin, 1969). Inorganic mercury may be converted to the more toxic methylmercury by bacteria in the environment (Jensen and Jernelov, 1969; and Rowland, Davies, and Grasso, 1977, citing Matsumura et al., 1972) or possibly by bacteria living in the digestive systems of animals (as occurs in rats; Rowland, Davies, and Grasso, 1977). Conversion of inorganic mercury to methylmercury may occur within hours (bacteria in rat digestive system: Rowland, Davies, and Grasso, 1977) or a few days (Jensen and Jernelov, 1969). Depuration of mercury may also occur. Methylmercury also has been demonstrated to bioaccumulate in food webs (Gardner et al., 1978; Swartz and Lee, 1980, citing Young and Mearns, 1979).

Mercury contamination may persist for years. Mercury or cinnabar (mercuric sulfide) tailings released during mining activities at a freshwater lake in Canada were still an important source of contamination 25 years later (Fimreite et al., 1971). Information from Sweden suggests that mercury contamination may last for 10 to 100 years unless the mercury is made biologically inactive, which given current technology, is not likely (Lofroth, 1969, as cited by Fimreite et al., 1971).

Mercury or related compounds can affect species, as well as individuals within a species, differentially (Fimreite et al., 1971; and Hannerz, 1967). Also, different tissues or organs can be affected. Acute toxic levels cause death of the organism, but a variety of potentially sublethal effects can also occur. Sublethal effects of mercury can include effects on growth, reproduction, and physiology. Viarengo (1985) has reviewed the biochemical responses of aquatic organisms to zinc, cadmium, copper, mercury, and silver. These effects include reductions in the rate of protein synthesis, and effects on ATP synthesis, etc. Acute toxic values of mercuric chloride to marine organisms (29 genera, including annelids, mollusks, crustaceans, echinoderms, and fishes) can range from 3.5 ppb for a mysid to 1,678 ppb for the winter flounder (USEPA, 1986a). Acute toxicity to mercury (II) occurs at lower concentrations for mollusks than for fishes, i.e., the fish are more resistant to effects.

Mercury in the forms of mercuric chloride (which occurs in Norton Sound waters), ethyl mercury phosphate, and phenyl mercury acetate is toxic to fishes at relatively low levels (Firmreite et al., 1971, citing Boetius, 1960; and Amend, Yasatake, and Morgan, 1969), but the muscle concentrations associated with toxicity were not reported by the investigators. Fish exposed to methylmercury have suffered degeneration of nerve cells in different parts of the brain (Fimreite et al., 1971, citing Kurland et al., 1960), and severe damage to liver, kidneys, and gills (Fimreite et al., 1971, citing Miettinen et al., 1969). Exposure of fish to mercuric chloride or methylmercury has been observed to cause flaring of the gill covers, increased frequency and force of respiratory movements, loss of equilibrium, sluggishness, emaciation, abnormal movements, impaired behavior, brain lesions, cataracts, diminished response to changes in light intensity, loss of appetite, and inability to catch prey (Armstrong, 1979, citing: Wobeser, 1975; Takeuchi, 1960; Scherer et al., 1975; and Matida et al., 1971). Severely poisoned or dead fish (Hemibarbus spp.) in Japan had tissue concentrations of more than 20 ppm of mercury. Methylmercury, as mentioned earlier, has been demonstrated to bioaccumulate in food webs. Mercury may enter organisms via their food, or through contact with contaminated sediments or water (e.g., transport through membranes). Fujiki (1980a) examined the mode of entry of methylmercury into a marine fish species, whether via dissolved methylmercury in seawater, via food containing methylmercury, or from contaminated bottom sediments. He found that the greatest accumulation of methylmercury by red sea breams (Chrysophrys major) came from methylmercury dissolved in seawater. Fish also accumulated methylmercury--but a lesser amount--from the food chain, and did not readily accumulate mercury from suspended solids and bottom sediments in these lab experiments. Gardner et al. (1978), in an examination of methylmercury in a salt marsh ecosystem contaminated by inorganic mercury, found that methylmercury levels were low in sediments and plants but accounted for most of the mercury found in tissues of higher-trophic-level organisms. Methylmercury became concentrated in tissues of higher-trophic-level organisms and was rather clearly related to diet. The form of metal consumed (e.g., mercury vs. methylmercury) was important to the accumulation by animals, since primarily herbivorous animals (the cotton rat and the fish, Brevoortia tyrannus) had lower concentrations of mercury than their predaceous counterparts. Results similar to this have been reported for different trophic levels of freshwater fishes (Gardner et al., 1978, citing Bainbridge et al., 1974), marine fishes (Fimreite et al., 1971) and marine food webs (Young and Mearns, 1979, as cited by Swartz and Lee, 1980).

Even though methylmercury is usually only a small percentage (less than 0.01) of total mercury in sediments (Andren and Harriss, 1973, as cited by Gardner et al., 1978), and is rarely found in natural waters (Chau and Saitoh, 1973, as cited by Gardner et al., 1978), it can accumulate in organisms and become concentrated in higher-trophic-level organisms. Methylmercury is the primary form of mercury found in tissues of fishes (Gardner et al., 1978, citing Zitko et al., 1971; Kamps et al., 1972; and Gardner et al., 1975). The differential concentration of methylmercury versus inorganic mercury may be due to its much greater absorption in the intestines of animals. Scheuhammer (1987) reports that adult mammals absorb only about 1 to 3 percent of orally-ingested inorganic mercury, while absorption of methylmercury is close to 100 percent. A similar relationship has been demonstrated for marine fish and their prey. Pentreath (1976a,b) has found, in examining the transfer of radio-labelled mercury from polychaetes (Nereis diversicolor) to their predators, that thornback rays and plaice retained a much larger proportion (about 90%) of organic mercury than inorganic mercury (less than 15%).

Biomagnification of mercury, especially the more toxic and readily absorbed methylmercury (Scheuhammer, 1987) has important and potentially serious implications for food webs, most notably for the higher-trophic-level organisms, including humans. The regular consumption of contaminated fish and shellfish by humans can pose severe health risks (Fujiki, 1980b), with the daily consumption of fish containing 5 to 6 ppm of mercury posing a lethal threat to humans (Birke et al., 1967, as cited by Fimreite et al., 1971).

The EPA (1986a) states that the best available data regarding long-term exposure of fish to mercury indicated that concentrations greater than 0.23 ppb caused statistically significant effects on the fathead minnow, and led the whole-body mercury concentration to exceed 1.0 ppm. Reproduction in fathead minnows was completely inhibited upon exposure to 0.12 ppb methylmercury for 3 months (Birge et al., 1979, citing Mount, 1974). Uptake of contaminated food might lead to a further increase in mercury concentration in the fish. The USEPA (1986a) also stated that other fish species such as rainbow trout and coho salmon might suffer chronic effects and accumulate high residues of mercury about the same as the fathead minnow. Adult fish may incur effects from absorption of dissolved mercury from the water column (Windom and Kendall, 1979, citing Pentreath 1976a,b,c) as well as from eating prey containing mercury. Uptake of mercury can be quite fast; up to 90 percent of the mercury taken up on the gills of anadromous fishes becomes bound to erythrocytes (red blood cells) within 40 minutes (Eisler, 1981, citing: Olson et al., 1973, and Olson and Fromm, 1973). Eggs and larvae of fishes may also take up and accumulate mercury from surrounding waters. Pentreath (1976a) found that eggs of the flatfish,

Pleuronectes platessa, concentrated environmental mercury levels by a factor of 465 in 12 days, and larvae demonstrated a concentration factor of 2,000 after 8 days. Adult fish of the same species also bioaccumulated mercury, primarily in muscle tissue, and showed concentration factors of 600 after 64 days. Thus, longer-term exposure to elevated mercury concentrations could lead to effects on fish, and presumably other organisms as well.

Mercury concentrations measured downcurrent of the Bima using state-of-the-art methodology show an average increase of 0.0004 ppb, with the highest downcurrent concentration reading 0.0014 ppb (Table IV-7). These numbers are considerably less than other measurements that have been made (see discussion in Sec. IV.B.2). These new, low numbers are below the EPA chronic criterion of 0.025 ppb, and, based on the setting of that standard plus the literature reviewed above, suggest that this amount of elevation of mercury should pose little threat to fishes.

In monitoring studies conducted in association with the Bima dredging operations in State waters, analyses of trace-metal concentrations in a variety of invertebrates (with emphasis on red king crab) and fishes were made (Rusanowski, Gardner, and Jewett, 1987, 1988; and Jewett, Gardner, and Athey, 1989).

Mercury levels in fishes (Rusanowski, Gardner, and Jewett, 1987, 1988) were below the FDA action levels for fish and shellfish, but often very few tissue samples were analyzed (only 1 to 3 per location; Table 3.3-10, Rusanowski, Gardner, and Jewett, 1988). Several samples in 1986 had tissue-mercury values greater than 1.5 times background-sediment values, indicating potential bioaccumulation effects according to Rusanowski, Gardner, and Jewett, 1987. These included least cisco liver samples (mean of nine values equalled 0.12 ppm, and one value equalled 0.24 ppm). Other mercury-tissue values for invertebrates and fishes in 1986 ranged from .004 ppm to .100 ppm (Rusanowski, Gardner, and Jewett, 1987). There should be emphasis put on looking at the ranges of values, in addition to the mean and median values. High values (termed in the report "aberrant" values) may be extremely meaningful as an indication of the levels of concentration that can be present.

Although most tissue samples analyzed to date have been below FDA action levels, there is still potential for accumulation of mercury in marine organisms. Populations of fishes are not threatened by the increased release of mercury, but contamination of these individuals could affect higher-order consumers, especially birds, marine mammals, and humans.

Based on the latest measurements of mercury released by dredging activities in State waters (average increase of 0.0004 ppb; Table IV-8) and reviews of potential effects, the effect of such a mercury release on fishes would be expected to be NEGLIGIBLE.

The EPA (USEPA, 1990a) has recently developed new NPDES permit restrictions for future Bima mining activities (see Sec. IV.B.2, Effect on Water Quality). These more restrictive effluent limitations should, among other things, reduce the level of total-recoverable metal discharges. Thus, mercury levels would be expected to be lower under the new permit. Since effects at the higher concentrations were already judged to be NEGLIGIBLE, there is no expected change in level of effect under the new permit.

The most likely effect on fishes from the release of mercury by dredging activities is NEGLIGIBLE.

(3) Lead: Lead concentrations downcurrent of the Bima are an average of 6.7 ppb higher than ambient concentrations, and the highest downcurrent concentration was 13.3 ppb. One of the three samples exceeded the EPA chronic criterion of 5.6 ppb (Table IV-8). Comparisons of filtered and unfiltered samples indicate that almost all of the lead released during dredging is in the particulate rather than in the dissolved phase (Sec. IV.B.2). According to Wong et al. (1978), as cited by Eisler (1988), only soluble waterborne lead is toxic to aquatic biota, and free cationic forms are more toxic than complexed forms.

Acute toxicity tests for 2 marine fishes produced a range of lethal values from 315 ppb lead for the mummichog (Fundulus heteroclitus) to a high of 300,000 ppb for the plaice (Pleuronectes platessa; Eisler, 1988). Toxicity experiments with the plaice revealed the greatly differing toxicity of various lead compounds. In LC<sub>50</sub> tests conducted over 96 hours, lethal concentrations of lead ranged from 50 ppb tetramethyl lead to 300,000 ppb dimethyl lead. Divalent lead had an LC<sub>50</sub> concentration of 180,000 ppb (Eisler, 1988). Very few of the toxicity tests conducted with lead have used concentrations as low as those measured near the Bima dredging operation. In Eisler's review (1988), tests with only a few organisms used concentrations of lead less than 20 ppb.

No significant biomagnification of lead in aquatic food chains is thought to occur (Eisler, 1988, citing: Boggess, 1977; Rolfe and Reinbold, 1977; Branica and Konrad, 1980; Demayo et al., 1982; and Flegal, 1985), since lead concentrations are usually highest in algae and benthic organisms, and lowest in upper trophic level predators. Within a species, younger, more immature organisms are more susceptible to adverse effects from lead exposure.

The increase in lead levels associated with the dredging activities of the Bima can represent a low-level threat to marine organisms. The exceedence, at least periodically, of the EPA chronic criterion suggests that sublethal effects to marine organisms are likely. Acute effects are not likely. Therefore, the effect of increased lead levels on fishes from such dredging activities is expected to be NEGLIGIBLE.

The EPA (USEPA, 1990a) has recently developed new NPDES permit restrictions for future Bima mining activities (see Sec. IV.B.2, Effect on Water Quality). These more restrictive effluent limitations should, among other things, reduce the level of total-recoverable metal discharges. Thus, lead levels would be expected to be lower under the new permit. Since effects at the higher concentrations were already judged to be NEGLIGIBLE, there is no expected change in level of effect under the new permit.

The most likely effect on fishes from the release of lead by dredging activities is NEGLIGIBLE.

(4) Copper: Copper concentrations downcurrent of the Bima have been measured to increase by an average of 33 ppb over ambient levels. The highest downcurrent concentration was 51.3 ppb (Table IV-8). Comparisons of filtered and unfiltered samples indicate that almost all of the copper released during dredging is in the particulate rather than the dissolved phase (Sec. IV.B.2). All the values measured downcurrent exceed the EPA acute criterion (2.9 ppb) for copper. Thus, elevated copper levels pose the greatest direct risk to sensitive marine organisms of any of the trace metals measured.

Acute values of copper for fishes range from 23 to 10,200 ppb (Hodson et al., 1979). Adverse sublethal effects to fishes occurred at concentrations up to the lethal level, and thresholds of effects were observed below 160 ppb (Hodson et al., 1979). Behavior and growth of salmonids represented the most sensitive parameters tested.

Exposure levels below 25 ppb are not acutely toxic to most common species of fishes and the no-effect level for copper appears to range from 5 to 15 ppb (Birge and Black, 1979). Copper will readily complex with organic compounds, and complexed or precipitated copper is less toxic to organisms (Birge and Black, 1979; Hodson et al., 1979). In static-renewal laboratory tests, copper was more toxic to fish eggs and embryos than to larvae or early fry (Birge and Black, 1979).

Juvenile Atlantic salmon (Salmo salar) did not die when exposed to 28 ppb of copper for 168 hours (7 days), but did show an avoidance response to 4 ppb (Birge and Black, 1979). Migrations of coho salmon also could be affected by exposures to 5 to 20 ppb copper for 144 hours (6 days) or greater (Hodson et al., 1979).

Fertilization of herring eggs can be substantially affected by exposure to 30 ppb copper, but an exposure concentration of 1,000 ppb was necessary to cause high mortality of newly hatched larvae (Birge and Black, 1979, citing Blaxter, 1977). Low survival and premature hatching of herring eggs at exposure to concentrations above 10 ppb was observed by Steele et al. (1973; cited by Birge and Black, 1979). Blaxter (1977) saw no reduction in the hatchability of herring eggs exposed to 30 ppb copper, but about 70 percent of the early larvae were deformed (cited by Birge and Black, 1979).

The elevated copper levels associated with dredging by the Bima are likely to lead to the deaths of some marine organisms within the area affected by the discharge plume. In addition, a variety of sublethal effects are possible. Therefore, the most likely effect of increased copper concentrations on marine fishes from such dredging activities is MINOR if dredging activities are unmitigated. If, as specified by Stipulation 1, dredging activities are modified or stopped by the RS/FO in response to elevated copper levels, then some deaths would still be likely to occur (a MINOR effect) even though the extent of effect would be reduced.

The EPA (USEPA, 1990a) has recently developed new NPDES permit restrictions for future Bima mining activities (see Sec. IV.B.2, Effect on Water Quality). The more restrictive limitation on copper discharge, 52.2 ppb total-recoverable copper in the effluent, would reduce the likelihood that the copper criterion would be exceeded at the edge of the mixing zone. Thus, the effect of copper discharges on fishes would become NEGLIGIBLE.

(5) Nickel: Nickel concentrations downcurrent of the Bima have been measured to increase by an average of 35 ppb, which exceeds the EPA chronic criterion for nickel (8.3 ppb; see Table IV-



8). Only three dates were sampled by the MMS contractor and the highest concentration sampled at the edge of the mixing zone was 68.0 ppb. Comparisons of filtered and unfiltered samples indicate that almost all of the nickel released during dredging is in the particulate rather than in the dissolved phase (Sec. IV.B.2).

In laboratory studies of toxicity, the acute values of nickel for marine fishes ranged from 7,960 ppb for the Atlantic silverside (Menidia menidia) to 350,000 ppb for the mummichog (Fundulus heteroclitus), although it must be noted that these are the only values for marine fishes reported by the EPA (1980). No chronic toxicity tests were reported for fishes (USEPA, 1980).

Even though the data for nickel concentrations near the Bima dredging operation indicate that the EPA chronic criterion is being exceeded, the results of the laboratory tests discussed by the EPA only show effects at levels higher than those observed near the Bima. In addition, since the nickel released in association with dredging is primarily particulate, lesser effects on fishes are anticipated. Therefore, it is most likely that effects on fishes from elevated nickel concentrations associated with such dredging activities would be NEGLIGIBLE.

The EPA (USEPA, 1990a) has recently developed new NPDES permit restrictions for future Bima mining activities (see Sec. IV.B.2, Effect on Water Quality). These more restrictive effluent limitations should, among other things, reduce the level of total-recoverable metal discharges. Thus, nickel levels would be expected to be lower under the new permit. Since effects at the higher concentrations were already judged to be NEGLIGIBLE, there is no expected change in level of effect under the new permit.

The most likely effect on fishes from the release of nickel by dredging activities is NEGLIGIBLE.

In summary, exposure to trace metals in the sale area may cause some sublethal effects on fishes. Sublethal effects on reproduction and productivity are possible, and developing eggs and larvae might be affected in localized areas and/or over a short time period. The effect of trace metals on fishes is expected to be NEGLIGIBLE.

e. Effect of Noise and Disturbance: Seismic surveys conducted during exploration and for prospect assessment during production will generate frequencies varying from several hundred cycles per second to several thousand cycles per second. These energies are less than those generated by airguns, which are typically used in petroleum exploration. See Section II.A.2.c. for details of the extent, timing, and type of surveys to be done.

The effects of seismic surveys used for petroleum exploration have been discussed in the Proposed Beaufort Sea Oil and Gas Lease Sale 97 FEIS (USDOJ, MMS, 1987) and this information is incorporated by reference. The use of airguns was expected to have MINOR effects on fishes due to the mortality of fish eggs very close (less than 5 m) to the energy source (Kostyuchenko, 1973). Effects of seismic exploration associated with the dredging scenario should have a lesser effect. Thus, effects on fishes should not exceed MINOR.

f. Effect of a Fuel Spill: Offshore-dredging activities are attended by the risk of a fuel spill. A dredge the size of the Bima carries about 6,000 bbl of diesel fuel. Although smaller spills are more likely during refueling, a spill of up to 6,000 bbl also is possible. For the purpose of analysis, a spill of 3,500 bbl is assumed. This amount is equivalent to the average, onboard fuel load of a Bima-sized dredge. Diesel fuel lacks both the lightest and heaviest fractions of petroleum components, and will initially evaporate more slowly than crude oil. Eventually, however, more will evaporate (see Sec. IV.B.2). The effects of oil spills have been evaluated in the Sale 100 FEIS (USDOJ, MMS, 1985a) and MINOR effects on fishes from offshore spills were anticipated. A large spill would be most likely to occur during fall storms (see Table IV-10 for details of the area and weathering of such a spill), which could result in the grounding of a dredge and the spilling of some or all of its stored fuel. The probability of an offshore spill versus one occurring in nearshore areas is not known, but for the sake of analysis, since some fishes in nearshore waters are more vulnerable, a spill in nearshore waters will be assumed.

If a fuel spill occurred during a storm, the fuel slick would be expected to be dissipated by the fifth day (Table IV-10). The 4 to 5 days of its existence could allow time for some diesel fuel to be dispersed onto the beach bordering Safety Sound or over the sand barrier and into the Sound (with storm waves). If fuel did contact this region, it would be expected to cause more problems than crude oil would. Some fishes could be affected, with eggs, larvae, and juveniles more susceptible, but it is most likely that only a portion of Safety Sound and its inhabitants would be affected. This could result in a MODERATE effect on fishes if spawning individuals, eggs, larvae or smolts of salmon were contacted.

The widespread distributions of fish species in the Norton Sound area generally make them less vulnerable to effects from spilled oil. However, when salmon, capelin and herring are gathering to spawn or are spawning in coastal areas, they are more vulnerable to effects of a fuel spill. Eggs and developing larvae of herring and capelin are especially vulnerable since they are more sensitive to oil and are found in the intertidal and shallow subtidal adjacent to land. In coastal regions near the sale area there is spawning by capelin, as well as the gathering of salmon returning to spawn, and later, smolts leaving rivers. Thus, a fuel spill that occurred and contacted the nearshore region in the open-water season during times when spawning fish, eggs, larvae, or smolts were present, is likely to result in a MODERATE effect to fishes since multiple year classes could be affected or effects on a single year class could be felt for more than one generation.

**SUMMARY:** Offshore dredging and spoils discharge have the potential to affect fishes via the effects of habitat alteration, including turbidity; entrainment of organisms; exposure to trace metals; noise and disturbance; and a fuel spill. The highest-order effect is likely to come from a fuel spill that contacted fish in nearshore waters. A MODERATE effect is likely if the fuel contacted spawning herring or capelin, their developing eggs and larvae in nearshore waters, adult salmon congregating in the nearshore prior to spawning, and outmigrating salmon smolts. MINOR effects on fishes are expected from habitat alteration, turbidity, entrainment, and noise and disturbance. A NEGLIGIBLE effect is expected from exposure to trace metals.

**CONCLUSION (Effect on Fishes):** The effect of the proposal on fishes is likely to be MODERATE for the base case.

**CUMULATIVE EFFECTS:** Effects on fishes in the Norton Sound area may derive from past, present, and reasonably foreseeable future actions such as: Federal offshore mining (this proposal), State offshore mining, past and future Federal OCS oil and gas lease sales in Norton Sound, onshore mining projects in the Norton Sound area, harbor dredging, and fishing activities, both commercial and subsistence. The scope of these activities has been described in greater detail in Section IV.A.2 (Major Projects Considered in Cumulative-Effects Assessment) and are presented in condensed form in Table IV-2a. Although some of these activities (State offshore mining, harbor dredging, onshore mining, and fishing) have reached the development stage, the probability of other similar activities reaching the development stage is not known.

**Effect of Offshore Mining and Harbor Dredging:** Offshore-mining effects to fishes may come from both Federal (this proposal) and State offshore-leasing activities. Of most concern are habitat alteration, a fuel spill, and absorption and possible bioaccumulation of mercury. Habitat alteration includes not only the physical effects to the benthic environment from dredging, but effects on prey, and other changes in the interactions of organisms with each other and with the environment. Under the scenario for the proposed Federal offshore mining (see Sec. II.A.2), 1,300 acres of the benthos will be dredged over the life of the lease. In State waters, assuming a 20-year activity period for a lease and the number of acres dredged per season given in Table IV-2a (300 acres total by 3 dredges), a total of 6,000 acres is likely to be dredged. Other potential mining activities could increase the area affected, but the probable extent of these activities is not known. The actual area affected by dredging is going to be much larger than the 7,300 acres that may be dredged in the cumulative case, since settling particulates from the turbidity plume, and possibly from eroding tailings, will affect a larger area. In the base case under the proposal, increased sedimentation resulting from dredging activities was estimated to cover an area perhaps one-half the size of the sale area (Sec. IV.B.2.a). The potential effects of such sedimentation have not been assessed in the current offshore-mining operation. As described in Section IV.B.4.a, habitat alteration from proposed Federal offshore-mining activities is likely to have a MINOR effect on fishes. The additive effects of other offshore-mining activities increase the likelihood of a MODERATE effect on fishes; however, a MINOR effect is viewed as being most probable.

In the cumulative case, it is possible that several dredges could operate at once, and that dredges could move into and operate in shallow nearshore waters. Habitat alteration is less a concern from very nearshore-operating dredges than is the possibility of a fuel-oil spill contacting the nearshore environment. An offshore fuel-oil spill is most likely to have a MINOR effect on fishes, but a spill from a dredge in nearshore waters is likely to have a MODERATE effect on fishes, due to possible effects on spawning capelin or herring, their developing eggs and larvae in nearshore waters, adult salmon congregating in the nearshore prior to spawning, and outmigrating salmon smolts.

In addition to effects on habitat, dredging activities may increase the levels of trace metals in the water column, surficial sediments, and in organisms. Of particular concern are the high concentrations of copper associated with the Bima dredging activities, and the potential biomagnification of mercury and arsenic through the food

web (see Sec. IV.B.3.d and IV.B.4.d, Effect of Trace Metals). Data from current offshore-dredging activities in State waters suggest that mercury concentrations in the water column are elevated, but state-of-the-art analysis from a Federal study suggests that that is not the case (see Sec. IV.B.2). These latter data do suggest that water concentrations of nickel, lead, and copper can exceed Federal water-quality standards. The EPA (USEPA, 1990a) has recently developed new NPDES permit restrictions for future Bima mining activities (see Sec. IV.B.2, Effect on Water Quality). These more restrictive effluent limitations should, among other things, reduce the level of total-recoverable metal discharges, leading to an expected NEGLIGIBLE effect on fishes. The addition of other offshore-dredging operations to the current operation in State waters could lead to areas being exposed to elevated trace-metal levels. This could increase the probability of lethal, sublethal, and biomagnification effects. Wide-ranging foragers, most notably higher-trophic-level organisms (see appropriate sections for effects on birds, marine mammals, endangered species, and humans) are those most likely to biomagnify trace metals. Roving fishes are also more likely to accumulate mercury and arsenic in their tissues under the cumulative case. Harbor dredging in the mouth of the Snake River, next to Nome, may affect demersal eggs and the timing of fish movements into and out of the river but is not expected to affect fishes to a large degree. However, the dredging and dumping each year of 13,000 yd<sup>3</sup> of sediments (Table IV-2a) likely to be contaminated from previous gold-processing activities could result in the release of additional mercury into the environment. The State Department of Fish and Game has imposed a timing restriction on dredging in the Snake River to protect outmigrating salmon fry (Bielawski, written comm., July 10, 1989). Under the cumulative case, the effect of trace metals on fishes is likely to be MINOR, rather than the NEGLIGIBLE effect expected for the proposal. Overall, offshore mining activities under the proposal were considered likely to have a MODERATE effect on fishes; and the same level of effect is expected under the cumulative case.

Effects of Onshore Mining: Onshore-mining activities, as detailed in Section IV.A.2.b and Table IV-2a, may have effects on fishes by increasing the concentration of mercury in the marine environment. Onshore placer-gold mining (in the Nome area) has resulted in the discharge of a considerable amount of mercury into streams, onto the ground around dredges, and around gold-processing houses. Water runoff via streams and from coastal land may carry dissolved mercury and contaminated sediments into the marine environment. Although much of the mercury coming into the marine environment may be in the metallic or inorganic forms, it may be converted to more toxic and absorbable forms (e.g., methylmercury) by organisms in the marine environment (see preceding discussion in Sec. IV.B.3.d). It is not possible to say how much of the mercury in offshore sediments originated from terrestrial runoff, but the addition of mercury from terrestrial environs is not expected to increase the level of effect of trace metals on fishes above that likely for the proposal, MINOR.

Effect of Federal OCS Oil and Gas Activities: Oil spills are more likely to cause widespread negative effects to fishes than are other activities or events associated with exploration, development, and production of oil and gas resources in Norton Sound. At present, the only foreseeable effects could come from actions associated with future Norton Sound oil and gas lease sales. If an oil spill were to occur, the most likely effect on fishes would be MINOR. However, a spill that contacted fish in nearshore waters could have a MODERATE effect on fish if it affected spawning herring or capelin, their developing eggs and larvae in nearshore waters, adult salmon congregating in the nearshore prior to spawning, and outmigrating salmon smolts.

Effects of Fishing: The largest effects on exploited fish stocks (e.g., salmon and herring) are probably derived from fishing activities, both commercial and subsistence. Commercial and subsistence harvests are managed by the Alaska Department of Fish and Game (ADF&G). Information on the fisheries is contained in Sections III.C.2 and IV.B.9. At present, the ADF&G is enacting subsistence closures on salmon in the Nome area, in particular, the Nome River. According to Charles Lean (Lean, 1990, oral comm.), there are tremendous problems with stocks in the Nome River, due primarily to effects of subsistence fishing. Chum salmon escapement goals have not been met for 4 years. This situation, where recruitment is not returning the population to its former level and shows no indication of such a return, signifies a MAJOR effect on salmon. Strong measures such as closures or enhancement may be necessary for rebuilding the population(s).

SUMMARY: The greatest effect on fishes in the cumulative case comes from fishing activities, primarily the subsistence take of salmon in the Nome River. This effect is MAJOR. Other concerns for fishes are alteration of the habitat by offshore-dredging activities, a possible fuel spill, and effects of trace metals. Habitat alteration is likely to lead to a MINOR effect on fishes. The release and resuspension of trace metals as a result of dredging also could have a MINOR effect on fishes. Biomagnification of mercury and arsenic through the food web also may affect higher-trophic-level organisms, including birds, marine mammals, endangered species, and humans. Activities related to Federal offshore oil and gas activities are expected to have a MINOR effect on fishes, although an oil spill contacting spawning fishes or developing eggs and larvae in nearshore waters could

have a MODERATE effect. A fuel spill from dredging activities is more likely than an oil spill from offshore oil activities, and it is more likely to occur in nearshore waters and have a MODERATE effect on fishes.

**Conclusion:** Under the cumulative-case scenario, fishes are likely to experience a MAJOR effect.

**Cumulative Effects on Migratory Species--Fishes:** Two fish groups whose migrations take them outside of the Norton Sound area will be considered here under cumulative effects. These two groupings are salmon (five species) and Pacific herring. Descriptive material on the life histories of these two groups is presented in Section III.B.2.b. The effects described above under cumulative effects apply, as appropriate, to the following migratory species. Because of the added geographic range of migratory species, they are subject to the following additional effects.

a. **Salmon:** As described in Section III.B.2.b, all five species of North American Pacific salmon occur in the Norton Basin area. The patterns of movements of all these species are thought to be wide-ranging, occurring mostly in the Bering Sea. Chum, coho, and pink salmon from Norton Sound streams are thought to rarely make it past the Aleutians or the Alaska Peninsula in their migrations (Lean, 1989, oral comm.). There may be some exchange of salmon between Norton Sound and Hope Basin to the north, but salmon from Norton Sound are thought to move primarily to the south. Salmon stocks originating from the Yukon River may also pass the Nome area.

Activities that could affect Norton Sound stocks of migrating salmon include: the proposed OCS Mining Program Norton Sound Lease Sale analyzed in this document; mining activities in State waters of Norton Sound; proposed and existing Federal OCS activities in the Norton, Navarin, St. George, and North Aleutian Basins; and commercial and subsistence-fishing activities.

The largest effects on salmon stocks in the Norton Sound area are probably derived from fishing activities, both commercial and subsistence. At present, the ADF&G is enacting subsistence closures on salmon in the Nome area, in particular, the Nome River. According to Charles Lean (Lean, 1990, oral comm.), there are tremendous problems with stocks in the Nome River due primarily to effects of subsistence fishing. Escapement goals for chum salmon have not been met for 4 years. This situation represents a MAJOR effect on salmon, since recruitment is not returning the population to its former level and shows no indication of such a return. Strong measures such as closures or enhancement may be necessary for rebuilding the population(s).

Commercial fishing activities also have effects on salmon populations. Commercial (and subsistence) harvests are regulated by the ADF&G. Information on the fisheries is contained in Sections III.C.2 and IV.B.9. Of more recent concern is the possible effect of the high seas drift net fishery and other open ocean nondiscriminant gear fisheries on salmon and other fish stocks. Effects are speculative given lack of data due to problems with observer programs. The potential for significant effects definitely exists. According to Chuck Meacham (Meacham, 1990, oral comm.) and Charles Lean (Lean, 1990, oral comm.) effects on Norton Sound stocks are most likely to range from MINOR to MODERATE. Effects could carry over for multiple generations if the stock from one region were grouped together and were heavily exploited.

Effects from the proposed Norton Sound Lease Sale are analyzed in Section IV.B.4, as are the cumulative effects of the proposal, State mining activities, and Federal OCS activities in Norton Sound. The likely effect of both the proposal, and the cumulative activities of the projects enumerated above, is MODERATE for salmonids, due primarily to potential effects of a fuel spill contacting fish in the nearshore zone. Salmon are vulnerable to effects of oil when adults are migrating to nearshore areas preparatory to spawning, and when smolts are outmigrating from fresh or brackish water environs. All stages of pink salmon are susceptible to effects since this species may spawn in tidal areas (Morrow, 1980). Homing abilities of migrating salmon could be affected by spilled oil; consequently, reproduction could be eliminated or reduced. In general, it is expected that salmon in open-ocean areas are not very vulnerable to spilled oil. In order to be affected, either the salmon or their food supply would have to be contacted. The broad distributions of both the salmon and their prey and the mobility of the salmon suggest that only very localized effects might occur. Other effect-causing agents associated with offshore oil and gas activities include seismic activities, construction activities (installation of pipelines and platforms, onshore construction associated with offshore exploration and development), and discharge of drilling fluids. Unless onshore construction affected spawning areas, rearing areas, or access to these areas, its effects should be NEGLIGIBLE to MINOR. The other activities listed are expected to have at most MINOR effects on salmon. Therefore, the proposed Federal OCS activities in the Navarin, St. George, and North Aleutian Basins are not likely to affect Norton Sound salmon stocks to any great degree.

The effect of cumulative activities on migrating salmon that originate from the Norton Sound area is expected to be MAJOR.

b. Pacific Herring (*Clupea harengus pallasii*): The herring that spawn in the nearshore areas of Norton Sound may winter offshore, perhaps in the known herring wintering ground near the Pribilof Islands. However, it is possible that some or all of these herring may remain in Norton Sound year-round. Barton (1978) found an autumn, nonspawning run in Golovnin Bay in northern Norton Sound, and herring have been caught by local residents jigging through the ice in the Golovnin Bay area and near Nome (Wespestad and Barton, 1981).

This analysis takes a conservative stance and assumes that herring migrate to an area near the Pribilof Islands to overwinter. Activities that could affect Norton Sound stocks of herring include: the proposed Norton Sound Lease Sale analyzed in this document; mining activities in State waters of Norton Sound; proposed and existing Federal OCS activities in the Norton, Navarin, and St. George Basins; and commercial and subsistence fisheries.

The largest existing effects on herring stocks aside from natural mortality factors are probably derived from commercial fishing activities, although subsistence take also reduces herring numbers. Herring stocks in Norton Sound are managed by the Alaska Department of Fish and Game, and information on the fisheries is contained in Sections III.C.2 and IV.B.9. Of more recent concern is the possible effect of the high seas drift net fishery and other open ocean nondiscriminant gear fisheries on herring and other fish stocks. Effects are speculative given lack of data due to problems with observer programs. The potential for significant effects definitely exists. According to Charles Lean (Lean, 1990, oral comm.), possibly up to one-fifth of the herring stocks in the Bering Sea are being taken by joint venture and domestic trawl fisheries as incidental catch. This catch would be in addition to target fisheries. Herring stocks in Norton Sound seem to be in a stable situation, although last year ADF&G was unable to get good survey data due to poor weather conditions. Some Bering Sea herring stocks outside of Norton Sound (e.g., Nelson Island) have declined. Thus, although at present the cumulative effect of fisheries on Norton Sound herring appears to be MINOR, over the next 20 years the effect could be MODERATE.

Effects from the proposed Norton Sound Mining Sale are analyzed in Section IV.B.4, as are the cumulative effects of the proposal, State mining activities, and Federal OCS activities in Norton Sound. A pelagic species like the Pacific herring is not viewed as being very vulnerable to effects of offshore activities, but would be more vulnerable when it comes into nearshore areas to spawn. Eggs and developing larvae attached to benthic substrates in the intertidal and shallow subtidal would be the most sensitive and vulnerable stages, especially to effects from oil spills. Oil spills are the effect-causing agent likely to have the greatest effect on herring. Fuel spills are possible from State and Federal mining activities, and from oil spills associated with offshore Federal oil and gas activities. Even though a fuel spill contacting the nearshore zone could cause great mortality to eggs and developing larvae, because adults spawn repeatedly after reaching maturity, and it is most likely that only a portion of the eggs and larvae in Norton Sound would be affected, a MINOR effect on the Norton Sound herring population would be expected. An oil spill that occurred in more open-ocean areas could conceivably affect herring by affecting the abundance of their prey, but these effects are little studied and would be very difficult to predict and to quantify. Effects to herring from spills in nearshore areas have a much greater likelihood of affecting herring. Other effect-causing agents associated with offshore oil and gas activities that could also affect herring include construction activities, seismic testing, and the discharge of drilling fluids. These are expected to have NEGLIGIBLE to MINOR effects on herring.

The effect of cumulative activities on migratory herring that spawn in the Norton Sound area is expected to be MODERATE, based on potential effects from fisheries.

SUMMARY: The largest existing effects on the two species groups (salmon and herring) considered here are expected to be derived from fishing activities, both commercial and subsistence. Of particular concern lately is the effect of the high seas drift net fishery on salmon stocks in Alaska. At present, the effect of this activity on salmon from Norton Sound is not known. However, subsistence fisheries are having a MAJOR effect on salmon near Nome. Therefore, the cumulative effect of activities external to and including the proposal is expected to be MAJOR for salmon and MODERATE for herring, due primarily to effects from fishing.

Conclusion: Cumulative effects on migratory fishes from activities within the Norton Sound area and within the range of migratory fish populations of Norton Sound are expected to be MAJOR.

5. **Effect on Marine and Coastal Birds:** Several thousand to tens of thousands of marine and coastal birds occur within or immediately adjacent to the proposed gold-mining lease-sale area along the southern coast of the Seward Peninsula (Fig. III-17). Six seabird species (common murre, glaucous gull, black-legged kittiwake, horned puffin, pelagic cormorant, and thick-billed murre), six waterfowl species (pintail, American widgeon, Taverner's Canada goose, greater scaup, Pacific brant, and whistling swan), and four shorebird species (semipalmated sandpiper, northern phalarope, western sand-piper, and dunlin) are among the most abundant birds in the proposed lease area. A number of these marine and coastal birds could be displaced and, or local abundance reduced as a result of noise and disturbance from aircraft, boat, and dredge traffic associated with the proposal, from habitat alteration associated with dredging from toxic trace-metal release associated with dredging activities, and from a fuel spill from the dredge. This section briefly discusses the nature of effects of benthic material excavation, spoil deposition and redistribution, toxic trace-metal release and noise and disturbance from air traffic on marine and coastal birds and on their food sources and habitats. The reader is directed to Sections IV.B.2 through 4 for a more comprehensive discussion of offshore-mining effects on benthic and pelagic communities.

This analysis assumes that a biological monitoring and operations management program would be in place. The use or storage of mercury or other toxic substances would be prohibited onboard the dredge (Stipulation No. 2), thus preventing any accidental spillage of mercury. An effective biological and chemical (water and sediment) monitoring and operations management program would be conducted to measure the effects of benthic excavation, sediment deposition and trace-metal release (especially mercury) in the environment (Stipulation No. 1). This stipulation could limit or prevent significant increases in the bioaccumulation of mercury or other trace metals as a result of OCS dredging in seabirds and in their environment. The potential bioaccumulation of mercury or other trace metals could have a long-term (several generation) effect on exposed bird populations.

To aid in the interpretation of the following effects discussion, an explanation of the term "population in the region," found in the definitions presented in Table IV-2, follows. A population of marine and coastal birds is the number of birds of a particular species of seabird, waterfowl, or shorebird that breed within or number of birds that occur seasonally within Norton Sound or within the Norton Basin. A portion of a population in the region would be, for example, the number of black-legged kittiwakes that nest on Sledge Island or number of pelagic cormorants that nest at Topkok Head.

a. **Effect of Noise and Disturbance:** Human activities associated with mining operations--especially air traffic--are known to disturb birds. The responses of birds to human disturbances (including aircraft) are highly variable. These responses depend on the species; the physiological or reproductive state of the birds; distance from the disturbance; type, intensity, and duration of the disturbance; and many other factors. The movement and noise of low-flying aircraft passing near bird colonies often frighten most or all adult birds off their nests, leaving the eggs and young vulnerable to exposure, predation, and accidental displacement from the nest (Jones and Peterson, 1979). Evidence has indicated that repeated disturbance could significantly reduce hatching success, fledgling success, and perhaps cause adult abandonment of eggs and young (Scott, 1976). Potential disturbance of nesting seabirds of locally important colonies at Safety Sound, Bluff, and Sledge Island is a primary concern (Fig. III-17). The seabird population (common murre) at Bluff has experienced a substantial decline in the past 10 years. Repeated air-traffic disturbance of nesting seabirds at the Bluff colony could significantly delay the recovery or cause further decline of this seabird population.

Aircraft disturbance of waterfowl has been shown to cause lower nesting success of Pacific brant and common eider (Gollup, Goldsberry, and Davis, 1972). Air-traffic disturbance of concentrations of feeding and molting waterfowl and shorebirds on coastal lagoons and other wetlands may reduce the ability of migratory birds to acquire the energy necessary for successful migration. If such disturbance occurred frequently, migration mortality might increase and winter survival of other affected birds might be reduced.

(1) **Site-Specific Noise and Disturbance Effects:** Placer-mining operations are assumed to include one dredge and one support vessel operating in the proposed sale area from late May to early November over a 14-year-production period. An estimated 360 to 450 helicopter flights between Nome and the dredge are assumed to occur from May to November each year. This air traffic would coincide seasonally with the marine- and coastal-bird breeding seasons and with migratory-bird spring-and-fall use of coastal wetlands and marine environments within and adjacent to the proposed sale area. This air traffic also would be the primary source of noise and disturbance that could affect nesting seabird colonies and waterfowl and shorebird-molting and -feeding concentrations along the coast. Direct helicopter flights from Nome, offshore to the dredges and return, are likely to avoid disturbance of nesting seabirds and coastal concentrations of

waterfowl and shorebirds. Direct offshore flights would unavoidably disturb some feeding flocks of seabirds along the flight paths to the dredges; however, these disturbance events would be very brief (no more than a few minutes) and are not likely to significantly affect seabird-feeding success (NEGLIGIBLE effect). On occasions of poor weather, helicopter traffic may follow the coastline to and from Nome and the dredge. On these occasions, helicopter flights might pass over or within 1 mi of some coastal concentrations of waterfowl and shorebirds (such as at Safety Sound). Helicopter flyovers of waterfowl and shorebird concentrations at Safety Sound or other coastal wetlands could reduce migration fitness and winter survival of some disturbed birds, but such disturbance events are not likely to disturb most birds on the sound because the aircraft would fly over the spit bordering Safety Sound rather than cross over the wetlands within the sound where most bird concentrations occur. These events are likely to have a short-term (one season or year) effect on some local flocks of birds (MINOR effect) because the dredge would be operating on different lease blocks in different parts of the sale area; thus, aircraft flight patterns would be different each year and bird populations are thus unlikely to be disturbed frequently enough to have a population effect.

Noise and movement of the dredges and support vessels associated with the mining operations are likely to disturb and temporarily displace (for one season) feeding or rafting birds within about a mile or a couple of kilometers of dredging operations offshore (greater than 5 km from shore), representing a MINOR effect on local assemblages of seabirds. The OCS mining operations would not occur within 5 km of the important seabird colonies at Bluff, Square Rock, and Sledge Island, near other local colonies, or waterfowl and shorebird wetlands. These waters (within 5 km of the coast) are under State of Alaska jurisdiction; however, OCS offshore dredging operations could have some direct effects on seabird offshore-foraging habitat, food sources, and the marine ecosystem.

b. Effect of Dredging and Tailings Deposition: The OCS mining operations would include the dredging-excavation of sea-bottom material and sediments and subsequent removal and destruction of benthic infauna and slow-moving epibenthic fauna within the dredge path (see Sec. IV.B.3). Sea-bottom excavation is unlikely to affect the abundance of pelagic food sources of seabirds because fish and macroplankton prey organisms would avoid being entrained in the dredge buckets. However, some pelagic fish could be entrained in the seawater-intake system on the dredges. Water turbidity resulting from dredging excavation and tailings deposition could reduce the availability of pelagic prey of seabirds by the possible displacement of fish from dredge-plume areas and by reducing the visibility of prey to foraging seabirds near the dredges and within 3 km downstream of the dredge in the plume. It is possible that the availability of some seabird-prey organisms could be reduced at least for one or two seasons; however, such food-web effects would be very local (within about 3 km) near the dredging operations. An estimated 100 acres of sea bottom would be mined per year, with 1,300 acres or 5.3 km<sup>2</sup> mined over the life of the mining leases, representing less than 1.0 percent of the proposed sale area. Although the benthic area affected by dredge deposition could be about 2,000 to 3,000 acres or 5 to 8 km<sup>2</sup>, the overall abundance and availability of primary food sources of seabirds, such as sandlance and cod (that occur throughout Norton Sound), are not likely to be directly or indirectly affected by dredging activities because these highly mobile prey are likely to avoid the dredge plume. A NEGLIGIBLE effect on the availability of seabird-food sources is expected.

c. Effect of Trace Metals: Mercury and other trace metals particularly arsenic, cadmium, and lead are toxic to marine organisms and birds. Mercury, cadmium, and lead have no beneficial or essential biological functions even at trace or very low levels (<1 ppb or ppt). Other trace metals such as zinc, copper, nickel, and even arsenic are biologically essential elements--trace metals at low levels in marine organisms and in birds. These latter trace metals could become toxic to birds through accumulation in prey organisms if the metals reach very high levels in the birds (>several hundred ppm). Even at very high levels, the toxicity of the latter trace metals is minor due to the efficient excretion of excess amounts of the metals by the birds. Of the most toxic trace metals (mercury, lead, arsenic, and cadmium), mercury is the only one known to consistently biomagnify in the food chain (Lindberg et al., 1987). This means that the concentration of mercury greatly increases when it is taken up in marine organisms such as fish and clams from the water column and from the sediments, respectively, and, in turn, taken up into and concentrated in seals and birds that consume the clams and fish. Bioaccumulation is a more general term that means that some of the trace metal is taken up and retained by the animal but might not concentrate up the foodchain.

(1) Arsenic: Arsenic is a relatively common element that occurs in air, water, soil and in all living organisms. It has been demonstrated to be biologically essential in mammals at trace levels (0.35 mg/kg) (Eisler, 1988). Arsenic can biomagnify in the food chain in some cases (Mance, 1987); however, the biomagnified arsenic in marine organisms such as fish is predominately in an organic form which is less toxic



than inorganic arsenic (Bohn, 1975). Arsenic is far less toxic than mercury (lethal diet dosage in birds = 17-48 ppm arsenic/kg of body weight vs. 4 ppm mercury/kg of body weight) (Eisler 1988, 1987).

Arsenic levels measured 100 m downcurrent from the dredge operation were as high as 23.2 ppb and might affect some phytoplankton at this level but are expected to have little, or no effect on invertebrates or fish (see Secs. IV.B.3 and 4). At an average level of 11.0 ppb, arsenic does not exceed EPA chronic or acute criteria and is not expected to significantly bioconcentrate in marine food organisms of marine and coastal birds. Therefore, the effect on birds is expected to be NEGLIGIBLE.

(2) Mercury: The effect of mercury on marine and coastal birds was the primary topic in the following analysis because: (1) some elevated levels of mercury were reported in the beach sediments of Norton Sound (Nelson et al., 1975); (2) the disposal of metallic mercury has occurred in the Nome area over the past century in association with gold mining-processing; (3) mercury has a high potential to be converted from metallic or inorganic forms to methylated or other organic forms and to biomagnify up the food chain; (4) seabirds are near the top of the food chain and they are known to be highly sensitive to low levels (2-3 ppm mercury) of mercury exposure (Scheuhammer, 1987) and (5) significant declines in bird populations have been attributed to high mercury levels in the birds and in the environment.

We do not know the present levels of mercury in Norton Sound seabirds (of particular concern are the common murre from the Bluff colony population which has declined in the past 20 years). However, the bioaccumulation of mercury (methylation of inorganic and elemental mercury) is a natural process and is known to occur in the marine environment. The concern is with a potential manmade increase in the availability of mercury resulting in an increase in the methylation process through the dredging of bottom sediments containing mercury.

The seabird populations that forage within the proposed sale area and nest at Bluff or at adjacent colonies are the birds most likely to be exposed to the dredge plume and a potential increase in bioaccumulation of mercury in prey organisms that come in contact with the dredge plume and/or contact with excavated marine sediments. (Norton Sound sediments have been reported to contain up to 0.6 ppm-1.3 ppm mercury; Nelson et al., 1975.)

Because baseline levels of mercury in the common murre population is not known and in order to analyze the potential effects of the proposal, it is assumed that some mercury bioaccumulation and an increase in other trace metals in the food chain and ecosystem could occur. This assumption regarding an increase in mercury bioaccumulation is necessary to assess the potential consequences of dredging activities. (For another example, effects of an oil spill cannot be assessed unless you assume a spill occurs). It is also assumed that mercury levels in common murre that nest at Bluff are presently high ( $\geq 1$  ppm mercury in liver tissue, eggs, or young birds) and that mercury is at or near threshold levels at which an increase in mercury in the food chain could affect the population's productivity. This is not a worst-case assumption because existing mercury levels in the population could be well above threshold levels at present (1 ppm). Therefore, any increase in mercury in the population could be a significant additional stress on the population. Existing credible scientific information on the effects of mercury on birds is summarized below under Effects of Trace Metals. The specific effects of mercury bioaccumulation on birds in the Norton Sound lease area were assessed using current scientific theory and existing credible scientific research information (see Site Specific Effects of Trace Metals).

The excavation of sea-bottom material and sediments and the deposition of dredge tailings could result in the introduction or repartitioning of mercury into the water column and onto the sea-bottom surface. Mercury especially methylmercury, is highly toxic to marine organisms and birds (Armstrong, 1979; Scheuhammer, 1987; Ohlendorf, Risebrough, and Vermeer, 1978). Methylmercury is readily ingested and taken into the tissues of filter-feeding invertebrate benthos and readily absorbed through the gills of fish that might be exposed to mercury released from the dredged sediments containing mercury. Mercury is well known to bioaccumulate within marine ecosystems (Gardner et al., 1978; Scheuhammer, 1987; Lindberg et al., 1987).

Of all trace metals, mercury is by far the most toxic, especially methylmercury compounds, which have been shown to cause significant effects on bird reproduction and cause direct mortality. Ingested amounts of methylmercury as low as 2 to 3 ppm have significantly reduced reproduction in some bird species, while doses of only 33 ppm for 1 month have caused as much as 90-percent mortality in some bird species (Scheuhammer, 1987). Large doses of cadmium (48-200 ppm) were required to demonstrate reproduction effects on birds, while levels of lead below 100 ppm in the diet of birds usually caused few significant reproductive effects (Scheuhammer, 1987). Large doses of arsenic (17-48 mg/kg body weight) are required to cause lethal effects to sensitive bird species (Eisler, 1988).

The effect of mercury on birds does not depend directly on the concentrations released from the sediments during dredging operations but rather on the chemical nature of the mercury present within or released from the sediments. Metallic or inorganic mercury is much less toxic than methylmercury compounds, because only a small percentage of inorganic mercury that is ingested by the organisms is absorbed into the body, while nearly 100 percent of ingested methylmercury is absorbed into body tissues (Scheuhammer, 1987). However, metallic-inorganic mercury can easily be converted to methylmercury (organic compounds) and readily bioaccumulate or biomagnify within the food web of the ecosystem, increasing from less than 0.002 ppm to several ppm while transferring from sediments to plants, and then to filter-feeding invertebrates, to fish (or directly to the fish from the water column), and finally to seabirds and marine mammals (Gardner et al., 1978; Scheuhammer, 1987). The release of trace amounts of methylmercury into the marine environment from inorganic deposits or from metallic mercury contamination could significantly affect the reproduction and abundance of seabird populations that forage within that marine habitat. Seabird populations that forage outside of mercury contaminated areas could also be affected through the consumption of fish that have fed within mercury contaminated habitats. Other trace elements can modify the toxicity of methylmercury. Selenium can reduce the toxicity of methylmercury through the formation of stable, nontoxic mercury-selenium compounds that prevent the reaction of mercury with important biological enzymes (Sugiura et al., 1976, as cited by Scheuhammer, 1987). Mercury concentrations in the liver of marine mammals are highly correlated (associated) with selenium concentrations in the liver. Through association with selenium, mercury can accumulate in liver tissue without exerting any apparent toxicity (Risebrough, 1978). However, ingested mercury can be easily transferred from the female to the developing embryo or egg which is more sensitive than the adult to mercury poisoning. The bioaccumulation of mercury and selenium in the liver of birds could indicate the production of mercury-selenium detoxification compounds as apparently occurs in marine mammals (Scheuhammer, 1987). However, the presence of a mercury-selenium detoxification capability in birds is not well established; some birds species may possess this ability, while others may not. The ability to detoxify mercury would also vary with the health of individual birds and vary with the exposure of the population to other environmental stress factors, such as a reduced food supply.

High levels of mercury in ecosystems probably are attributed to both human activities, such as mining, and to natural geologic sources such as cinnabar.

**Site-Specific Effects of Mercury:** An estimated 12,500 to 15,000 m<sup>3</sup> of seafloor would be excavated daily by the one dredge during the 100- to 150-day mining season (May-November), and an estimated 20 million m<sup>3</sup> of seafloor would be excavated over the 14-year life of mining operations in the proposed lease area. Average dredge-excavation depth was estimated to be 3.6 m. The excavation and deposition (redistribution) of this amount of sea-bottom material and sediments are sufficient to mobilize and repartition mercury, and mercury compounds into the water column and onto the benthic surface, where this mercury could be ingested and absorbed into marine organisms.

Concentrations of mercury (the metallic form) of both human (gold mining) and natural origin (cinnabar ore), are present in the Nome/southern Seward Peninsula area. The marine environment of Norton Sound, particularly the Nome area, has been exposed to mercury contamination from gold processing through runoff from contaminated soil and from streams where gold dredging has occurred for decades. Sea-bottom sediments constitute the principle sink or deposition area for mercury (Birge et al., 1979). Much of this mercury probably is in metallic or inorganic form. However, inorganic or metallic mercury in the sea-bottom sediments (up to 0.6-1.3 ppm) that could be dredged can be readily acted upon by micro-organisms and/or chemically converted to methylmercury compounds that are highly absorbable and toxic to marine organisms and that readily bioaccumulate in the ecosystem (Windom and Kendall 1979; Silver 1984). Therefore, dredging operations associated with gold mining in the Norton Sound proposed lease-sale area have the potential of increasing the exposure of marine organisms and seabirds to mercury. However, mercury levels in the water column associated with current dredging are low (1-2 ng/L, Sec. IV.B.2.) indicating that very little mercury is being released from the sediments.

The effect of mercury contamination on seabirds depends on: (1) the form in which the mercury is in when exposure occurs (methylmercury is the most toxic form at low levels, 2-3 ppm); (2) the species of bird contaminated; and (3) the presence or deficiency of other trace elements or metals in the birds such as selenium which, in the case of methylmercury contamination, helps to alleviate the toxicity (Fimreite, 1979; Scheuhammer 1987). If dredging operations excavate sea-bottom sediments with high or elevated levels of mercury (up to 0.6-1.3 ppm in sediments), some contamination and bioaccumulation of mercury compounds in marine organisms and birds is considered likely to occur. A chronic increase in mercury bioaccumulation from the above level of dredging activity could potentially contribute to a significant decline in reproduction and nesting survival for the seabird populations at Bluff, Safety Lagoon, or other local bird populations that forage within the proposed sale

area. Part of the mercury in sediments recorded in the Nome area is expected to bioaccumulate through the food-chain from the sediments and water column to plankton and benthic invertebrates, to fish and to seabirds; and increase in seabird tissues. Mercury doses as low as 2 to 3 ppm can significantly reduce reproduction in some bird species (Scheuhammer, 1987).

However, recent accurate data on water chemistry mercury levels in Norton Sound, including measurements taken near current dredging, indicate that mercury levels in the water do not exceed the EPA chronic criterion standard and that very little mercury is being released from the sediments (Sec. IV.B.2). This recent finding indicates that there would not be any significant increase in mercury bioaccumulation in the food chain or in marine and coastal birds associated with the proposal. Similar low mercury levels are expected to be measured in the water when dredging occurs in Federal OCS waters under the proposal; the effect of mercury on marine and coastal birds is expected to be NEGLIGIBLE.

The implementation of Stipulation No. 1 (an effective monitoring and operations control program) and Stipulation No. 2 (prohibition of the use or storage of mercury onboard the dredge) is likely to prevent any significant increases in mercury or other trace metals from occurring in birds and in the marine environment of Norton Sound as a result of the proposed action.

(3) Lead: This trace metal does not biomagnify in the food chain but it is neither essential nor beneficial to living organisms (Eisler, 1988). The most known effects of lead on birds are through the direct ingestion of metallic lead (lead shot) with significant effects on reproduction and survival (for example 50 ppm). It is unlikely that lead effects on marine and coastal birds would come through the marine food chain in association with the proposed or current dredge operations because the increased levels associated with the dredging, including the highest concentrations (13.4 ppb), would be rapidly diluted beyond the dredge plume. Thus, the effects of lead on marine and coastal birds are expected to be NEGLIGIBLE.

(4) Copper: Copper is an essential element required for a wide range of metabolic processes in living organisms (Bremner, 1979). However, some benthic invertebrates such as oysters bioaccumulate copper in high concentrations without significant mortality (see Secs. IV.B.3 and 4). In general, filter feeding bivalve mollusks concentrate the highest levels of copper and vertebrates the lowest amounts (Eisler, 1979). Although current dredging operations had exceeded EPA criteria for copper (see Sec. IV.B.2), and some sensitive invertebrates and fish are likely to be affected within 100 m of the dredge (see Secs. IV.B.3 and 4) significant effects on food sources or direct effects on marine and coastal birds are very unlikely to occur. Marine and coastal birds do not feed on benthic invertebrates in the proposed sale area but rather on pelagic prey that generally do not concentrate copper; copper accumulation in marine food chains from pollution sources in other marine areas is not known to have population effects on birds as mercury has had. Thus, effects on marine and coastal birds from copper are expected to be NEGLIGIBLE.

(5) Nickel: Nickel is believed to be an essential element that is important in the physiology of living organisms (Nielsen, 1971); thus, the toxicity of nickel to marine organisms and birds is related to concentrations generally much higher than nonessential elements such as mercury. Although nickel levels measured within 100 m of current dredge operations had exceeded EPA criteria, the levels measured near the dredge are below the levels where effects on invertebrates and fishes are likely to occur (see Secs. IV.B.3 and 4). Thus, no significant effects on the food chain and no significant accumulation of nickel in the prey of marine and coastal birds are expected to occur. The effects of nickel on marine and coastal birds are expected to be NEGLIGIBLE.

(6) Cadmium: Cadmium bioaccumulates in the food chain and is not a biologically essential or beneficial element. Birds are comparatively resistant to the biocidal properties of cadmium (Eisler, 1985). Cadmium is at least 10- to 100-fold less toxic than mercury (lethal diet dose in mammals = 150 to 250 mg cadmium/kg of body weight vs. 1-5 mg mercury/kg of body weight). Neither projected discharges of cadmium from the proposed sale nor reported concentrations near the current dredge operations are large enough to exceed EPA criteria (see Sec. IV.B.2). Thus, the effects of cadmium on marine and coastal birds are expected to be NEGLIGIBLE.

(7) Chromium: Chromium has been demonstrated to be an essential trace element in humans and in some laboratory animals and no biomagnification of chromium has been observed in food chains (Eisler, 1986). No effects were observed in birds fed diets with up to 100 ppm Chromium with a +6 valence (Cr+6) for 32 days (Rosomer et al., as cited by Eisler, 1986). However, ducklings fed diets containing 10 or 50 ppm showed changes in growth and reduced survival (Haseltine et al., 1985, as cited by

Eisler, 1986). Because levels where effects on birds might occur are high, and because chromium does not biomagnify in the food chain, adverse effects on marine and coastal birds are not expected. Neither projected discharges of total chromium from dredged sediments (2.9-6.7 ppb) nor concentrations reported from the current dredge operations exceed EPA criteria. Thus, effects of chromium on marine and coastal birds are expected to be NEGLIGIBLE.

d. Effect of a Fuel Spill: The effects of oil spills on birds are well-documented. (For a detailed discussion of the nature of these effects, refer to Alaska OCS Technical Paper No. 3, Hansen, 1981, which is summarized here and incorporated by reference). Direct oil or diesel-fuel-oil contact is usually fatal or, in addition to indirect effects, results in substantial mortality. Oiling of birds causes death from hypothermia, shock, or drowning. Oil ingestion through preening of oiled feathers significantly reduces reproduction in some birds and causes various pathological conditions. Oil contamination of eggs by oil-fouled feathers of parent birds also significantly reduces egg hatching.

Potential indirect effects of oil pollution could include reduction, contamination, and displacement of food sources, as well as contamination of habitat. A sudden diesel-spill-related, local adverse effect on major food sources that occurs during a migration stopover period, or during the nesting period could lower reproduction and survival of bird populations that depend on that food source.

If a spill event occurred during the egg-laying or chick-rearing period for seabirds and reduced the availability of key forage species such as sandlance, the productivity or nesting success of seabirds within an area could be reduced for that season. However, a fuel spill is not likely to have measurable effects on fish populations even in a local area for more than one season (or year).

Site-Specific Effects of a Fuel Spill: An assumed fuel spill occurring in association with offshore-mining activities, is assumed to be 3,500 bbls of diesel fuel (see Sec. IV.B.2). The oil slick from the fuel-spill site could cover about .5 to .6 km<sup>2</sup> of ocean surface as continuous slick within 3 days or could move over 150 km<sup>2</sup> from the spill site (Table IV-10). Such a spill has a estimated 32-percent chance or greater of contacting important coastal habitats of marine and coastal birds such as Safety Sound within 3 days of spill release (USDOJ, MMS, 1985, Appendix A, Table 6, Land Seg. 52, Spill Pt. E-9 and Graphic 12). If the diesel spill were released from the dredge on the beach, such as the sand spit bordering Safety Lagoon, most of the fuel would evaporate or be dispersed during the storm (that caused the dredge wreck) by wind and waves. Some of the fuel spill would enter the sound through flooding and wave action over the spit. A small portion of the marsh-wetlands within the sound could be contaminated, but most of the marsh land is not likely to be contaminated. If the spill occurs during the summer months (June-September) several hundred to perhaps a few thousand birds could be killed but such a loss of common species is likely to be replaced within less than one generation (MINOR effect). If local coastal wetlands were contaminated, the indirect effects of habitat pollution on marine and coastal birds are expected to persist for less than one generation of marine and coastal birds and thus represent a MINOR effect.

SUMMARY: An estimated 360 to 450 helicopter flights between Nome and the dredges is assumed to occur each year under the proposal. This air traffic is likely to be the primary source of noise and disturbance that could affect local populations of marine and coastal birds in the Nome area. Offshore-air traffic would unavoidably disturb some feeding flocks of seabirds but these events would be very brief (a few minutes) and are not likely to affect seabird-feeding success (a NEGLIGIBLE effect). During poor weather conditions, air traffic could follow the coast and pass near some coastal concentrations of waterfowl and shorebirds at Safety Sound. On these occasions, air-traffic disturbance, although very brief (a few minutes or less), could reduce migration fitness and winter survival of some waterfowl or shorebirds for that year (a MINOR effect), but such disturbance events are likely to be infrequent and not affect overall abundance and distribution of bird populations.

An estimated 1,300 acres or 5.3 km<sup>2</sup> of sea bottom are assumed to be dredged over the life of the proposal--an area representing less than 1.0 percent of the proposed lease area. Benthic habitat alteration over an adjacent 5 to 8 km<sup>2</sup> represents a very small portion of the sale area. The temporary changes in water turbidity within about 3 km of the active dredge is not expected to affect the overall abundance and availability of primary mobile food sources of marine and coastal birds such as sandlance and cod that are widely distributed throughout Norton Sound (a NEGLIGIBLE effect).

An estimated 12,500 to 15,000 m<sup>3</sup> of seafloor is assumed to be excavated daily by the one dredge during the 100- to 150-day mining season (May-November) and 20 million m<sup>3</sup> of seafloor over the 14-year life of the

project. This excavation and deposition of sea-bottom material is sufficient to mobilize and repartition mercury in the marine environment and could increase bioaccumulation of this trace metal in marine and coastal birds. The levels of arsenic, chromium, lead, cadmium, copper, and nickel measured in association with current dredge operations are expected to have NEGLIGIBLE effects on marine and coastal birds. Similar levels are expected to be measured in association with the proposal under the monitoring program (Stipulation No. 1).

Mercury is by far the most toxic of the trace metals present in the Nome area and comes from both natural and manmade sources (onshore-gold processing). Mercury levels as low as 2 to 3 parts ppm are capable of reducing reproduction rates in some bird species. High elevated levels of mercury (1.3 ppm in beach sediments) of both human (gold mining) and natural origin (cinnabar ore) are present in the Nome/southern Seward Peninsula area. Dredging operations could release or repartition elevated concentrations of mercury in the marine environment, and some bioaccumulation of mercury compounds in local seabird populations that forage in the sale area is possible. Potential chronic release of low levels of mercury over the 100- to 150-day mining season for the 14-year life of the project could cause some increased bioaccumulation of mercury in the marine environment of the Nome area.

However, recent data on water chemistry mercury levels measured near current dredging indicates that the mercury levels in the water do not exceed the EPA chronic criterion standard and indicate that there would not be any significant increase in mercury levels in the marine environment associated with the proposed action. Similar low mercury levels are expected to be measured in the water during Federal OCS mining; the effect of mercury and other trace metals on marine and coastal birds is expected to be NEGLIGIBLE.

An assumed fuel spill occurring in association with offshore-mining activities is assumed to be 3,500 bbls of diesel fuel. Such a spill has an estimated 25-percent chance or greater of contacting important habitats of marine and coastal birds within 3 days. A spill during the summer months (June-September), could kill several hundred to perhaps a few thousand birds (MINOR effect). The local contamination of wetlands used by marine and coastal birds is expected to persist for less than one generation due to the rapid evaporation and dissipation of the fuel oil and represent a MINOR effect.

**CONCLUSION (Effect on Marine and Coastal Birds):** The effect of the proposal on marine and coastal birds is expected to be MINOR.

**CUMULATIVE EFFECTS:** The additive effects of past, present, and reasonably foreseeable future actions as well as the proposal on marine and coastal birds are discussed in this section.

The following offshore and onshore projects have potential noise and disturbance, and habitat-alteration effects on marine and coastal birds: offshore mining of the proposal, State offshore mining, previous and future Federal OCS oil and gas lease sales in Norton Sound, onshore and coastal development projects (including ongoing mining projects in the Norton Sound area) and commercial fishing operations.

**Effect of Offshore Mining:** The proposal is assumed to include the dredging of 3.2 to 6.5 km<sup>2</sup> of sea bottom in Norton Sound over the life of the mining leases as discussed above. At present, WestGold is mining for gold on 8,802 hectares (21,741 acres) of offshore State of Alaska leases near Nome and a small dredge has been operating in the Nome harbor dumping 13,000 yd<sup>3</sup>/year of dredge spoil near the mouth of the Snake River. The latter dredge spoil has been contaminated with mercury (see discussion in Sec. IV.A.3). Cumulative mining operations could include, for example, the dredging of a total of 15 to 30 km<sup>2</sup> of sea bottom (or about 4-8% of the sale area) near Nome and along the southern coast of the Seward Peninsula (Fig. IV-1). These activities would represent a small incremental (8%) significant change in benthic habitat within the proposed sale area. This localized habitat alteration of benthic organisms is not likely to reduce the availability of pelagic prey of seabirds along the coast of the Seward Peninsula except temporarily (one season) within the dredge plume. Existing leases and planned and ongoing dredging operations by WestGold occur west of important seabird and waterfowl habitats at Safety Lagoon and Bluff and east of the seabird colony on Sledge Island (Fig. IV-1). Thus, existing offshore-mining operations probably are having no effect on food-source availability to marine and coastal bird populations at these colonies. However, cumulative dredging of, for example, 30 mi<sup>2</sup> of sea-bottom sediments, including the possible dredging of beach sediments/gravel offshore of the seabird colony at Bluff on existing State lease holdings (see Fig. IV-1), could result in an increase in concentration levels of mercury and other trace metals within marine organisms and food sources of marine and coastal birds. Increased bioaccumulation of mercury or other trace metals in seabirds could occur as a result of cumulative offshore mining, but increases in levels of mercury in bird tissues would vary between bird species and individual birds

depending on what type and amount of particular food organisms are consumed. These levels also would vary greatly depending on the molecular form of the mercury concentration when consumed by the birds.

Because seabirds in the Nome area, particularly at Bluff, are exposed to natural mercury levels from cinnabar deposits, one may speculate that this seabird population is adapted to mercury within its environment. However, cumulative offshore dredging could increase mercury concentrations in seabirds beyond threshold levels at which symptoms of mercury poisoning occur. Seabird tolerance to accumulations of mercury or other trace metals is likely to vary from species to species, and from individual bird to individual bird depending on age, sex, and physiological condition. Mercury contamination could cause significant declines in reproduction; also, mercury may be stored in the liver in nontoxic form and excreted in the feathers (Scheuhammer, 1987; Honda, Nasu, and Tatsukawa, 1986).

At relatively low levels (13-33 ppm) mercury contamination in birds can cause direct mortality and at lower levels (2-3 ppm) cause significant reduced reproduction (Scheuhammer, 1987). The cumulative effect of mercury contamination due to offshore mining is uncertain. Effects from increased levels of mercury could truly be NEGLIGIBLE if local seabird populations are tolerant of mining-related increases of mercury levels in the ecosystem, or the cumulative effect could cause a significant decline in abundance of local seabird populations at Bluff or Safety Sound that could persist for several generations (a MODERATE effect). Present mercury levels in seabirds in the Norton Sound area are unknown. The extent of mercury contamination from dredging of perhaps 10 to 30 km<sup>2</sup> of sea bottom excavated from both State of Alaska and proposed Federal leases is not likely to significantly contaminate marine organisms or seabird food sources over a large portion of the Norton Sound region. However, some increase in the bioaccumulation of mercury in local seabird populations in the Nome area could occur and contribute to reduced reproduction and local abundance of seabirds that could persist over the next 15 to 20 years (expected cumulative life of mining operations) representing a long-term (several generations of seabirds) effect on a portion of the regional population (MODERATE effect).

The estimated 360 to 450 annual helicopter flights between Nome and the gold dredge used under the proposal could double or triple the potential amount of aircraft traffic that marine and coastal birds could be exposed to in the proposed sale area. However, existing WestGold dredging activities and subsequent aircraft (helicopter) traffic do not transect or pass near important local seabird colonies at Bluff, Sledge Island, or Safety Sound. Thus, aircraft or other noise and disturbance (vessel and dredge traffic) from existing offshore mining is not expected to increase the potential noise and disturbance effect level over that described for the proposal (MINOR effect).

If gold dredging is allowed to occur on State lease holdings at Bluff, noise and disturbance from dredging and associated helicopter traffic could result in long-term effects--several years or more than one generation--on this local seabird population (MODERATE effect).

Effect of Federal OCS Oil and Gas Activities: Potential oil spills and aircraft traffic are the primary sources of cumulative effects associated with OCS oil and gas activities in Norton Sound on marine and coastal birds. OCS oil and gas exploration in Norton Sound from Oil and Gas Lease Sale 57 included the use of two drill platforms for one season (June-October) and one drill platform for a second season with about two helicopter trips per day per platform, (see Table IV-2a). This low level of air traffic and exploration activity has had a minimal effect on marine and coastal birds in Norton Sound. Further exploration from a potential future oil and gas lease sale is likely to have similar levels of air traffic. If oil were discovered in Norton Sound, this air traffic would increase in volume and duration. The incidence of aircraft disturbance of marine and coastal birds would be expected to increase slightly over that caused by other projects. The level of effect is still likely to be short term (less than 1 year) and local (within 1 mi of the aircraft). Potential oil spills that could be associated with OCS oil and gas exploration and development in Norton Sound pose the greatest concern to birds. Oil spills could have a long-term (more than one to several generations) (MODERATE) effect on local abundance or distribution of sensitive seabirds and waterfowl in Norton Sound (USDOJ, MMS, 1985). Sale 57 oil and gas exploration activities in Norton Sound did not result in any major oil spills. Thus, OCS oil and gas exploration activities have had a NEGLIGIBLE effect on marine and coastal birds; any further exploration in the area is also expected to result in NEGLIGIBLE effects.

Effect of Onshore and Coastal Development: Primary onshore and coastal development in the Nome area have been associated with placer gold mining both in the past and at present. Historically, up to 45 different gold dredges have operated at some time around Nome. The primary effect associated with past and present placer gold mining in regard to marine and coastal birds is potential mercury repartitioning and mercury contamination of coastal and marine habitats. The recovery of gold through the use of mercury used to occur

on the dredges but now occurs only at the gold house. A typical gold dredge had several thousand pounds of liquid mercury onboard for gold processing. A considerable amount of mercury was discharged into the streams, onto the ground around the dredge, and around gold recovery houses. Water runoff from mercury contaminated soil, stream sediments, and dredge spoil eventually reached the marine environment.

Although metallic mercury is not readily absorbed by biological organisms, natural chemical processes convert the metallic mercury to compound molecular forms that are acted on by bacteria and are readily absorbed by plants and animals (Fimreite et al., 1971). Willows and other plants growing on soils with less than 1 ppm of mercury readily concentrate mercury (Warren, Delavault, and Barakso, 1966). Natural deposits of mercury ore, such as cinnabar, are often present in association with gold deposits. Cinnabar (mercuric sulphide) can be readily converted to methylmercury by bacteria and made absorbable in other biota (Fagerstrom and Jernelov, 1971). Dredging of streambeds and gold bearing beach-gravel deposits could repartition natural mercury compounds in terrestrial and coastal habitats, thus increasing the uptake of mercury into plants and animals including marine and coastal birds.

Ongoing placer gold mining near Nome occurs on 17,000 acres of patented mining claims with 75 acres disturbed per year (Table IV-2a). Currently two dredges are operating in this area (see Sec. IV.A.2). Exploration for gold deposits is occurring in the Rock Creek area about 10 mi northwest of Nome and in the Bluff area within about 1 km of the important seabird-nesting colony at Bluff (Figs. III-17 and IV-1). The seabird-nesting cliffs at Bluff contain natural deposits of cinnabar (mercury ore). If significant economic gold deposits are discovered in the Bluff area, a serious conflict between gold mining interests and protection of the seabird colony site could occur. However, the Bluff seabird nesting cliffs are part of the Alaska Maritime National Wildlife Refuge and are expected to be given adequate protection based on National Wildlife Regulations.

Current and past gold mining activities in the Nome area might have increased the level of mercury in the marine and coastal bird environment of northern Norton Sound. The present level of mercury in Norton Sound marine and coastal birds is unknown. Natural deposits of mercury ore (cinnabar) probably contribute to the level of mercury present in terrestrial and marine organisms and in seabirds. Elevated mercury levels ( $> 1$  ppm) are found in soils near mineral deposits of mercury, and vegetation growing in the soils readily concentrates the mercury in plant tissues (Warren, Delavault, and Barakso, 1966). Inorganic mercury in soils may be transformed to methylmercury with or without bacterial action (Rogers, 1976). Onshore gold mining/processing and geologic mineral deposits in the Nome area probably represent the primary cumulative source of mercury in benthic sediments within the proposed sale area that may be released into the water column and dredge plumes. Both the natural and manmade sources of mercury in benthic sediments pose a potentially serious toxic effect on marine and coastal birds inhabiting the Norton Sound area. It is not unreasonable to speculate that marine and coastal birds exposed to mercury coming from natural sources such as cinnabar deposits in the Bluff area are tolerant towards some bioaccumulation of mercury within their food sources and, subsequently, within themselves. However, there is likely to be an upper threshold of mercury bioaccumulation at which significant symptoms of mercury poisoning occur and adversely affect the survival of contaminated birds and their populations. Tolerance of mercury bioaccumulation, as well as sensitivity to the toxicity of mercury, varies greatly with species of bird, age, reproductive status, and physiology (Scheuhammer, 1987). The cumulative effect of increased levels of mercury in the marine environment on marine and coastal birds can only be estimated or predicted by long-term monitoring of mercury in bird populations and in the marine environment. At present, marine and coastal birds that seasonally inhabit the northern Norton Sound area could be under some level of physiological stress (body burden-mercury contamination) from both natural and manmade sources of mercury. The murre population at Bluff has declined dramatically in the past 20 years. An incremental increase in mercury due to offshore dredging from the proposal and State of Alaska mining leases could result in an incremental increase in total environmental stress on the population.

**Overall Cumulative Effect:** Cumulative, onshore gold mining has resulted in some increase in toxic metal (mercury) levels in the coastal environment of the Nome area. Cumulative State of Alaska and Federal OCS proposed offshore mining could increase the availability of or repartition natural mercury and manmade mercury contaminants present in the marine sediments of Norton Sound, thus increasing the bioaccumulation of mercury and other potentially toxic trace metals in marine organisms including marine and coastal birds. Assuming that significant bioaccumulation occurs, mercury levels in some local populations of marine and coastal birds (at Safety Sound or Bluff) could exceed the threshold tolerance level of the population and result in a long-term (several generations) reduction in the productivity in local bird populations (a MODERATE effect).

Cumulative offshore dredging associated with State of Alaska and proposed Federal OCS mining would result in the alteration of local seabird habitats of several square miles near active dredging operations. However, this



effect on the availability (one season or less) of pelagic and plankton prey items of seabirds is likely to be short term because of the rapid recruitment and high dispersal rates of these prey populations (MINOR effect). Benthic infauna, such as clams, that are more affected by dredging are not primary food items of marine and coastal birds.

Cumulative noise and disturbance of marine and coastal birds primarily would be from aircraft traffic along the coast of Norton Sound. Both State of Alaska and Federal OCS mining and oil and gas activities could result in several hundred or more helicopter flights per year during the seabird-nesting season and fall-feeding and -molting periods. This air traffic is likely to have some short-term (less than one season or less than one generation) effect on nesting, feeding, and molting birds within a mile of the air traffic if and when the aircraft pass near seabird colonies or near coastal concentrations of waterfowl and shorebirds (a MINOR effect). Air traffic would vary in direction, route of travel, and number of aircraft involved. Different populations or assemblages of seabirds, waterfowl, and shorebirds are likely to be affected by different disturbance events. Such disturbance events are not likely to be additive to the same bird population; thus, long-term (more than one generation) displacement of birds or significant reduction in reproduction of local bird colonies are not expected. However, if dredging operations occur on State lease holdings offshore of Bluff, long-term noise and disturbance (MODERATE) effects on this local population could occur.

Potential oil spills that could be associated with OCS oil and gas exploration and development in Norton Sound pose the greatest concern to birds. Oil spills that could be associated with OCS oil and gas activities could have a long-term (more than one to several generations) (MODERATE) effect on local abundance or distribution of sensitive seabird and waterfowl populations in Norton Sound (USDOI, MMS, 1985a). However, up to this time, Sale 57 oil and gas exploration activities in Norton Sound and exploration in other OCS areas have not resulted in any major oil spills.

**Summary:** Cumulative development activities in the Norton Sound area could have some long-term (more than one generation to several generations) (MODERATE) effect on local populations of seabirds at Bluff and waterfowl and shorebirds at Safety Sound. This effect could be associated with increases in the release of toxic trace metals (especially mercury) from the sediments to marine organisms and to bioaccumulation of mercury in seabirds from their food sources through mercury uptake by fish and invertebrates from the water column and sediments. Cumulative sources of mercury include past onshore gold mining, State offshore dredging, the proposal, and natural sources of mercury in the environment. Cumulative increases in mercury levels in local bird populations could result in direct mortality of highly contaminated birds but are more likely to result in some significant reduction in reproductive rates in the contaminated population (MODERATE effect). Potential oil spills that could be associated with possible OCS oil and gas development in the future could also have a MODERATE effect on marine and coastal birds, but such oil-spill effects are unlikely to occur. Physical alteration of habitats from dredging and dredge-plume turbidity are likely to have a short-term (one season or less than one generation) (MINOR) effect on the availability of marine and coastal bird prey. Cumulative air traffic is likely to have no more than a MINOR noise and disturbance effect on marine and coastal bird populations. However, noise and disturbance related to mining activities (especially if it occurs near the Bluff seabird colony) could have MODERATE effects on the murre and kittiwake populations if the dredging occurs throughout the nesting season for several years.

The potential MODERATE effect on seabirds from mercury bioaccumulation together with potential MODERATE effects from oil spills (including potential fuel spills from the dredges), and MINOR effects from noise and disturbance associated with air and vessel traffic from the above projects (plus potential MODERATE noise and disturbance effects from possible dredging adjacent to the Bluff seabird colony on State of Alaska leases) are expected to have a combined MODERATE effect on marine and coastal birds in the Norton Sound area.

**Conclusion:** Cumulative effects on marine and coastal birds is estimated to be MODERATE.

**Cumulative Effects on Migratory Species--Marine and Coastal Birds:** The additive effects of other ongoing and future development occurring beyond Norton Sound and OCS planning areas in Alaska within the summer and winter ranges of migratory birds are discussed in this section. The following development activities do have actual or could have potential habitat destruction, environmental contaminants, and direct mortality effects on migratory waterfowl, seabirds, and shorebirds that summer in the Norton Sound area. The effects described above under cumulative effects apply, as appropriate, to the following migratory species. Because of the added geographic range of migratory species, they are subject to the following additional effects.

**Effect of Habitat Loss from Agriculture and Other Development on Migratory Waterfowl Along the Pacific Flyway and on Winter Range:** The populations of four species of geese: cackling Canada geese, emperor geese, white-fronted geese, Pacific brant, and dabbling ducks (such as the common pintail) have declined drastically over the past 25 to 30 years (93%, 50%, 84%, and 17% declines, respectively, for the above geese populations) due in part to the loss of wetland habitats on the winter range of these populations. Agricultural development, the filling of wetlands in California (over 600,000 acres or more lost per year in the contiguous United States), and the loss of more wetlands to urban development (subdivisions, shopping centers, airports, and factory complexes) in Washington and Oregon have contributed to the loss of wetland habitat. The further loss of wetlands and other winter range feeding habitat is expected to continue to reduce the habitat carrying capacity for regional migratory waterfowl populations for several generations (MAJOR effect) or indefinitely. Although there will continue to be abundant nesting habitat for the above geese and duck populations in Alaska, with high recruitment of young birds, the reduction in the amount of winter range and habitat carrying capacity is expected to limit or prevent the recovery of these waterfowl populations. Even reducing hunting pressure on these waterfowl populations is not likely to completely reverse the trend in continued population declines due to loss of winter range habitats.

**Effect of Increased Hunting Pressure on Migratory Waterfowl:** The hunting of waterfowl particularly cackling Canada geese, white-fronted geese, emperor geese, and Pacific brant, on both the summer (Yukon-Kuskokwim Delta) and winter range (California) and along the Pacific Flyway (British Columbia, Washington, and Oregon) has increased as these areas became more populated and interest in hunting waterfowl increases. Hunting pressure has undoubtedly contributed to the declines in these geese populations over the past 25 to 30 years. However, current cooperative management of waterfowl hunting by the Yukon-Kuskokwim Delta villages and FWS has greatly reduced the loss of geese recruitment on the summer range. The excessive mortality of waterfowl due to hunting is likely to be a short-term (less than one generation), MINOR effect in the future if cooperative management of hunting in Alaska continues and enforcement of sports hunting regulations along the Pacific Flyway remains diligent.

**Effect of Environmental Contamination from Industrial Development:** Migratory waterfowl that occur in the Norton Sound area can be affected by environmental contaminants (lead, selenium, insecticides and other toxic organochlorine pollutants) on their winter range. Agricultural and industrial activities in California adjacent to some remaining wetlands (wildlife refuges) have resulted in the contamination of the wetlands with high concentrations of selenium and other toxic substances that have resulted in the deaths of several thousand waterfowl and the long-term (several generation) contamination or poisoning of winter range habitat. Such contamination reduces the winter survival of migratory waterfowl and shorebird populations that use this habitat. The effect is expected to last for generations (MAJOR effect).

The use of lead shot in the hunting of migratory waterfowl has been a contributing factor in the reduction of waterfowl populations (nesting success) through the ingestion of spent lead shot by the birds in wetland areas. Ingested lead shot is readily absorbed/digested by female ducks during the egg laying period when they are calcium deficient (lead is taken up to replace the calcium in the bird). Further restriction and the eventual elimination of lead shot in waterfowl hunting should eventually alleviate or eliminate the poisoning problem (estimated MODERATE effect).

**Effect of Oil Spills from Marine Vessel Traffic:** The direct mortality of seabirds and waterfowl from oil spills associated with oil tanker traffic and other marine vessel fuel spills (including fishing vessels and barge traffic) in the Bering Sea, Gulf of Alaska, and along the Pacific coast is well documented. The recent tanker spill in Prince William Sound has killed tens of thousands of seabirds and seaducks. Large tanker spills (100,000 bbls or greater) and smaller oil spills (such as 10,000 bbls) from large fish-processing vessels can kill very large numbers of seabirds (100,000 or more) depending on the location and season. Such spills can have long-term (more than one to several generation) MODERATE effects on portions of the migratory seabird populations occurring in Norton Sound and the northern Bering Sea.

**Effect of Commercial Fishing in the North Pacific:** Seabird mortalities due to marine oil spills are additive to the losses of seabirds that occur from the high seas (foreign) driftnet fishery in the North Pacific, Bering Sea, and Gulf of Alaska where an estimated 500,000 or more birds are incidentally killed each year. Such losses occur over a large geographic area in the North Pacific and probably do not seriously reduce the number of seabirds that nest at a particular colony. However, an increase in the intensity of the fishing effort could increase the take of seabirds. The growing exploitation of bottomfish, such as the pollock fishery in the Bering Sea and Gulf of Alaska, could significantly reduce the availability of prey to some seabird populations if pollock stocks are overharvested in the future. The present level of pollock harvest in the Bering Sea and Gulf of Alaska has

apparently contributed to the recent drastic decline of northern sea lion populations in the southern Bering Sea and the Gulf of Alaska (Perez and Loughlin, 1989).

**Overall Interregional Cumulative Effects:** Migratory waterfowl populations that have been and continue to be affected by cumulative development on both the summer and winter ranges include cackling Canada geese, emperor geese, white-fronted geese, Pacific brant and dabbling ducks such as pintails. These waterfowl populations have declined drastically over the past 25 to 30 years due to the loss of wetland habitats on their winter ranges in California and other Pacific coast states due to agricultural and urban development. Further loss of wetlands and other feeding habitat on the winter ranges is expected to continue in the near future (over 600,000 acres are lost each year in the contiguous United States) reducing the carrying capacity of the range of these regional waterfowl populations for several generations (MAJOR effect). The overharvest of migratory waterfowl that nest in the Norton Sound/Yukon-Kuskokwim Delta area has been a contributing factor in the decline of the geese populations. However, current cooperative management of waterfowl hunting in Alaska by Yukon-Kuskokwim villages and the Fish and Wildlife Service has greatly reduced the loss of geese recruitment on the summer range. Future migratory waterfowl hunting is likely to have a short-term (less than one generation) MINOR effect if cooperative management of waterfowl hunting on the Delta continues and if enforcement of sports hunting regulations along the Pacific Flyway remains diligent. Migratory waterfowl that occur in the Norton Sound area can also be affected by environmental contaminants (lead, selenium, insecticides and other toxic organochlorines) on their winter range in California, Mexico, and the Pacific Northwest. Such agricultural and other industrial pollutants contaminate adjacent wetland habitats and poison thousands of waterfowl each year. These habitat and population effects are likely to persist for several generations and can affect an entire regional population (MAJOR effect).

Oil spills from oil and gas development, marine vessel traffic and commercial fishing are the main types of development activities affecting migratory seabird populations that occur in Norton Sound. Large oil spills such as the Prince William Sound spill and smaller fuel spills from large fishing vessels can kill very large numbers of seabirds (100,000 or more) depending on the location and season. Such spills can have long-term (more than one to several generation) effect (MODERATE) on portions of the migratory seabird populations occurring in Norton Sound. Seabird mortalities due to oil spills are additive to the losses of seabirds that occur from the high seas driftnet fisheries in the North Pacific where an estimated 500,000 or more birds are incidentally killed each year. Although such losses occur over a large geographic area, an increase in the intensity of the fishing effort would increase the take of seabirds. The growing exploitation of bottomfish such as the pollock in the Bering Sea and Gulf of Alaska could significantly reduce the availability of prey to some seabird populations if the pollock stocks are overharvested in the future.

**Summary:** Interregional cumulative effects on migratory waterfowl populations occurring in Norton Sound have been and are expected to be MAJOR. The primary contributing factors to this effect are the loss of wetland and other habitats on the winter range of regional populations of geese and ducks and the contamination of some of the remaining wetlands by pollutants (insecticides, selenium, and toxic compounds and toxic trace elements) from adjacent agriculture and industrial development in the Pacific coast states. The effect of the hunting overharvest of waterfowl on the summer range and fall flyway has been a MODERATE to MINOR effect. The cumulative effect on migratory seabirds is expected to be MODERATE. The primary contributing factors to this effect are oil spills (tanker, crude oil, and fuel oil) from marine vessel traffic and mortality from commercial fishing nets. The contribution of the proposal to cumulative effects on migratory waterfowl and seabirds from additional noise and disturbance is expected to be MINOR.

**Conclusion:** Cumulative effects from activities within the Norton Sound area combined with other activities within the range of migrating birds are expected to be MAJOR on migratory waterfowl and MODERATE on migratory seabirds.

**6. Effect on Nonendangered Marine Mammals:** The following nonendangered marine mammals--Pacific walrus, spotted, bearded, and ringed seals, and belukha whale--commonly occur in the proposed lease-sale area and are likely to have some interaction with OCS mining activities. Noise and movement of aircraft and support vessels associated with mining operations could temporarily displace some marine mammals. Dredging activities could affect these marine mammals and their habitats found in the proposed lease area through excavation and deposition of dredge materials and through release of toxic trace metals from the sediments. This section briefly discusses the nature of effects of dredging and support activities on marine mammals, their food sources, and habitats. The reader is directed to Sections IV.B.3 and 4 for a more comprehensive discussion of the effects of dredging and spoil deposition on the benthic and pelagic communities. Stipulation Nos. 1, 2, 3 and 4 (see Sec. II.F.) would be implemented as part of the proposal.

The use or storage of mercury and other toxic substances would be prohibited onboard the dredge (Stipulation No. 2), thus preventing any accidental spillage of mercury. An effective biological and chemical (water and sediment) monitoring and operations control program would be conducted to measure the effects of benthic excavation, sediment deposition, and trace-metal release (especially mercury in the environment--Stipulation No. 1). This stipulation could limit or prevent significant increases in the bioaccumulation of mercury or other trace metals in marine mammals or in the marine environment. Potential increases in mercury or other trace-metal bioaccumulation in the food chain and in marine mammals could pose a serious health threat to human consumers of marine mammal meat (see Sec. IV.B.15).

To aid in the interpretation of the following effects discussion, an explanation of the term "population in the region," found in the definitions presented in Table IV-2, follows. A population of nonendangered marine mammals in the region is the number of ringed, bearded, or spotted seals; walruses; or belukha whales that occur seasonally within Norton Sound or within the Norton Basin. A portion of a population in the region would be for example, the walruses that haulout on Sledge Island during the summer.

a. Effect of Noise and Disturbance: OCS mining activities may disturb marine mammals through either airborne or underwater noise and through the movement of aircraft and boats.

(1) Air Noise: Major sources of mobile air-noise disturbance are low-flying aircraft and high-speed motorboats, as well as other high-frequency, high-pitched sounds. Low-flying aircraft are known to panic hauled out seals and walruses; however, these brief displacements lasting from minutes up to 2 to 3 hours do not result in long-term (several days to months) or permanent abandonment of haulout areas or pinniped rookeries (Johnson, 1977; Salter, 1979). If disturbance of hauled out seals occurs frequently during molting, the successful regrowth of skin and hair cells may be retarded; thus, increasing physiological stress on seals during a normally stressful period. Increases in physiological stress may possibly decrease fertility and longevity of affected seals. Aircraft-noise disturbance of belukha whales from flyovers generally is very transient, with events not lasting more than a few seconds (Stewart, Aubrey, and Evans, 1983). Such brief disturbances are not likely to have any serious consequences to belukha whales. Stationary sources of air noise include the dredging operations. These activities, occurring within a few kilometers, may disturb hauled out seals, and walruses. However, underwater noises borne from these sources could influence belukha whale behavior over a greater area.

(2) Underwater Noise: Sources of underwater noise related to offshore mining operations primarily include dredges, support vessels, aircraft, sediment core drilling, and seismic vessels. Sound is more efficiently transmitted and travels at a greater velocity in water than in air. Underwater-sound-propagation loss is higher in shallow water than in deep water (Greene, 1981). Bottom material, structure, and the undersurface of ice cover strongly influence sound transmission. Propagation of most sound frequencies is greater in summer when dredge operations are to occur than in winter (Greene, 1981).

Underwater noise may alarm whales and pinnipeds, causing them to flee the sound source. For example, Fraker, Sargeant, and Hoek (1978) reported the startled response and flight of belukha whales from barges and boats traveling through a whale concentration area. Stewart, Aubrey, and Evans (1983) reported that belukha whales respond to outboard motor noises by immediately moving downriver away from the source, but whale exposure to playback recordings of drilling sound had little effect on the movement and general activity of the whales.

Underwater noise may interfere with or mask reception of marine mammal communication or echolocation signals, or it may interfere with reception of other environmental sounds used by marine mammals for navigation (Terhune, 1981). Noise produced by outboard motors operating at high speeds may have the greatest potential for interfering with belukha whale communication and some echolocation signals (Stewart, Aubrey, and Evans, 1983), but exposure to this interference source is likely to be very transient. Low-frequency noises from the dredges would not mask the high-frequency echolocation signals of belukha whales (Gales, 1982). Theoretically, very noisy dredges may slightly mask low-frequency whale sounds out to a range of 56 km, but the possible masking range would more likely be limited to about 5 km (Gales, 1982). If the distance between communicating whales does not exceed their distance from the dredge, no appreciable interference is likely to occur (Gales, 1982). Experiments exposing captive belukha whales to recorded drilling sounds suggest that whales can acclimate quickly to typical industrial sound levels (Aubrey et al., 1984). This suggestion has been supported by observations of belukha whales regularly occurring near oil and gas platforms in Cook Inlet (McCarty, 1981). However, the level of sound transmitted from a large gold dredge is unknown and could influence some belukha whale behavior.

Frequent and/or intense noise that causes a flight or avoidance response in marine mammals theoretically could permanently displace animals from important habitat areas. However, the presence of several thousand belukha whales and harbor seals in Bristol Bay and belukha whales in Cook Inlet during intensive commercial fishing activity and their exposure to noise from numerous fishing boats suggests that these species and perhaps other marine mammals can tolerate fairly high levels of noise and industrial activity.

(3) Project-Specific Noise and Disturbance Effects: Primary sources of noise and disturbance of marine mammals would come from air and marine traffic and specific mining operations such as from seismic surveys, exploratory core drilling and development operations. All of the following operations are assumed to occur within about 19 km of the southern coast of the Seward Peninsula--from just west of Nome and offshore of Safety Sound (Fig. III-18). Exploration-seismic surveys are assumed to be carried out over a 3-year exploration and over the 14-year production period during the open-water season using one vessel shooting 4,200 line km of low-sound-intensity profiles. Seismic surveys for prospect assessment are assumed to include 8,200 line km run over the 14-year life of the mining operations. These seismic surveys also are of low-sound intensity and are likely to be less disturbing to marine mammals than the high-intensity, seismic surveys used in oil and gas exploration. However, the noise and movement of the seismic vessel itself may briefly (a few minutes) disturb some seals, walruses, and belukha whales within about 1 km of the vessel when it passes nearby. Sediment sampling during exploration (3-4 years) is assumed to include the drilling of about 1,900 sediment cores (average depth is 72 ft) using 1 small (200-ft) drillship operating during the open-water season for about 90 days per year and the drilling of 8,200 cores for prospect assessment. Core drilling operations could disturb and temporarily displace (for a few days) some seals, walruses, and belukha whales within a few kilometers of the drillship (MINOR effect).

Production placer mining is assumed to include the use of one bucket-ladder dredge with one helicopter and support vessel (tug boat). The dredge is assumed to operate 100 to 120 days out of the 150-day open-water season (considering shut downs due to weather). An estimated 360 to 450 helicopter flights between Nome and the dredge are assumed to occur per dredging season.

This aircraft traffic could be the primary disturbance source to spotted seals hauled out on beaches along Cape Nome and Safety Sound, to walruses hauled out on Sledge Island, and to bearded and ringed seals hauled out on remnant ice during the spring. However, such disturbance events would be very brief (a few minutes), with disturbed seals and walruses returning to haulout locations probably within an hour to a few hours at most (MINOR effect)--see discussion above under Air Noise. Injury, death, or abandonment of young seals or walrus calves is not likely to occur from air traffic disturbance in the proposed sale area because seal pupping (in early spring--March-April) occurs prior to the mining season. Walrus nursery herds are located far to the west and north of Norton Sound during the mining season and would not be exposed to aircraft traffic.

Noise transmitted from the dredging operations would include noise from several large diesel generators, hydraulic operation of the dredge-bucket-conveyor system, vibration of the sediment processing equipment, and the scraping noise associated with sea-bottom excavation and spoil deposition. Noises transmitted from the large bucket-system dredges are believed to be very loud in comparison to the suction-type dredges that have been used for artificial island construction in the Canadian Beaufort Sea. However, sound-transmission levels from the typical bucket dredge (assumed to be used in mining operations for the proposal) are unknown. The zone of influence or distance at which belukha whales, walruses, and seals could hear and possibly be affected by bucket-dredge noises could be far greater than that zone of influence (effect) associated with suction dredges. For the most part, the dredge sounds probably are low-frequency sounds that could be transmitted over several to tens of kilometers away from the dredge location. Low-frequency sounds from the dredges are not likely to mask the high-frequency communication sounds of belukha whales (Gales, 1982) but lower frequency sounds of walruses and some sounds of bearded seals could be masked over several kilometers or more from the dredge operations. The sounds of dredging operations possibly could displace some seals, walruses, and belukha whales from habitats near (within a few to several kilometers) the dredge during mining operations for the season (less than one generation) when the dredges are operating in part of the lease area (excavation of 3.2 km<sup>2</sup>--mean case) (representing a MINOR effect). This seasonal displacement of a small number of marine mammals very near the dredge is not likely to be additive because the dredge would be operating in different areas each year, and the small seasonal displacement of marine mammals is not likely to represent a significant change in the seasonal distribution of seals, walruses, and belukha whales. Some marine mammals such as walruses might be attracted to the dredge out of curiosity over the dredge disturbance of benthic sediments as reported by the crew of the Bima dredge (Wells 1987).

b. Effect of Dredging and Tailings Deposition: OCS mining operations would include the dredging excavation of sea-bottom material and sediments with subsequent removal and destruction of benthic infauna and slow-moving epibenthic fauna within the dredge path (see Secs. IV.B.3 and 4). Benthic organisms destroyed during excavation and deposition would include some clams and other benthic food sources of walruses and bearded seals--marine mammals that feed in the proposed lease area during the open-water season. Dredging is unlikely to affect the abundance of pelagic food sources (salmon, smelt, herring, sandlance, and cod) of belukha whales and spotted seals nor affect the abundance of mobile epibenthic and macroplankton prey of ringed seals and juvenile spotted and bearded seals because these fish and invertebrates are able to avoid being entrained in the dredge buckets. Although some pelagic fish and macroplankton prey of marine mammals could be entrained into the seawater-intake system on the dredges, the relatively small number of prey organisms lost is likely to have a NEGLIGIBLE effect on food availability to seals and belukha whales.

The availability of some benthic food sources (clams) of walruses and to a lesser extent bearded seals could be reduced within the dredged areas for several years. Some clams and other infauna would be destroyed in the excavation and processing of sea-bottom material and sediments in the placer mining operation while other infauna would be smothered or crushed in the dredge-spoil-deposition process near the dredge sites. Some species of bivalves and polychaetes would be expected to survive entrainment and burial from the operation. Recolonization/recruitment of clams and other infauna benthos to the dredge sites is likely to be slow and take several years (Cruikshank et al., 1987). Benthic surveys of dredge sites and control sites within the State gold lease area near Nome indicate low abundance and diversity of benthic infauna-marine organisms 8 months after dredging in comparison to the control sites (Rusanowski, Gardner, and Jewett, 1988b).

(1) Site-Specific Dredging Effects: Mining operations are assumed to include one to two ladder-bucket dredges operating during the open-water season--May to early November. Each dredge is assumed to be excavating 12,500 to 15,000 m<sup>3</sup> of sea-bottom material per day totaling about 60 acres per year and 1,300 acres (5.3 km<sup>2</sup>) over the 14-year life of the proposal. This represents less than 1.0 percent of the proposed sale area. Although the benthic habitat affected by dredge deposition could be 1.5 to 1.8 times the size of the area excavated, the loss of benthic food sources of walruses and bearded seals within this comparatively small area of 2,600 to 5,200 acres (10.6-21.2 km<sup>2</sup>) is not likely to have an appreciable effect on the availability of benthic prey to local groups of walruses (a few hundred to a few thousand animals) or to bearded seals that feed within the proposed lease area during the open-water season. Walruses are highly mobile and opportunistic foragers capable of feeding elsewhere if local numbers of prey organisms are reduced (Fay and Lowry, 1981). The local reduction in benthic prey organisms due to dredging is not likely to be greater than natural differences in the availability of prey in feeding ranges of walruses and bearded seals (NEGLIGIBLE effect).

c. Effect of Trace Metals: Mercury and other trace metals particularly arsenic, cadmium, and lead are toxic to many marine organisms and potentially toxic to marine mammals. Mercury, cadmium, and lead have no known biological functions in the physiology of marine organisms. Other potentially toxic trace metals such as zinc, copper, nickel; and even arsenic are biologically essential elements--trace metals at low levels in marine organisms. The toxicity of the latter metals through bioaccumulation in the food chain is generally of minor concern because of the high efficiency excretion of excess amounts of these metals by marine organisms and the low accumulation rates in the food chain. Mercury is the only highly toxic trace metal to consistently biomagnify in the food chain (Lindberg et al., 1987). This means that the concentration of mercury greatly increases when it is taken up in marine organisms such as fish and clams from the water column and from the sediments, respectively, and, in turn, taken up into seals and walruses that consume the fish and clams.

(1) Arsenic: Arsenic has been demonstrated to be biologically essential in mammals at trace levels (1.35 mg/kg) (Eisler 1988). Arsenic can biomagnify in the food chain in some cases (Mance, 1987); however, the biomagnified arsenic in marine organisms such as fish is predominately in an organic form which is less toxic than inorganic arsenic (Bohn, 1975). Arsenic is far less toxic than mercury (lethal diet dose in mammals, 50 mg arsenic/kg body weight vs. 1-5 mg mercury/kg body) (Eisler, 1988). Although arsenic is expected to occasionally exceed EPA criteria within 100 m of dredge operations (see Sec. IV.B.2), levels that might bioaccumulate in the food chain and in prey of marine mammals are expected to be very low (in the magnitude of a few ppm at the very most) and well below the level at which any effect on individual marine mammals is likely to occur even if the marine mammals fed exclusively within the dredging area. Thus, the effects of arsenic on nonendangered marine mammals is expected to be NEGLIGIBLE.

(2) Mercury: The potential effect of mercury on nonendangered marine mammals was the primary topic in the following analysis because: (1) elevated levels of mercury (1.3 ppm) were reported in beach sediments of the Norton Sound area (Nelson et al., 1975); (2) the disposal of metallic mercury has occurred in the Nome area over the past century in association with gold mining-processing; (3) mercury has a high potential to be converted from metallic or inorganic forms to methylated forms and to biomagnify up the food chain; and (4) marine mammals are near the top of the food chain, and they are known to bioaccumulate mercury body tissues (such as liver, kidney, and muscle).

Only a few seal and walrus specimens (3 or 4) have been collected in Norton Sound and analyzed for mercury and other trace metals. An average of about 2.3 ppm mercury in liver tissue was observed for the spotted and bearded seal specimens (Rusanowski et al., 1987). The variation in average mercury levels in marine mammals occurring in Norton Sound could vary by plus or minus several hundred percent to more than 1,000 percent from this small sample value of 2.3 ppm (wet weight; Rusanowski, Gardner, and Jewett, 1987), as indicated from mercury levels found in seals in the Canadian Arctic where mercury levels in seals varied from less than 0.1 ppm to over 200 ppm in seal liver specimens (Wagemann and Muir, 1984). The recorded value of 2.3 ppm mercury in spotted seal and bearded seal liver specimens is above the 1.1 ppm value; indicative of a potential environmental mercury problem (Eisler, 1987). However, the actual average mercury level in seals and other marine mammals may be significantly lower (0.5 ppm) or significantly higher (10 ppm wet weight) than 2.3 ppm. If the average mercury level is much lower, the health risk to consumers of seal meat would be considerably less, but if the average mercury level is much higher (such as 10 ppm wet weight) the health risk to consumers could be far greater. The effect of higher baseline-mercury levels in marine mammals is expected to be NEGLIGIBLE to marine mammal populations because marine mammals apparently can tolerate high-mercury levels (50 ppm) in liver tissue by converting it to a nontoxic form without any adverse effects (Risebrough, 1978).

Trace-metal compounds from industrial-pollutant sources may affect marine mammals through accumulation in food sources. Risebrough (1978) reviewed bioaccumulation in marine mammals of mercury, cadmium, and lead--three heavy metals known to be toxic to organisms. Eaton and Farant (1982) and Smith and Armstrong (1978) reported high levels of mercury in the tissues of marine mammals, particularly in arctic species such as ringed and bearded seals, and polar bears, with high concentrations located in the liver, blubber, skin, and hair (centers of accumulation and routes of excretion). High levels of mercury and cadmium in arctic marine mammals and in their food sources are believed to be of natural geologic origin rather than a result of industrial pollution (Risebrough, 1978; Eaton and Farant, 1982; McDonald and Sprague, 1985). However, elevated mercury, lead, or cadmium levels were reported in ringed seals near a lead-zinc mine in the Canadian Arctic (Wagemann, 1989). Mercury reported in the tissues of marine mammals from estuaries and coastal areas (where industrial development is present) probably originates in part from manmade pollutants, but pollutant contributions are difficult to measure against the increase in mercury levels occurring with the age of the animals and against the high levels coming from local natural sources (Risebrough, 1978; Gaskin, 1982). Most of the mercury residues found in tissues appear to be in nontoxic, molecular forms and combined with selenium and/or bromine (Martin et al., 1976; Risebrough, 1978; Pelletier, 1985). Seals, polar bears, and other marine mammals appear to possess a mechanism that detoxifies the mercury present in their food sources (Risebrough, 1978; Gaskin, 1982; Scheuhammer, 1987).

A protective action (detoxification) of selenium against mercury (chemical binding of both metal ions) was reviewed by Parizek et al. (1974), Risebrough (1978), and Scheuhammer (1987); however, it is unknown whether all marine mammals possess this biochemical adaptation. Mercury levels were found to increase with the age of seals (Sergeant and Armstrong, 1973; Holden, 1975). To date, examination of marine mammal tissues for lead indicates that concentrations are low and that significant accumulation has not occurred in marine mammals or in marine foodwebs (Risebrough, 1978). Presently, none of the available data on concentrations of heavy metals in marine mammals can be definitely attributed to pollution. However, very high levels of mercury from a documented industrial source were the cause of lethal mercury poisoning in a wild river otter (Wren, 1985). Very high levels of methylmercury (25 mg/kg body weight) given to harp seals daily, resulted in blood levels of greater than 25 ppm and resulted in death due to apparent renal failure (Ronald et al., 1977).

(3) Lead: This metal does not biomagnify in the food chain, but it is neither essential nor beneficial to living organisms (Eisler, 1988). Lead is known to cause learning disabilities at very low levels (0.1 mg/kg body weight) in primates. For sensitive domestic and laboratory mammals, survival was reduced at chronic oral doses of 5 mg/kg body weight (dog) and at dietary levels of 1.7 mg/kg body weight (horse) as cited in Eisler (1988). However, lead levels measured within 100 m of current dredge operations are generally below levels (20 ppb) associated with toxic effects on invertebrates and fishes (see Secs. IV.B.3 and 4). Thus, invertebrates and fish as food sources of marine mammals are not expected to be affected by lead levels



in the dredge areas. It is unlikely that lead effects on marine mammals would come through the marine food chain because lead concentrations would be diluted beyond 100 m in the dredge plume, and, thus, food sources of marine mammals would not be significantly contaminated. Effects of lead on nonendangered marine mammals is expected to be **NELIGIBLE**.

(4) **Copper:** Copper is an essential element in the physiology of marine mammals as well as other organisms. Studies on copper toxicity in domestic mammals indicate that marine mammals are probably quite tolerant of relatively high levels of copper in the food chain; toxic effects on some domestic mammals were not apparent until copper levels were increased 20 to 50 times over normal levels (Bremner, 1979). However, young mammals might be affected by relatively low copper intakes when they are being fed milk-based diets (Shand and Lewis, 1957; and Weiss and Baur, 1968, as cited by Bremner, 1979). Although current dredge operations had exceeded EPA criteria for copper (with concentrations as high as 51.3 ppb in the water), these concentrations would be greatly diluted beyond 100 m of the dredge and are not likely to increase copper levels in marine mammal prey such as clams more than several times over background levels such that marine mammal populations would be affected. The effect of copper on nonendangered marine mammals is expected to be **NEGLIGIBLE**.

(5) **Nickel:** Nickel is believed to be an essential element that is important in the physiology of living organisms (Nielsen, 1971). However, nickel and nickel compounds can be toxic. Exposure to airborne nickel particles can give rise to allergic reactions and may be associated with respiratory cancer (Reichrtova, Kovacikova, and Takac, 1986). Although nickel levels measured within 100 m of current dredge operations had exceeded EPA criteria, the levels measured near the dredge are below the levels where effects on invertebrates and fishes are likely to occur (see Secs. IV.B.3 and 4). Thus, no significant effects on the marine food chain nor any significant accumulation of nickel in the prey of nonendangered marine mammals is expected to occur. The effects of nickel on nonendangered marine mammals is expected to be **NEGLIGIBLE**.

(6) **Cadmium:** Although cadmium bioaccumulates in the food chain, mammals are comparatively resistant to the biocidal properties of this trace metal (Eisler, 1985). It is at least 10- to 100-fold less toxic than mercury (lethal diet dose in mammals, 150-250 mg cadmium/kg body weight vs. 1-5 mg mercury/kg body weight). Cadmium concentrates in the kidneys and liver of mammals. Neither projected discharges of cadmium from the proposed sale nor reported concentrations near the current dredge operations are large enough to exceed EPA criteria (see Sec. IV.B.2). Thus, the effects of cadmium on nonendangered marine mammals is expected to be **NEGLIGIBLE**.

**Site-Specific Effects of Mercury:** An estimated 12,500 to 15,000 m<sup>3</sup> of seafloor would be excavated daily by the one dredge during the 100- to 150-day mining season (May-November), and an estimated 20 million m<sup>3</sup> of seafloor would be excavated over the 14-year life of mining operations in the proposed lease area. Average dredge-excavation depth is assumed to be 3.6 meters. The excavation and deposition (redistribution) of this amount of sea-bottom material and sediments is sufficient to mobilize and repartition mercury, mercury compounds and other potentially toxic trace metals into the water column and onto the benthic surface where this mercury could be ingested and absorbed into marine organisms. Concentrations of mercury (metallic) of human (gold mining) origin and of natural origin (cinnabar ore) are present in the Nome/southern Seward Peninsula area. Mercury concentrations of up to 1.3 ppm have been found in nearshore gravels in the Nome area--well above the average level of 0.034 ppm for the Norton Basin (see Sec. III.A.6.). The marine environment of Norton Sound, particularly the Nome area, has been exposed to mercury contamination from gold processing through runoff from contaminated soil and from streams in the Nome area where gold dredging has occurred for decades. Much of this mercury was in metallic or inorganic form with probably little being absorbed directly into marine organisms. However, inorganic and metallic mercury present in the sea-bottom sediments or ingested by marine organisms exposed to the sediment plume can be acted on by bacteria in the sediments or in the intestines of marine organisms (including marine mammals) and can be converted to methylmercury compounds (Rowland, Davies, and Grasso, 1977) that are highly absorbable and toxic to marine organisms and readily bioaccumulate in the ecosystem. Therefore, dredging operations associated with gold mining in the Norton Sound proposed lease area might increase the exposure of marine mammals to toxic levels of mercury and other trace metals including cadmium and lead. Assuming that dredging operations excavate sea-bottom materials and sediments with concentrations of mercury, some contamination of marine organisms, including marine mammals, could occur.

The effect of toxic trace metals on pinnipeds and belukha whales could depend on which trace metal is present in the animals (mercury is generally the most toxic trace metal at low levels in marine organisms), the chemical form of the trace metal (methylmercury is highly absorbable in marine organisms), and the presence or deficiency

of other trace elements or trace metals in the animal (in the case of methylmercury contamination, selenium helps to alleviate the toxicity). Dredging operations could excavate sea-bottom sediments with elevated levels of mercury (0.034 ppm) and some bioaccumulation of mercury compounds in the marine ecosystem could occur (perhaps an increase of a few ppm mercury). Potential contamination and bioaccumulation of mercury or other trace metals in marine mammals through contaminated food sources (fish, clams, and other prey) could result in direct mortality of highly contaminated animals (perhaps 25 ppm mercury in blood) if mercury concentrates in the brain and affects the central nervous system (Scheuhammer, 1987; Wren, 1985) or causes renal failure (Ronald et al., 1977). However, such effects are very unlikely considering the small area (60 acres per year) assumed to be dredged.

Mercury is likely to bioaccumulate within liver tissue of seals, walruses, and belukha whales in molecular association with the trace metal selenium. The toxicity of mercury contamination is likely to be reduced or neutralized within the tissues and organs of seals and walruses in molecular association with selenium (Risebrough, 1978; Scheuhammer, 1987). Thus, bioaccumulation of mercury and other toxic trace metals within marine mammal tissues is likely to have no apparent adverse effect on seals, walruses, and belukha whales. Very high levels of mercury (up to 420 ppm) in seal livers were reported from animals collected in the Canadian Arctic with no apparent effect on seal populations (Smith and Armstrong, 1978). High mercury levels in seals and polar bears in the Arctic are believed to come primarily from natural rather than manmade sources (Eaton and Farant, 1982; Smith and Armstrong, 1978). Potential increases in mercury levels, that might be associated with dredging, of a few ppm within some marine mammals is not likely to significantly affect the abundance of seals, walruses, and belukha whales in the Norton Sound area (NEGLIGIBLE effect) because these marine mammals can tolerate such increases in mercury by detoxifying and excreting mercury (Risebrough, 1978; Ronald et al., 1977). The dredging of 20 million m<sup>3</sup> of seafloor even with 0.034-ppm mercury is not likely to cause a very high (several ppm) increase in mercury levels in the food chain. The dredging of 3.2 km<sup>2</sup> of seafloor (800 acres) is not expected to greatly increase mercury levels in marine mammals (such as 25 ppm in marine mammal blood) beyond that which marine mammals may not be capable of tolerating. A concentration of 2.3 ppm mercury was found in seal liver specimens collected in the Nome area (Rusanowski, Gardner, and Jewett, 1987). The 2.3 ppm mercury value is within the lower midrange of mercury levels found in the Arctic (Wagemann and Muir, 1984), but the sample size of three to four seals is too small to indicate what the average mercury level is within seal populations occurring in Norton Sound. However, this level of mercury is generally low compared to mercury levels found in the liver of marine mammals in other regions.

**Summary:** The potential increases in mercury and other toxic trace metals within the marine ecosystem associated with the proposal are not likely to affect the abundance or distribution of marine mammals (ringed, bearded, and spotted seals, walrus, and belukha whale) that are present in the sale area (NEGLIGIBLE effect) because marine mammals have shown the ability to detoxify, neutralize, and excrete mercury as well as other trace metals with no apparent adverse effects.

Recent data on water chemistry mercury levels in Norton Sound including measurements taken near current dredging suggest that mercury levels in the water do not exceed the chronic criterion standard (Sec. IV.B.2). This finding indicates that there would not be any significant increase in mercury bioaccumulation in the food chain or in marine mammals associated with the proposal. Similar low mercury levels are expected to be measured in the water when dredging occurs in Federal OCS waters under the proposal. The effect of mercury on nonendangered marine mammals is expected to be NEGLIGIBLE.

The implementation of Stipulation No. 1 (an effective monitoring and operations control program) and Stipulation No. 2 (prohibition of the use or storage of mercury and other toxic substances onboard the dredge) is likely to prevent any significant increases in mercury or other trace metals from occurring in marine mammals and in the marine environment of Norton Sound.

d. **Effect of a Fuel Spill:** This section discusses the nature of the effects of oil on marine mammals. OCS Report MMS-85-0031 (Hansen, 1985), which is incorporated by reference, contains a detailed discussion of the various possible direct and indirect effects of oil pollution and other chemical pollutants on marine mammals. Direct contact with spilled oil may cause mortality of some marine mammals and have no apparent effect on others, depending on factors such as species involved, age, and physiological status of the animal. Some newly born seal pups are likely to suffer direct mortality from oiling through loss of thermo-insulation, resulting in hypothermia. On the other hand, walrus calves' natal pelage, which contains no underfur and is sparse compared to the lanugo pelage of ice-seal pups, is of little insulative value; thus, oiling of walrus calves would not significantly reduce thermo-insulation. However, oiling could increase physiological stress--particularly in very young calves--and contribute to the death of some animals. Adult and subadult ringed,

spotted, and bearded seals and walrus that rely on thick layers of blubber for thermo-insulation, may suffer some temporary adverse effects such as eye and skin irritation with possible infection if contact with oil occurs. Such effects may increase physiological stress and perhaps contribute to the death of some individuals (Geraci and Smith, 1976; Geraci and St. Aubin, 1980). Deaths attributable to oil contamination are more likely to occur during periods of high natural stress, such as during molting or times of food scarcity and disease infestations. The few recorded mammal deaths attributed to oil spills in case histories occurred during the winter months (Duval, Martin, and Fink, 1981), a season of increased natural stress.

Although species-specific effects of oil contact on belukha whales are uncertain, studies by Geraci and St. Aubin (1982) of hydrocarbon effects on dolphins and porpoises, as representative odontocetes, provide sufficient insight on the potential effects of oil-spill contact on belukha whales. The findings of these experiments suggest that smooth-skinned cetaceans such as belukha whales, dolphins, porpoises, and killer whales could suffer some minor skin damage if they were confined to a small surface area contaminated with oil (such as an ice lead). However, such effects on the skin are likely to be short-term or transient (oil is unlikely to adhere to the skin), with recovery occurring within a few days (Hansen, 1985).

Oil ingestion by marine mammals through consumption of contaminated prey and by grooming or nursing could have pathological effects, depending on the amount ingested, species involved, and the animal's physiological state. Death would be likely to occur if a large amount of oil were ingested or if oil were aspirated into the lungs. Ingestion of sublethal amounts of oil can have various physiological effects on a marine mammal, depending on whether the animal is able to excrete and/or detoxify the hydrocarbons. Geraci and Smith (1976b) demonstrated that seals are able to excrete as well as absorb oil. Both seals and cetaceans potentially can metabolize small quantities of ingested oil and detoxify hydrocarbons through the function of an oxygenase enzyme complement (Engelhardt, 1983) demonstrated as cytochrome p-450 in the liver of cetaceans (Geraci and St. Aubin, 1982) and as aryl hydroxylase in the liver and kidney tissues of seals (Engelhardt, 1982), suggesting that seals and whales may not suffer any serious physiological effects if they consume small quantities of oil (such as 75 ml, Geraci and Smith, 1976).

Seals, walrus, and belukha whales are not likely to intentionally avoid oil spills, although they may limit or avoid further contact with oil if they experience discomfort or apprehension as a result of contact with an oil slick (Hansen, 1985). Under some circumstances, they may be attracted to the spill site if concentrations of food organisms are nearby; or they may have little choice but to move through the spill site during migration.

Indirect effects of oil pollution on seals, walrus, and belukha whales would be those associated with changes in availability or suitability of various food sources. However, ringed, spotted, and bearded seals; walrus; and belukha whales opportunistically prey on a variety of available food organisms and are capable of moving from an area of local prey depletion to other locations of prey abundance. Breeding ringed seals that remain in local areas during the pupping season may be an exception, but the reduction of food organisms (arctic cod and epibenthic crustaceans) would persist for no more than one season due to rapid recruitment of these food organisms and represent no more than a MINOR effect.

Site-Specific Effects of a Fuel Spill: An assumed fuel spill occurring (during June to September) in association with offshore mining activities is assumed to be 3,500 bbls of diesel fuel (see Sec. IV.B.2). The diesel slick from the fuel-spill site could cover about 0.5 to 0.6 km<sup>2</sup> of ocean surface as a continuous slick within 10 days or it could move over 150 km<sup>2</sup> from the spill site. Such a spill has about a 32-percent chance or greater of contacting some coastal haulout locations of spotted seals or walrus within 3 days in the Nome area. Assuming the fuel spill contacts a haulout area, less than one hundred to perhaps a few hundred spotted seals and, or walrus might come in contact with the diesel slick. Some of these animals may become heavily oiled and suffer eye and perhaps skin irritation for a few hours to a few days after contact with the spill. In a severe case some heavily oiled seals or walrus that are highly stressed by disease might die as a result of contact with the fuel spill. Such potential losses would be a very short-term (less than one generation) effect on the abundance or distribution of seals, and walrus, (MINOR effect). No belukha whales are likely to be exposed to the diesel slick long enough to be adversely affected by the spill (NEGLIGIBLE effect)). The fuel spill is not likely to reduce the availability of widespread food sources of seals, walrus, and belukha whales for more than a few weeks very near the spill site. The effect of a fuel spill on these marine mammals is expected to be MINOR.

SUMMARY: Noise and movement of aircraft and support vessels associated with mining operations, as well as dredging activities and exploration sediment-core drilling could affect seals, walrus, and belukha whales and their habitats found in the proposed lease area. A total estimate of 12,400 line km of low-sound-intensity seismic surveys are assumed to occur over the 14-year life of the mining operations. The noise and movement

of the operating seismic vessel could briefly (a few minutes to perhaps an hour) disturb some seals, walruses, and belukha whales within about 1 km of the vessel when it passes nearby. The exploratory drilling of about 1,800 sediment cores over 3 to 4 years using 1 small (200-ft) vessel equipped with drilling rigs operating during the open-water season for about 90 days per year could disturb and temporarily displace (a few days) some seals, walruses and belukha whales within a few kilometers of the vessel (MINOR effect). An estimated 360 to 450 helicopter flights between Nome and the dredge are likely to be the primary noise and disturbance sources to spotted seals that haul out on beaches along Cape Nome and Safety Sound, to walruses that haul out on Sledge Island, and to bearded and ringed seals that haul out on remnant ice floes during the spring. Such disturbance events would be very brief (a few minutes), and disturbed seals and walruses are likely to return to haulout locations within an hour to a few hours or within a few days (MINOR effect).

The sounds of dredging operations might displace some seals, walruses, and belukha whales from habitats near (within a few to several km) the dredge during mining operations for one season (less than one generation) when the dredge is operating in a small part (5.3 km<sup>2</sup>) of the lease area (representing a MINOR effect).

The excavation and deposition of sediments by one dredge over about 2 to 4 percent of the proposed sale area is likely to have NEGLIGIBLE effect on the availability, abundance, and overall distributions of most pelagic and epibenthic prey of belukha whales, and spotted and ringed seals. The excavation of 1,300 acres (5.3 km<sup>2</sup>) over the 14-year life of mining operations represents less than 1.0 percent of the sea-bottom benthic habitat excavated and 2 to 4 percent of the seafloor of the proposed sale area significantly inundated by deposition of sediments. The loss of benthic food sources (such as clams) of walruses and bearded seals within 2 to 4 percent of the sale area is not likely to have a measurable effect (NEGLIGIBLE) on the availability of benthic prey to local groups of walruses (a few hundred to no more than 2,000) or to some bearded seals that feed within the Nome area because these pinnipeds are highly mobile and capable of utilizing other unaffected food organisms that are abundant throughout the rest of the sale area and Norton Sound.

The excavation and deposition of 20 million m<sup>3</sup> of seafloor under the proposal has the potential to mobilize and repartition mercury, mercury compounds, and other potentially toxic metals of both natural (geologic) and manmade (onshore-gold mining) origin present in the sea sediments along the coast of Nome/southern Seward Peninsula. Mercury, in its most absorbable form (methylmercury compounds), is one hundredfold more toxic than other toxic trace metals such as lead, and cadmium (see Sec. IV.B.2, Effect on Water Quality). The levels of arsenic, lead, cadmium, copper, and nickel measured in association with current dredge operations are expected to have NEGLIGIBLE effects on nonendangered marine mammals. Similar levels are expected to be measured in association with the proposal under the monitoring and operations control program (Stipulation No. 1).

Although the mercury present in the sediments probably is in metallic and inorganic forms, bacteria in the sediments, and in the intestinal tracts of marine animals are capable of converting inorganic mercury to methylated mercury compounds that are readily absorbed and bioaccumulate. Dredging operations could excavate some sea-bottom sediments with high levels of mercury (0.034 ppm); some bioaccumulation of mercury over and above natural mercury levels could occur (perhaps increases of a few ppm in higher trophic levels--birds and marine mammals). Mercury compounds or mercury ions are likely to form inert molecular compounds with trace elements such as selenium in the liver of the marine mammal and have no apparent effect on the health of the marine mammal. Very high (>100 ppm) concentrations of mercury-selenium compounds in liver tissue have been recorded in Arctic marine mammals with no apparent effect on the populations. The dredging of 5.3 km<sup>2</sup> of seafloor is not expected to greatly increase mercury levels (such as increases of 10-25 ppm) in marine mammal tissues beyond that which marine mammals may not be capable of tolerating. The potential increase of no more than 1 to 3 ppm mercury in higher trophic level organisms such as marine mammals is not likely to affect marine mammals in the Nome area because marine mammals apparently are able to detoxify, neutralize, and excrete mercury at these concentrations with no irreparable harm. Thus, the abundance and distribution (as well as the behavior and reproductive biology) of ringed, bearded, and spotted seals, walruses, and belukha whales present in the sale area are not likely to be affected (NEGLIGIBLE effect).

Recent data on water chemistry mercury levels measured near current dredging indicates that the mercury levels in the water do not exceed the EPA chronic criterion standard and indicate that there would not be any significant increase in mercury levels in the marine environment associated with the proposal. Similar low mercury levels are expected to be measured in the water during Federal OCS mining the bioaccumulation of mercury and other trace metals in marine mammals and in the food chain is expected to be NEGLIGIBLE.

If the assumed fuel spill occurred near some coastal haulout locations of spotted seals or walruses, some of these pinnipeds could be contacted by the spill. Less than one hundred to perhaps a few hundred spotted seals and/or walruses might come in contact with the diesel slick. Some of these animals may become heavily oiled and suffer eye and perhaps skin irritation for a few hours to a few days after contact with the spill. In a severe case some heavily oiled seals or walruses that are highly stressed by disease might die as a result of contact with the oil spill. Such potential losses would be a very short-term (less than one generation) effect on the abundance or distribution of seals and walruses (MINOR effect). No belukha whales are likely to be exposed to the diesel slick long enough to be adversely affected by the spill (NEGLIGIBLE effect). The fuel spill is not likely to reduce the availability of widespread food sources of seals, walruses, and belukha whales for more than a few weeks very near the spill site. The effect of a fuel spill on these marine mammals is expected to be MINOR.

**CONCLUSION (Effect on Nonendangered Marine Mammals):** The effect of the proposal on nonendangered marine mammals (ringed, bearded, and spotted seals, walruses and belukha whales) is expected to be MINOR.

**CUMULATIVE EFFECTS:** The additive effects of other ongoing and planned projects, as well as the proposal, on nonendangered marine mammals are discussed in this section. The following projects have potential habitat and noise and disturbance effects on seals, walruses and belukha whales: offshore mining on existing State of Alaska leases, proposed OCS offshore mining under the proposal, previous and future Federal OCS oil and gas industrial activities in Norton Sound, and onshore and coastal development projects including ongoing and past mining projects in the Nome area.

**Effects of Offshore Mining:** The proposal is assumed to include the dredging of 5.3 km<sup>2</sup> of sea bottom in Norton Sound over the life of the leases as discussed above. At present, WestGold is mining for gold on State of Alaska offshore leases that cover 21,741 acres near Nome with the dredging of 120 acres per year per operation (Table IV-2-A). A small dredge has been operating in the Nome harbor dumping 13,000 yd<sup>3</sup>/year of dredge spoil near the mouth of the Snake River. The latter dredge spoil has been contaminated with mercury (see discussion in Sec. IV.A.3) Cumulative mining operations could include the dredging of a total of perhaps 10 mi<sup>2</sup> or more of sea bottom in the Nome area and along the southern coast of the Seward Peninsula. This dredged area would include some benthic feeding habitat of an estimated 1,000 to 2,000 walruses and some juvenile bearded seals that summer in Norton Sound. Some clams and other benthic food sources of walruses and bearded seals would be destroyed during mining excavation of the sea bottom and during deposition of dredge spoil. However, this loss of benthic-food sources of some walruses and bearded seals is within a comparatively small area of perhaps 15 to 30 km<sup>2</sup> or about 4 to 8 percent of the proposed lease area. This small loss of benthic food sources is not likely to have an appreciable effect on the availability of benthic prey to local groups of walruses or to bearded seals that frequent the Nome area during the open-water season. Walruses and bearded seals are believed to forage over many miles in search of prey. The local reduction in benthic prey organisms due to dredging operations in the Nome area is not likely to be greater than natural differences in the availability of prey on the seasonal feeding range of walruses and bearded seals.

Existing WestGold leases and planned and ongoing dredging operations by this company occur west of local walrus and spotted seal haulout areas at Cape Darby and Safety Lagoon and east of walrus haulout locations on Sledge Island. Thus, existing offshore-mining operations probably are having minimal noise and disturbance effects on these pinnipeds. However, belukha whales and other seals that feed offshore of the streams in the Nome area (such as off the Snake River) are exposed to noise, the movement of the dredge, and air- and vessel-support traffic (2 helicopter trips/day and 2 support-vessel trips/day). Whales and pinnipeds may be locally displaced within a few miles of the dredge during actual mining operations for the season (less than one generation) when the dredge is operating in part of the present lease area (representing a MINOR effect).

The estimated 360 to 450 helicopter flights per mining season between Nome and the dredge assumed under the proposal could double or triple the amount of air traffic that walruses, seals, and belukha whales could be exposed to in the Nome area. Noise and disturbance of these marine mammals from aircraft and dredge--support vessels would be very brief (a few minutes) with disturbed seals, walruses, and belukha whales returning to habitat locations generally within an hour to a few hours at most. The cumulative increase in air and vessel traffic could increase the frequency of these temporary disturbance/displacement events. However, such seasonal and intermittent traffic is not likely to cause long-term (several years or one generation or more) displacement of pinnipeds and belukha whales from the Nome area. High cumulative air and vessel traffic in Bristol Bay, Alaska during the commercial fishing season apparently has not affected the distribution of belukha whales and seals in that area. Thus, cumulative air and vessel traffic associated with industrial activities in the Nome area is likely to cause brief startle/flight responses by pinnipeds and belukha whales, where the distribution of affected

animals is changed for a short period of time (a few hours or a few days) and would represent a MINOR effect on these marine mammal assemblages.

Cumulative dredging of sea-bottom sediments in the Nome area is likely to result in some increase in concentration levels of mercury and other toxic trace metals within marine organisms including food sources of seals, walruses, and belukha whales.

Some increased bioaccumulation (for example 1-3 ppm) of mercury or increases in levels of other toxic trace metals could occur as a result of cumulative offshore mining but the level of mercury increase in marine mammal tissues (especially liver) would vary between marine mammal species and between individual animals depending on what type and amount of particular food organisms are consumed. These levels also would vary greatly depending on the molecular form the mercury is in when consumed by seals, walruses, and belukha whales. Because marine mammals in the Nome area and marine mammals in the Arctic are exposed to natural mineral sources of mercury and other potentially toxic trace metals (see discussion for the proposal, Effect of Trace Metals), they probably have adapted to the presence of mercury and other trace metals (such as cadmium) within the marine environment and within their food sources. An increase in the mercury bioaccumulation in the Nome area marine and coastal environment due to cumulative offshore dredging/mining activities probably is not likely to result in significant increases in mercury contamination (1-3 ppm mercury) in marine mammal populations throughout the northern Bering Seabecause the dredge plume and potential contamination would be confined to Norton Sound.

Cumulative offshore mining could potentially result in increased mercury (perhaps 1 ppm mercury) and perhaps other trace-metal loads within the tissues of perhaps a total of 1,000 to 5,000 walruses, bearded seals, spotted seals, and belukha whales (a portion of the northern Bering Sea marine mammal populations) that summer in the Nome area. A cumulative increase in mercury and other trace-metal levels in the seals, walruses, and belukha whales that seasonally are present in the Nome area is not likely to have a measurable effect on the abundance or distribution of these marine mammals in the Nome area (NEGLIGIBLE effect, see Effects of Trace Metals: under the proposal). However, elevated mercury concentrations in seal, walrus, and belukha whale tissues should be considered as presumptive evidence of an environmental mercury problem.

Effect of Federal OCS Oil and Gas Activities: Air and marine-vessel traffic and potential oil spills are the primary sources of cumulative effects associated with OCS oil and gas activities in Norton Sound on seals, walruses, and belukha whales. OCS oil and gas exploration in Norton Sound from Sale 57 included the use of two jack-up drill platforms and two supply-support vessels for one season (June-October) and one drill platform for a second season with about two helicopter trips per day per platform between Nome and the platforms (Table IV-2a; Fig. IV-1). This low level of air and vessel traffic and other exploration activity has had a minimal effect on marine mammals in Norton Sound. Further exploration from a potential future oil and gas lease sale is likely to have similar levels of air and vessel traffic. If oil were discovered in Norton Sound this traffic would increase in volume and duration. The incidence of aircraft and marine-vessel disturbance of seals, walruses, and belukha whales would be expected to increase somewhat over that caused by other projects. The level of effect is still likely to be short term (less than 1 year) and local (within about 1.6 km of the air and vessel operations) and would represent a MINOR effect (see Noise and Disturbance Effects, under the proposal).

Oil spills that may be associated with OCS oil and gas activities in the future are likely to have short-term (less than one generation) MINOR effects on the abundance and distribution of seals, walruses, and belukha whales in the Norton Sound area (USDOI, MMS, 1985a). Sale 57 oil and gas exploration activities in Norton Sound did not result in any significant oil spills. Thus, OCS oil and gas exploration has had a NEGLIGIBLE oil spill effect on nonendangered marine mammals. Further exploration is expected to have NEGLIGIBLE oil-spill effects.

Effect of Onshore and Coastal Development: Primary onshore and coastal development in the Nome area has been associated with placer gold mining both in the past and at present with 75 acres disturbed per year by present placer mining operations (Table IV-2a). Historically, up to 45 different gold dredges have operated at some time around Nome (see Fig. IV-1 for locations of gold mining sites). The primary potential effect on seals, walruses, and belukha whales associated with the onshore gold mining activities is the mercury contamination of the marine and coastal environment from dredge spoil and gold-processing sites in the Nome area. A considerable amount of mercury was discharged into streams or onto the ground around the dredge and gold processing houses. This mercury is eventually broken down by bacterial and chemical action and eventually drains into the streams and marine environment as inorganic or organic compounds. Mercury that is converted to organic compounds is readily absorbed by marine and coastal organisms (including primary food organisms

of marine mammals) and bioaccumulates within the tissues of seals and other marine mammals. Past gold-dredging and gold-processing sites in the Nome area continue to be local sources of mercury contamination of the marine and coastal environment even though mercury is presently not being used in the mining process in the Nome area. These manmade sources of mercury might add to the bioaccumulation of mercury in marine mammal tissues. Elevated mercury levels could be present in some of the walruses, seals, and belukha whales that summer in the Nome area. Elevated mercury levels (over, for example, 25 ppm) could represent a significant physiological stress on these marine mammals that in turn could shorten the lifespan of the highly contaminated animals. But, such levels are not known to occur in Norton Sound marine mammals.

**Overall Cumulative Effect:** Cumulative onshore gold mining has resulted in some increase in mercury levels in the coastal environment of the Nome area. Cumulative State of Alaska and proposed Federal OCS offshore mining could potentially increase the availability of or repartition natural mercury deposits and manmade mercury contaminants present in the marine sediments of Norton Sound, that could in turn increase the level of mercury and other potentially toxic trace metals in marine organisms including seals, walruses, and belukha whales. These cumulative sources of mercury could result in some bioaccumulation mercury in marine mammal tissues and perhaps increase physiological stress on highly contaminated marine mammals and possibly shorten their lifespans. However, an increase in mercury levels (such as 1 ppm) in some marine mammals is not likely to affect the abundance or distribution of seals, walruses, and belukha whales in the Nome area. Marine mammals appear to be capable of detoxifying, neutralizing, and excreting mercury and other potentially toxic trace metals with no irreparable harm (NEGLIGIBLE effect) (see discussion under the proposal, Effect of Trace Metals).

Cumulative offshore dredging (of perhaps 15-30 km<sup>2</sup> or about 4-8% of the sale area) from both State of Alaska and proposed OCS mining would result in the alteration and destruction of a small portion (part of the 4-8%) of some seasonal benthic-feeding habitat and food organisms of perhaps 1,000 to 2,000 or more walruses and bearded seals that occur seasonally in the Nome area. This local effect would be limited to within a few hundred yards of the dredging sites and is not likely to significantly diminish the availability of clams and other benthic food sources of bearded seals and walruses. The availability of pelagic-food sources (such as cod and sandlance) of spotted and ringed seals and belukha whales is not likely to be affected at all (NEGLIGIBLE effect).

Cumulative noise and disturbance of marine mammals would be primarily from air and vessel traffic and dredging noise in the Nome area. Both State of Alaska and proposed Federal OCS mining and oil and gas activities could result in several hundred or more helicopter flights and support-vessel trips per year to offshore oil and gas and mining sites in the Nome area. This traffic and the noise from dredges are likely to cause short-term (one season or less than one generation) changes in the local distribution of seals, walrus, and belukha whales within a few miles of mining operations and near air and vessel traffic (MINOR effect). Such disturbance/displacement effects are not expected to be additive because dredges and air and vessel traffic would be occurring at different locations each year and marine mammals would not be continuously disturbed or displaced from the same locations (only frequent or continuous disturbance/ displacement is likely to cause permanent or long-term changes in marine mammal distribution).

Oil spills that may be associated with future OCS oil and gas activities and potential fuel spills associated with dredging operations in Norton Sound are expected to have short-term (MINOR) effects on the abundance or distribution of some seals, walruses, and belukha whales in the Norton Sound area. Sale 57 oil and gas exploration activities in Norton Sound did not result in any significant oil spills. Thus, OCS oil and gas exploration has had a NEGLIGIBLE effect on nonendangered marine mammals up to this time.

**Summary:** The cumulative effects from (1) potential increased bioaccumulation of mercury and other trace metals in the marine environment; (2) additive offshore dredging effects on marine mammal benthic habitats (an estimated 15-30 km<sup>2</sup>; less than 5% of the benthic habitat in Norton Sound); (3) cumulative noise and disturbance from air and vessel traffic associated with the above projects; and, (4) potential oil-spill effects from OCS oil and gas activities (including fuel spills) are likely to have short-term (less than one generation) MINOR effects on some seals, walruses, and belukha whales that seasonally occur in Norton Sound.

**Conclusion:** Cumulative mining, oil and gas, and other development activities in the Nome/Norton Sound area are expected to have MINOR effects on nonendangered marine mammals.

**Cumulative Effects on Migratory Species--Nonendangered Marine Mammals:** The additive effects of other ongoing and future development occurring within the Beaufort, Chukchi, and Bering Seas in the summer and winter ranges of migratory seals, walruses, and belukha whales occurring in Norton Sound are discussed in this section. The following development activities have actual or potential adverse effects on the abundance or distribution of seals, walruses, and belukha whales. The effects described above under cumulative effects apply,



as appropriate, to the following migratory species. Because of the added geographic range of migratory species, they are subject to the following additional effects.

Cumulative Effects of Oil and Gas Exploration and Development in the Bering, Chukchi, and Beaufort Seas: Migratory populations of belukha whales, walruses, and spotted, ringed, and bearded seals occurring in Norton Sound have been exposed to oil exploration activities (seismic, drilling, air and vessel traffic, dredging, and gravel dumping operations) in the Beaufort Sea and exposed to some of these activities in the Bering and Chukchi Seas. The exposure of the marine mammal populations to the above activities and to other marine vessel traffic (oil field sealift-barge traffic to the North Slope and increased icebreaker activity in support of Chukchi Sea oil exploration) is likely to increase in the near future. These industrial activities are likely to have some short-term (less than one generation) MINOR effects on the distribution of migratory seals, walruses, and belukha whales during the seasonal drilling season. If and when oil development occurs, some local changes in the distribution of some portions of the seal, walrus or belukha whale populations could occur over the life of the field (several generations). Thus, a MODERATE effect is possible. However, some habituation of marine mammals to marine and air traffic, to industrial noise, and to human presence is likely to occur, and the displacement associated with cumulative industrial activities or coincidental to such activities is not likely to result in a significant reduction in the overall abundance, productivity, or distribution of seals, walruses, and belukha whales in northern Alaska OCS areas. Thus, the effects of future oil and gas development on migratory nonendangered marine mammals are likely to be MINOR.

Oil spills associated with cumulative oil and gas exploration and development (oil-well blowouts, pipeline spills, and particularly tanker or other marine vessel fuel spills) are expected to have MINOR or short-term (less than one generation) effects on individual or groups of seals, walruses, or belukha whales that directly come in contact with an oil slick. Biological effects of such contact are expected to be sublethal for seals, walruses, and belukha whales although some very young seals and walruses contaminated by the oil could die from physiological stress or from abandonment by the adult females. These effects are likely to have short-term (less than one generation) MINOR effects on the abundance of migratory seal, walrus, and belukha whale populations.

Cumulative Effects of Commercial Fishing: The actual and potential effects of commercial fishing in the Bering Sea on migratory seals, walruses, and belukha whales include: (1) direct mortality from entanglement in fishing gear and from other interactions (shooting of marine mammals raiding fishing nets); (2) competition for prey/commercial fish species that could reduce the availability of prey for marine mammals; and (3) displacement of marine mammals due to noise and disturbance from boats and aircraft associated with intense fishing activities. The entanglement of belukha whales in the salmon driftnet fishery in Bristol Bay is an additive source of mortality for some pods of belukhas. Migratory spotted seals are likely to experience some mortality through entanglement interactions with the herring fishing operations along the coast of Norton Sound. Entanglement of migratory seals in discarded fishing gear, as well as incidental catches of sea lions in bottom fishing trawl operations, are likely to be significant mortality factors in the 20- to 30-year decline of seal and sea lion populations in the southern Bering Sea and the Gulf of Alaska (MODERATE to MAJOR effect).

Competition for fish (particularly pollock) is known to occur between migratory marine mammals and commercial fishing. The rapid increase in the bottom fishery in the Gulf of Alaska and southern Bering Sea is suspected to be the primary cause for the greater than 50-percent decline of northern sea lions in the past 30 years (Perez and Loughlin, 1989) a MAJOR effect. Other migratory pinnipeds have been less affected because they generally prey on smaller fish (smaller age-classes of pollock and other small fish) than those harvested in commercial fishing. At present, migratory spotted, ringed, and bearded seals, and walruses and belukha whales occurring in Norton Sound during the summer have experience only MINOR or NEGLIGIBLE effects (direct mortality or food-competition effects) from commercial fishing which involves a much smaller number of operations (probably a few hundred boats) than that occurring in the southern Bering Sea and Bristol Bay (thousands of boats and spotter aircraft). These marine mammal populations are not exposed to such intense fishing activities during the winter months when they migrate to the southern Bering Sea. However, the amount of commercial fishing activity has increased greatly in the northern Bering Sea and in Norton Sound, and migratory marine mammals are exposed to an increasing amount of vessels and air traffic associated with expanding commercial fishing operations.

There is no question that temporary displacement (minutes to hours to 2-3 days) of seals, walruses, and belukha whales occurs as a result of vessel and air traffic associated with commercial fishing in Bristol Bay and in Norton Sound (MINOR effect). Longer displacement (several days to a few months) of some portions of migratory marine mammal populations are probably occurring in areas of intense commercial fishing activity. Up to 33 percent of the walrus herd that seasonally hauls out on Round Island in Bristol Bay has apparently been

displaced from the area during the bottom trawl fishing operations occurring near the Island during the summer season (Lowry, 1989, oral comm.). This seasonal displacement of about 6,000 walrus to other haulout sites is not likely to have a significant adverse effect on the productivity and abundance of the walrus population but would represent a MODERATE (several generations) effect on the distribution of a portion of the population if this reduction (1/3) in habitat use persists for several years.

In summary, the overall effect of commercial fishing (including direct mortality from entanglement in fishing gear, shooting, competition for prey/commercial fish species, and disturbance/displacement from air and vessel traffic associated with commercial fishing) on migratory nonendangered marine mammals (seals, walrus, and belukha whales) occurring in Norton Sound has been MINOR up to this time. However, increases in the number of fishing vessels and related air traffic and increases in harvest rates could result in long-term (several generations) displacement of some portions of the marine mammal populations occurring in Norton Sound (MODERATE effect). Such increase also could cause an increase in the direct mortality of some seals and belukha whales that interact with fishing operations in Norton Sound and result in an increase in competition for prey/commercial fish species that could result in a long-term (several generations) effect on the productivity and abundance of part of the seal and belukha whale populations occurring in Norton Sound (MODERATE effect). The intense commercial bottom trawl fishery for pollock and other bottomfish has apparently had a long-term effect on regional northern sea lion populations in the southern Bering Sea and in the Gulf of Alaska (MAJOR effect).

Effect of Hunting/Harvest on the Pacific Walrus Population: The annual harvest of Pacific walrus has more than doubled from the 1970's (3,000-4,000 animals) to the 1980's (6,000 to over 10,000 animals) with a total catch by both Soviet and American hunters at 10,000 to 15,000 per year or 4 to 6 percent of the population (Fay, Kelly, and Sease, 1989). During this same time frame scientific data on the productivity of the population indicated that herd productivity and calf survival declined sharply. The increased harvest is occurring at the same time that the population is experiencing a natural decline in productivity as a result of the population reaching the carrying capacity of the environment (Fay, Kelly, and Sease, 1989). Harvest/exploitation rates of over 10,000 walrus per year have caused the population to decline by about 50 percent according to Fay, Kelly, and Sease (1989) representing a MAJOR effect on the walrus population in the past. A cooperative reduction in harvest rates by Soviet and American hunters would prevent such a population decline. However, some continued decline in the walrus population might continue into the next decade before any reversal or recovery of the population would begin (Fay, Kelly, and Sease, 1989). Optimistically, the international hunting of Pacific walrus would still have a MODERATE effect on the walrus population. International subsistence hunting of other pinnipeds and belukha whales is believed to have no more than a MINOR effect on migratory seals and belukha whales.

Overall Cumulative Effects on Migratory Seals, Walrus, and Belukha Whales: Cumulative activities that affect migratory marine mammals occurring in Norton Sound include oil and gas activities, commercial fishing, and the hunting/harvest of marine mammals. Migratory seals that occur in Norton Sound include ringed, spotted, and bearded seals. The combined effect of oil and gas activities (primarily noise and disturbance and oil-spill effects), commercial fishing (mortality due to entanglement in fishing gear, noise and disturbance, and competition for fish populations), and hunting/harvest is predicted to be MINOR on migratory ringed and bearded seal populations occurring in Norton Sound. Cumulative effects on spotted seals are expected to be MODERATE primarily due to interaction with commercial fishing activities and direct competition for fish populations with commercial fishing in the Bering Sea. Migratory pinnipeds such as the northern sea lion occurring in the southern Bering Sea and the Gulf of Alaska apparently have been seriously affected by the commercial harvests of pollock and other bottomfish.

The cumulative effect of oil and gas activities, commercial fishing, and hunting/harvest on the Pacific walrus population is predicted to be MODERATE.

The primary factor in this predicted effect is the increase in harvest rates from both Soviet and American subsistence hunting. The harvest of walrus has more than doubled in the past 10 years (more than 10,000/year), but at the same time the population productivity is low (Fay, Kelly, and Sease, 1989). Noise and disturbance of walrus near haulout sites from air and vessel traffic associated with commercial fishing and oil and gas activities are expected to have a MODERATE effect on the distribution of part of the Pacific walrus population. Cumulative effects of oil and gas activities, commercial fishing, and subsistence harvests on migratory belukha whale populations is predicted to be MODERATE. The primary factors are an increase in the competition for fish populations between the whales and commercial fishing and to some degree the interaction with oil and gas activities and other increases in vessel traffic. The cumulative effect of the proposal is likely to

represent an additional long-term noise and disturbance (less than one generation) MINOR effect on migratory seals, walrus, and belukha whales, but the overall cumulative effect is expected to be MODERATE.

**Conclusion:** Cumulative effects on migratory nonendangered marine mammals from development activities within the Norton Sound area and development over the range of migrating nonendangered marine mammals are expected to be MODERATE.

7. **Effect on Endangered and Threatened Species:** Section 7(c) of the Endangered Species Act of 1973, as amended, requires that, under certain circumstances, a Federal agency prepare a biological assessment for listed and proposed threatened and endangered species or critical habitat that may be present in an area of a proposed major Federal action. The assessment evaluates the potential effects of the action and may also be used to determine whether or not the action will "adversely affect" any listed species or critical habitat and thus require formal consultation.

The MMS completed the biological assessment for the proposed OCS Mining Program Norton Sound Lease Sale in March 1988. The assessment determined that the endangered gray whale, *Eschrichtius robustus*, and the threatened arctic peregrine falcon, *Falco peregrinus tundrius*, were the only species likely to be found in or near the proposed lease-sale area. The assessment concluded that the proposed lease sale and the resulting mining activities would not adversely affect the gray whale or arctic peregrine falcon. The biological assessment was submitted to NMFS and FWS on April 4, 1988, for their 30-day review. Concurrence was received from both agencies on the assessment conclusion of no adverse affect. The NMFS, in a concurrence letter (May 9, 1988), recommended that a gray whale monitoring program be required in lease blocks west of 166° W. longitude. The biological assessment addressed a much larger proposed sale area. Since the assessment was written, the proposed sale area was greatly reduced during Area Identification and all potential lease blocks are now east of 166° W. longitude. The FWS recommended in their memorandum of concurrence (May 24, 1988) that protection measures for nesting peregrine falcons be incorporated into lessees' exploration and mining plans and that water quality meet Federal criteria for mercury and cadmium.

Subsequent to the assessment, and after review of available information, MMS determined that water-quality criteria for cadmium and mercury may be exceeded. Also, FWS informed MMS that new information from a 1988 peregrine falcon survey documented additional nesting sites in the Norton Sound area (Ambrose, 1988, oral comm.). Due to this new information concerning trace metals and additional nesting sites, MMS requested initiation of formal Section 7 consultation with FWS by a September 21, 1988, memorandum. Formal consultation was conducted and concluded with a June 7, 1989, biological opinion from FWS. The opinion concluded that the proposed OCS mining activity would not jeopardize the continued existence of the arctic peregrine falcon. The FWS recognized that there could be an "incidental take" of arctic peregrine falcons due to the activities (primarily from bioaccumulation of mercury), and provided the MMS with "reasonable and prudent measures" and "terms and conditions" that are necessary to minimize the amount or extent of "incidental take". Also, MMS notified NMFS (September 28, 1988) that it had concluded that the new information concerning trace-metal effects would not change the original decision of the biological assessment--"no adverse effect" on the gray whale--and therefore, formal consultation would not be requested.

In recent state-of-the-art sampling and analysis for trace metals in waters and sediment of Norton Sound during the summer and fall of 1989, the EPA criteria for mercury and cadmium were not exceeded (see Sec. IV.B.2.). Therefore, MMS reinitiated formal Section 7 consultation with the FWS on January 23, 1990, to obtain a new biological opinion which would reflect this updated information. The FWS reviewed the new information on water quality and the new data collected on mercury concentrations in the Norton Sound arctic peregrine falcon population (see Sec.III.B.5) and concluded in their June 26, 1990, second biological opinion that the proposed mining activity would not jeopardize the continued existence of the arctic peregrine falcon. This conclusion was "based, in part, on the inclusion of Stipulation No. 2 (prohibition of the use or storage of mercury on-board the dredge) in the lease conditions and the assumption that the Federal water-quality criteria (marine chronic) for mercury will not be exceeded." The FWS also determined that an "incidental take" was no longer anticipated, as described in their June 7, 1989, opinion. The FWS recommended that the arctic peregrine falcon be included in Stipulation No. 1 as a species to be monitored for accumulation of trace metals and for population status.

The NMFS issued an emergency interim rule listing the Steller (northern) sea lion as threatened on April 5, 1990. The MMS reviewed information on Steller sea lions and determined that no "may affect" situation exists for this proposed sale. The MMS notified NMFS of this determination (July 26, 1990, letter). The October 25, 1990, letter from NMFS concurred with the MMS conclusion.

(See Appendix B for the biological assessment, biological opinions, and other documentation of the Section 7 consultation process.)

Since the proposal includes Stipulation Nos. 1 through 4, the following analysis assumes that an effective chemical (water and sediment) and biological monitoring and operational management program would be conducted to measure the effects of benthic excavation and spoil deposition, trace-metal release and accumulation in the environment, and that such a program would prevent long-term local effects on endangered and threatened species. This stipulation would limit or prevent significant increases in the bioaccumulation of mercury or other trace metals in endangered and threatened species and their environment. The use of mercury or other toxic substances in processing would be prohibited onboard the dredge (Stipulation No. 2), thus eliminating any accidental spillage of mercury.

To aid in the interpretation of the following effects discussion, an explanation of the "regional population" term used in the definitions presented in Table IV-2 follows. The arctic peregrine falcon regional population is the west coast population from Cape Lisburne to Cape Denbigh in Norton Sound, including tributaries. This population is estimated at approximately 20 to 30 pairs and is considered distinct from the north population (Colville-Sagavanirktok River) (Ambrose, 1987; Ambrose, 1988, oral comm.). The gray whale regional population is the migratory/summer resident population using the Chirikov Basin/St. Lawrence Island/Norton Sound area (essentially the OCS Norton Basin Planning Area).

a. Effect on Gray Whales: Small numbers of migrating or feeding gray whales may be found near or within the proposed sale area during the ice-free period, which is generally mid-May through November (see Sec. III.B.5.a). Some gray whales would be exposed to the potential effects from OCS mining activities. The primary effect-producing agents which may affect some gray whales are habitat alteration, turbidity, trace metals, noise and disturbance, and fuel spills. This section briefly discusses potential dredging and spoil deposition effects on gray whale feeding habitat. The reader is directed to Sections IV.B.2 through 4 for a comprehensive discussion of the potential effects of mining activities on water quality and benthic and pelagic communities.

(1) Effect of Habitat Alteration and Turbidity: The proposed OCS mining lease sale would result in seafloor alteration by dredging and the deposition of tailings from the onboard washing process. An estimated 100 acres of seafloor would be mined annually by one dredge, with 1,300 acres mined over the 14-year production life of the mining leases (less than 1% of the proposed sale area). The deposition of tailings will be primarily upon the mined seafloor; however, a minimal amount of tailings would likely be deposited upon the adjacent unmined seafloor which would increase the total acres of benthic habitat that are altered. The benthic habitat within the proposed lease-sale area is of low value as a gray whale feeding area (see Sec. III.B.5). Consequently, the direct alteration of the benthic habitat would have a NEGLIGIBLE effect on the regional gray whale population.

It is expected that mining at individual sites from one dredge would create local turbidity plumes within 2 to 3 kilometers of the dredge (Sec. IV.A.2.a). The turbidity plumes are expected to be comparable in intensity to turbidity caused by natural phenomena associated with arctic conditions (storm waves, ice gouging, direct influx of muddy river water) but the duration would be long term (mining season) versus short term (storm). Since these natural phenomena have no apparent adverse effects on gray whales, local turbidity plumes associated with mining are not expected to affect the few gray whales that may encounter them (NEGLIGIBLE effect).

(2) Effect of Trace Metals: The proposed seafloor excavation and tailings deposition could result in a redistribution of trace metals in the sediment material and increase the trace-metal levels in the water column. Levels of trace metals could increase in the proposed sale area due to the dredge/mining operation (see Sec. IV.B.2). Of the trace metals of concern (arsenic, mercury, lead, zinc, cadmium, copper, chromium, and nickel), mercury (especially methylmercury compounds) is potentially the most toxic.

(a) Mercury: In terms of mercury, it is not the quantity of mercury in the sediments, but the mercurial form that determines the toxicity to the environment. Since the inorganic/metallic form is not fully ingested by an organism it is not nearly as toxic as methylmercury compounds where ingested amounts are fully absorbed into the tissues (Scheuhammer, 1987). The major concern is that inorganic mercury can be converted into methylmercury compounds by microorganisms within the marine benthic community through the methylation process (Charlebois, 1977); and thus, during the mining operation be released into the water column to bioaccumulate in the marine ecosystem.

Evidence supports the evolutionary adaptation by marine mammals of a detoxification process that converts mercury and cadmium into nontoxic forms by combining with selenium and bromine. The nontoxic forms are stored within the liver resulting in tissue-mercury levels increasing with age (Risebrough, 1978; Koeman et al., 1975; Scheuhammer, 1987). Not all marine mammals have been studied for this process, therefore, it is impossible to state that all species possess this biochemical protection from mercury and cadmium. Mercury is the primary trace metal concern in Norton Sound since (1) elevated levels of mercury (1.3 ppm) were reported in beach sediments of the Norton Sound area (Nelson et al., 1975), (2) disposal of metallic mercury from gold mining-processing has occurred in the Nome area over the past century, and (3) as discussed above, mercury is the most toxic and most likely to bioaccumulate through the food chain.

(b) Other Trace Metals: Arsenic, cadmium, chromium, and lead do not present the same threat to the marine environment as mercury does since they are either far less toxic or they do not bioaccumulate in the food chain. Zinc, copper, and nickel toxicity through bioaccumulation in the food chain are generally of minor concern due to the excretion of excess amounts of these metals by marine organisms and the low accumulation rates in the food chain (Eisler, 1988; Risebrough, 1978).

Assuming dredging/mining operations could release high concentrations of toxic trace metals (especially mercury) from marine sediments, then some contamination of the marine ecosystem could occur. However, only a small number of gray whales may use the proposed sale area to a limited extent (see Sec. III.B.5). Therefore, only a minor part of the regional gray whale population would likely encounter any potentially toxic trace metals. In addition, since the proposed sale area is not a major feeding area, that greatly decreases the opportunity for gray whales to ingest any trace metals that would occur in the marine benthic ecosystem. Consequently, any increase of trace metals (especially mercury) in the proposed sale area is expected to have a NEGLIGIBLE effect on the gray whale regional population. In addition, no significant release of trace metals (especially mercury) nor increases in the bioaccumulation of trace metals within the food chain is expected to occur, since Stipulation Nos. 1 and 2 are implemented with the proposal.

(3) Effect of Noise and Disturbance: Increases in noise and disturbance to gray whales from vessels, aircraft, seismic activity, core-sample drilling, and mining and dredging would be anticipated within the proposed lease area. One tending-vessel (usually a tug) and three helicopter flights per day would support the offshore mining operation. An estimated 4,200 line km of low-intensity shallow-seismic activity and core-drilling activity would be performed during the initial 5 years of the lease. Prospect assessment seismic surveys (low intensity) of 8,200 line km are estimated for the remaining 13 years of the mining program (see Sec. II.A.2 for complete scenario).

Disturbance effects to gray whales due to helicopter support would be minimal and short-term unless low-level flights repeatedly encountered whales (Malme et al., 1983, 1984; Greene, 1984; Ljungblad et al., 1982; Ljungblad, Moore, and VanSchoik, 1984). The seismic surveys would be of low-intensity for shallow-depth data, not of the high-intensity deep-penetrating type performed for oil and gas surveys (estimated at one-tenth to one-seven-hundredth that of high intensity). Therefore, seismic activities would likely be less disturbing to gray whales than reactions recorded for oil and gas seismic activity (Reilly, 1981a,b; Ljungblad et al., 1982; Malme et al., 1983, 1984). Mineral sampling during exploration (2-3 years) is assumed to include the drilling of an estimated 3,240 core samples from a small (200-ft) vessel equipped with a drilling rig during the open-water season. The drill rigs are comparable in size to water-well drill rigs. The vessel and drilling activity could disturb and temporarily displace gray whales within a few kilometers of the drillship.

The actual dredging/mining site would be a composite of noise producing activities: generators, dredge-bucket conveyer belt, the actual dredge excavation, vibrations from the sediment-processing equipment, and tailings deposition. Greene (1987) estimated that sounds produced from operating cutter-suction dredges would be at ambient levels at ranges from 3.7 to 16 km. Miles, Malme, and Richardson (1987) estimated a "zone of responsiveness" (50% of whales would show avoidance responses) for a clamshell dredge at 0.1 to 3.1 km. The noises transmitted from the proposed larger bucket-ladder or bucketline dredges are unknown, but are thought to be louder, especially with the additional noise associated with the onboard processing system. Therefore, the area of noise influence could be much larger than the ranges described above for cutter-suction and clamshell dredges, and a higher percentage (greater than 50%) of whales would show avoidance responses.

A small number of the gray whale regional population use the proposed sale area (see Sec. III.B.5). Therefore, only a few whales would be affected by an encounter with the noise and disturbance from the proposed dredging/mining activities. Consequently, the anticipated increase of noise and disturbance factors within the

proposed sale area would have a MINOR effect on the gray whale regional population (individuals affected over a short time period).

(4) Effect of Fuel Spills: There is the possibility of fuel spills (diesel fuel) due to the proposed OCS mining activities: (1) refueling spills, and (2) the sinking of the dredge due to a severe storm (see Sec. IV.B.2). The following analysis is based on Table IV-10 and Tables 3 through 8 in Appendix A, Sale 100 FEIS (conditional probabilities of an oil spill contacting given target areas).

The proposed sale area is not considered valuable gray whale habitat in comparison to the Chirikov Basin feeding area (see Sec. III.B.5). Refueling spills (1,000 bbl or less) would be completely dissipated within the proposed sale area by 4 to 5 days, and therefore, would not affect the Chirikov Basin. It is assumed for analysis that when a large dredge would sink, perhaps during a storm, a spill of 3,500 bbl would occur. Here again the Chirikov Basin would not be contacted since the fuel would be dissipated within 5 to 6 days (before reaching the Basin).

Effects that oil spills would have on gray whales of Norton Sound have been discussed in detail in Section IV.B.1 of the Sale 100 FEIS, and this discussion is incorporated by reference. The few gray whales that occasionally use the proposed sale area could encounter a diesel-fuel spill. However, any fuel spilled, including an assumed 3,500-bbl spill, would be dissipated within 5 to 6 days, and there would be no threat to the important Chirikov Basin feeding area. Gray whales within the proposed sale area that may encounter a fuel spill could experience skin contact with fuel, baleen fouling, and inhalation of sublethal concentrations of hydrocarbon vapors. However, considering the small potential slick size (0.3 to 0.4 km<sup>2</sup>), dissipation within 5 to 6 days, and the limited number of gray whales using the proposed sale area, the potential of contact with gray whales is minor.

Considering the few whales that use the proposed sale area and the minor threat of a spill contacting the Chirikov Basin, only a NEGLIGIBLE effect is expected from any fuel spill within the proposed sale area.

SUMMARY: A minor portion of the regional gray whale population would be exposed to the following potential effect-producing agents from the proposed OCS Mining Program Norton Sound Lease Sale: habitat alteration, turbidity, trace metals, noise and disturbance, and fuel spills. A few individuals, or small groups, could be affected over a short time period, especially due to noise and disturbance. The proposed OCS mining activities are expected to have an overall MINOR effect on the regional population.

CONCLUSION (Effect on Gray Whales): The overall effect of the proposed OCS Mining Program, Norton Sound Lease Sale on the endangered gray whale regional population is expected to be MINOR in the base case.

CUMULATIVE EFFECTS: In addition to the proposal, the following past, present, and reasonably foreseeable future actions in the Norton Sound area (current and planned) would have potential effects on gray whales: offshore mining on leases within State waters, proposed Federal oil and gas activities, Nome harbor-maintenance dredging, and onshore mining (see Sec. IV.A.2.b). The primary cumulative effect-producing agents from these projects would be habitat alteration and turbidity, noise and disturbance, trace metals, and fuel and oil spills.

Cumulative offshore dredging from both the proposed OCS mining and the mining in State waters would result in the alteration and destruction of benthic habitat and turbidity plumes. This would be a localized effect occurring within a few hundred yards of the dredge sites. A total of 2,600 acres (high case) of seafloor could be excavated during the 14-year production life of the leases, which approximates 2 percent of the 147,050 acres offered in the proposed lease sale. Gray whales are infrequent users of the proposed sale area and the adjoining State waters and the benthic habitat is of low value for feeding (see Sec. III.B.5). Consequently, the cumulative effects from habitat alteration and turbidity would have a NEGLIGIBLE effect on the regional gray whale population.

Cumulative noise and disturbance would occur from offshore dredging in State waters and the proposed Federal OCS mining and oil and gas activities. Also, support vessels and aircraft to the above activities would create additional noise and disturbance. Gray whales may be displaced within a few miles of dredging/mining operations and the one oil and gas exploration well in OCS Sale 57. Also, noise and disturbance from the cumulative air- and vessel-support traffic would increase the frequency of short-term (few minutes) disturbance of gray whales. Overall, cumulative effects due to noise and disturbance are expected to cause only short-duration or startle responses by gray whales, not resulting in any long-term displacement (MINOR effect).

Cumulative onshore and offshore mining could increase the availability and bioaccumulation of toxic trace metals in the marine food chain. This could lead to elevated levels in tissues of a few gray whales frequenting the area, but would not affect the abundance of gray whales in the Norton Sound area. Since the mining areas are not frequented by large numbers of gray whales, the cumulative effect from toxic trace metals is expected to be NEGLIGIBLE.

Fuel spills from offshore mining activities and oil spills that may be associated with any future OCS oil and gas activities would likely have short-term (less than one breeding cycle) MINOR effects on the few gray whales in the area. Sale 57 oil and gas activities (3 exploration wells) did not result in any related fuel or oil spills, and thus has had a NEGLIGIBLE effect on gray whales to date. All Sale 57 leases now have been relinquished.

In summary, the proposal and the other development projects within the Norton Sound area are not expected to produce significant effects to the regional gray whale population. The NEGLIGIBLE effects from potential fuel and oil spills, cumulative habitat alteration, turbidity, and trace-metal bioaccumulation due to dredging/mining activities, together with the MINOR effects from cumulative noise and disturbance from vessels, aircraft, and drilling are likely to have a combined overall MINOR effect on the gray whale.

**Conclusion:** The cumulative effects from habitat alteration, turbidity, trace metals, noise and disturbance, and oil and fuel spills are expected to be MINOR for the regional gray whale population.

b. **Effect on Arctic Peregrine Falcons:** The threatened arctic peregrine falcon occupies coastal nesting sites in Norton Sound generally from April to September (see Sec. III.B.5.b). There are six known nest sites near the proposed sale area that may be exposed to some adverse effects related to OCS mining activities. The primary effect-producing agents which may affect arctic peregrine falcons are habitat alteration, turbidity, trace metals, noise and disturbance, and fuel spills. This section briefly discusses potential indirect effects from dredging and spoil deposition to peregrine falcons through their prey species. The reader is directed to Sections IV.B.2 through 4 for a comprehensive discussion of the potential effects from mining activities on water quality and benthic and pelagic communities.

(1) **Effect of Habitat Alteration and Turbidity:** The proposed mining operation--one dredge--would alter an estimated 100 acres of seafloor annually and 1,300 acres over the life of the leases. The benthic habitat will be directly altered by the actual dredging (approximately 3.6 m in depth) and the deposition of tailings from the mineral extraction and washing process on the dredge. The nesting peregrines could be indirectly affected by any reduction or dislocation of prey-species populations within the peregrine-feeding territories (15 mi of nest sites). The direct alteration of benthic and pelagic habitat due to dredging, tailings deposition, and resulting water turbidity could reduce availability of seabird prey species (see Secs. IV.B.3 through 5). Seabirds are a common prey species found in coastal falcon nest sites of northwest Alaska (Wright, 1987). However, with the adverse effects to the seabird species being confined to the general vicinity of the dredging operations, it is not anticipated that the overall populations of seabirds would be reduced. The nesting of peregrine falcons near the proposed sale area are not expected to change due to habitat alteration and turbidity resulting from offshore mining (NEGLIGIBLE effect).

(2) **Effect of Trace Metals:** The proposed seafloor excavation and tailings deposition could result in a redistribution of trace metals in the sediment material and increase the trace-metal levels in the water column. Levels of trace metals could increase in the proposed sale area due to the dredge/mining operation (see Sec. IV.B.2). Of the trace metals of concern (arsenic, mercury, lead, zinc, cadmium, copper, and nickel), mercury (especially methylmercury compounds) is potentially the most toxic. Cadmium and mercury are the two metals of concern by FWS for potentially effecting the Norton Sound arctic peregrine falcon population (FWS May 24, 1989, June 7, 1989, and June 26, 1990, memorandums; Appendix B).

(a) **Cadmium:** Cadmium bioaccumulates in the food chain but birds are comparatively resistant to the biocidal properties, requiring high doses (mallards and chickens tolerated 200 ppm) in their diets for adverse effects. Sublethal effects include growth retardation and anemia but at much higher concentrations than aquatic biota. It is estimated that cadmium concentrations would have to exceed 3 ppb in freshwater, 4.5 ppb in saltwater, or 100 ppb in the diet to result in adverse effects (Eisler, 1985). Neither projected discharges of cadmium from the proposed sale nor reported concentrations near the current dredge operations are large enough to exceed EPA criteria (see Sec. IV.B.2). Therefore, the effects of cadmium on the arctic peregrine falcon regional population is expected to be NEGLIGIBLE.



(b) **Mercury:** Mercury is the primary trace metal concern in Norton Sound since (1) elevated levels of mercury (1.3 ppm) were reported in beach sediments of the Norton Sound area (Nelson et al., 1975), (2) disposal of metallic mercury from gold mining-processing has occurred in the Nome area over the past century, and (3) as noted above, mercury is the most toxic and most likely to bioaccumulate through the food chain.

There is limited data on the bioaccumulation of mercury or other toxic trace metals within the local (Norton Sound) arctic peregrine falcon population. The FWS and ADF&G collected several peregrine eggs and primary feathers from nestlings during the 1989 field surveys for mercury analysis (see Sec.III.B.5). Limited sampling of the Norton Sound arctic peregrine falcon population showed a mean wet weight of mercury for eggs at 1.64 ppm and nestling feathers at 6.383 ppm. No trace-metal data have been collected on peregrine falcon prey species, such as marine or upland birds. Therefore, it is unknown, at this time, to what extent mercury or other trace metals may exist within the prey-species populations.

Recent state-of-the-art water-quality and sediment sampling indicates that water-quality criterion for mercury is not exceeded in the vicinity of the proposed sale area, contrary to previously reported sampling for mercury (see Sec. IV.B.2.b(2)). Considering the high concentrations of mercury potentially present (as cited above) within the proposed sale area from both man-induced and natural sources, the proposed mining operation could redistribute mercury and other less toxic trace metals from the sediments and increase the potential for bioaccumulation in the ecosystem, eventually affecting the local arctic peregrine falcon population.

Mercury (especially methylmercury compounds) is potentially toxic and has been implicated in causing direct mortality and reproduction malfunctions in bird populations. It is not the quantity of mercury in the sediments, but the mercurial form that determines the toxicity to the environment. Since the inorganic/metallic form is not fully absorbed by the organism, it is not nearly as toxic as methylmercury compounds where ingested amounts are fully absorbed into the tissues (Scheuhammer, 1987). The major concern is that inorganic/metallic mercury can be converted into methylmercury compounds by microorganisms within the marine benthic community through the methylation process (Charlebois, Rivest, and Nichols, 1977); and thus be released into the water column to bioaccumulate in the marine ecosystem.

Toxic effects of methylmercury to birds vary by species. For example, while ingestion of 33 ppm produced mortality rates of 90 percent, 85 percent, and 7.5 percent to pheasants, ducks, and chickens, respectively, 13 ppm was lethal for kestrels (a raptor species) (Gardiner, 1972; and Koeman et al., 1971, as cited by Scheuhammer, 1987). In a study, a steady diet of chicks containing 7 to 10 ppm mercury fed to red-tailed hawks is likely to be lethal (Fimreite and Karstad, 1971). Ingested levels as low as 2 to 3 ppm significantly reduced the reproductive rates in several bird species (Scheuhammer, 1987). Such variance in susceptibility to methylmercury may be due to species differences in the ability to detoxify the methylmercury to the less toxic inorganic form. Also, bioaccumulation within the liver of the trace metal selenium and its ability to counter the toxic effects of mercury accumulation has been demonstrated (Scheuhammer, 1987). To the extent these mercury-protection mechanisms operate has yet to be fully substantiated for all bird species, and probably varies by species.

Mercury levels in peregrine falcon populations have been recorded in several studies. Lindberg and Odsjo (1983) studied mercury levels in northern and southern Swedish peregrine falcon populations and their prey species. Mercury levels were approximately three times higher in the northern population and prey; demonstrating that the aquatic food chain has a higher level of mercury contamination than the terrestrial food chain. A comparison of mean mercury levels in feathers from 1834 (museum specimens) to 1977 clearly showed the period of severe alkyl-mercury contamination due to seed treatment: 2.58 ppm (before), 37.9 to 52.5 ppm (1940 to 1966, seed treatment period), and 7.78 to 17.60 ppm (after 1966 treatment ban). It is difficult to evaluate the mercury contamination role in the drastic falcon population declines that occurred during the same period, since large quantities of chlorinated hydrocarbons were also used during the period. A study of mercury contamination in predator and prey bird species found levels of mercury (wet weight) in eggs of peregrine and prairie falcons that ranged from 0.315 to 0.568 ppm and 0.019 to 1.71 ppm, respectively (Fimreite, Fyfe, and Keith, 1970). They concluded that mercury contamination of prey species was responsible for falcon population declines. Nelson and Myres (1975) measured 0.74 ppm (wet weight) of mercury in addled eggs collected from a coastal peregrine falcon population in British Columbia. Concerns were that these levels could cause embryonic mortality. They also theorized that mercury could be responsible for the drastic decline of the ancient murrelet population, the peregrine's principal prey species. Newton et al. (1989) reported on contaminants measured in 550 addled peregrine falcon eggs collected in Britain from 1963 to 1986. A mercury analysis of eggs collected from 1971 through 74 and 1981 through 86 showed coastal nest sites had significantly higher levels than inland sites--1.27 versus 0.21 ppm dry weight. Their data indicate that mercury may have resulted in reduced brood-sizes more so than DDE. An explanation for higher mercury levels in coastal peregrines is explained by

the marine diets of the coastal peregrines which prey primarily upon waders and seabirds. Their analysis showed that marine birds, especially fulmars and auks, had the highest levels of mercury. Coastal peregrine populations are still depleted, and to what extent high levels of PCB's, mercury, and other possible contaminants in prey species contribute needs further study.

Parrish et al. (1983) in trace-element studies to locate natal areas of peregrine falcons found mean levels of mercury in nestling feathers for W. Greenland, the Yukon River, the Colville River, of 0.8, 3.1, and 1.5 ug/g (ppm), respectively. They concluded that the varying levels were due to local background levels resulting from varying diets or natural mercury deposits, or both, and not due to any mercury pollution. Parrish et al. (1983) cited several studies that documented background mercury levels in raptors. Studies in Sweden reported mean levels of mercury in feathers for peregrine skins collected between 1834 and 1940 at  $2.6 \pm$  ug/g (ppm) (15-20 ug/g [ppm] were reported during polluted times), and 3 to 4 ug/g (ppm) was concluded for goshawks and ospreys. A study in Scotland concluded that  $2.4 \pm 2.1$  ug/g (ppm) was the normal background level for mercury in peregrines (Parrish et al., 1983, citing Berg et al., 1966; Johnels and Westermak 1969; and Lindberg and Mearns 1982). Mercury values for peregrine nestling feathers in Scotland (Lindberg and Mearns, 1982) and Finland (Lindberg et al., 1983) were 1.40 and 4.45 ug/g [ppm]), respectively, in 1974 through 75.

In a limited sampling study during 1989, egg and nestling feather samples were collected from arctic peregrine falcons nesting in the Norton Sound and Colville River areas for mercury analysis (see Sec. III.B.5 and Appendix B). Three eggs were collected from three separate nest sites in Norton Sound, and 12 eggs were collected from the Colville River sites. Feather samples were taken from 12 and 8 nestlings in the Norton Sound and Colville River areas, respectively. The mean wet weight mercury level was 1.64 ppm in the Norton Sound eggs compared to a higher level of 2.55 ppm for the Colville River. Conversely, the feather sample mercury levels were higher for Norton Sound (mean wet weight of 6.383 ppm) than the Colville River (mean wet weight of 4.975 ppm). The limited data indicate that falcons in Norton Sound are laying eggs with less mercury than those from the Colville River, but the Norton Sound nestlings may be accumulating mercury at an accelerated rate compared to the Colville River nestlings. The FWS concluded that both populations appear to be near mercury levels which are believed to affect reproduction, although both populations are at expected reproduction levels.

(c) Other Trace Metals: Zinc, copper, and nickel toxicity through bioaccumulation in the food chain is generally of minor concern due to the excretion of excess amounts of these metals by marine organisms and the low accumulation rates in the food chain. Arsenic, lead, and chromium do not present the same threat to the food chain and, ultimately, to the peregrine falcon as does mercury since they are either far less toxic (requiring large amounts to produce adverse effects) or they do not bioaccumulate in the food chain to effect higher trophic levels (Eisler, 1988; Risebrough, 1978).

Considering the concentrations of mercury found in the sediments of the proposed sale area (0.034 ppm; Sec. IV.B.2) and the potential pockets of high mercury concentrations from both man-induced and natural sources, the proposed mining operation could redistribute mercury and other less toxic trace metals from the sediments and increase the potential for bioaccumulation in the ecosystem. Also, the mercury levels in the Norton Sound arctic peregrine falcon population reported by the FWS (discussed above) may be near levels that could affect reproduction. The specific extent of bioaccumulation of trace metals (especially mercury) due to the proposal, and subsequent effects on the arctic peregrine falcon are unknown. However, there is sufficient evidence that the peregrine falcon, similar to other raptors, is very susceptible to toxic substances in their food-chains. For example, bioaccumulation of chlorinated hydrocarbons from pesticides (primarily DDT) through the food-chain was the primary cause of peregrine falcon population declines which eventually resulted in the listing of the species as endangered (USDOI, FWS, 1982).

The FWS Recovery Plan (USDOI, FWS, 1982) considers a 15-mi feeding territory for a nest site. The feeding territories of the six nest sites near the proposed sale area include seabird and other aquatic bird concentrations, such as Bluff, Sledge Island, Safety Lagoon, and Topkok Head (Fig. III-17). These prey populations could become contaminated by bioaccumulation of toxic trace metals through the marine ecosystem (see Sec. IV.B.5). Therefore, in an extreme case, direct mortality and/or reproductive failure due to ingestion of contaminated prey species and (in addition) the possible reduction of prey-species populations due to mercury contamination could result in a long-term reduction (several generations) of the local (Norton Sound) arctic peregrine falcon population. The trace-metal effect on the local population could result in the loss of some or all of the six nesting pairs near the proposed sale area from the regional population (20-30 pairs), resulting in a MODERATE effect to the regional arctic peregrine falcon population. However, recent data on water and sediment trace-metal levels suggest that mercury and cadmium levels do not exceed the EPA chronic criterion standard (Sec.

IV.B.2), suggesting no significant increase in trace-metal bioaccumulation in the peregrine falcon population from the proposed action. In addition, potential toxic trace-metal effects are assumed to be mitigated by the implementation of Stipulation Nos. 1 and 2 in the proposal, which would prohibit onboard use of mercury in gold processing and require an active monitoring program (including the arctic peregrine falcon) to prevent any significant increase of toxic trace metals in the Norton Sound ecosystem. Therefore, assuming that the recent water-quality data are indicative of future data for dredging in the proposed sale area, and the incorporation of the above stipulations to protect the marine ecosystem from toxic concentrations of trace metals (especially mercury); the potential MODERATE effects to the arctic peregrine falcon population are expected to be reduced to NEGLIGIBLE.

(3) Effect of Noise and Disturbance: The nearest that peregrine falcon nest sites occur to the proposed lease-sale area is 3 mi. The FWS Peregrine Falcon Recovery Plan recommends the prohibition of high noise-level activities within 2 mi of nest sites (USDOJ, FWS, 1982). Therefore, the direct noise and disturbance from the actual dredging/ mining operation would not be near enough to affect the nesting peregrines above a NEGLIGIBLE level.

The FWS Recovery Plan also recommends the prohibition of aircraft below 1,500 ft within 1 mi of nest sites from April 15 through August 31. During inclement weather, helicopter-support flights (360-450 per year) would likely follow the coastline during trips to the mining operations from the base in Nome, possibly exposing some nest sites to low-level helicopter disturbance. Only under unusual circumstances would the nest sites east of the proposed sale area be exposed to helicopter flights. Ritchie (1987) in a study of disturbances to nesting peregrines along the Trans-Alaska Pipeline System found no severe reactions to aircraft at distances greater than 2,000 ft, but severe reactions were recorded from aircraft below 1,000 ft and from 500 to 1,500 ft from the nest. A study of nesting gyrfalcons documented disturbance by helicopter overflights at altitudes of 150 m, but showed no disturbance at 600 m (Platt, 1975). Low-level flights within a mile of a nest site could cause disturbances during critical nesting periods and thus may result in a lower seasonal production for individual nest sites within the local (Norton Sound) peregrine falcon population. Since the disturbance activity (low-level flights) are likely to be infrequent and produce short-term effects to the local population (MINOR effects), the effect from noise and disturbance to the regional population is expected to be MINOR. ITL No. 2 would be implemented in the proposal, which could aid in mitigating noise and disturbance effects. However, since ITL's are advisory and not enforceable (as stipulations), it is assumed that noise and disturbance effects could still occur at the same level.

(4) Effect of Fuel Spills: There is the possibility of fuel spills (diesel fuel) due to the proposed OCS mining activities from: (1) refueling and (2) the sinking of a dredge due to a severe storm (see Sec. IV.B.2). The following analysis is based on Table IV-10 and Tables 3 through 8 in Appendix A, Sale 100 FEIS (conditional probabilities of an oil spill contacting given target areas).

Although relatively unlikely, fuel spills may affect peregrines through direct contact by adults (when hunting or via prey caught in the vicinity of the spills) or indirectly through disruption and loss of prey organisms (seabird and shorebirds). It is assumed for analysis that when a large dredge would sink, perhaps during a storm, a spill of 3,500 bbl would occur. Under the OSRA (Appendix A, Tables 3 and 4, Sale 100 FEIS), the land area would have a 25-percent chance for a spill contacting land within 3 days after a spill of 3,500 bbl at spill point E-9. The 3,500 bbl spill would be dissipated within 5 to 6 days. A smaller refueling spill (1,000 bb or less) would have dissipated within 4 to 5 days. Peregrines prefer to take their prey in flight and would not be likely to physically enter the diesel fuel for prey species. However, they could become oiled from a contact with fuel contaminated prey. Also, with a 3,500 bbl fuel spill it is unlikely that numerous peregrines would become oiled. Effects of fuel spills are expected to be MINOR since it may affect only a few individuals in the local population over a short-time period (less than one breeding cycle).

SUMMARY: A local population of six arctic peregrine falcon nest sites could be exposed to the following potential effect-producing agents from the proposed OCS Mining Program Norton Sound Lease Sale: habitat alteration, turbidity, trace metals, noise and disturbance, and fuel spills. There would be a potential for a MODERATE effect to the arctic peregrine falcon population from trace-metal contamination. However, the effect level would be reduced to NEGLIGIBLE assuming projected low toxic trace-metal levels released by the proposed mining operation (indicated by recent data) and the incorporation of Stipulation Nos. 1 and 2 as part of the proposal. The proposed OCS mining activities are expected to have an overall MINOR effect on the regional arctic peregrine falcon population.

**CONCLUSION (Effect on Arctic Peregrine Falcons):** The effect of the proposed OCS Mining Program Norton Sound Lease Sale on the threatened arctic peregrine falcon regional population is expected to be MINOR for the base case.

**CUMULATIVE EFFECTS:** In addition to the proposal, the following past, present, and reasonably foreseeable future actions would have potential effects on arctic peregrine falcons: offshore mining on leases within State waters, proposed Federal OCS oil and gas activities, harbor-maintenance dredging and onshore mining (see Sec. IV.A.2.b). The primary cumulative effect-producing agents from these projects would be habitat alteration, noise and disturbance, trace metals, and fuel and oil spills.

Cumulative offshore dredging from the proposed OCS mining, mining in State waters, and Nome harbor dredging would result in the alteration and destruction of benthic habitat. This would be a localized effect occurring within a few hundred yards of the dredge sites. A high-case total of 2,600 acres (200 acres annually) of seafloor could be excavated during the 14-year production life of the leases, which approximates 2 percent of the 147,050 acres offered in the proposed lease sale. An additional 300 acres per year may be mined in State waters. There would be no direct effect to peregrine falcon nest sites, but nesting falcons could be affected if their marine-prey-species populations (seabirds and shorebirds) were depleted within a 15-mi hunting territory of the nest site, such as the seabird colonies at Sledge Island, Bluff, and Topkok Head. However, cumulative effects due to habitat alteration are not expected to decrease these populations, and therefore would be a NEGLIGIBLE effect on the arctic peregrine falcon.

Cumulative noise and disturbance would occur primarily from aircraft-support flights associated with offshore mining in State waters and the Federal OCS and any future oil and gas activities. The estimated 360 to 450 annual helicopter flights associated with the proposed OCS mining would double or triple the current amount of aircraft traffic from State mining activity. Also, additional aircraft support would occur from any future State mining or OCS oil and gas activities. If any aircraft passed at low levels within a mile of falcon nest sites, some short-term (less than one breeding cycle) effects to individual nest sites could occur. Since the disturbance activities (low-level flights) are likely to be infrequent and produce short-term effects to the local population (MINOR effects), the cumulative effects from noise and disturbance to the regional arctic peregrine population is expected to be MINOR.

Cumulative onshore gold mining and offshore dredge mining (State waters and the proposal) would greatly increase the potential for toxic trace-metal (especially mercury) contamination of the marine ecosystem within and adjacent to the proposed sale area, which could be detrimental to the higher-trophic-level species in the food-chain, such as the local peregrine falcon population. Increases in mercury levels in the local bird populations (within a 15-mi area of the nest sites) that falcons consistently prey on (seabirds, shorebirds, and other aquatic birds at such sites as Sledge Island, Safety Lagoon, and Bluff) could lead to direct mortality and/or significant reproduction decreases in the local peregrine population.

The limited sampling of mercury levels in the Norton Sound arctic peregrine falcon population during 1989 indicates that levels may be near those that could affect reproduction. The current level of mercury in the peregrine prey species is unknown. There is likely a threshold level where cumulative increases in mercury bioaccumulation would result in severe effects. Only a long-term mercury monitoring program would assist in predicting the cumulative effect of increased mercury levels in the marine ecosystem. Historically, it has been well documented that peregrine falcon populations have suffered severe declines due to bioaccumulation of toxic chemicals (see discussion for the proposal, Effect of Trace Metals). Therefore, cumulative effects from toxic trace metals (especially mercury) could result in severe effects and decline of the local peregrine falcon population that would require several generations for recovery and consequently cause a MODERATE effect to the regional population. However, as described for the proposal, recent data on water and sediment trace-metal levels in Norton Sound suggest that mercury and cadmium levels do not exceed the EPA chronic criterion standard (Sec. IV.B.2), suggesting no significant increase in trace-metal bioaccumulation in the peregrine falcon population. Also, mitigation measures (Stipulation Nos. 1 and 2) would lower trace-metal effects as described for the OCS mining program. In addition, current and future offshore mining programs within State waters must monitor the local peregrine falcon population for trace-metal accumulation, as required in current EPA and COE permits. These requirements resulted from the FWS biological opinions issued to EPA and COE, which were identical to the June 7, 1989, opinion issued to MMS (See Appendix B). (*Note to reader:* These opinions are expected to be modified due to the reinitiation of consultation with FWS by MMS and the resulting June 26, 1990, second biological opinion [Sec. IV.B.7, introduction]). Assuming that the recent water-quality data are indicative of future data for mining in all offshore waters, and the incorporation of the above mitigation measures

to protect the peregrine falcon population, the potential cumulative effects to the arctic peregrine falcon population are expected to be reduced from MODERATE to NEGLIGIBLE.

Fuel spills from offshore mining activities (State waters and the proposal) and oil spills that may be associated with any future OCS oil and gas activities would likely have a minimal effect on the local peregrine falcons. Sale 57 oil and gas activities (3 exploration wells) did not result in any related fuel or oil spills, and thus has had a NEGLIGIBLE effect on peregrine falcons. All Sale 57 leases now have been relinquished. Peregrines prefer to take their prey in flight and would not be likely to physically enter an oil or fuel spill for a prey species. However, they could become oiled from a contact with oiled prey. The cumulative effects from any fuel or oil spills are expected to be MINOR (same as the proposal) for the peregrine falcon regional population.

In summary, the proposal and the other development projects within the Norton Sound area could combine to produce significant long-term effects (especially from trace metals) on the local peregrine population (Norton Sound). However, as described above, the incorporation of mitigation measures should reduce the cumulative effects from trace-metal bioaccumulation. The potential NEGLIGIBLE effects from habitat alteration due to dredging; MINOR effects from noise and disturbance due to support aircraft; NEGLIGIBLE effects from oil and fuel spills; and the NEGLIGIBLE effects from trace-metal bioaccumulation (especially mercury) through the marine ecosystem are likely to have an overall MINOR cumulative effect on the regional arctic peregrine falcon population.

**Conclusion:** Cumulative effects are likely to be MINOR on the arctic peregrine falcon regional population.

**Cumulative Effects on Migratory Species--Endangered and Threatened Species:** Since the Norton Sound regional populations of the endangered gray whale and the threatened arctic peregrine falcon are both migratory species, they both are affected by numerous activities outside the Norton Sound area both on their winter and summer areas and during their respective migrations.

**Gray Whale:** Gray whales breed and calve in the various lagoons of Baja California (January to March) and then migrate to their northern summer feeding areas in the Bering and Chukchi Sea. The southerly migration to their breeding grounds begins in October. The majority of the gray whale population passes through Unimak Pass during their north and southbound migrations.

Currently, the major effect-producing agents affecting this species are noise and disturbance from vessels and OCS activities, entanglement in gillnets, and the risk of oil spills. Effects from some of these agents exist on the entire length of this species' range.

Whales are known to respond to noise from vessels of any size, typically react when a boat is within a few miles, and actively avoid a vessel within a mile. Gray whales are most sensitive to vessels in their calving lagoons. However, three of five major calving lagoons are designated as National Refuges by the Mexican Government and vessel traffic is restricted. Noise- and disturbance- effects activities associated with OCS proposed oil and gas exploration in the Alaska/Pacific Regions include geophysical surveys, exploration drilling, and aircraft and vessel support traffic. Whales generally tolerate noise and disturbance associated with the drilling activities within 3 to 5 mi and show avoidance generally within 3 mi. Noise associated with geophysical surveys is potentially the most disruptive of OCS-related noise and disturbance since it is not the chronic, routine noise from a stationary source to which wildlife generally habituate. Miles (1984) reported that 430,000 mi of survey lines were conducted off the Pacific Coast between 1964-1983 with the number of mi of line increasing steadily per year from 2,000 line-mi in 1964 to 64,000 line-mi in 1983. Approximately half of these surveys were conducted during the whale migration; yet, the number of gray whales has steadily increased since 1937. Over the last 15 years, during which time geophysical survey activity has increased 5 percent, the gray whale population has continued to grow at a rate of about 2.5 percent. Therefore, it appears that, at least at the current level, geophysical operations have had no overall harmful effect on the population. An undetermined number of whales drown after becoming entangled in gillnets each year. Gill netting has been documented as the cause of death for several gray whales found stranded on California beaches (1 of 8 in 1983 and 4 of 21 in 1984) (Seagers et al., 1986). Mortality caused by gill netting entanglement is expected to continue, if not increase, in the future. The most serious effects of an oil spill on the gray whale would occur on the summer feeding grounds or winter calving grounds. As tanker routes are well offshore of the calving grounds in Baja, Mexico, the chance of an oil spill effecting the calving lagoons is unlikely. Since there is currently no tankering of oil north of the Aleutian Island Chain, there is no chance of an oil spill on the feeding grounds in the Chukchi and Bering Seas. Therefore, the most likely time a gray whale would come in contact with tanker-spilled oil is during migration. Since gray whales have completed a successful migration through the Santa Barbara oil spill and negotiate the

natural oil seeps in the Santa Barbara Channel twice yearly, effects of a large oil spill from tankering to migrating gray whales are expected to be MINOR. The probability of an oil spill from exploration drilling due to proposed lease sales in the Alaska/Pacific Regions is NEGLIGIBLE, and therefore, would not produce the same oil-spill-effect potential as oil tankering.

The gray whale is by far the most abundant of the endangered cetaceans and has steadily increased in numbers since it was given protection from whaling. The population is currently estimated at 21,000, which is above precommercial whaling levels (IWC, 1988, in press). This indicates that the current level of cumulative effects to the gray whale is not at a level that threatens population growth.

In summary, the other potential and existing projects within the migratory range of the regional gray whale population are not expected to increase the level of effect to this species above the MINOR level.

**Conclusion:** The cumulative effects from activities associated with the proposal and other projects within the Norton Sound area combined with the other activities within the range of the migrating gray whale are expected to have MINOR effects on the regional gray whale population.

**Arctic Peregrine Falcon:** The arctic peregrine falcon nests during the summer in the arctic regions of Alaska and Canada and winters in Central and South America. The population suffered severe declines in the 60's and 70's due primarily to reproductive failure due to bioaccumulation of pesticide residues (primarily chlorinated hydrocarbons). The Norton Sound local population comprises part of the Alaska west coast population (the "regional population" used in the effects definitions) estimated at 20 to 30 pairs. The total Alaska population is estimated at 80 pairs and 120 young. It is a gradually increasing population with lower levels of pesticide contamination (FWS, 1987; Ambrose, 1988, oral comm.).

Primary effect-producing agents are pesticides and other toxic contaminants, habitat destruction, and noise and disturbance. The ban of DDT use in the United States has greatly reduced the bioaccumulation and reproductive failure of the peregrine falcon; however, the continued use of toxic pesticides (including DDT) in Third World countries of Central and South America results in a persistence of the contamination in the peregrine. Large-scale habitat destruction in these countries (clearing of forests for agriculture production) could contribute to a slow recovery for the peregrine falcon. Habitat destruction of wetlands along migration routes and within feeding territories of nesting sites also inhibit the recovery of the species.

Noise and disturbance near nest sites could cause some nestling mortality--a MINOR effect to the population. A minor threat to the peregrine falcon would be from oil spills. Peregrines tend to capture their prey in flight, and it is unlikely that spilled oil would contact the falcons directly. However, it is possible that peregrines could be oiled while feeding on partially oiled sea-birds, waterfowl, or shorebirds. Also, peregrines could be affected by a reduction in prey availability if many birds in the area are contacted by spilled oil and die.

Since the arctic population has been recovering and has been delisted to a threatened status from endangered, the current overall cumulative effects to the species throughout its range have not resulted in the decline of the population nor deterred the gradual recovery of the species (MINOR level). In summary, due to the incorporation of mitigation measures to protect the ecosystem from trace-metal accumulation effects from offshore mining, the additive effect of the activities associated with the proposal and other projects within Norton Sound are not expected to increase the level of cumulative effect for the regional arctic peregrine falcon population above the MINOR level throughout its range.

**Conclusion:** The cumulative effects from activities associated with the proposal and other projects within the Norton Sound area combined with the other activities within the range of the migrating arctic peregrine falcon are expected to have MINOR effects on the regional arctic peregrine falcon population.

8. **Effect on the Economy of Nome:** Employment and population projections for the City of Nome are from the Rural Alaska Model developed by the Institute for Social and Economic Research. Offshore-mining-employment projections were developed by MMS.

**Employment and Income:** In 1988, there were approximately 85 full-time equivalent (FTE) jobs with WestGold in the offshore-mining industry in Nome. These jobs include dredge-crew members, clerical staff, geologists, and engineers. Virtually all of these employees live in Nome while employed. The dredge operates around the clock during the mining season from May to November, involving two shifts per day. Each shift is flown to the dredge from Nome. Fifty-seven percent of present offshore-mining-industry jobs are held by local residents. In 1989,

employment was approximately 62 FTE jobs. In September 1990, WestGold announced it would be shutting down offshore operations near Nome. For the purpose of analysis in this section, it is assumed that if there is mining activity in the OCS, there would also be mining activity in adjoining State waters; it is assumed that the losses in employment and income resulting from the WestGold shutdown in State waters would be regained if there is mining activity in the OCS. The initial level of employment and income is important but the most significant issue for the analysis of effects is the increment of change resulting from OCS activity.

Mining activity on the OCS is expected to begin in 1992. For the years 1992 through 1994, this activity will consist of exploration activities. Exploration vessels will make infrequent visits to Nome for resupply and to make crew changes. An estimated 8 local residents will be employed each year during exploration. These jobs will last 3 months during each of the years of exploration. This amounts to 2 FTE jobs per year (Appendix C, Table 1).

The production phase will begin in 1995 and continue through 2008. Additional employment from OCS mining activities is expected to total 77 FTE mining-related jobs in the base case. (Appendix C, Tables 1 and 4). Because of the multiplier effect, this translates into an approximately 120 FTE jobs in the Nome economy during the period of production. (The multiplier effect means that an additional basic sector job translates into greater than one addition to total employment. This is due to the fact that additional employment in the basic sector will create additional employment in the nonbasic sector, in the service sector, for example). This is an average of 7 percent for the base case above the no-sale alternative (Appendix C, Tables 3 and 5). A comparison of projected no-sale employment and projected employment with the sale is shown in Figure IV-2.

In the Nome census division the rate of unemployment has been between 11 and 14 percent for a number of years. (Even this is probably a low estimate of those desiring employment because it counts only those who are actively seeking employment.) It is estimated that 40 percent of the jobs in OCS offshore dredging would be filled by local residents.

Unemployed individuals who receive jobs as a result of offshore-mining activities may substitute wage and salary income for other sources of income. For example, some public assistance income is expected to be replaced by wage and salary income. In addition, some offshore-mining jobs will occur during the winter, offsetting some of the regular downturn in winter employment. For the base case, an estimated \$4 million (1988 dollars) in wages and salaries would be paid yearly by OCS mining companies during the production period. In addition, \$1 million to \$2 million (1988 dollars) would be spent per year by the industry in Nome for goods and services.

**Inflation:** An increase in economic activity in the Nome economy may cause an increase in price inflation. The infusion of new money could cause a relative shortage of goods and drive prices up. If inflation were to occur, it is expected to be of a temporary nature. Economic activity is expected to increase to a new plateau, as a result of offshore mining, but then remain somewhat constant. This potentially could cause a one-time increase in prices but not a sustained rise in inflation. In addition, it is likely that the economy would adjust to the increased demand, alleviating some or all of the effects of a one-time price inflation. Any increase in the price level may affect the surrounding villages to a greater extent than Nome itself. This is due to less cash income and a reliance on Nome for supplies.

**Population:** The 1987 Nome population was estimated to be 3,872 (Appendix C, Tables 3 and 5). It is possible that the shutdown of operations of WestGold announced in September 1990 will result in some population decline. Whatever population is lost as a result of the WestGold shutdown is assumed to be regained; it is assumed that if mining occurs in the OCS, that mining also would occur in adjacent State waters. The 1990 Census preliminary population count for Nome is 3,460. The 1989 population estimate for the city accepted by the State is 4,303. Nome is appealing the census figure as too low (Kelly, 1990). Because there is such a wide discrepancy between the 1990 Census and the State-accepted 1989 figure, and because the 1987 estimate is between the 1990 and 1989 figures, the 1987 figure is used in this analysis. The starting population has importance, but the most significant issue for the analysis of effects in the EIS is the increment of change. The population is expected to increase beginning in 1995 as a result of the OCS Mining Program Norton Sound Lease Sale. For the base case, the difference in population between the no-sale case and the base case ranges between 135 in 1995 to a high of 205 in 1999. The base-case-population projections are an average 4.5 percent above the no-sale case. Projected base-case-population trends are illustrated in Figure IV-3. Native and non-Native population trends also are shown.

**SUMMARY:** Employment resulting from OCS mining activity is expected to average approximately 7 percent above the no-sale alternative. An estimated 40 percent of direct OCS mining jobs will go to area residents. This



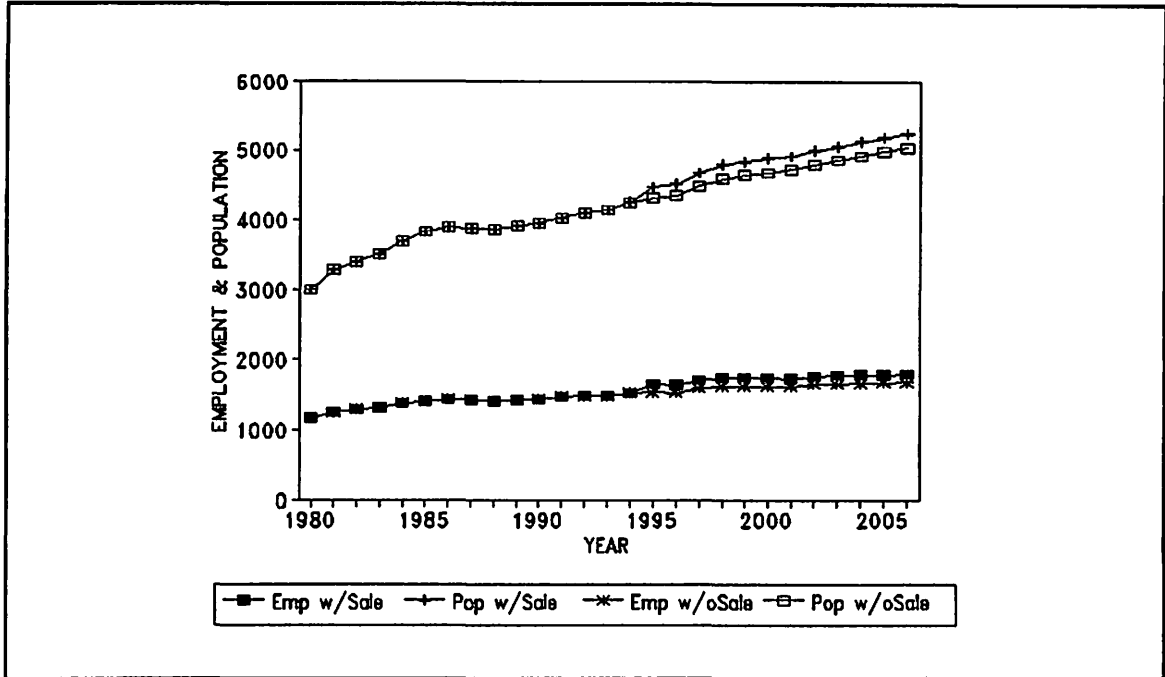


FIGURE IV-2. BASE-CASE POPULATION AND EMPLOYMENT PROJECTIONS WITH AND WITHOUT SALE

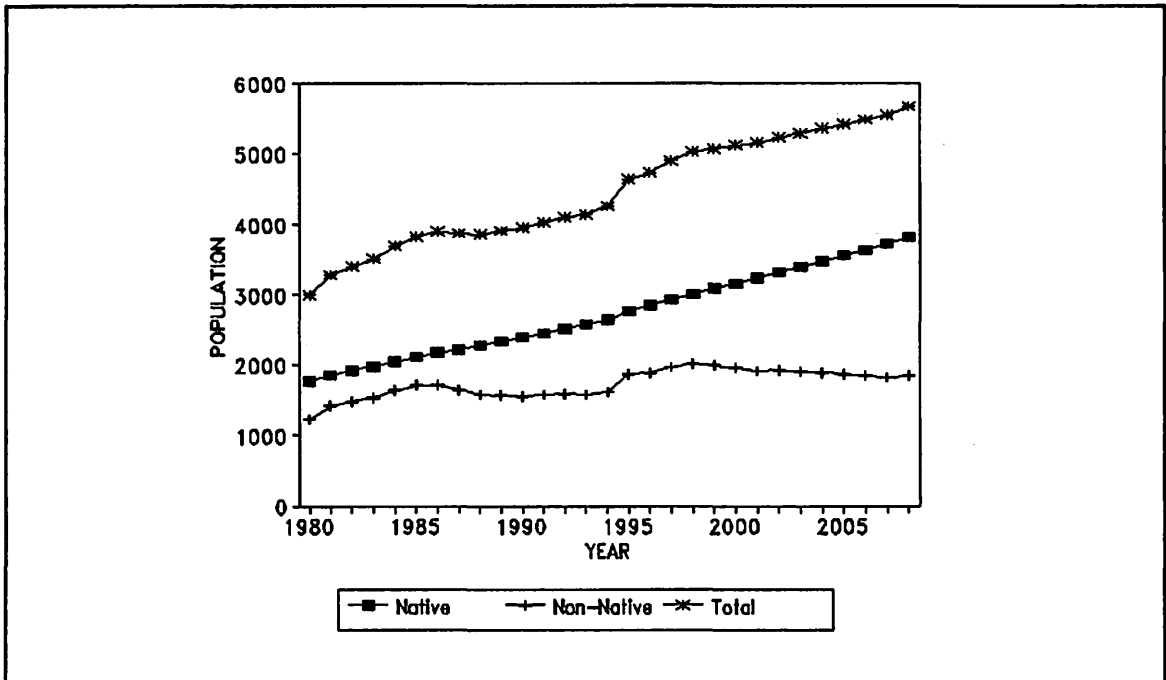


FIGURE IV-3. BASE-CASE POPULATION PROJECTIONS FOR NOME WITH THE SALE

is expected to decrease unemployment and improve income conditions within the local economy. A one-time increase in prices may occur, but is expected to be short-lived. Population is expected to average 4.5 percent above the no-sale case.

**CONCLUSION (Effect on the Economy of Nome):** The effect of the proposal on the economy of Nome is expected to be MINOR in the base case.

**CUMULATIVE EFFECTS:** In addition to the proposal, the following past, present, and reasonably foreseeable future actions would have potential effects on the economy of Nome. Included in the possible mining ventures are two (other than the Bima) shallow water offshore dredges mining offshore placer gold, and onshore mining operations at the Lost River Mine, the Rock Creek area, and in the area of Bluff. When considering these or other projects, the probability of occurrence must be considered in analyzing the effect of development on the Nome economy. In the case of an undeveloped region and the incidence of high development costs, assigning probabilities to potential projects is highly subjective.

Until 1990 it appeared that the WestGold mining operation had been very successful and this gave some indication that other offshore dredging operations would occur. In September 1990, WestGold announced it would be discontinuing operations in the offshore area near Nome because of financial losses. For the purposes of this EIS, it is assumed that if there is mining activity in the OCS, there would also be activity in adjoining State waters. As discussed in Section IV.A.3, it is possible that two shallow water dredges could start operating in State of Alaska waters.

The Lost River Mine is embroiled in lawsuits and bankruptcy proceedings. In addition, development would require a large investment in infrastructure, including processing facilities, a marine terminal, an airport, and a surface-transportation system. Even in the event that these hurdles were cleared, it is unlikely that development would occur before the year 2000. In addition, it is likely that much of the development would bypass Nome. This project is seen as having a MINOR effect on the economy of Nome.

There are two companies doing exploration work for lode gold deposits and these activities are likely to have some effect on the Nome economy. One deposit in the Rock Creek area, about 8 miles north of Nome, would take 5 to 10 years to bring on line if sufficient quantities are found. Once production occurs, this operation is expected to employ anywhere from 100 to 200 people for a 10- to 15-year period. The other lode exploration project likely to occur is near Bluff. If results are favorable, several more years of exploration are expected, followed by a 2- to 3-year period before a small underground mine is in operation. The combination of these two projects is expected have a MODERATE effect on the economy of Nome.

Any presumption of oil and gas development and production in Norton Sound appears to be highly speculative. This is expected to have a NEGLIGIBLE effect on Nome.

**Conclusion:** The cumulative projects in combination with the proposal are expected to have a MODERATE effect on the economy of Nome.

9. **Effect on Commercial Fisheries:** Commercial fisheries in the area of the proposal include red king crab, salmon, and herring. The red king crab fishery could be affected by dredging, sedimentation, and the resuspension of mercury during dredging. A fuel spill could affect the salmon and herring fisheries.

The Effect on Commercial Fisheries section depends heavily on the analysis presented in Section IV.B.3, Effect on Marine Plants and Invertebrates (Including Red King Crab) and Section IV.B.4, Effect on Fishes. The reader should refer to these sections for more detail.

a. **Effect of Habitat Alteration:** The winter red king crab harvest is generally within 5 mi of Nome, and the summer harvest has, in recent years, been at a minimum of approximately 18 mi south of Sledge Island. Potential harm to the crab habitat could result from the actual excavation of the environment and, in addition, from sedimentation that results from dredging (see Sec. IV.B.3). As indicated in Section IV.B.3, crab prefer a cobble habitat to sand. Of prime concern is the loss or alteration of cobble habitat that is potentially critical for juveniles and possibly females. The cobble habitat is altered by direct dredging and by sedimentation, resulting in sites dominated by sands and silt.

As discussed in Section IV.B.3, cobble, boulder, and gravel substrates are known to be important to juvenile king crabs. Studies in other areas indicate that the distribution of young-of-the-year red king crab is generally

limited to coarse substrates such as boulders, gravel, cobble, and shell debris with attached epifauna (Jewett and Onuf, 1988, citing Powell and Nickerson, 1965b; Tsalkina, 1969; Sundberg and Clausen, 1977; and McMurrey et al., 1984). Young crabs are dependent on an environment that provides both adequate food and refuge from predators such as demersal fish. Females and juveniles show a clumped distribution, while males, particularly larger ones, migrate both inshore and offshore farther than females and, thus, have a broader pattern of distribution. The more clumped distribution of juveniles and females may be related to the distribution of cobble habitat. Rocks may provide important protection to females while they are soft following molting and during subsequent mating. Recently molted crabs, in general, are more vulnerable to predators, and are readily taken by other marine mammals and fishes (see Sec. IV.B.3).

There are conflicting reports concerning the effect dredging has had on red king crab habitat. Some observations by Nome area crab fishermen have been made. The new Nome Causeway presumably has caused the ice near Nome to fracture differently than in the past, forcing winter crab fishermen into utilizing an alternate site which has been dredged by the Bima. Fishermen report that this dredged area, formerly a productive crab fishing site, is relatively barren of crab (Lean, 1988, oral comm.). On the other hand, in studies associated with the Bima monitoring program, crab pots were set in both dredged and non-dredged areas in March and no significant difference in catch among the areas was reported (see Sec. IV.B.3). More recent pot studies by the Bima monitoring program showed no clear trend in 1988 (one control area had a significantly greater catch than the other three sites--two dredged and one control). But in 1989, there was a significantly smaller catch at a dredged site (R6) than at either control site (Jewett et al., 1990). No definite trend is apparent yet. The possibility exists that dredging affects males differently than juveniles and females and that the catch of crabs (primarily the more mobile males) in previously dredged areas will not reflect the true effects of dredging on the population, which will not show up until a later time.

The settling of dredged material may further harm crabbing sites. The one dredge in the base case has the potential of affecting one-half of the sale area with silt and sand sedimentation over the life of the project. As discussed in Section IV.B.3, the effect of sedimentation depends on the depth and the type of sediment deposited. Sand deposition could become a relatively permanent alteration of habitat (see Sec. IV.B.3). Areas outside the actual dredged sites that were excavated 1.5 years ago by the Bima have boulder areas covered by 6 inches of sand (see Sec. IV.B.3). Dredging in the proximity of commercial crab fishing sites could cause significant localized habitat alteration and affect future generations of red king crab. The analysis for Section IV.B.3 finds that the effect of dredging and sedimentation on red king crab is expected to be MAJOR. This is based on the assumption that the red king crab in Norton Sound are a discrete population; that the alteration of benthic habitat could last for a number of years in some areas; that a high proportion of cobble or boulder habitat that is directly dredged would be reduced in quality; and that gravel, cobble, or boulder habitat is critical for the survival of young-of-the-year red king crabs. Cobble and boulder habitat also may be preferred by older juvenile red king crabs and by females. General information on the life history and biology of the red king crab, the scale of projected activities, and information from dredging activity in State waters support the conclusion that effects from habitat alteration under the proposal are likely to affect the red king crab population for more than one generation and to affect subsequent recruitment or the success of juveniles (see Sec. IV.B.3). It is for these and other reasons that a monitoring program is included as part of the proposal. An assessment of the distribution of habitats in the proposed sale area (with special attention to the trench area) is needed, as well as an understanding of the relationship among habitat, community types, and successful recruitment of juvenile red king crabs. This knowledge could lead to the limitation of dredging in prime red king crab habitat and could allow the amount of area to be dredged to be based on recovery rates of the communities. The level of effect on red king crabs will be directly related to the extent of dredging that occurs in prime red king crab habitat. The effect of the proposal on the red king crab fishery is expected to be MODERATE.

Habitat alteration resulting from bottom dredging is not expected to affect salmon and herring. As discussed in Sec. IV.B.4, it is expected that adult fish will avoid the area of dredging. Those fish that do not may be harmed, but this is expected to be few. The general effect of habitat alteration on salmon and herring is expected to be NEGLIGIBLE.

b. Effect of Trace Metals: Metals of interest in the sale area include arsenic, mercury, lead, copper, zinc, and cadmium. Based on concentrations observed in the water column, or other concerns, arsenic, mercury, lead, copper, and nickel were discussed in Sections IV.B.3 and IV.B.4 (Effects on Marine Plants and Invertebrates and Effects on Fishes, respectively) as having potential effects on red king crab, salmon, herring, and consequently on the commercial fishery.

**Effect of Mercury:** If the mercury level in waters near the area of dredging operations were found to exceed the EPA chronic criterion, then the State of Alaska DEC would test the edible portions of the commercial seafood catch, including red king crab. If the concentrations exceeded FDA action levels, then the ADF&G would close the fishery, either because of a threat to human health or because of the threat to the species population. The closure of the fishery for one or more years would be a MAJOR effect on the red king crab fishery. There is no clear evidence concerning the susceptibility of red king crab to bioaccumulation of mercury. Furthermore, existing data of measured levels of mercury in the muscle tissue and the hepatopancreas of red king crab have shown generally very low values for mercury (see Sec. IV.B.3).

Mercury concentrations measured downcurrent of the Bima using state-of-the-art methodology show an average increase of 0.0004 ppb, with the highest downcurrent concentration reading 0.0014 ppb (Table IV-6a). These numbers are considerably less than other measurements that have been made which were believed to have been contaminated and are considered incorrect (see discussion in Sec. IV.B.2). These new low numbers are below the EPA chronic criterion of 0.025 ppb, and, based on the setting of that standard, suggest that this amount of elevation of mercury should pose little threat to fishes and king crabs. Although there are no specific studies of mercury effects on red king crabs, the literature reviewed in Sec. IV.B.3 suggests that the concentrations of mercury more recently measured pose no apparent threat to red king crab (a NEGLIGIBLE effect). Elevated copper levels actually pose a greater threat and may have the potential to cause a MINOR effect (see Sec. IV.B.3).

**Effect of Other Trace Metals:** As discussed in Sec. IV.B.3, the effects of arsenic, lead, and nickel are expected to have NEGLIGIBLE effects of red king crabs, salmon, and herring and therefore, a NEGLIGIBLE effect of the commercial fishery. Elevated levels of copper in the water associated with dredging by the Bima are expected to have MINOR effects on marine plants and invertebrates (including red king crabs), and on salmon and herring. The effect of elevated trace metals due to dredging activities on the commercial fishery is expected to be MINOR.

c. **Effect of a Fuel Spill on Commercial Fishing:** The current offshore dredging operation in Norton Sound carries a maximum of approximately 6,000 bbl of diesel fuel. Diesel fuel has a greater concentration of aromatic hydrocarbons than does crude oil, and these are generally more toxic to organisms. A large spill would be most likely to occur during fall storms (see Table IV-10 for details of the area and weathering of such a spill), which could result in the grounding of a dredge and the spilling of some or all of its stored fuel. For this analysis we assume a spill of 3,500 bbl. As discussed in Section IV.B.4, the probability of an offshore spill versus one occurring in nearshore areas is not known, but for the sake of analysis, since some fishes in nearshore waters are more vulnerable, a spill in nearshore waters will be assumed. In the event of a fuel spill, harm to the commercial fishery could occur. Fishes gathering to spawn or spawning in coastal areas are vulnerable to the effects from a fuel spill. Commercial species of importance that fall into this category include salmon and herring (see Sec. IV.B.4).

The effects of spilled oil on fishes in the Norton Basin area have been considered in the Sale 100 FEIS (USDOI, MMS, 1985a), and that information is incorporated herein. According to Section IV.B.4, the widespread distributions of fish species in the Norton Sound area generally make them less vulnerable to effects from spilled oil. However, salmon and herring are vulnerable during the time they are gathering to spawn or are spawning in coastal areas. Eggs and developing larvae of herring are especially vulnerable since they are found in the intertidal and shallow subtidal adjacent to land. During the open-water season, an oil spill that occurred within the offshore sale area has an estimated 32-percent or greater chance of contacting land within 3 days of the spill (see Sec. IV.B.4). In coastal regions near the sale area, salmon return to spawn and, later, smolts leave the rivers. Because of this, it has been determined that a fuel spill that occurred and contacted the nearshore region in the open-water season when spawning fish, eggs, larvae, or smolts were present, is expected to result in a MODERATE effect to fishes, since multiple year-classes could be affected or effects on a single year-class could be felt for more than one generation. For these reasons, it is likely that a fuel spill will have a MODERATE effect on commercial fisheries.

**SUMMARY:** The commercial fisheries in the vicinity of Nome include harvests of red king crab, salmon, and herring. Red king crab habitat is expected to be disrupted by dredging and the sedimentation from dredging, although this would be mitigated by a monitoring program and would result in a MODERATE effect on the fishery. Dredging is expected to cause resuspension of naturally occurring mercury into the water column. Measured levels of mercury in the water column do not exceed the Federal water-quality criteria. If increased levels of mercury in the water column were to occur, this could cause the closure of the commercial crab fishery for 1 or more years, although a well designed monitoring program should prevent this from happening and the

effect on the commercial crab fishery would be MINOR. The effect of a fuel spill on the commercial salmon and herring fisheries is expected to be MODERATE. The effect of the proposal on commercial fisheries in the Nome area is expected to be MODERATE in the base case.

**CONCLUSION (Effect on Commercial Fisheries):** The effect of the proposal on commercial fisheries is expected to be MODERATE.

**CUMULATIVE EFFECTS:** Effects on commercial fisheries in the Norton Sound area may derive from past, present, and reasonably foreseeable future actions such as: Federal offshore mining (this proposal), State offshore mining, past and future Federal OCS oil and gas lease sales in Norton Sound, onshore mining projects in the Norton Sound area, and harbor dredging in Nome. The scope of these activities has been described in Section IV.A.2. Some of these activities are in a development stage. For others, the probability of development is uncertain.

**Effect of Offshore Mining and Harbor Dredging:** Federal (this proposal) and State offshore leasing activities may affect the commercial fishery. Of most concern is the alteration of habitat and the possible bioaccumulation of mercury. Habitat alteration includes the physical effects of dredging to the benthic environment, the effects on prey, and the changes in the interactions of organisms with each other and with the environment (see Sec. IV.B.3 and IV.B.4). The scenario for the proposed Federal offshore mining program (Sec. II.A.2) states that 1,300 acres of the benthos will be dredged over the life of the lease. In State waters, assuming a 20-year activity period for a lease and the number of acres dredged per season given in Table IV-2a (300 acres total by 3 dredges), a total of 6,000 acres is likely to be dredged. Other potential mining activities could increase the area affected, but the probable extent of these activities is not known. Due to the settling of particulates from the turbidity plume, the actual area affected by dredging will be much larger than the 7,300 acres that may be dredged in the cumulative case. In the base case under the proposal, increased sedimentation resulting from dredging activities was estimated to cover an area one-half the size of the sale area (Sec. IV.B.2.a). The potential effect of such sedimentation has not been assessed in the current offshore mining operation. As described in Sec. IV.B.3.a, habitat alteration from proposed Federal offshore mining activities is expected to have a MODERATE effect on red king crab and, in turn, on commercial fishing (see also Sec. IV.B.9.a). The additive effects of other offshore mining activities in nearshore waters near Nome and Sledge Island is not expected to increase the magnitude of effect on red king crab beyond what is expected in the base case, that is, MODERATE.

In the cumulative case, it is possible that several dredges could operate at once, and that dredges could move into and operate in shallow nearshore waters. For dredges operating in the very nearshore region, there is a potential for harm from a fuel spill. An offshore fuel spill is expected to have a MODERATE effect on commercial fishing, due to possible effects on spawning herring, their developing eggs and larvae in nearshore waters, adult salmon congregating in the nearshore prior to spawning, and outmigrating salmon smolts.

Dredging activities also have the potential of increasing the levels of mercury in the water column, surficial sediments, and in organisms. Of particular concern is the potential bioaccumulation of mercury through the food web (see Secs. IV.B.3.d and IV.B.4.d). Data from current offshore dredging activities in State waters suggest that dredging may have increased somewhat the concentration of mercury in the water column, but state-of-the-art analysis from a Federal study suggests that this is not the case (see Sec. IV.B.2). The effects of offshore mining activities in the cumulative case are not expected to increase the level of effects from mercury beyond that of the base case, that is, NEGLIGIBLE.

**Effect of Onshore Mining:** Onshore mining activities, as detailed in Section IV.A.2.b and Table IV-2a, may have effects on marine plants, invertebrates, and fishes by increasing the concentration of mercury in the marine environment. Onshore placer-gold mining (in the Nome area) has resulted in the discharge of a considerable amount of mercury into the streams, onto the ground around dredges, and around gold-processing houses. Water runoff via streams and from coastal land may carry dissolved mercury and contaminated sediments into the marine environment. Although much of the mercury coming into the marine environment may be in metallic or inorganic forms, it may be converted to more toxic and absorbable forms (e.g., methylmercury) by organisms in the marine environment (see Sec. IV.B.3.d). It is not possible to say how much of the mercury in offshore sediments originated from terrestrial runoff, but the addition of mercury from terrestrial environs is not expected to increase the level of effects expected under the proposal, which were judged to be MINOR.

**Effect of Federal OCS Oil and Gas Activities:** Any presumption of oil and gas development and production in Norton Sound is highly speculative. If oil and gas development and production were to take place, the most

likely effect is expected to be NEGLIGIBLE. If an oil spill were to occur, the most likely effect on commercial fisheries would be MODERATE. However, a spill that contacted fish in nearshore waters could have a MAJOR effect on commercial fishing if it affected spawning herring or capelin, their developing eggs and larvae in nearshore waters, adult salmon congregating in the nearshore prior to spawning, and outmigrating salmon smolts.

**Summary:** The greatest concerns for the commercial fishery under the cumulative case are alteration of habitat by offshore dredging activities, a possible fuel spill, and effects of trace metals. Habitat alteration is likely to lead to a MINOR effect on commercial fisheries because of the potential harm to the red king crab population. Also, the release and resuspension of trace metals are expected to have a MINOR effect on red king crab, and, in turn, the commercial fishery. Activities related to Federal offshore oil and gas leases are expected to have a NEGLIGIBLE effect on the commercial fishery, although an oil spill is expected to result in a MODERATE effect, and if it contacted spawning fishes or developing eggs and larvae in nearshore waters it could have a MAJOR effect. A fuel spill from dredging activities is expected to occur in nearshore waters and have a MODERATE effect on commercial fishing.

**Conclusion:** Cumulative effects on commercial fishing are expected to be MODERATE.

**Cumulative Effects on Migratory Species:** Two fish groups whose migrations take them outside Norton Sound will be considered here under cumulative effects. These two groupings are salmon (five species) and Pacific herring. Further descriptive material on these two species are presented in Section III.B.2.b and in Section III.C.2.

**Salmon and Herring Commercial Fisheries:** Activities that could affect Norton Sound stocks of migrating salmon and herring include: the proposed OCS Mining Program Norton Sound Lease Sale analyzed in this document; mining activities in State waters of Norton Sound; and, proposed and existing Federal OCS activities in the Norton, Navarin, St. George, and North Aleutian Basins.

Effects from the proposed Norton Sound Lease Sale are analyzed in Section IV.B.9, as are the cumulative effects of the proposal, State mining activities, and Federal OCS activities in Norton Sound. The expected effect of both the proposal and the cumulative activities of the projects enumerated above is MODERATE for these fisheries, due primarily to potential effects of an oil spill contacting fish in the nearshore zone. Salmon are vulnerable to effects of oil when adults are migrating to nearshore areas preparatory to spawning, and when smolts are outmigrating from fresh or brackish water environs. All stages of pink salmon are susceptible to effects since this species may spawn in tidal areas. Homing abilities of migrating salmon could be affected by spilled oil; consequently, reproduction could be eliminated or reduced. In general, it is expected that salmon in open-ocean areas are not very vulnerable to spilled oil. An oil spill contacting the nearshore zone could cause great mortality to herring eggs and developing larvae; this is expected to result in a MODERATE effect to the commercial herring fishery.

**Conclusion:** The cumulative activities on migrating salmon and herring that originate from the Norton Sound area are expected to have a MODERATE effect.

#### 10. Effect on Subsistence-Harvest Patterns:

a. **Introduction:** This section analyzes the effects of the proposal on subsistence-harvest patterns of Nome, which is the community adjacent to the sale area. Effects on subsistence harvests in communities in the Norton Sound region (such as Teller, Gambell, Savoonga, White Mountain, Golovin, Koyuk, Shaktoolik, Unalakleet, Stebbins, St. Michael, and Kotlik) were considered, however, these communities are quite distant from the sale area. These communities do not normally conduct subsistence harvests within the sale area (Magdanz, 1990, oral comm.) and with Stipulation Nos. 1 and 3 in place, effects on migratory species which may move through the sale area and into other subsistence harvest areas are not anticipated (see analysis below) nor are effects on other subsistence resources expected. The village of Solomon near Nome only has a few elderly residents--subsistence activities these residents pursue are in conjunction with their Nome relatives and are considered under Nome's subsistence-harvest patterns.

This analysis is organized by subsistence resource and discusses effects on subsistence-harvest patterns as a result of habitat alteration, dredging and tailing deposition, trace metals, noise and disturbance, diesel-fuel spills, and in-migration and population growth. An analysis of the effects of mercury on human health is located in Section IV.B.15. The reader is referred to Section III.C.3 for (1) a description of Nome's subsistence-harvest patterns, (2) an outline of the important seasonal subsistence-harvest patterns in the sale area, (3) figures

depicting the areal extent of the subsistence-harvest area and the timing of harvests, and (4) information regarding participation in subsistence-harvest activities. Sections III.C.3 and III.C.4 demonstrate that significant aspects of Inupiat and Yup'ik economy, culture, social organization, normative behavior, and beliefs interact with--and depend on--patterns of subsistence-harvest. The sociocultural aspects of effects on subsistence are addressed in Section IV.B.11.

Subsistence hunting and fishing, the use of subsistence resources, and access to subsistence resources could be affected by reductions in subsistence resources and changes in subsistence-resource-distribution patterns. These changes could occur as a result of dredging, disturbance, dumping of bottom substrate, turbidity, entrainment, toxic levels of trace metals in the water, noise and traffic disturbance, fuel spills, and changes in population. The following analysis examines the effects of each of these causal agents on the subsistence resources harvested by the Inupiat and Yup'ik and others living near the sale area.

New data were collected in the fall of 1989 on mercury levels in 200 women of child-bearing age in Nome. The levels of mercury reported (in hair, almost all of the mercury is methylmercury) in this study (Creelius, 1990) were low (1 ppm or less for hair) with only 4 people having mercury levels above 1 ppm (see Sec. IV.B.15). The MMS workshop held in November 1989 to plan monitoring studies for the proposed lease sale recommended that further studies be done on known high-subsistence consumers. The MMS is planning to collect this information in the fall of 1990. The only other published report of levels of mercury in Alaskan residents was of women and infants in the Yukon-Kuskokwim Delta (Galster, 1976). No data are available on consumption levels of seafood in Nome, although MMS is coordinating with the Norton Sound Health Corporation in their attempts to gather such information, possibly in the fall of 1990. For the purposes of this analysis, assumptions of seafood consumption were based on 180 grams per day (wet weight), which is an amount equal to 11 meals of seafood a week or the average American consumption of total protein (Pastorak, 1988). This amount may actually be much higher than some residents in Nome consume, but it is assumed that at least some of the Native population in Nome consume this much seafood (see Section IV.B.15 for further discussion of these assumptions).

b. Causal Agents Affecting Subsistence-Harvest Patterns:

(1) Habitat Alteration: OCS mining activities include dredging, disturbance, and the dumping of bottom substrate. One dredge has the capacity to excavate approximately 100 acres a season, totalling 1,300 acres (base case) over the life of the mining lease. An estimated 12,500 to 15,000 m<sup>3</sup> of seafloor would be excavated daily by one dredge during the 100- to 120-day mining season, and an estimated 40 to 80 m<sup>3</sup> of seafloor would be excavated over the life of mining operations in the proposed sale area. The subsistence-resource areas for Nome are shown in Figures III-23 through III-28, to indicate important marine mammal-harvest areas that would be vulnerable to habitat alteration as a result of dredging, disturbance, and the dumping of bottom substrate. Analyses of the effects of dredging, disturbance, and the dumping of bottom substrate on the subsistence-resource habitat are provided below.

(2) Trace Metals: The sediments in the sale area contain high levels of trace metals. The excavation and deposition (redistribution) of sea-bottom material and sediments is sufficient to mobilize and repartition mercury, mercury compounds, and other trace metals including cadmium, copper, arsenic, nickel, zinc, and lead into the water column and onto the benthic surface where mercury and other trace metals would be ingested and absorbed into marine organisms. Based on concentrations observed in the water column, or other concerns, the following metals will be discussed: arsenic, mercury, lead, copper, and nickel. Of particular concern are copper, because of the elevated concentrations associated with Bima dredging activities, arsenic, and mercury. However, only mercury is considered in this analysis because mercury could biomagnify through the food web (Mance, 1987; Eisler, 1987) while the other metals would not (see Sec. IV.B.15 for this discussion). Toxic properties of trace metals ingested by marine mammals, fishes, and birds could affect the subsistence resources harvested in the area.

(3) Noise and Disturbance: Animals may avoid areas of high noise and disturbance and, thus, become unavailable to a particular community or become more difficult to harvest. Short-term effects, such as flight behavior or increased wariness, also may make animals difficult to harvest. Noise and disturbance can, for example, lower reproductive success of waterfowl by causing them to leave their nests, which could adversely affect the availability of some species. Fish eggs may be killed by seismic activities (airguns) and, this too, might affect the availability of harvestable resources. Fish are likely to avoid areas of noise and disturbance, and seal and walrus haulout areas during moulting periods can be disturbed by noise.



Noise and disturbance would be associated with (1) seismic surveys that are part of preliminary prospecting activities in the lease-sale area, (2) movement and operation of the dredges, (3) core drilling during prospecting, and (4) aircraft and marine support of the preceding activities. During prospecting and exploration (3 years) there would be one seismic-survey vessel operating during the open-water season (a total of 855 days) shooting 8,200 line km of low-sound-intensity profiles. Seismic surveys for prospect assessment are assumed to include 16,600 line km run over the 14-year production life of the operation. There would be two small vessels (200 ft) taking core samples (1,890 cores) during the 3 years of exploration for a maximum of 90 days a season. This process would continue during the mining period (a total of 1,170 days taking core samples). One dredge for the base case is anticipated for the mining operation with three helicopter flights a day servicing each dredge. Each dredge would also have an anchor-handling vessel. The dredges are assumed to operate 100 to 120 days of the 150-day open-water season.

(4) Fuel Spill: Offshore-dredging activities are attended by the risk of a fuel spill. A dredge the size of the Bima carries about 6,000 bbl of diesel fuel. For the purpose of analysis, a spill of 3,500 bbl is assumed. This amount is equivalent to the average, onboard fuel load of a Bima-sized dredge. A spill is most likely to occur from a dredge sinking during a fall storm, in which case the dredge would probably sink on location offshore. Diesel fuel lacks both the lightest and heaviest fractions of petroleum components, and will initially evaporate more slowly than crude oil. Eventually, however, more will evaporate (see Sec. IV.B.2). The effects of oil spills have been evaluated in the Sale 100 FEIS (USDOI, MMS, 1985a). The probability of an offshore spill versus one occurring in nearshore areas is not known, but for the sake of analysis, since some subsistence resources in nearshore waters are more vulnerable, a spill in nearshore waters with contact of the Nome subsistence harvest area will be assumed. There is a 32-percent chance or greater that the Nome subsistence-harvest area along the coast would be contacted within 3 days (see Graphic 12 and Appendix A, Table 6 of the Sale 100 FEIS [USDOI, MMS, 1985a]).

(5) Increased Human Population: Sale-induced population growth in Nome is expected to increase by about 4 percent (approximately 155 non-Native residents and 47 Natives by the peak year of non-Native growth in the year 2000 (see Appendix C, Table C-1. It is anticipated that non-Natives will not participate in marine mammal hunting, as has been the usual practice in Nome, since the Marine Mammal Protection Act of 1972 forbids non-Native hunting of marine mammals (see Sec. III.C.4 and Fig. III-21). Non-Native participation in other subsistence harvests tends to be primarily in fishing, moose and duck hunting, collecting eggs, and berry picking (see Fig. III-21). Of the additional 164 non-Natives expected to be in Nome in 2000 as a result of the proposed sale, 114 are expected to be between 19 and 64 years of age (see Appendix C, Tables C-6 and C-7); a small portion of these would be female and not as likely to be participating as heavily in subsistence hunts, and many of the non-Natives would not be participating heavily in subsistence activities. Thus, the number of people new to Nome who would actually be competing with current residents for subsistence resources would be much smaller than 164. Even so, this addition to the population would add some competition for subsistence resources.

c. Effect on Subsistence Resources: The following discussion analyzes the potential effects of habitat alteration, turbidity, entrainment, trace metals, noise and disturbance, and fuel spills on subsistence-resource-harvest patterns in the OCS Mining Program, Norton Sound Lease Sale area. This analysis assumes that Stipulation Nos. 1 through 4 (see Sec. II.F) will be in place for the proposed lease sale. Stipulation No. 1, Environmental Survey and Monitoring Program and Operations Management, Stipulation No. 2, Prohibition of Use of Mercury or Other Toxic Substances in Processing, and Stipulation No. 3, Baseline and Monitoring Studies on Mercury Levels in Humans, would reduce effects on subsistence-harvest patterns.

(1) Fish and Shellfish: Fish are a primary subsistence resource harvested by residents in Nome along the coast, rivers, and streams in the area. Fish are generally not harvested within the sale area (see Figs. III-21 and III-23). Harvests occur primarily during the summer and early fall months (Fig. III-22; see Sec. III.C.3.b). Shellfish also are an important subsistence-harvest resource for residents in Nome (Fig. III-21); shellfish also are harvested commercially (Sec. III.C.2). Red king crab is the primary shellfish harvested. Red king crab are generally not harvested within the sale area, rather they are harvested within the shorefast ice up to approximately 3 mi from shore (see Fig. III-21). The primary subsistence harvest period is from mid-November through mid-April (Fig. III-22). Some crab are occasionally harvested by boat in the summer months within the proposed sale area, but this is rare.

Dredging activity in the sale area would occur near the primary red king crab subsistence-harvest area offshore of Nome from Sledge Island to Cape Nome. Dredging would occur 3 mi or more offshore; crab harvests do not occur beyond about 3 mi on shorefast ice. Under this proposal habitat alteration from dredging and tailings

deposition is expected to have MODERATE biological effects on red king crab. If the red king crab habitat were affected, this could in turn affect the red king crab local population which is harvested outside of the sale area. The harvest of crab could experience significant reductions, but harvests would still occur--a MINOR effect on the subsistence harvest of crab. Habitat alteration should not have more than MINOR biological effects on fish and would not affect the subsistence-harvest of fish--a NEGLIGIBLE effect.

Under this proposal exposure to trace metals in the sale area is not expected to cause more than NEGLIGIBLE effects on fishes and shellfish. With monitoring of fishes and shellfish as well as monitoring of levels of mercury in humans, all marine subsistence resources should be protected from levels of trace metals exceeding EPA criteria. The acceptable level of increase of mercury into the water column and consequently into the food web has not been defined because at this point without knowing how much seafood Nome residents consume it is difficult to determine what degree of an increase in trace metals would be dangerous to human health. There have been no baseline studies of consumption of seafood by Nome residents to determine more precisely how much and what types of seafood are consumed by Nome residents. Thus, it is not known what levels of mercury in subsistence resources consumed by humans would keep the allowed daily intake (ADI) of mercury in humans at or below the level recommended by the WHO (see Sec. IV.B.15 for this discussion). For the average American who consumes only one meal of seafood a week (about 20 gm/day), the FDA action level for mercury of 1 ppm is adequate. The FDA action level for mercury in fish and shellfish is set so that for the average 70 kg male no more than 0.03 mg mercury would be ingested per day if only consuming 20 gm of seafood a day; for the Nome resident who may consume as much as 11 meals or more of seafood a week (approximately 180 to 215 gm/day of seafood), the FDA action level of 1 ppm is too high (see Table IV-12 in Sec. IV.B.15 for the methylmercury-risk assessment for consumption of seafood). A lower action level for mercury also would require a lower water-quality criterion because the EPA used consumption of 6.5 g/day of fish and shellfish to develop its water-quality criteria based on human health guidelines (Pastorak, 1988). If people are consuming more than 6.5 g/day of seafood, it could be necessary to establish a local water-quality criterion as well as an action level for mercury levels in seafood. These local standards would determine when mercury levels in the water, food chain, and subsistence resources were high enough to affect human health. Since at this point it is not known how much seafood is consumed in Nome, these local standards of mercury levels in the water and in the seafood cannot be determined accurately. However, even in the absence of a local water-quality criterion and action level for mercury in seafood, it is not likely that levels of any trace metals attributed to the proposed action would be high enough to threaten human health because: (1) the background levels of mercury in seawater in the Nome area are low (1.0 ppt; see Sec. IV.B.2.b) and typical of nonpolluted coastal water (Crecelius, Apts, and Lasorsa, 1990); (2) background concentrations of mercury in undisturbed sediment samples taken offshore the Nome area are low (0.032-0.038 ppm in three sediment samples); (3) preliminary measurements of mercury levels in the seawater associated with the current dredging operation indicate there is only a slight increase of mercury (0.4 ppt) at the edge of the mixing zone (Crecelius, Apts, and Lasorsa, 1990; see Table IV-8), resulting in a total mercury level of 1.4 ppt which is below the EPA chronic criterion level (25 ppt; see Sec. IV.B.2); (4) mercury released into the water column from the discharged sediments is rapidly reabsorbed to the sediments which are dispersed and resettle to the seafloor; (5) the repartitioning of mercury in the sediments is not expected to be measurable in the food chain above background conditions; (6) present indications of mercury levels in subsistence food sources are unusually low for Arctic waters; and (7) recent information on mercury levels indicates that present levels of methylmercury in Nome women of child-bearing age are below the 10 to 20 ppm hair-methylmercury range in which effects on prenatal and natal life could occur (see Sec. IV.B.15). Thus, it is not likely that levels of mercury attributed to the proposed action would be high enough to threaten human health and, consequently, the harvesting of subsistence resources. With levels of mercury in humans below the WHO recommended threshold of 10 ppm, subsistence harvests would not be threatened, resulting in no more than a NEGLIGIBLE effect on the subsistence harvest of fish or shellfish.

Noise and traffic disturbance are expected to have insignificant effects on subsistence-fish and shellfish stocks (see Secs. IV.B.3 and 4). Disturbance from seismic activity associated with the lease sale would occur more than 5 km (3 mi) from subsistence-fishing areas and, although it would occur in the crabbing areas, it should not affect the shellfish. Dredge and boat noise would have only transitory effects on fish and shellfish. Effects on subsistence fishing and crabbing from noise and traffic disturbance associated with this lease sale are expected to be NEGLIGIBLE.

A fuel spill is expected to have MODERATE biological effects on the fish and shellfish population, harvested in the sale area (see Secs. IV.B.3 and 4 for this analysis). Losses to the populations are expected to be less than one generation. These effects would be short term and MINOR to the regional population and, while harvests are likely to be reduced and some fishermen would be forced to travel to new locations and take longer to harvest fish or crab, it would still be possible to harvest some fish and crab, and no fish would become

totally unavailable. Although the fish and crab harvests would still be available, it is likely that harvest levels might be reduced for a year or less. The effect of a fuel spill on the subsistence harvest of fish and crab is expected to be MINOR. This effect is expected to occur on fish and crab harvested outside of the proposed sale area since fish and crab are not generally harvested in the sale area.

Sale-induced population growth in Nome is expected to be 4 percent (see previous discussion and Sec. IV.B.8). Although there are a large numbers of fishing areas in the Nome area, most new residents tend to fish in the immediate area in the Nome River. Fishing in the Nome River is already stressed and requires a permit to fish--and could not support many more fishermen (Magdanz, 1988a, oral comm.). Either current Nome River fishermen would have to move to other spots or the new residents would have to travel farther to fish. In the region as a whole there would not be any reductions in fish harvest levels over the years as a result of the proposal (a NEGLIGIBLE effect), however, in the Nome River there could be some reduction in harvest levels--a MINOR effect. Crab fishing also could not support much additional harvest pressure due to an increase in the human population, particularly in years when there is a lot of rubble ice and not much flat ice. Crab pots cannot be placed too close together so there is not as much room as one would expect for expansion. In addition, crabbing is limited to about 3 mi offshore. Fishermen would be forced to travel farther to the east and west of Nome which would take longer to harvest crab, possibly leading to some slight reductions in the crab harvests--a MINOR effect. This effect would occur to red king crab harvested outside of the proposed sale area since red king crab are not generally harvested within the sale area.

(2) Seal and Walrus: Seal and walrus are also important subsistence resources harvested by residents in Nome. Seal and walrus are harvested within and outside of the sale area (see Sec. III.C.3.b, Fig. III-22). Seals are harvested almost year-round with mid-July to mid-August being the only time period when seals are not harvested. Walrus are harvested primarily in May and June and occasionally in April, September, and October (see Figs. III-22 and III-24 and Sec. III.C.3.b).

Although regeneration and recolonization rates after dredging occurs are unknown, dredging of sea-bottom material and sediments most likely would remove and destroy walrus and bearded seal benthic-food sources for several years within the dredged area; food sources for spotted and ringed seals should not be affected (see Sec. IV.B.6). The loss of benthic-food sources of walruses and bearded seals within the dredged area (1,300 acres) would be very small and is not likely to have significant biological effects on seals and walruses (see Sec. IV.B.6 for this discussion). The presence of dredges may occasionally disturb seal and walrus harvests, but while it might make the harvest take longer and be less convenient, it would not cause the harvest level to decrease. Thus, the effect of dredging of sea-bottom material would affect the subsistence harvest of seals and walruses--a NEGLIGIBLE effect.

The excavation and deposition (redistribution) of sea-bottom material and sediments would mobilize and repartition mercury and other trace metals into the water column where they could be ingested and absorbed into bearded seals and walruses. High concentrations of mercury, cadmium, and selenium have been reported in seal and walrus livers and kidneys (see Sec. IV.B.6). Seal liver samples taken for the Bima monitoring study showed 2.1 ppm mercury--well above the FDA action level of 1.0 ppm for acceptable levels of mercury in marine life (Federal Register, 1986). However, as with the harvest of fishes and shellfish (discussed above in Sec. IV.B.10.c[1]), the environmental monitoring program and operations management and monitoring of human health (Stipulation Nos. 1 and 3) would reduce the likelihood of levels of any trace metals attributable to the proposed action being high enough to affect human health and, consequently, of the harvest of subsistence resources, a NEGLIGIBLE effect on the harvest of seals and walruses.

Seals and walrus are somewhat susceptible to noise and disturbance from aircraft and vessel traffic. Industrial activity associated with this lease sale is not expected to result in distributional changes in seal or walrus populations (Sec. IV.B.6). Disturbance from aircraft, vessels, and dredges could cause short-term, localized biological effects on seals and walrus (see Sec. IV.B.6 for the analysis) and some displacement of seals and walruses from habitats near the dredge (within a few to several kilometers from the dredge) during the mining season. Short-term, localized biological effects could cause some short-term disruption to the seal and walrus harvests; however, while such disturbance could cause seal and walrus hunting to take longer, this would not affect annual harvest levels, and seals and walruses would not become unavailable during the year. Subsistence harvests would be affected, but seals and walruses would still be available. Such MINOR effects from noise and traffic disturbance would be expected on Nome subsistence seal and walrus harvests within the sale area and outside of the sale area.

A fuel spill is expected to have MINOR biological effects on the walrus and seal populations harvested in the sale area (see Sec. IV.B.6 for this analysis). Losses to the population are expected to be less than one generation and would occur to less than one hundred to perhaps a few hundred seals and walrus. While these effects would be short term and MINOR to the regional population, they would force hunters to travel farther and longer to harvest seals and walrus. Although neither seals nor walrus would become unavailable, it is likely that harvest levels might be reduced, particularly for walrus whose peak harvests occur during May and June. If a spill occurred, it would most likely occur during the mining season from late May to early November. The effect of a fuel spill on the subsistence harvest of seals and walrus is expected to be MINOR. Harvests within and outside of the proposed sale area would be likely to be affected.

Sale-induced population growth in Nome is expected to be minimal. Of the residents expected by 2007, only 1 percent growth is expected to be Native. The Marine Mammal Protection Act of 1972 forbids non-Natives from hunting walrus and seals, thus only the additional 47 Natives (of which some would not be walrus or seal hunters or would be women and children--and of this 47 only 23 would be between the ages of 19 and 64, primary ages of hunters [see Appendix C, Tables C-6 and -7]) would be hunting walrus and seals. This population increase is not significant enough to cause more than NEGLIGIBLE effects on the subsistence harvest of walrus and seals.

(3) Waterfowl: Migratory waterfowl are an important subsistence-harvest resource to residents in Nome particularly in spring and early summer when fresh meat is less available (see Sec. III.C.3.b). Waterfowl are harvested along the entire coastal area near the proposed lease-sale area (see Fig. III-27), but generally not within the sale area. Bluff, Sledge Island, and Safety Sound are primary waterfowl-harvest areas. Dredging and excavation of sea-bottom material and sediments are expected to have a NEGLIGIBLE biological effect on marine and coastal birds (see Sec. IV.B.5). While some pelagic fish could be entrained in the seawater-intake system on the dredge, and water turbidity resulting from dredging excavation and tailing deposition could reduce the availability of pelagic prey, these effects would be localized near the dredging operations and would not affect the overall abundance and availability of primary food sources of seabirds. Most subsistence harvests of waterfowl occur on or nearshore--well outside of the lease-sale area where the dredges might be located. Thus, the presence of the dredges should not interfere with the subsistence harvest. NEGLIGIBLE effects on the subsistence harvest of waterfowl are expected as a result of activities associated with the proposed lease sale.

Dredging operations associated with gold mining in Norton Sound are expected to have a MODERATE biological effect on seabirds due to toxic levels of mercury and other trace metals including cadmium and lead (see Sec. IV.B.5). However, this effect is for seabirds, which are not heavily harvested. Waterfowl--the primary birds harvested--are coastal birds and should not be affected by trace-metal concentrations resulting from activities associated with the proposal. Seabird eggs are harvested by Nome residents at Sledge Island, Bluff, and Safety Sound. However, as with the harvest of fishes and shellfish (discussed above in Sec. IV.B.10.c[1]), the environmental monitoring program and monitoring of human health would reduce the likelihood of levels of any trace metals attributable to the proposed action being high enough to affect human health and, consequently, of the harvest of subsistence resources--a NEGLIGIBLE effect on the harvest of seabirds or their eggs.

Noise and disturbance caused by aircraft and vessel traffic may disrupt waterfowl-feeding and -nesting activities. The areas of particular concern are nesting areas (which are also primary subsistence-harvest areas) at Bluff and Sledge Island; nesting, feeding, and staging areas at Safety Sound; and feeding or rafting birds within about 2 kilometers of dredging operations offshore. Noise and disturbance are likely to result in local and short-term biological effects on waterfowl (see Sec. IV.B.5). Such low-level biological effects would not have significant effects on bird harvesting by Nome residents. Noise from helicopters could disrupt the harvest temporarily; however, it would not cause waterfowl to become unavailable. Effects on all bird harvests in or adjacent to the sale area from noise and disturbance are expected to be MINOR. This effect is expected to occur on bird harvests outside of the sale area.

A fuel spill is expected to have MODERATE biological effects on marine and coastal birds harvested in the sale area (see Sec. IV.B.5 for this analysis). If the spill occurred during the summer months (June-September), several thousand birds could be killed and the effects of habitat pollution could persist for more than one generation. Such a MODERATE biological effect on marine and coastal birds would force hunters to travel farther and longer to harvest waterfowl and seabirds. It is likely that if the spill occurred during peak harvest times (May through September for waterfowl and April through June for seabirds) that the harvest could become significantly reduced; however, a reduced harvest should still be possible--a MINOR effect. This effect is expected to occur on bird harvests outside of the sale area.

Sale-induced population growth in Nome is expected to be minimal (see previous discussion and Sec. IV.B.8). Although the number of waterfowl harvesting areas are limited and some slight effects may be felt from more people harvesting waterfowl, there are sufficient numbers of waterfowl to support the slight population increase as a result of the proposed sale--a NEGLIGIBLE effect.

(4) Moose: Moose are the largest terrestrial mammals available to Nome hunters and are harvested heavily by Natives and non-Natives (see Sec. III.C.3). Moose harvests would not be affected by dredging activities, habitat alteration, noise and traffic disturbance, and fuel spills because moose are terrestrial and industrial activities would be occurring outside of the moose range. However, moose could be affected by increases in population and indirectly as a result of effects on other subsistence resources.

The Nome moose harvest does not have much room for additional harvest pressure (Magdanz, 1988a, oral comm.). Currently the moose harvest is limited to 15 days in September near Nome; harvests until December or January are allowed about 50 mi outside of the immediate Nome area (Magdanz and Olanna, 1986). Permits are not required except for antlerless moose. It is likely that additional harvest pressure as a result of increased human population might cause a permit system to be instituted. Recent studies have shown some overpopulation of moose in areas outside of regional centers on the Seward Peninsula; consequently moose-hunting seasons will most likely be extended in those areas. However, there are no plans to relax the moose-hunting season within 50 mi surrounding Nome. Hunters would have to travel outside of Nome 60 or more mi away and beyond the reach of the Nome road system. Nome moose hunters would still be able to harvest moose, although the numbers potentially could be reduced, and hunting could take longer and be less convenient. Thus, there would be an effect on the moose harvest, but the harvest would still occur, although per capita it would be reduced--a MINOR effect. This effect is expected to occur on the moose harvests which occur outside of the sale area.

SUMMARY: Effects on Nome subsistence-harvest patterns is likely to occur as a result of habitat alteration, dredging and spoil deposition, increased levels of trace metals in the water column, noise and traffic disturbance, fuel spills, and increases in Nome's population.

Under this proposal the alteration of the sea bottom would cause MODERATE biological effects on the red king crab population in Norton Sound. The sale area is also the primary habitat for red king crab. While harvests of red king crab may become more difficult and take longer, some harvests of red king crab should occur. MINOR effects on the red king crab subsistence harvest are expected as a result of habitat alteration.

Excavation and deposition of sea-bottom material and sediments would mobilize and repartition mercury and other trace metals into the water column. This could cause higher levels of mercury to be ingested by seals, walrus, crabs, birds, fishes, and ultimately, humans. However, the dredging operation is not expected to cause levels of mercury to exceed the EPA water-quality criterion. Other trace metals which also are not expected to be elevated (see Sec. IV.B.15). With the stipulations in place levels no trace metals attributable to the proposed action are expected to be high enough to affect human health and, consequently, the harvest of subsistence resources. A MINOR effect on the harvest of subsistence resources is expected due to trace metals.

Noise and traffic disturbance are expected to cause short-term and temporary disruptions to seal, walrus, and waterfowl harvests. Although harvests may be disrupted and harvests could be decreased, harvests would still occur. This would result in a MINOR effect on seal, walrus, and waterfowl harvests. Fish and shellfish are not expected to have more than NEGLIGIBLE effects on harvests due to noise and traffic disturbance.

A fuel spill could cause harvests of fish, seals, walrus, and waterfowl to be decreased. Hunters may have to travel farther or hunt longer and while harvests could be decreased, harvests should still occur.

Increases in the human population due to the proposed lease sale are likely to cause the moose harvest to be regulated by a permit system. While moose harvest would still occur, there could be some reduction in the moose harvests--a MINOR effect. No more than NEGLIGIBLE effects are expected as a result of increased human population on the harvests of fish, crab, walrus, seal, or waterfowl.

Overall effects on subsistence-harvest patterns as a result of the proposal are expected to be MINOR.

CONCLUSION (Effect on Subsistence-Harvest Patterns): The effect of the proposal on subsistence-harvest patterns is expected to be MINOR.

**CUMULATIVE EFFECTS:** Cumulative effects on subsistence-harvest patterns include effects of the proposal and other past, present, and reasonably foreseeable future actions in the Norton Sound area (see Sec. IV.A.3 and Table IV-2a for a list of these ongoing and planned projects, and their scenarios and timetables). Activities associated with development of oil and gas leases from development on future Norton Sound oil and gas leases, proposed on the next 5-Year lease schedule, could contribute to cumulative effects on subsistence; however, at this point such a sale is speculative. Norton Sound Oil and Gas Lease Sale 57 leases have been relinquished and Norton Sound Oil and Gas Lease Sale 120 has been postponed. Projects and activities in the cumulative case include State offshore mining for gold on 8,802 hectares of offshore leases. Three dredges a season are proposed with 300 acres a season dredged with a total of approximately 6,000 acres likely to be dredged. Onshore mining activities include tin mining at the Lost River Mine, gold mining and prospecting near Nome, as well as harbor dredging offshore of the Snake River. Effects of cumulative case projects on subsistence could occur from dredging and tailings deposition, repartitioning of mercury and other trace metals, noise and traffic disturbance, industrial activities, and oil spills.

Cumulative offshore mining could include mining on State leases which would increase the area of dredging, tailings deposition, and habitat alteration. Offshore dredging would also alter and destroy some benthic-feeding habitat and food organisms of walrus and seals off the coast of Nome. In the proposal and in the cumulative case this is expected to have NEGLIGIBLE biological effects on walrus and seals (see Sec. IV.B.6). Effects on the subsistence harvest of walrus and seals are expected to be short-term, temporary effects and should not result in more than NEGLIGIBLE effects. Increasing the size of the area dredged in the cumulative case also would affect a larger proportion of the red king crab population. The subsistence harvest of red king crab occurs from the shore-fast ice which is within 3 miles from shore in the State lease-sale area. Biological effects on the red king crab would remain MODERATE in the cumulative case (see Sec. IV.B.3)--red king crab would become less abundant and more difficult to harvest causing harvests to be significantly reduced or possibly unavailable to Nome residents for a year or more, particularly since the subsistence harvest of red king crab occurs primarily within the State lease-sale area which was dredged from 1986 to 1990. If State leases continue to be dredged--and it is unknown at this point if dredging will continue--the red king crab harvest could become unavailable or greatly reduced for local residents up to a year, resulting in a MODERATE effect on the subsistence harvest of red king crab in the cumulative case. Overall cumulative effects on subsistence-harvest patterns in the proposed sale area as a result of dredging, soil deposition, and habitat alteration are expected to increase from MINOR in the base case of the proposal to MODERATE as result of MODERATE biological effects on red king crab, due to habitat alteration. This effect is local and is not expected to occur on any other crab harvests for other Norton Sound communities.

The dredging area in the cumulative case would increase the area of sea bottom disturbed and increase the concentration levels of mercury and other trace metals in the water column. With an effective monitoring program on State leases for levels of trace metals and if provisions are made to alter dredging activities if trace metals exceed EPA water-quality criteria, then no more than MINOR effects on subsistence-harvest patterns in the State lease area would be expected from dredging activities.

Cumulative noise and disturbance would be from air and vessel traffic and dredging noise in the Nome area. Cumulative offshore mining and oil and gas activities would increase air and vessel traffic by 100 trips or more. This disruption is expected to cause short-term disturbance/displacement effects on subsistence resources, particularly seals, walrus, and marine and coastal birds (see Sec. IV.B.3, 4, 5, and 6). In the cumulative case without the proposed lease sale these effects are expected to be MINOR for activity on State leases and Sale 57. The effects are not expected to be entirely additive because dredging, air and vessel traffic, and drilling activities would not occur at the same locations at the same times. While these disruptions might not have more than NEGLIGIBLE biological effects, they could interfere with subsistence harvests. Noise and traffic disturbance could cause harvests to be interrupted, make the harvest more difficult to achieve, and could force hunters to travel farther for a successful harvest. However, while the harvest might be affected, harvests of seals, walrus, and marine and coastal birds would still be possible and no harvest would become unavailable; therefore, there would be a MINOR effect in the cumulative case, the same as the proposal.

In the cumulative case, MAJOR effects are expected on fishes as a result of pressure from the Nome subsistence fishery (see Sec. IV.B.4 for this discussion). The Nome River is currently the only river that is regulated by a permit system. It is anticipated that perhaps some rivers will be closed to subsistence fishing or placed on a permit system. This is expected to result in a reduction of subsistence fish harvests, although fish would continue to be harvested--a MINOR effect.

**Conclusion:** Cumulative effects on subsistence-harvest patterns are expected to be MODERATE.

11. **Effect on Sociocultural Systems:** This discussion is concerned with Nome's sociocultural system. Under the scenario for this sale (see Sec. II.A), Nome is the community that would be used for the base of operations, housing of workers, and marine and air support. Nome's subsistence harvest of marine resources occurs within the sale area. The primary aspects of the sociocultural system covered in this analysis are (1) social organization and (2) cultural values, as described in Section III.C.3. For the purpose of effects assessment, it is assumed that effects on social organization and cultural values could be brought about at the community level--predominantly by industrial activities, increased population and employment, or effects on subsistence-harvest patterns associated with the sale.

a. **Introduction:** An analysis of the social organization of a society involves examining how people are divided into social groups and networks. Social groups are generally based on kinship and marriage systems, as well as nonbiological alliance groups formed by such characteristics as age, sex, ethnicity, and community. Kinship relations and nonbiological alliances serve to extend and ensure cooperation within the society. Social organization could be affected by an influx of new population that causes growth in the community or change the way these groups are organized. Activities such as the sharing of subsistence foods are profoundly important to the maintenance of family, community, and cultural ties. Rural Alaskan-Native communities and task groups associated with subsistence harvests are important in defining social roles, kinship relations, and world view. The specific tasks reflect and reinforce the roles of husbands, wives, grandparents, children, friends, etc. (see Sec. III.C.4.). Disruption of the subsistence cycle also could undercut the system of traditional leadership and family ties, kinship networks, and the individual community's sense of well-being.

An analysis of cultural values looks at values shared by most members of a social group. These values are shared conceptions of what is desirable. They are ideals which the members of some social group accept, explicitly or implicitly. Forces powerful enough to change the basic values of an entire society include a seriously disturbing change in the physical conditions of life--a fundamental cultural change imposed or induced by external forces, when a series of fundamental technological inventions change the physical and social condition. Such changes in cultural values can occur slowly and imperceptibly or suddenly and dramatically (Lantis, 1959). Cultural values in the sale area include strong ties to Native foods, the environment and its wildlife, the family, the virtues of sharing the proceeds of the harvest, spirituality, and independence (see Sec. III.C.4). A serious disruption of subsistence-harvest patterns could alter these cultural values. For the system of sharing to operate properly, some households must be able to produce--rather consistently--a surplus besides adequately satisfying its own needs. For this reason, sharing, and the supply of subsistence foods in the sharing network, may be more sensitive to harvest disruptions than the consumption of these foods by active producers.

b. **Causal Agents:** This section discusses the agents associated with the OCS Mining Program Norton Sound Lease Sale that could affect the sociocultural systems in Nome (described in Sec. III.C.4): industrial activities changes in population and employment, and effects on subsistence-harvest patterns. Analysis of the effects on sociocultural systems as a result of these effect agents is found in the following sections.

(1) **Industrial Activities:** The expected level of industrial activity as described in Section II.A for the base case is small, and existing facilities at Nome are adequate to handle projected needs during exploration and mining production as a result of this lease sale. No effects on sociocultural systems are expected as a result of industrial activities.

(2) **Population and Employment:** The OCS Mining Program Norton Sound Lease Sale is projected to affect the population of Nome through two types of employment in the region: (1) direct employment with the offshore-mining operations; and (2) increased indirect employment as a result of the mining operations. Employment projections as a consequence of the lease sale are provided in Section IV.B.8 and are based on WestGold's 1989 employment figures for operation of the Bima dredge in Nome. In 1989 Bima employment was 62 full-time equivalent (FTE) jobs (see Sec. IV.B.8 for the discussion on employment). The mining season extends from May to December, and two shifts, totalling 62 FTE workers, would be needed on the dredge for operations of one dredge. About 57 percent of the employees are expected to reside permanently in Nome; approximately 37 percent of the local employees are anticipated to be Native (see Sec. III.C.1). According to RAM-model projections, the proposal is projected to increase Nome's population in the base case from 3,991 in 1991 (see Appendix C, Table C-1) to 5,316 in 2008--the last projected year of the project. The population increase for the proposal is almost 4 percent (5,316 residents with the sale and 5,117 residents without the sale by 2008; see Appendix C, Tables C-1 and C-2). In the year 2000, the peak year of non-Native population, 63 percent of the residents are expected to be Native and 37 percent non-Native



in the base case. The Native proportion of the population will grow from 60 percent in 1991 to 69 percent in 2008 as a result of the proposal compared to the no-sale-case population projection of 70 percent in 2008 (see Appendix C, Tables C-1 and C-2). The difference in Native population growth between the base case and the no-sale case is an insignificant 1 percent (47 people). The non-Native population would decrease from 39 percent in 1991 to 29 percent in 2008 without the sale and to 31 percent with the sale--a difference of 2 percent as a result of sale-induced population growth (see Appendix C, Tables C-6 and C-7). The population growth and changes in the percent Native and non-Native populations as a result of this lease sale is expected to be insignificant and is not expected to affect Nome's sociocultural systems--a NEGLIGIBLE effect.

(3) Effect on Subsistence-Harvest Patterns: Subsistence is central to the Inupiat and Yup'ik way of life and critical to the Inupiat and Yup'ik sociocultural system (see Sec. III.C.3 for a detailed description). With stipulations considered in place for the analyses of the base and high cases, overall MINOR effects are expected on subsistence-harvest patterns in the lease-sale area.

c. Effect on Nome: This section analyzes the effect of population and employment, and subsistence-harvest patterns on Nome's Native social organization and cultural values. More than NEGLIGIBLE effects are not anticipated on Nome's non-Native population's social organization and cultural values. The effects of stress on the sociocultural system in Nome are also discussed.

(1) Social Organization: The social organization of Nome includes typical features of Inupiat and Yup'ik cultures: kinship networks that organize much of the community's subsistence-production-distribution- and -consumption levels; formally and informally derived systems of respect and authority; strong stratification between families focused on success at subsistence endeavors; and access to subsistence technology. These non-Western elements of social organization could be altered to become less oriented toward the family and exhibit a breakdown of kinship networks as result of induced social conditions in Nome as a result of this lease sale. In Nome, there was a decrease in the Inupiat and Yup'ik populations from 62.6 percent in 1967 to 58.5 percent in 1980 (Kevin Waring Associates, 1988) as well as an increase in higher paying jobs (see Sec. III.C.1). The majority of the non-Native population in Nome is "permanently" residing in Nome (although not necessarily long term; 9 years is the average length of residence [Impact Assessment, 1986]). The base case of the proposed lease sale would only increase the percentage of non-Natives permanently residing in Nome from 36 percent to 38 percent at its peak in 1999 and down to 32 percent at the end of the projected project in 2007 (see Appendix C, Tables 6 and 7). This increase should not be significant enough to alter sociocultural systems in Nome. The total population would increase by 205 or 5 percent--an increase a community like Nome should be able to absorb. This lease sale would increase the temporary population of Nome (61 or 57% of the Westgold employees in 1987 were Nome residents; 53 or 43% were non-local), although it is also likely that a number of these workers coming to Nome temporarily would choose to reside there year-round, as has already occurred with six of the employees on the gold dredging project in the State offshore lease area (Kosell, 1988, oral comm.). Disruptions would occur to Nome's social organization as a result of increases in the temporary and permanent population. These disruptions would be short term and periodic and would most likely occur over the 14-year life of the project; even so, these disruptions to the social organization should not be significant enough for displacement of Nome's social organization. It is also likely that this lease sale would enable some residents to remain in Nome and to enhance their economic situation which would bring some stability to the community (Kosell, 1988, oral comm.). Thus, while there could be short-term disruption to the social organization in Nome, it is not likely that this would lead to the displacement of existing institutions, and disruption would not be significantly higher than those already occurring in Nome as a result of changing demographic conditions (Kevin Waring Associates, 1988)..

Increased interaction between Natives and non-Natives in any community, as a result of non-Natives moving into the community, has the potential for causing disruptions in the community. Nome is typical of expanding rural communities composed of a wide array of ethnic groups, with their varied histories, diverse educational backgrounds, interests, religious affinities, and normative behaviors. The primary focus of stress and conflict in Nome is closely related to this ethnic structure. For three-quarters of a century, a minority of non-Natives dominated an Inupiat and Yup'ik majority in the villages economically and politically. This produced, for many Inupiat and Yup'ik, feelings of inferiority and suppressed hostility. Over the intervening years, internal adjustments have improved interethnic relations. For many of Nome's inhabitants, tolerance and respect have been the end result of a lengthy understanding and communication. Mutual stereotyping, based on ignorance and lack of interpersonal contact exists, but not nearly to the degree found in some urban, multi-ethnic community settings. Nome has seen short-term, non-Native residents come and go. While some temporary residents exhibit a respect and understanding of the cultures they find in Nome, others come equipped with prejudices too ingrained to be modified by experience. With an influx of new, temporary and permanent

residents in Nome as a result of this lease sale, it could be expected that new tensions would occur. However, such tensions are not new and could place additional stresses on Nome's sociocultural system. The average non-Native lives in Nome no more than 9 years, most considerably less (Impact Assessment, Inc., 1987). For some time, the non-Native population of Nome has experienced a degree of transiency linked to seasonal occupations such as mining. This lease sale would continue to attract transient or short-term non-Native residents as has been the pattern in the past. In addition, the lease sale may add some stability to the Nome population by providing new permanent employment and allowing some transient workers who would have left to stay in Nome (this has apparently already occurred in the case of Bima workers).

Subsistence is important to Inupiat and Yup'ik social organizations through sharing, task groups, and strengthening social bonds. With an effective monitoring program, effects on subsistence-harvest patterns of Nome are expected to be MINOR. Such effects on subsistence harvests are likely to be short term and are not expected to cause more than MINOR effects on social organization.

(2) Cultural Values: Cultural values and orientations (as described in Sec. III.C.4) can be affected by changes in the population, demographic conditions, social organization, economy, and alterations to the subsistence-harvest patterns.

Changes in the population, demographic conditions, and economy as a result of this lease sale are not expected to be significant enough in the base case to alter trends already in existence, and thus, should not change any effects on cultural values which may already be occurring without the sale. Interaction with nonlocal mining workers could result in the introduction or strengthening of new values and ideas, as well as increased racial tensions and increased usage of drugs and alcohol (as coping mechanisms for dealing with increased tensions and stress resulting from the proposed lease sale). Tensions could be created and could result in increased incidents of socially maladaptive behavior and family stress, that could potentially strain traditional Inupiat and Yup'ik institutions for maintaining social stability and cultural continuity (see discussion below). Cultural values and orientations can change slowly or suddenly (Lantis, 1959). Long-term change depends on the relative weakening of traditional stabilizing institutions through prolonged stress and disruption effects. These changes are already occurring to some degree in Nome as a result of increased dependency on a cash economy, higher levels of western education, improved technology, improved housing and community facilities, improved infrastructures, increased presence of non-Natives, under representation in economic and political arenas, increased travel outside of Nome, increased levels of alcohol and drug abuse, and television. Although the degrees of intensity of these changes are not yet documented (nor are they easily quantifiable), it appears that these changes are trends that could increase rapidly with more intensive development.

Subsistence is considered the core value and a central feature of Inupiat and Yup'ik cultural values (see Sec. III.C.4). With an effective monitoring program in place, no more than MINOR effects are expected on subsistence-harvest patterns. Such effects would be short term and would not be expected to have more than MINOR effects on cultural values in Nome.

The Effect of Stress on Sociocultural Systems: Effects on sociocultural systems are often evidenced in rising rates of mental illness, suicide, substance abuse, and violence. This has proven true for Alaskan Natives who, since the 1950's, have faced increasing acculturative pressures. During this period they have also experienced "a steadily increasing burden of mental illness, alcohol abuse, and social disorder..." (Kraus and Buffler, 1979).

While such behaviors are individual acts, the rates at which they occur vary among different groups as well as through time. These changing rates are recognized as the results of a complex interaction of interpersonal, social, and cultural factors occurring within a historical context (Kraus and Buffler, 1979; see also, Kiev, 1964; Murphy, 1965; Inkeles, 1973). The rates of all types of mental illness appear to be higher "in larger rural Native towns than in the more traditional Native villages" (Foulks and Katz, 1973; Kraus and Buffler, 1979). Native villages help buffer the individual by providing a sense of continuity and control. People live with recognized role expectations, beliefs, and lifestyles. On the other hand, rural towns are the foci of increasing outside influences. Bethel experienced acculturative pressures earlier than most Native towns, as seen in its violent death-rate increase in the 1930's (Anderson and Eells, 1935). Similarly, others found that a "notable increase in mortality due to these causes in non-native Fairbanks parallels the pipeline work" (Klausner and Foulks, 1982).

Complex sets of causal relationships lead from acculturative effects to the social pathologies that raise these rates. Increased social mobility may isolate individuals from kinsmen and supportive social situations. The growth of smaller communities into larger ones may have a similar effect, particularly if it is accompanied by

the immigration of an unfamiliar, highly skilled group that fills many important positions. Thus, problems of self-image are critical to the development or nondevelopment of social pathologies (Chance, 1965).

The psychic stress which leads to social pathologies "may be significantly determined by the extent of the gap between the old and the new norms" (Brower, 1980; see also Kiev, 1964, 1972; Chance, 1966; Murphy, 1965). Such problems may result from people being socialized for a lifestyle that no longer exists (Milan, 1964), particularly when this change has occurred because of outside forces beyond their control. New routes to success, created by development, may contradict the more traditional patterns of reciprocity and egalitarianism and lead to social conflict, isolation, and feelings of guilt (Hippler, 1969). Conversely, people may identify with new goals that are inaccessible or for which they lack skills. This leads to lowered self-esteem and increased anger and frustration (Chance, 1965, 1966; Chance et al., 1966; Kiev, 1964; Murphy, 1965). The substitution of one set of nominative behavior for another may disrupt the standard set of expectations, predictions, and responses used to understand social settings. This too leads to lowered self-esteem and increased frustration (Erasmus, 1961; Kiev, 1964), often resulting in increased incidences of drug and alcohol abuse, violence, and suicide.

Finally, the nature and direction of change may not be clear or understood, or it may accelerate and "overload" the existing sociocultural system (Murphy, 1965). Such a situation decreases the sense of control and increases perceptions of an external threat as well as psychic stress. A sense of control is particularly important for adjustment (Chance, 1966), just as a sense of an uncontrolled, external threat is particularly detrimental (Murphy, 1965; Kiev, 1964).

Several salient points in the evaluation of possible sociocultural effects of development should be made. First, change itself, even though induced primarily by forces outside the communities, does not necessarily cause the levels of psychic stress that lead to pathology (for a general discussion, see Inkeles, 1973). Second, and related to the first point, not all sociocultural change (directly or indirectly related to development) may be negative. Higher levels of employment can be viewed as possible positive sociocultural effects on Nome's development. Third, rapid and wide-ranging sociocultural effects are significant not only because a way of life is altered but also because these alterations can come with high social costs. These costs include growing alienation, increasing rates of mental illness, suicide, homicide and accidental death, growing disruption of family and social life, and the abuse of alcohol and drugs. Fourth, what makes sociological change disruptive "is the manner in which changes occur" (Murphy, 1965). A general discussion of the conditions that make sociocultural change stressful has already been presented (see discussion above; see particularly Murphy, 1965). Fifth, the conditions that make sociocultural change stressful must be viewed as ongoing. If the stressful conditions alter, the society can make successful adjustments to the changes that have occurred and rates of violence, suicide, and substance abuse will drop. For this reason, the fact that such rates are already elevated does not mean that all effects that could occur have occurred.

Anxieties are strong about the future of the subsistence way of life. Feelings of loss and frustration and a distrust of outside interests combine to form a general sense of lack of control. A sense of control is central to successful adjustment. The proposal could lead to an unpredictable amount of socially dysfunctional behavior due to a sense of lack of control over the mining development and the lack of a sense of control over the social, economic, and political effects as a result of mining. Because households and kinship systems among Nome's Native population tend to be extended, this behavior would affect more than just the people exhibiting it. Much of Nome's Native community has extended family in communities outside of Nome, thus socially dysfunctional behavior would be felt by extended families and friends in Nome and "natal communities." Fears about the future of the subsistence way of life would multiply the psychological consequences of any effect the proposal would have on subsistence pursuits. However, with a monitoring program in place (see Sec. II.F), these fears should be substantially reduced. These fears also may be offset by the increase in employment opportunities.

**SUMMARY:** Effects on Nome's sociocultural systems would occur as a result of industrial activities, changes in population and employment, and effects on subsistence-harvest patterns. These casual agents would affect Nome's Inupiat and Yup'ik social organization, cultural values, and well-being. Nome's non-Native population should not experience more than NEGLIGIBLE sociocultural effects from the sale. Nome is expected to be affected by the proposed lease sale for the following reasons: (1) Nome will be the base of operations for the mining activities; (2) sale-related employment and population growth predicted for the sale area are expected to occur in Nome; (3) nonlocal employees will reside in Nome; (4) marine and air support will be based in Nome; (5) each of Nome's marine-subsistence resources are harvested in the sale area; and (6) MINOR effects on Nome's subsistence-harvest patterns are expected. Nome is a fairly large, heterogeneous community and should be able to withstand some degree of increased population and employment opportunities. With an

effective monitoring program in place, only MINOR effects are expected on subsistence-harvest patterns. MINOR effects on subsistence-harvest patterns are not expected to result in more than MINOR effects on sociocultural systems.

**CONCLUSION (Effect on Sociocultural Systems):** The effect of the proposed sale in the base case on sociocultural systems is expected to be MINOR.

**CUMULATIVE EFFECTS:** Cumulative effects on sociocultural systems are assessed as the aggregate result of effects associated with this lease sale in combination with other activities or projects identified in Section IV.A. Projects and activities in the cumulative case include State offshore mining for gold on 8,802 hectares of offshore leases. Onshore mining activities include tin mining at the Lost River Mine, gold mining and prospecting near Nome, as well as harbor-maintenance dredging at the Snake River. Activities associated with development of oil and gas leases from development on future Norton Sound oil and gas leases, as proposed in the next 5-Year Leasing Program could contribute to cumulative effects from this proposed lease sale; however, at this point such a sale is speculative. Norton Sound Oil and Gas Sale 57 leases have been relinquished and Norton Sound Oil and Gas Sale 120 has been postponed.

**Cumulative Effect on Social Organization:** In the cumulative case, effects on social organization would be the result of effects from industrial activities, changes in population and employment, and effects on subsistence-harvest patterns. These effects would be similar to the MINOR effects described for the proposal; however, the level of effects would be increased and intensified due to the intensity of activity in the cumulative case. Each of the projects described in the cumulative case alone should not be expected to experience more than MINOR effects on social organization, however, the additive effect of all of these projects would be MAJOR. In the cumulative case growth of the non-Native population would be expected from offshore and onshore mining, as well as some from possible offshore oil exploration and development. Growth of the non-Native population would increase the interactions and competition between Natives and non-Natives and could cause additional stress between these groups. Increases in population growth would be long term in the cumulative case and would cause a widening of the disproportionate disparity of Native representation in Nome's economic and political environments and would cause disruptions to: (1) the kinship networks that organize Inupiat and Yup'ik subsistence-production and consumption levels, (2) extended families, and (3) informally derived systems of respect and authority (primarily respect of elders and other leaders in the community). MODERATE cumulative effects on subsistence-harvest patterns would affect Inupiat social organization through disruptions to their kinship ties, sharing networks, task groups, crew structures, and other social bonds. Effects on sharing networks and subsistence task groups could cause a breakdown in family ties, the sense of well-being in the community, as well as tensions and anxieties leading to high levels of social discord. In the cumulative case, these disruptions to the social organization would be long term and would cause eventual displacement of the existing social organization resulting in a MAJOR effect.

**Cumulative Effect on Cultural Values:** Effects on cultural values in the cumulative case would be the result of effects of industrial activities, changes in population and employment, and effects on subsistence-harvest patterns. These effects would be similar to the MINOR effects described for the proposal; however, the level of effects would be higher due to the intensity of activity in the cumulative case. Each of the projects described in the cumulative case alone should not be expected to experience more than MINOR effects on cultural values; however, the additive effect of all of these projects would be MAJOR. Effects on the social organization in the cumulative case also would lead to a decreased emphasis on the importance of traditional values regarding family, cooperation, sharing, and subsistence as a livelihood, and an increased emphasis on individualism, wage labor, and entrepreneurism. Increased interaction with miners and oil industry workers in the cumulative case would result in increased stress and strain on traditional Inupiat and Yup'ik institutions. In the cumulative case, MODERATE effects are expected to affect subsistence-harvest patterns. Disruptions of subsistence-harvest patterns would affect subsistence task groups, have a tendency to displace sharing networks, and consequently, cause a decrease in the importance of subsistence as a cultural value.

Long-term effects on cultural values, social organization, and subsistence-harvest patterns would be likely to contribute to increasing social problems: rising rates of alcoholism and drug abuse, domestic violence, wife and child abuse, rape, homicide, and suicide. The social health and well-being of Nome is already experiencing stress. Additional development in the cumulative case could lead to further disruptions which would contribute to displacement of existing sociocultural institutions.

**Conclusion:** Cumulative effects on sociocultural systems in the OCS Mining Program Norton Sound Lease Sale area are expected to be MAJOR.

**12. Effect on Archaeological Resources:** Archaeological resources offshore and onshore of the OCS Mining Program Norton Sound Lease Sale area could be affected by exploration and dredging activities of the proposal. The MMS Archaeological Update Report, 1989 states that blocks 586 and 587 of OCS Protraction Diagram No. 3-8, which are outside of the sale area, contain a major paleochannel near the sale area. This channel could have high potential for prehistoric site occurrence. However, it is outside the sale area and would not be impacted by activities resulting from the sale. The upper Pleistocene sediments within the proposed sale area are described as limnic peaty muds thought to be Pleistocene tundra deposits. These deposits are cut by relict braided stream channels and probably contain numerous small lakes and ponds (Appendix A). Although these relict Pleistocene bog deposits are areas where archaeological site deposits reworked by thermokarst and stream erosion probably occur and where even organic materials may be preserved, detecting such features and specific areas having higher archaeological site potential than others would probably be difficult in such an area. Peat deposits, typically attenuate the high frequency seismic signal necessary to delineate landforms and areas of archaeological site potential. Therefore, although the proposed sale area may contain reworked archaeological site deposits, detecting such deposits with current remote sensing technology would be difficult under these particular sedimentological conditions. Any archaeological deposits present would probably be discovered during operations. Section (c) of Stipulation No. 4 requires the lessee to notify the RS/FO if any archaeological resource is discovered during lease operations.

It is estimated that there are about 62 dredge workers in Nome now for exploration and support activities and operation of the Bima dredge for the mining operations in State waters. This number is expected only slightly to increase the mining-related jobs in the base case when one other dredge is operating on the Federal OCS (see Sec. III.C.1 for employment and population numbers). Because of the multiplier effect, this means an increase in jobs in the range of 3 in 1991 to 1993 to 120 for the years 2000 through 2003 and an increase in population.

Increases in population around Nome would increase visits to prehistoric and historic archaeological sites in that area (see Sec. III.C.5 for a description of sites). Possible pilfering could take place by people unfamiliar with the protection laws regarding these sites.

There would be insignificant direct effects from a 3,500-bbl fuel spill on either offshore or onshore archaeological resources (oiled artifacts can be dated by modern carbon-dating methods). Consultation with the State Historic Preservation Officer (SHPO) would be advisable if such a spill occurred. The SHPO would see that cleanup operations would not damage buried sites and wrecks along the shore. Fuel-spill-cleanup activities would cause only MINOR indirect effects in limited areas of the beach.

Activities on the sea bottom related to dredging and especially the dredging itself could affect historic shipwrecks in the area. Shipwrecks could be disturbed unintentionally by employees of the dredging operations. Three known shipwrecks, the Letha R. Thomas (1900) wrecked "off" Nome, the El Sueno (1903) wrecked "off" Nome, the Jessie (1910) wrecked "near" Nome, and the P.C.S. Co. No. 1 (1911) barge wrecked "off" Cripple Creek are close enough to the sale area to make survey of certain blocks prudent. The Letha R. Thomas, is reported to lie 2.25 miles offshore, just inshore of the proposed sale area. The reported location accuracy of this shipwreck indicates that it could occur somewhere in NQ 3-7 within Blocks 555, 599, and 600. Likewise the P.S.C Co. No.1 barge is reported to lie 2 miles offshore and southwest of Cripple River. The reported location accuracy of this wreck indicates that it could also occur somewhere in NQ 3-7 within Blocks 506, 507, 551 and 552. The archaeological report requirement of the lease stipulation (Stipulation No. 4) will be invoked on these seven blocks, if leased, to insure detection of a shipwreck prior to conducting lease operations.

Projections indicate that the resident population of Nome would increase by only about 2 percent during dredging due to the proposal (see Sec. IV.B.8); some of this population may visit areas and beaches where shipwrecks have occurred.

**CONCLUSION (Effect on Archaeological Resources):** The overall effect of the proposal on archaeological resources is expected to be NEGLIGIBLE.

**CUMULATIVE EFFECTS:** In addition to the proposal, other past, present, and reasonably foreseeable future actions would have effects on archaeological resources. Offshore mining from present leases is expected to continue. Mining on current OPP's (a prospecting permit for state waters with a 10-year life that can be converted to a mining lease if a marketable quantity of mineral resources is located) cannot occur until the OPP's are converted to leases. If mining does occur, such activity would increase potential disturbance to archaeological sites and increase visitation to National Register Sites. Three dredges employing 30 people each will continue

dredging operations on their leases. This could produce a slight increase in accidental and visitor disturbance. Thirty people each for the three dredges in Nome would contribute to the activity in the community and the harbor, that could disturb archaeological sites. Onshore mining of gold and tin would continue to contribute some activity to the Nome area, including the harbor (refer to Sec. IV.A.2.b). Dredging maintenance on the harbor is expected to deposit 13,000 yd<sup>3</sup> of material about 1.5 mi east of the mouth of the Snake River. Ocean discharge is not authorized; onshore dumping also could affect archaeological resources. Those onshore places where accidental and visitor activity due to dredging are most likely to result in disturbance to archaeological sites are at Lost River, Sinuk River, Nome, Big Hurrah load-deposit area, Solomon mining area, Bluff, White Mountain, Council, Kachauik, and Amalik.

The Lost River Mine permits will be filed again and its activity continued. Such activity would contribute slightly to the effects on archaeological resources. Alaska Gold Company expects to continue operations with peak employment in the summer of about 115 people. Such activities are expected to increase the accidental and visitor disturbance to archaeological sites. Alaska Gold has subleased to other companies on Third Beach. These companies employ about 20 persons each. Should these operations continue, they would contribute some disturbance to sites in the area. If Placer Dome U.S., Inc. and Aspen Exploration operations continue, they could contribute some accidental and visitor disturbance to archaeological sites in the area around Rock Creek. The BHP Utah Minerals International expects to employ 10 persons in a drilling operation near Bluff. Small disturbance to archaeological sites could be expected from this operation.

**Conclusion:** Cumulative effects on archaeological sites are expected to be MINOR.

13. **Effect on Recreation and Tourism:** It is estimated that there are about 62 FTE jobs in Nome now for exploration, support, and operation of the Bima dredge in State waters. This number is expected to increase by 77 mining-related jobs in the base case when one other dredge is operational on the the Federal OCS (see Sec. III.C.1 for population numbers). Because of the multiplier effect, this means an increase in the range of 3 to 120 FTE jobs at different times during operations and an increase in population.

The Bering Land Bridge National Preserve north of Nome is likely to receive more tourists because of the increased interest in the area due to gold dredging. Already, news of this dredging operation has reached the public in states on the East Coast. Because of the increased attention drawn to the area by dredging activities, the number of tourists visiting when another dredge is operating would increase effects.

The Andreafsky Wilderness is one recreational wilderness area to the south of the sale area where Nome residents occasionally visit. It will not be a significantly affected recreational resource due to its distance from the area of dredging.

For both Native and non-Native residents, there would be a slight increase in recreational hunting and fishing pressures due to increased visitor numbers and the increased mining population. Although increases in sports hunting and fishing pressure and recreational mining are expected to be slight, several fish and game resources are currently at threshold levels that could be significantly impacted, resulting in substantial effects to subsistence and sociocultural systems. There is also concern that some recreational hunting and fishing would result in trespass on private lands. This effect would be largely mitigated by the hunting laws which specify areas where hunting is allowed.

Intrinsic cultural and recreational qualities of Golovin, Elim, Solomon, White Mountain, Council, and Nome would be stressed because of increased numbers of tourists visiting the area. These tourists will find more modern cultural settings (industrial and transportation development, modern industrial attitudes and values, etc.) that would not be expected to exist in traditional, subsistence-type Native villages.

There would be an increase in the number of visitors to historic gold rush relics such as old mining camps, subsistence camps, dredges, and cabins. This increase would be noted along the beaches, especially at subsistence camps, and would be especially stressful to the recreation and tourism resources in the Bluff area near Safety Sound.

The increased interest by outsiders in the OCS mining project would result in increased expenditures by tourists and the mining population in Nome and other local communities. The negative effect of the base-case proposal on recreation and tourism resources would be due to significant effects resulting from increased trespass on Native lands and the cost of trespass monitoring and enforcement. Such negative effects are estimated to be

MODERATE and the positive effect--such as increased tourism expenditures such as sightseeing excursions by boat and aircraft out to dredges operating in State and Federal waters--would also be somewhat higher.

**CONCLUSION (Effect on Recreation and Tourism):** The effect of the proposal on recreation and tourism resources is expected to be MINOR.

**CUMULATIVE EFFECTS:** In addition to the proposal, other past, present, and reasonably foreseeable future actions would have an effect on recreation and tourism. Offshore mining from present leases will probably be active during the next 10 years (refer to Sec. IV.A.2.b). Such activity would increase disturbance to recreation and tourism resources and increase visitation to National Register sites. Three dredges are to continue dredging operations on their leases. This would produce a slight increase in tourists and, consequently, increased accidental and visitor disturbance to recreation and tourism resources. Mining activity also would increase the economic expenditure in the area. The expenditures of the dredge employees in Nome would contribute to the recreation and tourism industry. Onshore mining of gold and tin would continue to contribute some activity to the Nome area, including the harbor (refer to Sec. IV.A.2.b). Dredging for harbor maintenance is expected to deposit 13,000 yd<sup>3</sup> of material about 1.5 mi east of the mouth of the Snake River. Those onshore places where accidental and visitor activity are most likely to result in disturbance to recreational resources would be at Lost River, Sinuk River, Nome, Big Hurrah load-deposit area, Solomon mining area, Bluff, White Mountain, Council, Kachauik river entering at Golovin Bay, and Omilak north of Golovin.

The Lost River Mine permits will be filed again and its activity continued. Such activity would contribute slightly to the effects on recreation and tourism resources. Alaska Gold Company expects to continue operations with peak employment in the summer of about 115 people. Such activities are expected to increase the accidental and visitor disturbance to recreation and tourism resources and increase the economic expenditures of the local area. Alaska Gold has subleased to other companies on Third Beach. The two companies employ about 20 persons each. Should these operations continue, they would contribute some disturbance to recreation and tourism resources but also would contribute to the economic expenditures in the area. If Placer Dome U.S., Inc. and Aspen Exploration operations continue, they would contribute some accidental and visitor disturbance to recreation and tourism resources and some change in the economic expenditures of the the area around Rock Creek. The BHP Utah Minerals International expects to employ 10 persons in a drilling operation near Bluff. Small disturbance to recreation and tourism resources and a change in the economic expenditures could be expected from this operation.

**Conclusion:** Cumulative effects on recreation and tourism resources are expected to be MINOR.

#### 14. **Effect on Land Use Plans and Coastal Management Programs:**

a. **Introduction:** Effects identified in previous sections of this EIS are assessed with respect to policies established in the Northwest Area Plan, the Alaska Maritime National Wildlife Refuge Comprehensive Conservation Plan, and the appropriate portions of the Alaska Coastal Management Program (ACMP)--the statewide standards, and the district programs of the City of Nome (NCMP) and the Bering Straits Coastal Resource Service Area (CRSA) Coastal Management Program (BSCMP). Statewide standards developed for the ACMP provide the framework for the analysis. Region-specific district policies supplement the more general statewide standards and are discussed within the context of the related ACMP standard. The Yukon-Kuskokwim CRSA (Ceñaliulriit) abuts the southern portion of Norton Sound. Policies of the Ceñaliulriit CMP are not included as no effects have been identified at this time for the Yukon-Kuskokwim Delta or the residents of the Delta. Likewise, land management plans for Sitnasauk and Bering Straits Native lands are not included as effects on these lands would be indirect and not subject to their regulations.

Delineation, testing, and mining plans have been determined to constitute a plan for "exploration or development of, or production from, any area leased under the Outer Continental Shelf Lands Act" (CZMA, Sec. 307[c][3][B] and DOI/SOL, 1990). As a result, lessees are required to certify that each activity described in the plans that affects any land or water use or natural resource of the coastal zone complies with the enforceable policies of the State's approved management program and will be carried out in a manner consistent with the coastal management program. Recent amendments to Section 307(c)(1)(A) of the CZMA require that a lease sale that affects any land or water use or natural resource of the coastal zone also must be consistent with the enforceable policies of a State's CMP to the maximum extent practicable.



However, this analysis of potential conflicts between the activities assumed to occur and the ACMP is not a consistency determination pursuant to the CZMA, nor should it be used as a local planning document. It is highly unlikely that all events will occur as hypothesized in this EIS.

b. Land Use Plans:

(1) Alaska Maritime National Wildlife Refuge Plan: An FEIS on the Comprehensive Conservation Plan for the Alaska Maritime National Wildlife Refuge (Alaska Maritime Refuge) has been completed. In the three alternatives considered in the FEIS (status quo, significant increases in land designated as wilderness, and a preferred alternative which includes some additional wilderness land and some increases in land managed more intensively), those segments of the Alaska Maritime Refuge near Nome (with the exception of the road bed) are retained in a minimal management category.

The "minimal management" category is "directed at protection of existing fish and wildlife populations and habitats, and restoration of endangered and other species to natural levels" (USDOI, FWS, 1988). Only uplands are within the boundaries of these segments of the Alaska Maritime Refuge. Therefore, the specific refuge policies for marine environments would not apply, but "monitoring of water quality [will be routinely practiced] to enable the Service to propose mitigation of adverse effects that originate on or off the refuge" (USDOI, FWS, 1988).

The FEIS on the Comprehensive Conservation Plan identified several concerns with respect to mining in State waters. These same concerns, among others, also would apply to mining associated with this lease sale. However, the distance between the proposed leases on the OCS from the refuge sites minimizes several potential adverse effects on birds and marine mammals. For example, a concern expressed in the FEIS is that turbidity from offshore gold dredging would interfere with capelin spawning; a similar problem has not been identified for dredging in Federal waters. Rather, concern has been directed to the potential effects of a fuel spill (Sec. IV.B.3). Another concern identified in the FEIS is the possibility that trace metals such as mercury may biomagnify in the food chain. This possibility could be exacerbated with this sale; however, monitoring included as part of the proposal should identify problems in time for mitigation to occur.

It is unlikely that the effects identified in Sections IV.B.1 through IV.B.13 of this EIS would alter the "minimal management" designation proposed for Sledge Island, Safety Sound/Barrier Island, Topkok Head, Bluff, and Cape Darby. The detailed management plan that is developed to implement the Comprehensive Conservation Plan and the annual operating plan may be altered slightly if risks to specific areas are perceived. For example, the FEIS assumes that the current FWS seabird-monitoring program at Bluff would continue. If effects to the seabird population at Bluff were considered at risk, it is likely that this monitoring program would receive a higher priority among other FWS monitoring programs.

(2) Northwest Area Plan: The Southwest Seward Peninsula Subregion of the Northwest Area Plan includes the area adjacent to the lease sale area. This plan guides the management of all State lands--offshore and onshore--within its boundary. Although all State lands remain open for mineral entry, limitations have been established for mineral entry in the following instances: (1) prior to the sale of State lands; (2) on tidelands and uplands within 1/4 mi of six important seabird colonies, including Topkok Head and Bluff; and (3) within 1 mi of the mouths of anadromous fish streams and Safety Sound until information has been provided to establish that significant adverse effects to anadromous fish and their habitat can be avoided.

Guidelines in the Northwest Area Plan were designed to be consistent with the ACMP statewide standards and appropriate district policies. Any activity or use that would conform with the ACMP standards and policies would be permissible under the Northwest Area Plan.

c. Alaska Coastal Management Program: Statewide standards of the ACMP that seem particularly relevant to activities assumed in this lease sale include those for habitats, especially offshore and wetland habitats; air, land, and water quality; coastal development; mining and mineral processing; and subsistence. As noted above, the framework for the analysis is based on the statewide standards; district policies are included under the standard to which the policy relates according to the Final Findings and Conclusions prepared for each district program by the Alaska Division of Governmental Coordination.

As noted in the introduction, this analysis is not a consistency determination pursuant to Section 307 (c)(1)(A) of the CZMA.

(1) Habitats (6 AAC 80.130): All habitats in the coastal zone "must be managed so as to maintain or enhance the biological, physical, and chemical characteristics of the habitat which contribute to its capacity to support living resources" (6 AAC 80.130[b]). The standard for offshore habitat requires that offshore areas "be managed as a fisheries conservation zone so as to maintain or enhance the State's sport, commercial, and subsistence fishery" (6 AAC 80.130[c][1]).

Activities that accompany offshore dredging involve severe modifications of benthic habitat. Habitat is altered by both dredging and sedimentation. It is not possible to say if or when benthic communities would recover from this alteration of offshore habitat (Sec. IV.B.3). The monitoring program is expected to preclude MAJOR effects; however, MODERATE long-term effects on red king crab could occur (Sec. IV.B.3). This in turn could lead to MODERATE effects on the commercial red king crab fishery and a lesser effect on the subsistence fishery (Sec. IV.B.9 and 10). These effects could lead to MODERATE levels of conflict with the statewide standard for offshore habitat.

Mining also could affect the offshore habitat by resuspending trace metals from the substrate. However, the monitoring program should identify these problems so that bird populations and the commercial and subsistence king crab fisheries are not seriously impaired. Monitoring for resuspended trace metals should preclude long-term reduction of the local arctic peregrine falcon population (Sec. IV.B.7). As a result, no conflict should occur with either the ACMP statewide standard for all habitats or the BSCMP habitat policy that prohibits "significant impacts to the habitats or populations of the...peregrine falcon, or other designated endangered species..." (BSCMP, B-21).

Offshore habitat would be affected if a fuel spill occurred. The most serious effects would be to spawning fish, eggs, larvae, and smolts in the event of a nearshore spill. In addition to a MODERATE effect on fishes, fuel-oil spills could have a MODERATE effect on commercial fishing for herring and salmon (Sec. IV.B.3 and 9). Long-term effects on birds and bird habitat are not expected as a result of a fuel spill (Sec. IV.B.5).

The BSCMP offshore habitat policy (BSCMP B-3) does not limit offshore management to commercial, sport, and subsistence fisheries; it also includes all offshore subsistence harvests. Levels of effects noted in Section IV.B.10 for the subsistence harvests of seal and walrus reflect the benefits of an effective monitoring program. No conflict with the BSCMP policy is expected.

Noise and disturbance are addressed in two other policies of the BSCMP. These policies establish buffer zones to protect marine mammal haulouts and seabird colonies from development, activities that have high levels of visual or acoustical disturbance, and aircraft flights (BSCMP B-18 and B-19). As noted previously, marine mammals could experience MINOR effects as a result of noise and disturbance associated with air and vessel traffic. Air traffic would be the primary source of noise and disturbance that could affect nesting seabird colonies and waterfowl and shorebird-molting and -feeding concentrations along the coast. Direct flights to the dredge from Nome are not expected to affect the shorebirds significantly. However, flights over the spit of Safety Sound and other coastal wetlands could lead to disturbances that would affect some birds and have a MINOR effect (See Sec. IV.B.5). Noise from the dredging operations would be continuous and could displace some seals and walruses within the vicinity of the dredge and mask the lower frequency sounds of walruses and some bearded seals. These effects would be MINOR for these populations (see Sec. IV.B.6). Thus, noise and disturbance should not lead to significant conflicts with BSCMP policies on noise and disturbance.

Wetland habitat "must be managed so as to assure adequate water flow, nutrients, and oxygen levels and avoid adverse effects on natural drainage patterns, the destruction of important habitat, and the discharge of toxic substances" (6 AAC 80.130[c][3]). The wetlands around Safety Sound have a 32-percent chance of being oiled should fuel from a damaged gold dredge be released (Sec. IV.B.5). However, the indirect effects of habitat pollution on marine and coastal birds are not likely to persist for more than one generation (Sec. IV.B.5) and, as such, are not likely to lead to conflict with the ACMP statewide standards for all habitats and wetlands. Uses and activities in the coastal zone that will not conform with habitat standards may be allowed if "(1) there is a significant public need for the proposed use or activity; (2) there is no feasible prudent alternative to meet the public need for the proposed use or activity which would conform to the standards...; and (3) all feasible and prudent steps to maximize conformance with the standards...will be taken" (6 AAC 80.030[d]). The State has employed these exceptions in the past to allow activities to proceed (State of Alaska, OMB, 1985). The monitoring program should insure that most of the effects resulting from trace-metal contamination are identified and timely remedial action is taken. Therefore, most conflicts with the statewide standard and district policies for habitat can be mitigated with the implementation of Stipulation Nos. 1 and 2. Even with these stipulations, however, effects of altering offshore habitat and accidentally spilling fuel could lead to MODERATE effects on

red king crab and fishes, respectively, and the commercial fishing of these resources; conflict with the State's habitat standard likewise could be MODERATE.

(2) Air, Land, and Water Quality (6 AAC 80.140): The statewide standard for this element of the ACMP incorporates "the statutes pertaining to and the regulations and procedures of the Alaska Department of Environmental Conservation [DEC] with respect to the protection of air, land, and water quality...into the Alaska Coastal Management Program and, as administered by that agency, [they] constitute the components of the coastal management program with respect to those purposes" (6 AAC 80.140). In addition, conservation of water quality in compliance with the Alaska Water Quality Standards is identified as a State concern in the Alaska Coastal Policy Council Resolution No. 13. The State has conditioned continued operation of the current offshore-mining operation upon the results of the monitoring program. Using BACT, activities associated with offshore mining assumed for this lease sale should conform with ACMP statewide standards for air quality.

Water-quality problems could occur, but EPA (USEPA, 1990d) considers that in this case and under NPDES discharge limitations the occasional exceedences of EPA acute criteria for copper would have negligible effect on LOCAL and REGIONAL water quality. Turbidity from dredging and potential fuel spills could have MINOR effects on water quality. Monitoring for possible exceedences of Federal and State water-quality criteria and standards should prevent potential conflict with the ACMP statewide standard for air, land, and water quality and the CPC resolution on uses of State concern. District policies reiterate and elaborate on the requirements of the statewide standard (e.g., NCMP 25.010 and BSCMP C-1 through C-4). As a result, monitoring also should preclude conflict with policies of the district programs.

(3) Coastal Development (6 AAC 80.040): The coastal development standard gives priority to water dependent uses and activities and requires that "the discharge of dredged ... material into coastal water must, at a minimum, comply with the standards contained in Parts 320-323, Title 33, Code of Federal Regulations" that were in effect in 1977 (6 AAC 80.040[b]). These regulations address the various types of activities that require U.S. Army Corps of Engineers (COE) permits issued under several sections of the Rivers and Harbors Act (most notably section 10), section 404 of the Clean Water Act, and section 103 of the Marine Protection, Research, Sanctuaries Act of 1972 and include policies and procedures applicable to those activities. COE permits cover actions within the waters of the United States (for permit purposes this is limited to the 3-mi Federal/State offshore boundary) and ocean dumping; COE permit authority does not apply to the deposition of tailings from a mining operation on the OCS.

The BSCMP contains additional policies related to the statewide standard for coastal development that could be relevant for offshore-mining activities (State of Alaska, OMB, 1987). Mitigation criteria have been enacted that provide sequential steps to be followed to mitigate potential impacts that cannot be avoided through timing or modifying locations (BSCMP, F-2 and F-7). Several mitigation measures are included in the proposal and should ensure that no conflict with these policies will occur. Other mitigation measures may be requested during subsequent reviews.

No onshore development within the BSCRSA is anticipated as a result of mining on the OCS. However, in the event that an operator were to choose that option, two additional policies in the BSCMP would guide the development and removal of the facility (BSCMP F-5 and F-9). Conflict with these policies is not inherent in the scenario. BSCMP policy F-12 is not project specific, but would have a bearing upon establishing State priorities for monitoring projects to ensure compliance with stipulations placed on permits. Again, conflict with this policy is not inherent in the scenario.

(4) Mining and Mineral Processing (6 AAC 80.110): "Mining and mineral processing in the coastal area must be regulated, designed, and conducted so as to be compatible with (1) the standards contained in this chapter, (2) adjacent uses and activities, (3) statewide and national needs, and (4) district programs" (6 AAC 80.110[a]). Compatibility of the assumed mining program that would follow this lease sale with the appropriate statewide standards of the ACMP are assessed throughout this section on coastal management. Compatibility with adjacent uses and activities is assessed under the habitat standard for offshore and the subsistence standard; in both instances the potential for conflicts is mitigated to a large extent as a result of the monitoring program and prohibition on the use of mercury that are both required with Stipulation Nos. 1 through 3. The following paragraphs assess potential conflicts with district policies related to offshore mining.

Nome's CMP contains two mining policies that are not restricted to specific sites within their coastal boundary. First, "mining shall not occur in commercial and subsistence fishing areas during the open fishing periods"

(NCMP 20.110[c][1]). Dredging by the Bima has been done during open water when some commercial and subsistence fishing normally would occur. However, dredging was restricted to areas outside the Nome CMP boundary and the City determined that the activity would be consistent if it conformed with the stipulations attached to the consistency determination and the National Pollutant Discharge Elimination System (NPDES) permit. Mitigation that is part of the proposal for this lease sale provides additional assurance for the City of Nome. A second policy enacted by the City of Nome requires that "dredge spoils ... be discharged on the seabed previously disturbed by the dredge as near to the sea bottom as possible" (NCMP 20.110[c][3]). This practice was to be followed by the Bima and is assumed for mining on the OCS. However, discharges in the 1988 and 1989 seasons have deviated from this practice in an effort to identify the best disposal technique for reducing turbidity.

The BSCMP contains several policies that would be relevant to offshore dredging. Policy G-8.1 of the BSCMP requires that the "extraction of ... recoverable minerals from the sea bottom in offshore areas ... avoid significant adverse impacts to important and essential habitats, commercial fishing activities, subsistence harvest activities, and navigation." Monitoring requirements associated with this proposal are intended to avoid these types of negative effects. BSCMP policy G-8.3 requires that "dredge spoils and processed materials associated with offshore mining for recoverable minerals shall be discharged on the sea bottom in the area from which they were extracted unless discharge in an approved offshore or onshore site would cause less impact to the environment, subsistence activities, and historic/cultural sites." Assumptions for this lease sale indicate that the spoils and processed materials are disposed of on the sea bottom in the area from which they were dredged. Although dredging discharges may have negative effects on the benthic environment, efforts to identify the preferred disposal technique are continuing in State waters. No other disposal sites have been identified, and the feasibility and desirability of disposing of the spoils elsewhere would need to be demonstrated clearly. It is possible that using other sites could be more detrimental. Potential conflict with this policy is not inherent but would need to be examined when a plan for mining is considered.

Policy G-8.4 of the BSCMP requires that "offshore mining and mineral processing activities shall avoid discharge of toxic substances (as defined in Department of Environmental Conservation regulations) in processing effluent in concentrations which exceed State or Federal water quality criteria at the boundary of an approved mixing zone, or, if no mixing zone has been approved, at the point of discharge. In areas where toxic substances occur naturally in bottom sediments, offshore mining activities shall not resuspend such toxic substances in the water column in excess of that allowed by water quality regulations or contribute to additional bioaccumulation of toxic substances in marine organisms or fish." Water-quality problems associated with discharges from the dredging activity are identified in Section IV.B.2 and are assessed in this section under the heading of Air, Land, and Water Quality. These analyses indicate it is likely that resuspension of potentially toxic substances, as identified in Section IV.B.2, would have no more than a negligible (USEPA, 1990d) effect on water quality. If exceedences occur, Stipulation No. 1 enables these exceedences to be identified in a timely way.

As noted in the analysis of habitat and subsistence policies and standards, including Stipulation Nos. 1 through 3 as part of the proposal avoids potential conflict with adjacent uses and activities--one element of the statewide standard for mining--and mitigates potential MAJOR effects to the offshore habitat. However, MODERATE levels of conflict with the offshore habitat standard remain. Another element of the statewide mining standard requires that district policies be accommodated. Some BSCMP policies for mining also can be mitigated with these stipulations, such as the discharge of toxic materials and proper deposition of dredged material. Potential conflict with the statewide standard of the ACMP for offshore habitat leads to potential conflict with the statewide standard for mining.

(5) Subsistence (6 AAC 80.120): The ACMP statewide standard requires that "districts and State agencies ... recognize and assure opportunities for subsistence usage of coastal areas and resources" (6 AAC 80.120[a]). Although effects on subsistence use of coastal resources are possible, monitoring should prevent severe restrictions on subsistence activities (see Sec. IV.B.10).

The second and third provisions of the ACMP statewide standard require districts to identify areas in which subsistence is the dominant use of coastal resources and to designate "after consultation with appropriate State agencies, Native corporations, and any other persons or groups, ... areas as subsistence zones in which subsistence uses and activities have priority over all nonsubsistence uses and activities" (6 AAC 80.120[b] and [c]). If this is done, "before a potentially conflicting use or activity may be authorized within [these areas]... a study of the possible adverse impacts of the proposed potentially conflicting use or activity upon subsistence usage must be conducted and appropriate safeguards to assure subsistence usage must be provided" (6 AAC 80.120[d]). The City of Nome identified the offshore area of its coastal zone as an area of primary subsistence value (NCMP

25.050). The City requires that a study, as required by the State, be undertaken before a potentially conflicting use or activity can be authorized. The City of Nome found that the offshore mining conducted by the Bima would be consistent with its CMP as long as the mining was in compliance with the NPDES permit and with the stipulations attached to the activity by the State of Alaska through its consistency determination. Activities associated with this sale will be subject to MMS stipulations as well as those of the NPDES. As a result, no conflict with this policy is anticipated.

The BSCRSA Board identified several sites in the vicinity of the lease-sale area as important use areas for subsistence purposes (among others). The Safety Sound Important Use Area extends offshore to the Federal/State boundary. Portions of this offshore area are adjacent to the sale area. The designation of the Safety Sound area as an important use area reflects its value for habitat, subsistence, mining activities, and historic sites. Effects in this area from activities following this lease sale relate primarily to those associated with a large loss of fuel oil from a dredge; MINOR effects also could result if aircraft disturb birds that concentrate in that area. Although habitat value could be reduced, the loss is not expected to have a notable effect on subsistence.

The Nome River drainage, Sledge Island, and the area from Rocky Point to Topkok Head--essentially between Cape Darby and Bluff (Fig. IV-1)--also were designated as important use areas in part because of habitat and subsistence values. In all areas, monitoring is expected to identify and subsequently limit the effects of trace metals on marine resources, thereby limiting the potential for subsistence harvests to be restricted as a result of high levels of mercury.

The BSCMP elaborates on the statewide subsistence standards in the designated subsistence-use areas by requiring that major projects, such as offshore mining, use not only existing information, but "project applicants shall collect data to provide adequate information for identification and mitigation of adverse impacts to subsistence resources and activities in important use areas..." (BSCMP, A-5). A second requirement in these areas is that all non-subsistence activities or uses "shall locate ... at alternative sites outside the identified areas. Where location in alternative sites is not feasible or prudent, uses and activities shall minimize adverse impacts to subsistence resources, subsistence activities, and coastal habitats" (BSCMP, A-4). Activities occurring on the OCS, by definition, will occur outside the important use areas. However, effects on subsistence activities within these areas are possible as a result of mining activities on the OCS.

The first policy of the BSCMP emphasizes the fundamental importance of subsistence to residents of the region. Policy A-1 states that "subsistence use of coastal lands and waters of the Bering Straits CRSA has traditionally been the primary and highest priority use of all lands and waters within the coastal management plan area; therefore, all other land/water uses and activities shall ensure that through careful planning, development, and operation of a resource extraction or development project, all steps will be taken to mitigate adverse impacts to subsistence resources and their use in accordance with policy F-2."

Although the BSCMP contains policies that promote growth that is consonant with the subsistence culture and the economy of the region, the concern for continued subsistence opportunities evident in the subsistence policies of the BSCMP indicates that potential effects on subsistence likely will be central to the review of the activities that are assumed to follow this lease sale. When actual site-specific development proposals are reviewed, it will become possible to determine the extent to which specific requirements for studies and mitigation measures to protect subsistence resources, habitats, and activities are needed. Overall, MINOR effects on subsistence may result from this lease sale and require some additional mitigating measures. However, conflict with the subsistence standard of the ACMP is expected to be MINOR.

(6) NCMP Policy on Community Growth: The City of Nome enacted additional policies to help the city cope with any great influx of people that could arrive as a result of a single-employment opportunity. The NCMP states that "any employer who intends to hire or transfer from outside Nome for such an activity a number of employees exceeding five percent of the Nome population in any one year must show that adequate housing for those employees will be available without causing the housing vacancy rate to fall below five percent" (NCMP 25.040[a]). Based on that same population criterion, an employer also must provide 18 months advance notice to the City or relevant local institution so that sufficient time is available to provide adequate facilities and services for the increased population (NCMP 25.040[c]).

In 1995 when dredging employment first reaches peak numbers, 5 percent of the no-sale population in Nome would be 212 people (see Tables C-1 and 2). This figure is far greater than the projected employment for

dredging associated with this lease sale of 77 full-time equivalent positions. Thus, no conflict with this policy should arise as a result of mining on the OCS.

**SUMMARY:** Dredging associated with this lease sale would lead to significant changes in the benthic environment, resuspend toxic trace metals, and create turbidity. Effects on water quality are not anticipated to have more than a negligible (USEPA, 1990d) effect; exceedences of water-quality standards or criteria for copper are anticipated but EPA expects this to have negligible (USEPA, 1990d) effects on LOCAL and REGIONAL water quality. These exceedences should be detected through the monitoring program and mining activities could be modified as necessary. However, effects on the benthic environment could have MODERATE effects on red-king crab and the commercial fishing of red-king crab even if monitoring detected potential effects and plans were modified. This outcome is expected to lead to MODERATE conflicts with the offshore habitat. Conflict with the habitat standard, in turn, would lead to a conflict with the statewide standard for mining.

**CONCLUSION (Effects on Land Use Plans and Coastal Management Programs):** MODERATE conflicts with the ACMP are expected to occur as a result of activities associated with this lease sale.

**CUMULATIVE EFFECTS:** Levels of effects in the cumulative cases for most biological resources (Secs. IV.B.3-7) increase from those of the proposal. All sections note that the likelihood of the potential effects identified for the proposal would be greater because of the increase in offshore dredging activity. As a result, the ACMP remains the program that will have the greatest influence on future activities. Effects identified in the cumulative analyses are not greater for each individual dredging operation, but rather the greater number of operations leads to greater potential for increases in trace metals and for spilled oil to reach the shoreline, and a larger area to be disturbed by dredging activity. This is reflected in higher levels of effects for many resources (invertebrates--including red king crab--and birds--including the endangered peregrine falcon) and uses of the resources (commercial fishing and subsistence). LOCAL water-quality effects also are higher. These higher levels of effects increase the potential for conflict with several statewide standards and district policies of the ACMP that were discussed with respect to the proposal. Among these are the statewide standards for overall and offshore habitat, water quality, mining and mineral processing, and subsistence; and BSCMP policies related to avoidance of adverse impacts from mining (BSCMP G-8.1), resuspension of toxic substances during offshore mining (BSCMP G-8.4), and to negative effects on peregrine falcons (BSCMP B-21). These conflicts are not attributable to individual projects, but rather to all projects viewed collectively. As a result, conflicts would not be apparent initially, but would arise during mining.

The statewide standard for historic, prehistoric, and archaeological resources is more applicable in the cumulative case than in the base case. Many developments in the cumulative case occur onshore where there is a long history of occupation and where many sites of importance are located. The standard for such resources requires that "districts and appropriate state agencies ... identify areas of the coast which are important to the study, understanding, or illustration of national, state, or local history or prehistory" (6 AAC 80.150). Both the NCMP and BSCMP identified such areas within their boundaries. However, unknown sites could be affected during mining operations. The ACMP statewide standard and the BSCMP policies provide guidance for developers that propose activities that could have the potential to adversely affect cultural resources. Although conflict with ACMP policies is not apparent at this point, the potential for disturbing cultural sites in the cumulative case is greater than it was for the proposal.

Effects from a fuel spill would not be greater. No additional loss of fuel oil from a dredge is assumed in the cumulative case, although there is greater potential for a nearshore-spill location.

**Summary:** In the cumulative case, MODERATE levels of effects on invertebrates (including red king crab), commercial fisheries, birds, and subsistence create the potential for MODERATE conflict with several statewide standards of the ACMP. Among these are the standards for overall, offshore, and wetland habitats, water quality, mining and mineral processing, and subsistence. Effects of dredging also could conflict with two elements of the BSCMP policy related to offshore mining--avoidance of adverse impacts and resuspension of toxic substances, and the BSCMP policy concerning peregrine falcons.

**Conclusion:** MODERATE conflicts with the ACMP are expected to occur as a result of activities included in the cumulative case.

**15. Effect on Human Health:**

a. Introduction: This analysis focuses on a potential increase in the bioaccumulation of mercury in the marine environment of the Nome area through an increase in the bioavailability of mercury that could occur as a result of offshore dredging associated with the proposed OCS Mining Program Norton Sound Lease Sale. Mercury is the only trace metal in Norton Sound that could pose a potentially serious health risk to the people of Nome through biomagnification in the food chain (see Secs. IV.B.3-6).

Although arsenic, copper and nickel levels had exceeded EPA criteria in association with previous dredge operations, these concentrations were greatly diluted 100 m beyond the dredge and were unlikely to significantly accumulate in the marine food chain or in human seafood sources (fish and marine mammals) in Norton Sound (see Secs. IV.B.5 and 6). Future dredging on State and Federal leases would be subject to strict NPDES permit requirements as discussed in Section IV.B.2. The effects of these trace metals on human health are expected to be NEGLIGIBLE.

b. Assumptions About the Proposal: The proposed dredging operation is very unlikely to cause an increase in the bioaccumulation of mercury for the following reasons: (1) Background levels of mercury in seawater in the Nome area are low (1.0 ppt; see Sec. IV.B.2.b) and typical of nonpolluted coastal waters (Crecelius, Apts, and Lasorsa, 1990); (2) background concentrations of mercury in undisturbed sediment samples taken offshore the Nome area are low (0.032-0.038 ppm in three sediment samples); (3) preliminary measurements of mercury levels in the seawater associated with the current dredging operation indicate there is only a slight increase of mercury (0.4 ppt) at the edge of the mixing zone (Crecelius, Apts, and Lasorsa, 1990; see Table IV-8), resulting in a total mercury level of 1.4 ppt which is below the EPA chronic criterion level (25 ppt; see Sec. IV.B.2); (4) mercury released into the water column from the discharged sediments is rapidly reabsorbed to the sediments which are dispersed and resettle to the seafloor; (5) the repartitioning of mercury in the sediments is not expected to be measurable in the food chain above background conditions; (6) present indications of mercury levels in subsistence food sources are unusually low for marine waters; (7) recent information indicates that present levels of methylmercury in Nome women of child-bearing age are below the 10 to 20 ppm hair-methylmercury range in which effects on prenatal and natal life could occur; and (8) the monitoring of proposed dredging operations under Stipulation No. 1 and the monitoring of mercury-hair levels in humans under Stipulation No. 3 are expected to be effective in preventing any significant increase in the bioaccumulation of mercury in the Nome environment and in the human population.

Under the monitoring and operations management program, the effects of benthic excavation, sediment deposition and trace-metal release (especially mercury) in the marine environment would be measured (Stipulation No. 1). The use and storage of mercury would be prohibited onboard the dredge (Stipulation No. 2); thus, preventing any accidental spillage of mercury. The acquisition of baseline mercury and arsenic levels in Nome area residents and the potential monitoring of these levels in sensitive individuals (women of child-bearing age with elevated mercury levels) under Stipulation No. 3 should prevent any serious health threat to prenatal life and young infants. Stipulation Nos. 1 and 2 are expected to limit or prevent significant increases in the bioaccumulation of mercury or other trace metals in the marine environment and in marine food sources of the people living in the Nome area.

c. Generic Discussion of the Effects of Methylmercury:

(1) Importance of Mercury as a Health Issue: Mercury, particularly methylmercury could have serious effects on prenatal life and on infants of women who consume large amounts of seafood. The potential effects of mercury on human health is an important issue under the proposal for the following reasons: (1) Previous monitoring reports on water chemistry of the current dredge operation had indicated much higher mercury levels (100 times greater than the recent accurate measurements (Crecelius, Apts, Lasorsa, 1990); (2) mercury is potentially very toxic and can biomagnify through the marine food chain as described above (see Secs. IV.B.3-6); (3) elevated inorganic mercury levels (1.3 ppm) were reported in beach sediments of the Norton Sound area (Nelson et al., 1975) and the disposal of metallic mercury in the environment has occurred in the Nome area over the past century in association with gold mining and processing and these metallic and inorganic mercury sources could be sources of increased methylmercury in the Nome area (see Secs.

IV.B.5. and 6); and (4) it is possible that some Nome residents have hair-methylmercury levels approaching or exceeding the 10 to 20 ppm range at which there is some risk to prenatal and natal life.



The basis for the risk to prenatal and natal life is as follows: The World Health Organization (WHO) met in June 1989 to establish new environmental health criteria for methylmercury. Of particular concern was a review of recent research documenting effects of prenatal exposure to methylmercury. The new environmental health criteria document (to be published in 1990) will state that occasional psychomotor retardation effects from prenatal exposure to methylmercury can be seen in infants and children whose mothers had mercury hair levels between 10 and 20 ppm (Clarkson, 1989, oral comm.).

Mercury is the only trace-metal that poses a risk to heavy consumers of seafood, especially in areas with high natural mercury levels (Bernard and Andreae, 1984). In recent years attention has been focused on mercury partly because of the mercury poisoning in Japan of residents who consumed fish and shellfish that had accumulated methylmercury ("Minimata disease") (Hellowell, 1988). About 8,000 people in Japan are known or suspected to have mercury poisoning (Nriagu, 1988). Other outbreaks of Minimata disease occurred in Iraq in late 1971 (Bakir et al., 1973) and in New Mexico in 1969 (Hinman, 1972). Attention also has been focused on mercury poisoning because of the discovery that inorganic mercury can be converted by microbial activity into the more toxic methylmercury. Mercury can enter humans through inhalation and/or ingestion through the air, water, food or soil (see Fig. IV-4).

(2) Potential Effects of Methylmercury: An increase in the bioaccumulation of mercury in marine organisms occurring in the Nome area could pose a serious health threat to prenatal life and young infants of some women living in the Nome area who consume large amounts of seafoods (such as fish and seals) during pregnancy.

Of all known trace metals, mercury is known to pose the most serious health risk to humans whether the source of the trace metal comes from human activities or from natural causes. Mercury (especially methylmercury) is the only trace metal that consistently biomagnifies in the food chain (Lindberg et al., 1987). This means that the concentration of mercury greatly increases when it is taken up in marine organisms such as fish and clams from the water or sediments and where it is then taken up into seals, birds, and humans that consume the fish and clams.

Prenatal Effects: The developing central nervous system is more sensitive to damage from methylmercury than the adult nervous system. Methylmercury is known to adversely affect the fetus if the mother is exposed during pregnancy (U.S. Dept. of Health and Human Services, 1978; Marsh et al., 1980). As evidenced in the outbreaks of methylmercury poisoning in Japan and Iraq, mothers exposed to high levels of mercury while pregnant had infants with cerebral palsy (which was indistinguishable from cerebral palsy caused by other factors), microcephaly, hyperreflexia, gross motor and mental impairment, blindness, and deafness (Choi et al., 1978; Marsh et al., 1977, and 1981).

A study done in Iraq of 84 infant-mother pairs revealed maternal hair levels of mercury from 0.4 to 640 ppm. Severe neurological deficits were observed in 5 children when peak maternal hair concentrations were between 165 and 320 ppm. The worst child was blind, deaf, unable to stand, walk, or talk. At mercury-hair levels below 180 ppm, the infants had minimal clinical neurological signs, but there was clear evidence of effects on psychomotor function, such as delayed walking or talking (Marsh et al., 1979). The evidence that such non-specific symptoms are caused by methylmercury is based on a statistical correlation of the frequency of these symptoms with methylmercury exposure and the absence of confounding factors. From the data, a statistical analysis was done to estimate a "threshold" of highest no-effect concentration. The statistical analysis revealed that incidence of psychomotor retardation rose above background levels with maternal hair levels during pregnancy above 10 to 20 ppm (Cox et al., in press; Marsh et al., 1987). These estimates are subject to considerable uncertainty due to the small number of infant-mother pairs. A further study of a fish eating population is being conducted by Tom Clarkson, David Marsh, and others at the University of Rochester medical school (a pilot study of 500 infant-mother pairs has just been completed, but the results are not yet available)

to more accurately determine the threshold level for mercury intake for pregnant women (Marsh, as cited in USDOJ, MMS, 1989).

Kjellstrom et al. (1986) also has demonstrated evidence of developmental delays in infants whose mothers had prenatal exposure to high levels of mercury. In a study of 11,000 new mothers and their infants, approximately 1,000 of these mothers had eaten fish more than three times a week. Of these mothers, 73 had hair mercury levels above 6 ppm. After 4 years, 31 of these children were located and given the Denver Development Test to assess the effects of methylmercury on their development. The data showed a small but statistically significant influence on the test results of children whose mother's hair averaged (during the entire pregnancy) above 10

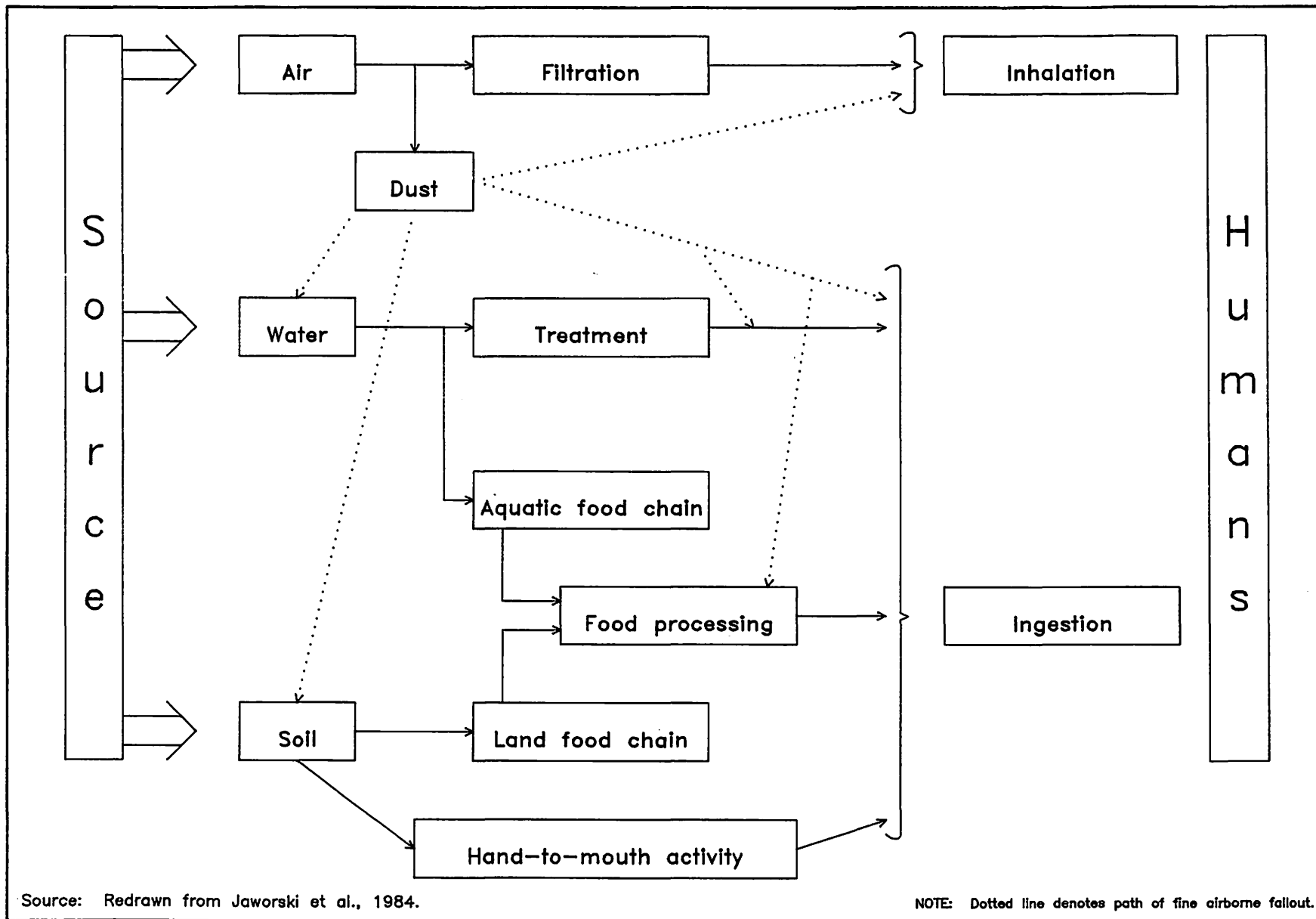


FIGURE IV-4. PATHWAYS OF METALS TO HUMANS

ppm of mercury. A study of methylmercury levels in the Cree Indians has been ongoing for 5 years since the development of a hydroelectric project in northern Quebec. In this predominantly fish eating population, the mean mercury level in their hair was 10 ppm in the early stages of the study. It is interesting to note that despite rising levels of methylmercury in the environment (from 0.5 ppm to 3 or 4 ppm in pike; 0.1 to 0.8 ppm in other fish), the mean level of mercury in humans decreased from 10 to 5 or 6 ppm in hair. This decrease in mercury was observed over a 9-month period, through analyses of hair (which grows at the rate of about 1 cm per month). The time period when the mercury levels decreased corresponded to when the Cree population became aware of the relationship between consumption of fish and mercury levels as well as the health concern associated with prenatal methylmercury exposure. From the Cree research it becomes clear the necessity for gathering consumption data in conjunction with levels of mercury in the resources and in the people in order to be able to clearly establish which variables have been changing (Kosatsky, 1989, oral comm.).

**Effects on Infants and Children:** Young children and infants are considered more sensitive to methylmercury consumption than adults. Bacteria in the intestinal tract of suckling mammals have a greatly diminished capacity to demethylate methylmercury; this apparently results in a greatly diminished excretion of mercury in suckling mammals. Excretion assumes an adult rate after weaning (Rowland et al., 1983); thus, more mercury is likely to be absorbed through the gut than is excreted in suckling mammals. This is expected also to occur in humans and may further elevate levels of mercury in infants. The gastrointestinal absorption rate for methylmercury is close to 100 percent and does not vary with age. In addition, food consumption and metabolic rate vary greatly with age, which tends to make children more vulnerable to high intakes of methylmercury. Kjellstrom (1987) demonstrated that this factor may account for twice as high hair-mercury levels among younger children as among older children.

(3) **Diagnosis of Mercury Poisoning:** Diagnosis of mercury poisoning is difficult. Currently, there are no known biochemical indicators of cellular distress associated exclusively with mercury poisoning. The clinical symptoms of acute poisoning in the general population are variable and unclear (Nriagu, 1988). One of the difficulties in diagnosing mercury poisoning is that the symptoms are very similar to other diseases such as Parkinson's disease. Blood and/or hair analyses are the best methods to determine levels of methylmercury exposure in humans. Methylmercury is incorporated into hair and provides a good index of exposure. The mean concentration of mercury in hair is 250 times greater than the mean-mercury concentration in the blood (Marsh, as cited in USDOJ, MMS, 1989); a mean blood-to-hair ratio of 300 is also sometimes cited in the literature (Sumari et al., 1972). There can be differences in the way in which mercury is absorbed in strands of hair; nevertheless, hair analysis provides historical information on exposure to mercury. With the average woman (because women's hair is usually longer than men's), 9 to 12 months of exposure to mercury can sometimes be analyzed. Head hair grows about 1.1 cm a month, and its segmental analysis proves to be a retrospective calendar of exposure to mercury (Marsh, as cited in MMS, 1988). Urinalysis should only be used for exposure to inorganic or elemental mercury because little methylmercury is excreted by this route (Elhassani, 1982).

d. Effect of Mercury in Nome:

(1) **Methylmercury Risk Assessment for Seafood Consumption:** Based on knowledge about Native lifestyles and dependence on subsistence resources (see Secs. IV.B.10 and 11) it was expected that high Native consumption of seafood is around 180 gm/day. This is based on the assumption that consumption of 180 gm/day is an amount equal to the average American consumption of total protein (equivalent to all of the red meat, poultry, fish, shellfish, and pork consumed [USDA, 1984 as cited in Pastorak, 1988]). The consumption of 180 gm/day of seafood (equivalent to 6 1/2 oz/day or about 11 meals per week of seafood [Pastorak, 1988]) may be low for some individuals such as elders or others who are accustomed to greater dependence on subsistence.

To determine an equivalent methylmercury action level (FDA action level) for high-seafood-subsistence users in Nome, the estimate of seafood consumption of 180 gm/day was used in the following equation adapted from Pastorak (1988) to determine the concentration of methylmercury allowed in seafood (the action level):

$$\frac{\text{MeHg Dose (mg/kg or ppm)}}{\text{Consumption Rate}} = \text{Concentrations of MeHg allowed in Seafood (i.e., equivalent (i.e., equivalent FDA action level))}$$

This equation assumes 100% absorption of MeHg.

Table IV-12  
Methylmercury-Risk Assessment for Consumption  
of Seafood

Concentration of Methylmercury in Seafood (mg/kg or ppm wet wt.) <sup>1/</sup>	Contact/ Consumption Rate (g/day) <sup>2/</sup>	Dose (mg/day) <sup>3</sup>	Predicted Mercury Levels in Hair (ppm)
0.77 7.7	6.5 <sup>4/</sup> 6.5 <sup>4/</sup>	0.005 0.05	1 10 <sup>5/</sup>
4.6 46.2	6.5 <sup>4/</sup> 6.5 <sup>4/</sup>	0.03 0.3	6 <sup>6/</sup> 60 <sup>7/</sup>
0.25 2.5 <sup>9/</sup>	20 <sup>8/</sup> 20 <sup>8/</sup>	0.005 0.05	1 10
1.50 <sup>10/</sup> 15.0	20 <sup>8/</sup> 20 <sup>8/</sup>	0.03 0.3	6 60
0.125 1.25 <sup>12/</sup>	40 <sup>11/</sup> 40 <sup>11/</sup>	0.005 0.05	1 10
0.75 7.5	40 <sup>11/</sup> 40 <sup>11/</sup>	0.03 0.3	6 60
0.03 0.28 <sup>14/</sup>	180 <sup>13/</sup> 180 <sup>13/</sup>	0.005 0.05	1 10
0.17 1.67	180 <sup>13/</sup> 180 <sup>13/</sup>	0.03 0.3	6 60

Source: Pastorak, 1988; MMS, Alaska OCS Region.

- <sup>1/</sup> Concentration of methylmercury in seafood (mg/kg = ppm by mass, wet weight). This value is obtained by dividing the dose (MeHg mg/kg or ppm) by the contact/ consumption rate listed as g/day but converted to mg/day). Estimated recommended action level for total mercury in fish and shellfish equivalent to the FDA action level.
- <sup>2/</sup> Amount of seafood ingested per day, assuming 100-percent absorption efficiency of MeHg.
- <sup>3/</sup> Effective ingested dose of methylmercury for humans based on averaged body weight of 70 kg over a 70-year lifetime.
- <sup>4/</sup> 6.5 g/day represents an estimate of average consumption of fish and shellfish from estuarine and fresh waters by the U.S. population (USEPA, 1980).
- <sup>5/</sup> The WHO has set 10 to 20 ppm as the level at which developing fetuses begin to show low-level effects from methylmercury exposure.
- <sup>6/</sup> The FDA action level is set so that no more than 0.03 mg are in taken per day by a man weighing 70 kg. This corresponds to 6 ppm methylmercury in hair (Sumari et al., 1972). This level is set as a safety factor of 1/10 of 0.3 mg.
- <sup>7/</sup> The WHO has set 0.3 mg ingested per day by a 70 kg male over a 70 year life-time as the amount of methylmercury which would cause the lowest level of methylmercury effects in adults. This level corresponds to 60 ppm in hair (Sumari et. al., 1972).
- <sup>8/</sup> 20 g/day represents an estimate of the average consumption of fish and shellfish (about one meal per week) from marine, estuarine, and fresh waters by the U.S. population (USDA, 1984).
- <sup>9/</sup> Based on the calculations for risk assessment this (2.5 mg/kg or ppm) would be the recommended action level of total mercury in fish and shellfish for pregnant women consuming 20 grams (about 1 meal a week) of seafood a day.
- <sup>10/</sup> The FDA action level of methylmercury in fish has been set for the general or U.S. population at 1 ppm.
- <sup>11/</sup> 40 g/day represents consumption of approximately two meals of seafood per week of fish or shellfish.
- <sup>12/</sup> Based on the calculations for risk assessment, 1.25 mg/kg or ppm would be the recommended action level for total mercury in fish and shellfish for pregnant women consuming 40 grams of seafood a day.
- <sup>13/</sup> 180 g/day represents an estimate of average consumption (about 11 meals per week based on the assumption that some individuals would consume fish at a rate equal to the combined consumption of red meat, poultry, fish, and shellfish in the U.S. (EPA Risk Assessment Council assumption based on data from the USDA Nationwide Food Consumption Survey of 1977-1978).
- <sup>14/</sup> Based on calculations for risk assessment 0.28 mg/kg or ppm would be the recommended action level for total mercury in fish or shellfish for pregnant women consuming 180 grams of seafood a day.

Using this equation, Table IV-12 provides the methyl-mercury-risk assessment for various levels of seafood consumption--the footnotes define the parameters. Four different consumption rates of seafood are used to assess the allowable methylmercury concentration in seafood. The calculations were done four times for each level of food consumption. The first calculation shows the amount of methylmercury (0.77 ppm) equivalent to 1 ppm methylmercury in hair. The second calculation shows the methylmercury concentration (7.7 ppm) equivalent to 10 ppm in the hair. The third calculation shows the allowable concentration of methylmercury in seafood times the consumption rate of seafood in order not to exceed the dose of 0.03 mg/day (the ADI of methylmercury set as the amount that allows no more than the safety level of 20 ppb methylmercury in blood or 6 ppm in hair). The fourth calculation uses the dose of 0.3 mg/day (the ADI of methylmercury set as the amount that allows no more than 60 ppm methylmercury in hair or 200 ppb in blood). The four consumption rates used in the equation are: (1) 6.5 g/day which is the estimate of average consumption of fish and shellfish from estuarine and fresh waters by the U.S. population (USEPA, 1980); (2) 20 g/day (equivalent to about one meal per week of fish or shellfish) which is an estimate of the average consumption of fish and shellfish from marine, estuarine, and fresh waters by the U.S. population (USDA, 1984); and (3) 180 g/day (equivalent to about 11 meals of seafood per week) which is an estimate of the average consumption of some Nome Native residents based on the assumption that some individuals would consume fish at a rate equal to the combined consumption of red meat, poultry, fish, and shellfish in the U.S. (EPA Fish Assessment Council assumption based on data from the USDA Nationwide Food and Consumption Survey of 1977-1978). It is assumed that today in Nome no one relies totally on subsistence resources because of the availability of other foods.

From the above assumptions on consumption, it was determined that 0.28 ppm would be the action level for methylmercury for pregnant women of Nome consuming 180 gm/day--equivalent to the FDA action level of 1.0 ppm for the general U.S. population (see Table IV-12). Applying a safety factor that would not allow mercury levels to exceed 6 ppm in hair (considered by the FDA to be the amount of mercury that would not allow the dosage of mg/day to exceed 0.03 ppm), the action level for consumers of 180 g/day of seafood could be as low as 0.17 ppm methylmercury. For a level of 10 ppm in hair (the level set by WHO as the lowest level producing effects to developing fetuses), the concentration of methylmercury in seafood for consumers of 180 g/day is 0.28 ppm.

(2) Background Mercury Levels in the Food Chain and Nome Residents: In the Nome area, the total highest mercury levels in liver tissue in bearded and spotted seals were reported as 2.3 ppm wet weight (Rusanowski et al., 1987). Although only 3 seals were collected, this level is low compared to liver tissue levels found in seals in the Arctic (see Section IV.B.6.). Almost all the mercury in seal liver is inorganic, far less toxic than methylmercury and probably posing little health risk. Mercury levels found in seal muscle were generally less than 0.1 ppm (Rusanowski et al., 1987). Mercury levels found in fish of Norton Sound were also low; 0.01 ppm in saffron cod, 0.02 ppm in least cisco, and 0.03 ppm in king crab wet weights (Rusanowski et al., 1987). These levels in fish and shellfish are from a limited data set; however, they are within the lower range of the concentration allowed for methylmercury in seafood for consumption of 180 g/day (0.28 to 0.17 ppm; see Table IV-12).

Results of a MMS funded study of methylmercury in hair of Nome women of child-bearing age are summarized as follows: A sample of 200 Nome women of child-bearing age (out of a population of 900 women) were measured for methylmercury exposure through analysis of individual hair samples from each woman. The laboratory results showed an average of about 1 ppm methylmercury in the hair, with the highest value at 8 ppm and the second highest value at 6.2 ppm (Crecelius, Apts, and Lasorsa, 1990). Only 1 percent of the sample approached the fetal-risk-exposure value of 10 to 20 ppm methylmercury.

These results are extremely low for a coastal human population that are expected to consume a high amount of seafood that naturally contains methylmercury (Marsh, 1989, oral comm.). The average methylmercury levels measured in hair and the hair-mercury equivalent calculated from the measured blood levels from Yukon-Kuskokwim Delta Native women and Native women living in Anchorage were 4.4 to 8.4 and 2.2 to 4.0, respectively, or 2 to more than 8 times higher than the mean level in the Nome sample (Sec. III-D, Table III-18). The Nome study of hair-mercury levels was much lower than expected based on the methylmercury risk assessment (Table IV-12). This would indicate that either the levels of methylmercury in the seafood are low, the consumption of seafood is low, or a combination of the two. Existing data on mercury levels in marine-subsistence foods are low (for example 0.01 ppm in saffron cod; Rusanowski, Gardner, and Jewett, 1987) and levels in the food chain are likely to be low (see Sec. IV.B.3 and 4) indicating that mercury levels are very unlikely to increase in seafood consumed by the Nome population such that hair-mercury levels would exceed 10 ppm even for the 1 percent of the population (8 ppm as indicated in the above study) that had the highest exposure index.

(3) Effect of Offshore Dredging: The chemical and biological monitoring of dredging operations including the measurement of mercury levels in the water and in indicator marine species under Stipulation No. 1. and the monitoring of mercury levels in women of childbearing age (Stipulation No. 3) is very likely to prevent any increase in the exposure of prenatal and natal life in the Nome area to methylmercury that might be associated with the proposed dredging operations.

A follow-up study to sample that portion of the population of Nome women of child-bearing age known to consume high levels of seafood, including segmental analysis of the hair samples to measure seasonal variation in mercury exposure, is necessary to verify and accurately determine the baseline exposure of Nome women with a potential fetal exposure to methylmercury. If hair levels are high (>10 ppm) a detailed dietary survey of the daily and weekly amounts of seafood consumed by these women is necessary in order to compare methylmercury exposure with seafood consumption. Nome women that might have hair-mercury levels above the 10 ppm threshold at which some risk of neural damage to the fetus and new-born is present, should be advised to reduce their seafood consumption somewhat during pregnancy and during breast feeding of the infant in order to minimize any methylmercury risk to the child.

The recommendation of the Human Health Session at the November 1989 MMS Workshop in regard to Stipulation No. 3 was that baseline and monitoring studies on mercury levels in humans be included in an Environmental Baseline/Monitoring Program in support of the OCS Mining Program for the Norton Sound Lease Sale.

Recent data on water chemistry mercury levels in Norton Sound including measurements taken near current dredging indicate that mercury levels in the water do not exceed the EPA chronic criteria standard (Sec. IV.B.2). This recent finding indicates that there would not be any significant increase in mercury bioaccumulation in the food chain or in residents of the Nome area associated with the proposal even if the mercury-hair levels in Nome women were higher than reported (such as an average of about 4 to 8 ppm found in Yukon-Kuskokwim Delta Native women). Similar low mercury levels are expected to be measured in the water when dredging occurs in Federal OCS waters under the proposal. The effect of mercury on human health is expected to be NEGLIGIBLE.

SUMMARY: This analysis focused on the potential increase in the bioaccumulation of mercury in the marine environment of the Nome area that could be associated with the proposed offshore dredging operations. Mercury is the only trace metal in Norton Sound that could pose a potentially serious health risk to the people of Nome (prenatal and natal life) through bioaccumulation in the food chain. Although arsenic, copper, and nickel levels had exceeded EPA criteria in association with previous dredging on State leases, these concentrations are greatly diluted 100 m beyond the dredge and were unlikely to significantly bioaccumulate in the marine food chain or in human seafood sources such as fish and marine mammals (see Secs. IV.B.4 and 5). Future dredging on State and Federal leases would be subject to strict NPDES permit requirements as discussed in Section IV.B.2. The effects of these trace metals on human health are expected to be NEGLIGIBLE.

The potential effects of mercury on human health was an important issue under the proposal for the following reasons: (1) Previous monitoring reports on water chemistry of the current dredging had indicated mercury levels were above EPA criteria and 100 times greater than the recent accurate measurements (Crecelius, Apts, and Lasorsa, 1990); (2) mercury, especially methylmercury, is very toxic and can biomagnify through the marine food chain (see Secs. IV.B.3-6); (3) elevated natural inorganic mercury in beach sediments (1.3 ppm) and metallic mercury contamination in association with past onshore gold mining and processing as well as natural mercury in offshore sediments are mercury sources from which dredging could increase the methylation of mercury and its biomagnification in the food chain; and (4) some Nome residents may have hair-mercury levels approaching or exceeding the 10 to 20 ppm range at which there is some risk to prenatal and natal life.

Based on knowledge about Native lifestyles and dependence on seafood (fish and marine mammals) as subsistence resources of coastal Norton Sound communities it was estimated that high Native consumption of seafood is about 180 g/day. Using this estimated high-seafood-consumption rate, the FDA action level for allowed methylmercury concentration in seafood was estimated to be 0.28 ppm (see Table IV-12). Applying a safety factor that would not allow mercury levels to exceed 6 ppm in hair (considered by FDA to be the amount of mercury that would not allow the dosage of mg/day to exceed 0.03 ppm), the action level for consumers of 180 g/day of seafood could be as low as 0.17 ppm methylmercury. However, for a level of 10 ppm in hair (the

level set by WHO as the lowest level producing effects of developing fetuses), the concentration in seafood for consumers of 180 g/day is 0.28 ppm.

It is not likely that levels of methylmercury attributed to the proposed action would be high enough to threaten human health because: (1) the background levels of mercury in seawater in the Nome area are low (1.0 ppt; see Sec. IV.B.2.b) typical of nonpolluted coastal water (Crecelius, Apts, and Lasorsa, 1990); (2) background concentrations of mercury in undisturbed sediment samples taken offshore the Nome area are low (0.032-0.038 ppm in three sediment samples); (3) preliminary measurements of mercury levels in the seawater associated with the current dredging operation indicate there is only a slight increase of mercury (0.4 ppt) at the edge of the mixing zone (Crecelius, Apts, and Lasorsa, 1990; see Table IV-8) resulting in a total mercury level of 1.4 ppt which is below the EPA chronic criterion level (25 ppt; see Sec. IV.B.2); (4) mercury released into the water column from the discharged sediments is not expected to be measurable in the food chain above background conditions; (5) present indications of mercury levels in subsistence food sources are unusually low for marine waters; and (6) recent information indicates that present levels of methylmercury in Nome women of child-bearing age are below the 10 to 20 ppm hair-methylmercury range in which effects on prenatal and natal life could occur. A follow-up study is being planned to verify these low concentrations of methylmercury in the hair of Nome women of child-bearing age known to consume high amounts of seafood. In addition, with the monitoring of dredge operations, including mercury levels in the water and in indicator marine species under Stipulation No. 1 and the monitoring of mercury levels in women of child-bearing age (Stipulation No. 3), no increase is expected in the exposure of prenatal and natal life in the Nome area to methylmercury that might be associated with the proposed dredging operations. The effect of the proposal on human health is expected to be NEGLIGIBLE.

**CONCLUSION (Effect on Human Health):** The effect of the proposed OCS Mining Program Norton Sound Lease Sale on human health is expected to be NEGLIGIBLE.

**CUMULATIVE EFFECTS:** Cumulative effects on human health in Nome include the effects of the proposal and other past, present, and reasonably foreseeable future actions in the Norton Sound area that might increase human exposure to mercury and other trace metals (see Sec. IV.A.3 for a list of ongoing and planned projects and their scenarios and timetables). Projects and activities in the cumulative case include State offshore mining for gold on 8,802 hectares of offshore leases, onshore mining primarily for gold or tin at the Lost River Mine and the Bornite Prospect, as well as gold prospecting near Nome, and harbor dredging offshore of the Snake River. Some mercury and arsenic levels in the soil, water, and atmosphere in the Nome area from the old and new Gold House, Dry Creek, and from Dredges 4 and 5 are elevated (see Sec. III.D for the description). Effects from State offshore mining for gold on human health could occur from the repartitioning of mercury and other trace metals into the environment to levels of concern to human health, as discussed under the proposal. State offshore mining might increase the bioaccumulation of mercury causing higher levels of mercury to occur in some local marine mammals, marine and coastal birds, fish, and shellfish. Other mining projects, while alone are not expected to have a significant effect on human health, are contributing to the overall mercury and arsenic levels in the Nome environment. Activities associated with the development of the Norton Sound Oil and Gas Lease Sale 57 should not affect human health.

The dredging activity in the cumulative case would increase the area of sea bottom disturbed and could increase the concentration levels of mercury and other trace metals in the water column. Potential increased bioaccumulation of mercury in the cumulative case could cause higher levels of mercury to occur in some marine mammals, birds, fish, and shellfish. This increase is not expected to be enough to greatly increase the level of biological effects on any wildlife populations in the cumulative case (see Secs. IV.B.3-6). A significant effect on human health as a result of mercury bioaccumulation in seafoods is possible if additional dredging greatly increased mercury levels in marine-subsistence resources (seafood) and, consequently, increased the existing levels of mercury in some pregnant women--who might already be at or near threshold levels. However, existing data on low mercury levels in subsistence foods (<0.1 ppm in fish and 2.3 ppm in seal liver) indicate that the risk of significant bioaccumulation is low. The results of the study on mercury-hair levels by Crecelius, Apts, and Lasorsa (1990) indicate that the risks to fetuses and newborns of Nome women are very low (average <1 ppm mercury-hair level) in general--although a small number perhaps 1 percent or less (8 ppm mercury-hair level)--could be at some risk if mercury levels in fish and marine mammals were to increase significantly. Such an increase in mercury bioaccumulation is not likely due to the present low levels of mercury (1-2 ppt) reported in the water in association with current dredging (Crecelius, Apts, and Lasorsa, 1990). Although, no increase in mercury-hair levels in Nome women nor any increase in exposure to fetuses or newborns or to the Nome population in general is expected to occur, there were levels of 8.0 and 6.2 ppm methylmercury in 2 out of a sample of 200 women (see Sec. IV.B.15.d.2)--a MODERATE effect.



**In summary, cumulative mining activities in the Nome area have contributed to the mercury levels in the environment; however, mercury levels in the water associated with current dredging are low, and mercury levels in the food chain are generally low. Thus, no significant bioaccumulation of mercury is apparent. Hair-mercury levels in Nome women indicate that the risk of methylmercury exposure to prenatal and natal life is low, although some fetuses and newborns maybe at risk. Based on existing information, cumulative effects on human health are expected to be MODERATE.**

**Conclusion: The cumulative effect on human health is expected to be MODERATE.**

#### **IV.C. Alternative II - No Lease Sale**

Under the no sale alternative, the effects on resources as described in the proposal (Alternative I) would not occur. The remaining cumulative effects are assumed to continue, minus those attributable to the proposed action, and are indicated below.

1. **Effect on Air Quality:** There would be no degradation of onshore air quality from the proposed lease sale under this alternative. A discussion of the cumulative case in Section IV.B.1.b demonstrates that most air-quality degradation would be from activities in State waters. Effects of the cumulative case on onshore air quality without the Norton Sound Lease Sale are therefore expected to be MINOR in accordance with the analysis of cumulative effects.

2. **Effect on Water Quality:** There would be no degradation of water quality from the proposed lease sale under this alternative. Ambient trace-metal concentrations in northwestern Norton Sound meet Federal criteria except downcurrent of the Bima during active dredging. In the remaining cumulative case without the Norton Sound Lease Sale, Norton Sound would still contain three gold dredges and one harbor dredge in State waters. A fuel spill from one of these dredges would be a MINOR LOCAL and REGIONAL effect on water quality. The single gold dredge that has worked in State waters already has exceeded Federal criteria or EPA permit restrictions for turbidity, copper, lead, and nickel. Future mining activity will be required to more closely control mining discharges. The EPA (USEPA, 1990a) recently reissued an NPDES permit for the Westgold Bima which provides for twofold-reduced discharge limitations for trace metals. The EPA (USEPA, 1990b,d) believes that operating conditions for future mining can be maintained that would "reduce trace metal concentrations to acceptable levels at the edge of the mixing zone." However, based on the trace-metal concentrations observed by Crecelius, Apts, and Lasorsa (1990)--as analyzed for the cumulative case with the proposal--this EIS still projects that each of the three dredges would exceed trace-metal and turbidity criteria and, in particular, the acute copper criterion, for a MAJOR effect on the LOCAL water quality around each dredge. Because the acute criterion for copper is exceeded, the overall effect of the cumulative case with Alternative II would be MAJOR on LOCAL cumulative water quality and because of the assumed fuel spillage, MINOR for REGIONAL cumulative water quality.

3. **Effect on Marine Plants and Invertebrates and Red King Crab:** There would be no adverse effects from the proposal on marine plants and invertebrates, including red king crab, as a result of this alternative. Dredging activities in State waters are expected to have less potential to cause effects on red king crabs than would activities in Federal waters, due to the differing concentrations of crabs by age and sex in the two areas (see Sec. III.B.1). The effect on red king crab is expected to be MINOR. In general, habitat alteration effects on other marine plants and invertebrates are expected to be MODERATE for organisms in State waters, due to the expected long-lasting effects of habitat alteration. Overall, effects of the remaining cumulative case without the Norton Sound Lease Sale on red king crab are expected to be MINOR, and effects on other marine plants and invertebrates are expected to be MODERATE.

4. **Effect on Fishes:** There would be no adverse effects on fishes from the proposed lease sale under this alternative. Effects of the remaining cumulative case on fishes without the Norton Sound Lease Sale are expected to be MAJOR. This MAJOR effect results from subsistence fishing of salmon stocks in the Nome River. More details of the analysis of effects are presented in Section IV.B.4.

The cumulative effects of Alternative II on migratory fish species are expected to be similar to the cumulative effects on migratory fishes associated with the proposal (Alternative I)--MAJOR.

5. **Effect on Marine and Coastal Birds:** There would be no adverse effects on marine and coastal birds from the proposed lease sale under this alternative. Remaining cumulative effects without the Norton Sound Lease Sale are expected to be MODERATE as a result of resuspension and bioaccumulation of mercury and/or from habitat alteration from dredging activity in State waters and onshore mining activities. Refer to Section IV.B.5 for more detail regarding cumulative factors that may affect marine and coastal birds.

The cumulative effects of the no sale (Alternative II) on migratory marine and coastal birds are expected to be the same as those cumulative effects associated with the proposal (Alternative I)--MAJOR on migratory waterfowl due primarily to loss of wetlands from other development on their winter ranges and MODERATE on migratory seabirds due to bird mortality from oil spills and commercial fishing nets (see Sec. IV.B.5).

6. **Effect on Nonendangered Marine Mammals:** There would be no adverse effects on nonendangered marine mammals from the proposed lease sale under this alternative. Remaining cumulative effects without the Norton Sound Lease Sale would remain MINOR as a result of noise and disturbance from dredging activity in State waters. Refer to Section IV.B.6 for more detail regarding cumulative factors that may affect marine mammals.

The cumulative effects of the no sale (Alternative II) on migratory species of nonendangered marine mammals are expected to be the same as described under the proposal, MODERATE.

7. **Effect on Endangered and Threatened Species:** There would be no adverse effects on endangered or threatened species from the proposed lease sale under this alternative. Remaining cumulative effects without the Norton Sound Lease Sale are expected to be MINOR for the arctic peregrine falcon and the gray whale primarily as a result of noise and disturbance from mining activities in State waters. Refer to Section IV.B.7 for more detail regarding cumulative effects that may result from other sources.

The cumulative effects of Alternative II (No Sale) on migratory endangered and threatened species are expected to be similar to the cumulative effects on migratory endangered and threatened species associated with the proposal (Alternative I)--MINOR for the gray whale and for the arctic peregrine falcon.

8. **Effect on the Economy of Nome:** There would be no effects on the economy of Nome from the proposed lease sale under this alternative. In the absence of the Norton Sound Lease Sale, remaining cumulative effects on the economy of Nome are expected to be MODERATE due to onshore and offshore mining activities.

9. **Effect on Commercial Fisheries:** There would be no adverse effects on commercial fisheries from the proposed lease sale under this alternative. In the absence of the Norton Sound Lease Sale, remaining cumulative effects on commercial fisheries are expected to be MODERATE as a result of offshore gold dredging activities in State waters.

The cumulative effects of Alternative II on commercial salmon and herring fisheries are expected to be similar to the cumulative effects on commercial salmon and herring fisheries associated with the proposal (Alternative I)--MODERATE.

10. **Effect on Subsistence-Harvest Patterns:** There would be no adverse effects on subsistence-harvest patterns from the proposed lease sale under this alternative. In the absence of the proposed Norton Sound Lease Sale, effects on subsistence-harvest patterns in Nome under this alternative are expected to be MODERATE as a result of offshore gold dredging activities in the State lease-sale area, onshore mining, harbor dredging on the Snake River, and effects from Norton Sound Oil and Gas Lease Sale 57. Effects on human health in the no sale case from offshore gold dredging in the lease sale area (see Sec. IV.C.14 for the analysis) could cause pregnant women to reduce consumption of some subsistence resources (see Sec. IV.B.15 for this analysis).

11. **Effect on Sociocultural Systems:** There would be no adverse effects on sociocultural systems from the proposed lease sale under this alternative. In the absence of the proposed Norton Sound Lease Sale, effects on sociocultural systems are expected to be MAJOR as a result of offshore dredging activities in the State lease-sale area, onshore mining activities, and the Norton Sound Oil and Gas Lease Sale 57. These activities are expected to cause MAJOR effects on sociocultural systems as a result of effects on subsistence-harvest patterns, population growth, and industrial activities which will alter the cultural values and social structure of Nome's Inupiat and Yup'ik populations.

12. **Effect on Archaeological Resources:** There would be no adverse effects on archaeological resources from the proposed lease sale under this alternative. The remaining cumulative effects under the No Sale Alternative on archaeological resources would be the same as for the proposal--MINOR.

13. **Effect on Recreation and Tourism:** There would be no adverse effects on recreation and tourism from the proposed lease sale under this alternative. The remaining cumulative effects under the No Sale Alternative on recreation and tourism resources would be the same as for the proposal--MINOR.

14. **Effect on Land Use and Coastal Management Programs:** There would be no adverse effects on land use plans and coastal management programs from the proposed lease sale under this alternative.

As noted in the cumulative analysis in Section IV.B.14, dredging on both State and Federal offshore leases could lead to conflict with several statewide standards and local policies of the ACMP. In the no-sale case, cumulative effects of dredging activities result from dredging only on State lands. Because State leases are in proximity to near-shore spawning areas and bird colonies and current activities have lead to exceedences in water-quality standards, potential conflict is the same as in the cumulative case of the proposal. Therefore, potential conflict with the ACMP would be MODERATE.

15. **Effect on Human Health:** There would be no adverse effects on human health from the proposed lease sale under this alternative. In the absence of the proposed Norton Sound Lease Sale, effects on human health in Nome under this alternative are expected to be MODERATE as a result of offshore gold dredging activities in the State lease-sale area (see Sec. IV.B.15).

#### **IV.D. Alternative III - Delay The Sale**

1. **Effect on Air Quality:** Air-pollutant emissions associated with this alternative would be the same as for the base case (Sec. IV.B.1). The effects on air quality relative to standards and the effects on the tundra and vegetation are expected to be no greater than NEGLIGIBLE.

**CONCLUSION:** The emissions of air pollutants would be the same for a delayed sale as for the proposal. The effects relative to air quality standards and other effects, including acidification of tundra, are expected to be NEGLIGIBLE.

**Cumulative Effects:** Delay of the sale would result in no change in the cumulative effects on air-quality standards and other effects of air pollution, which are expected to be MINOR.

2. **Effect on Water Quality:** The effects associated with this alternative would be essentially the same as those discussed for the proposal (Sec. IV.B.2). The RS/FO may have to order modification of operations to lessen the frequency and magnitude of turbidity and trace-metal concentrations that exceed Federal criteria. A major fuel spill could still occur. The 3-year delay, however, may allow for additional, improved monitoring of water quality and dredge discharges in State waters under the reissued WestGold Bima NPDES permit (USEPA, 1990a). The 3-year delay may also increase the operation record for offshore gold mining in Norton Sound, allowing a better evaluation of the likelihood and magnitude of potential fuel spills.

**CONCLUSION:** Alternative III would allow a more accurate estimate of water-quality effects which could result in more precise estimates of effects on water quality; however, based on current knowledge, the effects of this alternative are estimated to be MAJOR on LOCAL water quality as a result of copper concentrations above the acute criterion and MINOR on REGIONAL water quality as a result of the assumed fuel spill, the same as for the proposal.

**Cumulative Effects:** Delay of the sale would postpone a small portion of the cumulative effects, but because existing and assumed future State dredging activities have or are likely to exceed the EPA acute criteria for copper, the overall effect on LOCAL water quality would be MAJOR and the overall effect on REGIONAL water quality would be MINOR.

3. **Effect on Marine Plants and Invertebrates and Red King Crab:** Effects associated with this alternative could be the same as those discussed for the proposal (Sec. IV.B.3). Unavoidable adverse effects and the effects of additional mitigating measures also would be expected to be the same. Delaying the sale would provide additional time for ongoing research and perhaps additional studies to acquire data that would be useful in improving the accuracy and precision of the analysis of effects on water quality (see preceding discussion) and on marine plants and invertebrates. In particular, ongoing studies associated with dredging in State waters may indicate the extent of water-quality problems, whether trace-metal accumulation within organisms is occurring, and the degree to which it poses problems for organisms in the food web, including humans. Importantly, additional time afforded by the delay also may better indicate the extent of different habitats, habitat alteration, and sedimentation effects, and the degree and direction of recovery of communities in dredged areas. This would be especially significant for enabling effective monitoring and decisionmaking with respect to effects on red king crab habitat. In particular, information on the 30-meter trench area as a potential nursery area for red king crabs might be more easily obtained under this alternative.

**CONCLUSION:** Alternative III is likely to have the same effect on red king crab and other marine plants and invertebrates in Norton Sound as the proposal (MODERATE), but at a later date.

**Cumulative Effects:** Delaying the sale would postpone some of the potential cumulative effects on marine plants and invertebrates, including red king crab. Cumulative effects would be spread out over a longer time span and thus be reduced somewhat, but the level of effect to red king crab and other marine plants and invertebrates is not expected to be different than for the cumulative case associated with the proposal--MODERATE.

4. **Effect on Fishes:** Effects associated with this alternative could be the same as those discussed for the proposal (Sec. IV.B.4). Unavoidable adverse effects and the effects of additional mitigating measures also would be expected to be the same. Delaying the sale would provide more time for ongoing research, and perhaps additional studies to acquire data that would be useful in improving the accuracy and

precision of the analysis. In particular, improved data on water quality and habitats in the proposed sale area, as well as in areas affected by dredging activities in State waters, could affect the analysis.

**CONCLUSION:** Alternative III is likely to have the same effect on fishes in Norton Sound as the proposal, MODERATE.

**Cumulative Effects:** Delaying the sale would postpone some of the potential cumulative effects on fishes. Cumulative effects would be spread out over a longer time span and thus could be reduced somewhat, but the level of effect to fishes is not expected to be different than for the cumulative case associated with the proposal, MAJOR.

**Cumulative Effects on Migratory Species:** The cumulative effects of Alternative III on migratory fish species are expected to be similar to the cumulative effects on migratory fish species associated with the proposal (Alternative I)--MAJOR.

5. **Effect on Marine and Coastal Birds:** Effects associated with this alternative would be essentially the same, at least qualitatively, as those discussed for the proposal (Sec. IV.B.5). The magnitude of effects could vary, depending on the population status of affected bird species at the time the delay would terminate or when the undesirable effects would occur. Delay of the sale would provide additional time for ongoing research and monitoring to acquire data (particularly mercury levels in seabirds) useful in improving the accuracy and precision of effect prediction relative to marine and coastal birds.

**CONCLUSION:** Alternative III would delay potential effects of the proposal on marine and coastal birds; however, the proposal is likely to have MINOR effects on marine and coastal birds at a later date.

**Cumulative Effects:** Delay of the sale would postpone some of the potential cumulative habitat and some noise and disturbance effects on marine and coastal birds in Norton Basin, most notably mercury bioaccumulation from dredging in the Nome area; however, cumulative-spill risks from a fuel-oil spill and potential effects on marine and coastal birds in the northern Bering Sea would be about the same and could occur in the same timeframe as under the proposal. Overall, cumulative effects on marine and coastal birds would still be MODERATE.

**Cumulative Effects on Migratory Species:** The cumulative effects of Alternative III on migratory bird species are expected to be similar to the cumulative effects on migratory bird species associated with the proposal (Alternative I)--MAJOR.

6. **Effect on Nonendangered Marine Mammals:** Effects associated with this alternative would be essentially the same, at least qualitatively, as those discussed for the proposal (Sec. IV.B.6). The magnitude of effects could vary, depending on the population status of affected species at the time the delay would terminate or when the undesirable effects would occur. Delay of the sale would provide additional time for ongoing research and monitoring to acquire data (particularly mercury levels in marine mammals) useful in improving the accuracy and precision of effect prediction relative to marine mammals.

**CONCLUSION:** Alternative III would delay effects of the proposal on non-endangered marine mammals; however, the proposal is likely to have MINOR effects on nonendangered marine mammals at a later date.

**Cumulative Effects:** Delay of the sale would postpone some of the potential cumulative effects of habitat alteration and noise and disturbance on marine mammals in the Norton Sound Lease Sale area, most notably alteration of benthic feeding habitat and the loss of some local food sources of walrus and bearded seals in the Nome area. However, cumulative noise and disturbance and potential oil-spill effects on marine mammals in the northern Bering Sea would be about the same and could occur in the same timeframe as under the proposal. Overall cumulative effects on nonendangered marine mammals are likely to be MINOR, regardless of whether this sale is delayed or not.

**Cumulative Effects on Migratory Species:** The cumulative effects of Alternative III on migratory nonendangered marine mammals are expected to be similar to the cumulative effects on migratory nonendangered marine mammals associated with the proposal (Alternative I)--MODERATE.

7. **Effect on Endangered and Threatened Species:** Effects associated with this alternative would be essentially the same, at least qualitatively, as those discussed for the proposal (Sec. IV.B.1.e). The magnitude of effects could vary, depending on the population status of affected species when the delay ended,

or when the undesirable effects would occur. Delay of the sale would provide additional time for additional monitoring research to acquire data to improve the accuracy and precision of effects prediction. For example, studies and monitoring of the arctic peregrine falcon population and prey species could be conducted to determine baseline trace-metal-contamination possibilities and the overall population status.

**CONCLUSION:** Alternative III would delay the potential effect of the lease sale and would allow additional time for studies of trace-metal bioaccumulation (particularly mercury); however, upon termination of the delay, the effect of this alternative would likely be identical to that of the proposal: MINOR for the gray whale and the arctic peregrine falcon.

**Cumulative Effects:** Delay of the sale would postpone some potential cumulative effects on endangered species or would lessen these cumulative effects until termination of the delay. The delay would provide additional time to conduct studies and/or monitor trace-metal accumulation (particularly mercury) within various species within the food chain. Ultimately, however, upon termination of the delay, cumulative effects would be essentially the same as under the proposal: MINOR for the gray whale and the arctic peregrine falcon.

**Cumulative Effects on Migratory Species:** The cumulative effects of Alternative III on migratory endangered and threatened species are expected to be similar to the cumulative effects on migratory endangered and threatened species associated with the proposal (Alternative I)--MINOR.

8. **Effect on the Economy of Nome:** Delaying the sale 3 years has the same effect on the economy as the proposal, except that activity begins in 1994 rather than 1991 (see Sec. IV.B.8). Exploration activities would occur in the years 1994 through 1996, resulting in 2 FTE jobs for Nome residents. Production would begin in 1996 and continue through 2010. Employment in Nome during production would range from an average of 6-percent higher in the mean case to 10-percent greater in the high case than if the sale did not occur.

**CONCLUSION:** This alternative would have a MINOR effect on the Nome economy only at a later date.

**Cumulative Effects:** The cumulative effects under this alternative would be the same as discussed for the proposal, only the effects would be delayed 3 years. The cumulative projects in combination with the proposal are expected to have a MODERATE effect on the economy of Nome.

9. **Effect on Commercial Fisheries:** This alternative would result in the same effects as those discussed for the proposal (see Sec. IV.B.9). Delaying the sale 3 years would allow further study of the effects of the current dredging operations in State waters. Furthermore, it would allow time for studying red king crab, herring, and salmon and the habitat of these species. This could allow for development of a policy to mitigate any adverse effects dredging would have on the commercial fisheries.

**CONCLUSION:** This alternative would have the same effect (MODERATE) as discussed under the proposal, only at a later date.

**Cumulative Effects:** In the absence of a well formulated study of the area resulting in an appropriate policy, the cumulative-case effects would be the same as discussed for the proposal. That is, current mining operations in State waters in conjunction with the proposal would harm crab habitat and increase the levels of mercury in the water column. Cumulative offshore dredging projects are expected to have a MODERATE effect on commercial crab fishing.

**Cumulative Effects on Migratory Species:** The cumulative effects of Alternative III on migratory commercial salmon and herring fisheries are expected to be similar to the cumulative effects associated with the proposal (Alternative I) --MODERATE.

10. **Effect on Subsistence-Harvest Patterns:** The effect of Alternative III on subsistence-harvest patterns would be the same as described for the proposal, only delayed (see Sec. IV.B.10). Delaying the sale could provide additional information on background levels of mercury in the water column, wildlife, and the human population in the Nome area as well as provide better information on species abundance and availability. Such information also would allow for assessment of potential effects to be based on more studies rather than assumptions.

**CONCLUSION:** The effect of Alternative III on subsistence-harvest patterns is expected to be the same as for the proposal, MINOR, but delayed.



**Cumulative Effects:** The cumulative effects on subsistence-harvest patterns are expected to be the same as for the proposal, MODERATE, except for a postponement of effects resulting from the proposal.

11. **Effect on Sociocultural Systems:** The effect of Alternative III on sociocultural systems is expected to be the same as described for the proposal, MINOR, but delayed (see Sec. IV.B.11).

**CONCLUSION:** The effect of Alternative III on sociocultural systems is expected to be the same as for the proposal--MINOR.

**Cumulative Effects:** Delay of the sale would postpone the effect of the sale on sociocultural systems. However, MAJOR cumulative effects on Nome socio-cultural systems from dredging activities in the State sale area and from OCS oil and gas development in Norton Sound would still occur in the same time period. In the cumulative case, as a result of offshore dredging activities in the State lease-sale area, onshore mining activities, and the Norton Sound Oil and Gas Lease Sale 57, the effect of Alternative III on sociocultural systems is expected to be the same as for the proposal--MAJOR.

12. **Effect on Archaeological Resources:** The effect of Alternative III on archaeological resources would be the same as for the proposal (see Sec. IV.B.12) but delayed.

**CONCLUSION:** The effect of Alternative III on archaeological resources would be the same as for the proposal, NEGLIGIBLE, but delayed.

**Cumulative Effects:** The cumulative effects of Alternative III on archaeological resources would be the same as for the proposal, MINOR, but delayed.

13. **Effect on Recreation and Tourism:** The effect of Alternative III on recreation and tourism resources would be the same as for the proposal (see Sec. IV.B.13), MINOR, but delayed.

**CONCLUSION:** The effect of Alternative III on recreation and tourism resources would be the same as for the proposal, MINOR, but delayed.

**Cumulative Effects:** The cumulative effects of Alternative III on recreation and tourism resources would be the same as for the proposal, MINOR, but delayed.

14. **Effect on Land Use Plans and Coastal Management Programs:** Delaying the sale for 3 years provides a window to establish that Federal water-quality criteria can be met by current offshore dredging operations and to determine the extent of sedimentation and the subsequent recovery of benthic communities. This information could lead to lower levels of effects and facilitate the creation of effective mitigating measures, thereby leading to lower levels of potential conflict with the standards and policies of the ACMP. However, none of the levels of effects for biological resources, use of the resources, or water quality noted in this section has been reduced.

**CONCLUSION:** The potential conflict with the ACMP would remain MODERATE, the same as the proposal (see Sec. IV.B.14), only delayed 3 years.

**Cumulative Effects:** Delay of the sale would postpone some of the potential cumulative effects on water quality, habitat alteration, and subsistence, thereby postponing potential conflicts with the policies of the ACMP that relate to these resources and activities and to mining and mineral processing. Ultimately, however, cumulative effects would be comparable to those of the proposal --MODERATE (see Sec. IV.B.14 for a more complete description of cumulative effects).

15. **Effect on Human Health:** The effect of Alternative III on human health would be the same effect as described for the proposal, only delayed (see Sec. IV.B.15). Delaying the sale could provide time for studies on mercury levels in Nome residents as well as on subsistence resources to determine the level of effects from the proposed lease sale.

**CONCLUSION:** The effect of Alternative III on human health is expected to be the same as for the proposal, NEGLIGIBLE.

**Cumulative Effects:** The cumulative effects on human health could be the same as described for the proposal,  
**MODERATE.**

#### **IV.E. Alternative IV - Eastern Deferral Alternative**

Alternative IV would remove from the Norton Sound Lease Sale area 15 whole and partial blocks (about 63,595 acres) located southeast of Safety Sound (see Fig. II-6). The remaining blocks comprise the Eastern Deferral Alternative. For purposes of analysis, the exploration and mining scenarios for this alternative are based on the assumption that the level of activities and timing of events associated with exploration and mining for the Eastern Deferral Alternative would be the same as for Alternative I except that all of the activities would occur in that part of the lease area south of Nome. (See Table II-1 and Sec. II.A.2 for a complete description.) MMS estimates one dredge would operate in the sale area for 14 years and mine approximately 800 acres (40-60 acres per year).

1. **Effect on Air Quality:** Air-pollution emissions associated with this alternative would be the same as for the base case (Sec. IV.B.1), with the exception that the shoreline area east of Cape Nome would be more protected from offshore emissions because the emissions would be further away. The effects on air quality relative to standards and the effects of air quality not addressed by standards, including effects on tundra and vegetation, are expected to be NEGLIGIBLE.

**CONCLUSION:** The effect of the Eastern Deferral Alternative on air quality relative to standards and effects of air quality not addressed by standards would remain NEGLIGIBLE, the same as for the proposal.

**Cumulative Effects:** The effects of the Eastern Deferral Alternative under the cumulative case, with respect to both air-quality standards and aspects of the environment not addressed by air-quality standards, are expected to be MINOR, as discussed under the cumulative case analysis with the proposal in Section IV.B.1.

2. **Effect on Water Quality:** Because the rate of dredging does not change under this alternative, the area affected by increased turbidity about the one dredge would be the same as for the proposal, about 34 km<sup>2</sup>. However, the deferred area would not be subject to any increase in turbidity from this alternative because of its distance from dredging. Within the margins of the Eastern Deferral Alternative, elevated turbidity would extend over a severalfold-greater area than the site actually dredged, dredging would be very intensive, and turbidity plumes from different dredge sites would overlap in space but not time. All of the area offered under this alternative is likely to be affected by occasional short-term (few to several months) turbidity during at least one dredging season. This level of effect would still be considered a MINOR effect on LOCAL water quality and a NEGLIGIBLE effect on REGIONAL water quality. The area still within the alternative, however, includes the area with suspected sediment contamination by the mercury used and released in turn-of-the-century placer mining of Nome beaches (Sec. III.A.8; Nelson et al., 1972, 1975). A MINOR effect on LOCAL water quality from turbidity and an assumed fuel spill, a MAJOR effect on LOCAL water quality from trace metals (copper), plus a MINOR effect on REGIONAL water quality from the assumed fuel spill, are identical to those estimated for the proposal.

**CONCLUSION:** The effect of the Eastern Deferral Alternative on water quality is expected to be the same as for the proposal, MAJOR on LOCAL water quality and MINOR on REGIONAL water quality.

**Cumulative Effects:** Cumulative effects with the Eastern Deferral Alternative on marine water quality are expected to be MAJOR LOCAL and MINOR REGIONAL, the same as for the cumulative case under the proposal.

3. **Effect on Marine Plants and Invertebrates and Red King Crab:** The deferral of 15 blocks southeast of Safety Sound is not expected to reduce effects on red king crabs, since the deferred area generally has a low abundance of red king crabs, unlike the western area, which is an area of high crab abundance. In fact, the concentration of activity in the western area could intensify effects on red king crabs, since the likelihood of important red king crab habitat being affected is greater, both directly from dredging and from sedimentation effects. However, the level of effect on red king crabs from habitat alteration (as well as the overall effect) is not expected to increase since the monitoring program can result in limitations to dredging effects in prime red king crab habitat. Therefore, the effect should remain MODERATE, the same as for the proposal.

Effects on other marine plants and invertebrates also are not expected to decrease under the Eastern Deferral Alternative, but should remain MODERATE, as for the proposal, since the deferred area does not apparently contain the rocky substrate communities that are of concern in the western part of the sale area. This deferral alternative reduces the likelihood of a fuel-oil spill associated with the proposal from occurring and contacting

the Safety Sound region, an area that if contacted, could be affected for a number of years. Under certain circumstances, grasses in tidal areas might be affected and clams and other invertebrates also. Effects inside Safety Sound are not very likely since there are only 2 small openings into the Sound. If a spill did occur and contaminate plants or invertebrates within Safety Sound, then some individuals in localized areas could be affected for a number of years, approximating several generations. This could result in a MODERATE effect. A spill contacting the inner part of Safety Sound is not anticipated.

**CONCLUSION:** Under the Eastern Deferral Alternative, the effect on red king crab and other marine plants and invertebrates is expected to remain MODERATE, the same as for the proposal.

**Cumulative Effects:** Under the Eastern Deferral Alternative, cumulative effects on red king crab and other marine plants and invertebrates are expected to be MODERATE.

4. **Effect on Fishes:** The concentration of dredging activities in the western part of the sale area, as would occur under this deferral alternative, is not expected to change the effect levels for fishes compared to the proposal (Alternative I) since most fishes in the Norton Sound area are very mobile and have broad distributions within the Sound. The major demersal species, which are the fishes most likely to be affected by alteration of the benthic environment and reductions in benthic prey, are not known to be tied to specific sites and do not show concentrated distributions in either the eastern or western parts of the proposed sale area. The highest order effects to fishes come from the possibility of a fuel-oil spill occurring in the nearshore region and contacting salmon, herring, or capelin while they are concentrated there. The deferral of the region near Safety Sound reduces the probability of a spill contacting that region and affecting fishes there, but a spill in the western area also could have a MODERATE effect on fish. Therefore, even though there might be some advantage to salmon stocks near the eastern part of the sale area under this deferral alternative, the level of effect on fishes is expected to remain MODERATE, the same as for the proposal.

**CONCLUSION:** The effect of the Eastern Deferral Alternative on fishes is likely to remain MODERATE, the same as for the proposal.

**Cumulative Effects:** Under the Eastern Deferral Alternative, cumulative effects on fishes are expected to be the same as for the cumulative case under the proposal--MAJOR.

**Cumulative Effects on Migratory Species:** The cumulative effects of Alternative IV on migratory fish species are expected to be similar to the cumulative effects on migratory fish species associated with the proposal (Alternative I)--MAJOR.

5. **Effect on Marine and Coastal Birds:** The deferral of 15 lease blocks offshore of Safety Sound and near other seabird colonies at Topkok Head and Bluff could significantly reduce noise and disturbance, physical habitat alteration, and toxic trace-metal effects on marine and coastal birds (from MINOR under the proposal to NEGLIGIBLE). None of the 360 or more helicopter flights per year between Nome and the dredge would have reason to fly near coastal waterfowl and shorebird concentrations at Safety Sound or fly near seabird colonies east of Cape Nome because no dredging/mining activities would occur offshore of these coastal habitat areas (Fig. III-17). Turbidity plumes from dredging operations would not occur within the primary foraging range (within about 12 mi of the seabird colonies) of seabirds that nest at Bluff, Safety Sound or other colonies east of Cape Nome (Fig. III-17). Thus, the availability of seabird prey would not be affected. The potential release of toxic trace metals, especially mercury, would not occur within 12 mi of the above seabird colonies or within coastal waterfowl and shore-bird concentrations. However, no significant mercury or other toxic trace-metal contamination and bioaccumulation is expected to occur and affect marine and coastal birds, because Stipulation Nos. 1, 2, and 3 are assumed to be implemented under this alternative; thus, preventing any trace metals from affecting marine and coastal birds and their food sources.

Long-term (more than one generation) bioaccumulation of mercury or other toxic trace metals in seabirds is not likely to occur under this alternative or under the proposal if mercury and other trace-metal levels measured near dredging activities under Stipulation No. 1 continue to not exceed EPA water-quality criteria nor result in a significant increase in these trace metals in marine organisms as is the apparent finding from current dredging activity.

**CONCLUSION:** The effect of the Eastern Deferral Alternative on marine and coastal birds is expected to be reduced from MINOR for the proposal to NEGLIGIBLE for this alternative.

Cumulative Effects: Cumulative effects on marine and coastal birds under the Eastern Deferral Alternative are expected to be essentially the same as those discussed under the cumulative effects with the proposal--MODERATE.

5 Cumulative Effects on Migratory Species: The cumulative effects of Alternative IV on migratory bird species are expected to be similar to the cumulative effects on migratory bird species associated with the proposal (Alternative I)--MAJOR.

6. Effect on Nonendangered Marine Mammals: The deferral of 15 lease blocks offshore of spotted seal haulout areas east of Cape Nome could reduce some potential noise and disturbance effects on spotted seals, bearded seals, walruses, and belukha whales that occur offshore and along the coast of Safety Sound and other habitats east of Cape Nome (Fig. III-18). Physical habitat alteration by excavation and deposition of sediments could be avoided east of Cape Nome. However, local benthic habitats of walruses and bearded seals west of Cape Nome are likely to be altered by dredging activities in lease blocks offshore of Nome. No significant release of mercury or other trace-metals nor increases in the bioaccumulation of these metals in seals, walruses, and belukha whales that feed in this area is expected to occur assuming Stipulation Nos. 1, and 2 are implemented under this alternative.

Belukha whales, spotted seals, and walruses that frequent coastal habitats near Nome are still likely to be briefly disturbed by air traffic between Nome and the dredge and by the noise emitted by the operating dredge (MINOR effect).

CONCLUSION: The effect of the Eastern Deferral Alternative on nonendangered marine mammals is expected to remain MINOR, the same as the proposal.

Cumulative Effects: Cumulative effects on nonendangered marine species under the Eastern Deferral Alternative are expected to be essentially the same as those discussed under cumulative effects with the proposal--MINOR.

Cumulative Effects on Migratory Species: The cumulative effects of Alternative IV on migratory nonendangered marine mammals are expected to be similar to the cumulative effects on migratory nonendangered marine mammals associated with the proposal (Alternative I)--MODERATE.

7. Effect on Endangered and Threatened Species: This alternative would defer 15 lease blocks offshore and east of Cape Nome. The deferral would essentially eliminate disturbance, habitat alteration, turbidity, and trace-metal effects to the few gray whales frequenting the eastern area. However, gray whales would still be subject to the effects described for the proposal in the area west of Cape Nome. Therefore, deferral of this area is expected to have overall effects on gray whales similar to those for the proposal.

Four of the six arctic peregrine falcon nest sites near the proposed sale area would receive reduced effects by the deferral of the eastern blocks. Helicopter-support flights (360 or more annually) are not likely near these four nest sites since all dredging/mining activities would be west of Cape Nome. Also, effects to the major prey species populations (seabirds and other aquatic birds) at Bluff, Safety Sound, and Topkok Head would be lowered by this alternative (see Sec. IV.E.5). Since the nesting peregrines at the four sites depend on these populations for their prey (within a 15-mi hunting territory), the effects are also lowered for the local peregrine population. This alternative would substantially reduce habitat alteration and the potential for long-term bioaccumulation of toxic trace metals within the prey populations since the dredging would be outside their feeding ranges. Therefore, any potential risk for reduction of the local peregrine nesting population due to bioaccumulation of mercury or other toxic trace metals is essentially removed. Also, no significant release of toxic trace metals (especially mercury) nor increases in the bioaccumulation of trace metals within the food chain is expected to occur, the same as in the proposal. Although there would be a reduction of exposure to potential effects from the proposal (six to two nest sites), the overall effects to the regional population would remain as the proposal--MINOR (individuals in localized area affected for less than one breeding cycle).

CONCLUSION: The effect of the Eastern Deferral Alternative is expected to remain MINOR for the gray whale and arctic peregrine falcon, the same as for the proposal.

Cumulative Effects: The cumulative effects for the Eastern Deferral Alternative are expected to remain essentially the same as the cumulative effects with the proposal for the gray whale and the arctic peregrine falcon--MINOR.

Cumulative Effects on Migratory Species: The cumulative effects of Alternative IV on migratory endangered and threatened species are expected to be similar to the cumulative effects on migratory endangered and threatened species associated with the proposal (Alternative I)--MINOR.

8. Effect on the Economy of Nome: The scenario for the Eastern Deferral Alternative is not expected to differ from the proposal; the base case assumes one dredge operating in the sale area. Therefore, the effect on the economy of Nome for this alternative is expected to be the same as described in Section IV.B.8--increases in employment are expected to be approximately 6 percent and the overall effect on the economy would be MINOR.

CONCLUSION: The effect of the Eastern Deferral Alternative on the economy of Nome is expected to remain MINOR, the same as for the proposal.

Cumulative Effects: Cumulative effects under the Eastern Deferral Alternative would be the same as discussed for the proposal. The cumulative projects in combination with the proposal are expected to have a MODERATE effect on the economy of Nome.

9. Effect on Commercial Fisheries: The Eastern Deferral Alternative is not expected to reduce the effects on red king crab because the deferred area generally has a lower abundance of red king crab than the area to the west. Therefore, the level of effect on the red king crab fishery would be expected to remain the same as under the proposal, MINOR. The effect of a fuel-oil spill on commercial salmon and herring fisheries under this alternative would remain the same as described under the proposal, MODERATE.

CONCLUSION: The effect of the Eastern Deferral Alternative on commercial fisheries is expected to remain MODERATE, the same as for the proposal.

Cumulative Effects: Cumulative effects under the Eastern Deferral Alternative would be the same as discussed for the proposal. That is, current mining operations in State waters in conjunction with the proposal would harm crab habitat and increase the levels of mercury in the water column. Cumulative offshore dredging projects are expected to have a MODERATE effect on commercial crab fishing.

Cumulative Effects on Migratory Species: The cumulative effects of Alternative IV on migratory commercial salmon and herring fisheries are expected to be similar to the cumulative effects associated with the proposal (Alternative I) --MODERATE.

10. Effect on Subsistence-Harvest Patterns: Under the Eastern Deferral Alternative, dredging would only occur in the western portion of the sale area and industrial activities would occur at the same level as under the proposal. Thus, all causal agents for effects on subsistence would occur on the same scale as the proposal (habitat alteration, repartitioning of mercury and other metals, noise and disturbance, a fuel-oil spill, and increased human population). The difference between effects on subsistence-harvest patterns from the Eastern Deferral Alternative when compared to the proposal would be the elimination of habitat alteration, noise and disturbance, and a fuel-oil spill occurring in the Eastern Deferral area. With a monitoring program in place, the MINOR effect expected from the proposal on subsistence-harvest patterns is still expected under this alternative due to effects from increased excavation and deposition of sea-bottom material and sediments which would mobilize and repartition mercury and other trace metals into the water column.

The biological effect level from noise and disturbance on marine and coastal birds (see Sec. IV.E.5) would be reduced under this alternative because primary nesting areas are at Bluff and Safety Sound, well outside of the eastern portion of the sale area. However, noise and traffic disturbance was only expected to have a MINOR effect on subsistence harvests of birds since disruptions would be short term and temporary. Harvests of all marine resources in the eastern portion of the sale area may experience short-term disruptions, hunters may have to harvest outside of the sale area and travel farther and longer for a successful harvest, and harvests may be reduced, but no harvest would not occur as a result of effects from these causal agents.

CONCLUSION: The effect of the Eastern Deferral Alternative on subsistence- harvest patterns is expected to remain MINOR, the same as for the proposal.

Cumulative Effects: The effects of the Eastern Deferral Alternative on subsistence-harvest patterns in the cumulative case are expected to be MODERATE, as discussed under the cumulative case with the proposal in Section IV.B.10.

11. **Effect on Sociocultural Systems:** Deferring the eastern portion of the sale area would not alter the scenario assumed for the proposal; thus, effects from industrial activities, population, and employment would remain the same as for the proposal--MINOR. Effects on subsistence harvests would continue to be MINOR (see Sec. IV.E.10). There would be no difference between effects on sociocultural systems from the eastern deferral when compared to the proposal. Industrial activities, changes in population and employment, and effects on subsistence-harvest patterns would affect the social organization, cultural values, and well-being of Nome. Nome is expected to be affected by the proposed lease sale for the following reasons: Nome will be the base of operations for the mining activities; sale-related employment and population growth predicted for the sale area are expected to occur in Nome; nonlocal employees will reside in Nome; marine and air support will be based in Nome; all of Nome's marine- subsistence resources are harvested within the sale area; and MINOR effects on Nome's subsistence-harvest patterns are expected. Nome is a fairly large, heterogeneous community and should be able to withstand some degree of increased population and employment opportunities.

**CONCLUSION:** The effect of the Eastern Deferral Alternative on sociocultural systems is expected to remain MINOR, the same as for the proposal.

**Cumulative Effects:** The effects of the Eastern Deferral Alternative on sociocultural systems in the cumulative case are expected to be MAJOR, as discussed under the cumulative case with the proposal in Section IV.B.11.

12. **Effect on Archaeological Resources:** Activities affecting offshore archaeological resources are exploration activities, dredging, oil spills, and the plume discharge of sediments and rocks from dredging. Since there are no landforms in the area of the Eastern Deferral Alternative, there would be no reduction of effects by deferring the Eastern Deferral Area. There are some shipwrecks recorded in the Eastern Deferral Alternative Area. Deferral of this area (Fig. IV-6) east of Safety Sound would mean a reduction in adverse effects from dredging and deposition on offshore shipwrecks. Activities affecting onshore archaeological resources are increased visitor population and numbers of employees on the dredge. These activities would not be decreased under the Eastern Deferral Alternative. Visitor populations have influenced the cleanup of beaches at Nome and probably caused the disappearance of the MV Donaldson--a National Historic Site. The effects of not reducing the numbers of employees under the Eastern Deferral Alternative would not reduce the effects on onshore archaeological sites.

**CONCLUSION:** The effect of the Eastern Deferral Alternative on archaeological resources is expected to remain NEGLIGIBLE, the same as for the proposal.

**Cumulative Effects:** The effects of the Eastern Deferral Alternative on archaeological resources under the cumulative case are expected to be MINOR, the same as for the cumulative case under the proposal.

13. **Effect on Recreation and Tourism:** Activities affecting recreation and tourism resources are exploration activities, dredging, oil spills, and the plume discharge of sediments and rocks from dredging. Since there are recreational fishing and crabbing in the area of the Eastern Deferral Alternative, there would be a slight reduction of effects on recreational fishing and crabbing by deferring the area east of Safety Sound. The bird watching recreational activities afforded at Safety Sound would see a slight reduction of effects. Deferral of this area (Fig. II-6) would mean a reduction in adverse effects.

**CONCLUSION:** The effect of the Eastern Deferral Alternative on recreation and tourism resources is expected to remain MINOR, the same as for the proposal.

**Cumulative Effects:** The effects of the Eastern Deferral Alternative on recreation and tourism under the cumulative case are expected to be MINOR, the same as for the cumulative case under the proposal.

14. **Effect on Land Use Plans and Coastal Management Programs:** The Eastern Deferral Alternative reduces the potential for effects within the designated important use areas of Safety Sound and Topkok Head primarily as a result of the reduction of aircraft activity from the areas closest to the bird habitat. However, these effects were considered only MINOR for the proposal; therefore, the reduction does not have a significant effect upon the overall conclusion for coastal management. Effects on Safety Sound from spilled oil also may be reduced with this alternative because dredges would not be operating in the Federal area closest to the Sound. This reduced potential for oil to affect Safety Sound enhances conformance with the BSCMP subsistence policies for Special Use Areas. However, MODERATE effects on red king crab and the commercial fishery for red king crab are expected to occur as a result of habitat alteration in the western portion of the lease



sale. This area still would be affected with this alternative; potential conflict with ACMP habitat policies are expected to be the same as for the proposal--MODERATE.

**CONCLUSION:** Under the Eastern Deferral Alternative, potential conflict with the ACMP is expected to remain MODERATE, the same as for the proposal.

**Cumulative Effects:** As noted in the Proposal, cumulative effects primarily reflect offshore mining in State and Federal waters. Deferring the Federal area near Safety Sound precludes mining activity in the OCS. However, activity in State waters east of Nome still would occur and overall activities on the remaining Federal leases would be comparable to those described for the proposal. Mining in State waters and the remaining Federal waters would lead to cumulative effects for the Eastern Deferral Alternative and would be comparable to those of the proposal--MODERATE.

15. **Effect on Human Health:** Under the Eastern Deferral Alternative, dredging would occur only in the western portion of the sale area, and industrial activities would occur at the same level as under the proposal. Potential repartitioning of mercury and other metals is expected to occur at the same scale under this deferral alternative as under the proposal. The effect of this alternative on human health is expected to be NEGLIGIBLE due to the very low levels of mercury and other trace metals likely to excavated from the sea-bottom material as is apparent from current dredging activities. Levels of mercury and other trace metals in the water column are not expected to exceed EPA water-quality criteria. Even though levels of mercury in some Nome residents might be near or at threshold levels, particularly for pregnant women (see Secs. III.D and IV.B.15), the levels of mercury in seafood are generally low in the Nome area (see Sec. IV.B.15). With Stipulation Nos. 1 and 3 in place, no significant increases in the bioaccumulation of mercury in the food chain are expected to occur and would not be expected to pose a serious threat to human health in the Nome area. It is expected that no significant effect would occur whether the dredging activity is in the eastern portion of the sale area, the western portion, or both.

**CONCLUSION:** The effect of the Eastern Deferral Alternative on human health is expected to be NEGLIGIBLE, the same as for the proposal.

**Cumulative Effects:** The effect of the Eastern Deferral Alternative on human health in the cumulative case is expected to be the same as for the proposal in the cumulative case--MODERATE.

#### **IV.F. Alternative V - Western Deferral Alternative**

Alternative V would remove from the Norton Sound Lease Sale area 19 whole and partial blocks (about 83,458 acres) located west of Cape Nome and south of Nome (see Fig. II-7). The remaining blocks comprise the Western Deferral Alternative Area. For purposes of analysis, the exploration and mining scenarios for this alternative are based on the assumption that the level of activities and timing of events associated with exploration and mining for the Western Deferral Alternative would be the same as for Alternative I except that all of the activities would occur in that part of the lease area southeast of Safety Sound. (See Table II-1 and Sec. II.A.2 for a complete description of the scenario.) MMS estimates one dredge would operate in the sale area for 14 years and mine approximately 800 acres (40-60 acres per year).

1. **Effect on Air Quality:** Air pollution emissions associated with this alternative would be the same as for the base case (Sec. IV.B.1), with the exception that the shoreline area west of Safety Sound would be more protected from offshore emissions because the emissions would be further away from industrial activities in the Western Deferral Alternative. The effects on air quality relative to standards and the effects of air pollution not addressed by standards, including effects on the tundra and vegetation, are expected to be NEGLIGIBLE.

**CONCLUSION:** The effect of the Western Deferral Alternative on air quality is expected to remain NEGLIGIBLE relative to standards and to effects not addressed by standards, as for the proposal.

**Cumulative Effects:** The effects of the Western Deferral Alternative under the cumulative case, with respect to both air-quality standards and aspects of the environment not addressed by air-quality standards, are expected to be MINOR, as discussed under the cumulative case analysis for the proposal in Section IV.B.1.

2. **Effect on Water Quality:** Because the rate of dredging does not change under this alternative, the effect of increased turbidity would be the same as for the proposal, MINOR over about 34 km<sup>2</sup>. However, the deferred area would not be subject to any increase in turbidity from this alternative because of its distance from dredging. Within the margins of the Western Deferral Alternative, elevated turbidity would extend over a severalfold-greater area than the site actually dredged, dredging would be very intensive, and turbidity plumes from different dredge sites would overlap in space but not time. All of the area offered under this alternative is likely to be affected by occasional turbidity during two to three seasons out of a total of 14 years of production. The greater portion of the proposal would be deferred under this alternative and would be protected from turbidity problems. The level of effect of turbidity on REGIONAL water quality is NEGLIGIBLE and the effect on LOCAL water quality remains MINOR, both the same as estimated for the proposal.

The area potentially affected by trace-metal concentrations would be the 34 km<sup>2</sup> around the dredge. However, the deferred area would not be subject to any significant increase in trace metals because of its distance from dredging. The area still within the Western Deferral Alternative, however, includes that portion of the sale area closest to cinnabar deposits at Bluff (Sec. III.A.8; Nelson et al., 1972, 1975). Discharge of metalliferous sediments during active mining is expected to have a MAJOR effect on LOCAL water quality (because of copper) but a NEGLIGIBLE effect on REGIONAL water quality, as found for the proposal.

Gold dredging is estimated to cause negligible oxygen depletion under this alternative, for a NEGLIGIBLE effect on LOCAL or REGIONAL water quality, the same as estimated under the proposal.

One major fuel spill is assumed under this alternative. The likelihood of such a spill is unknown, but should be the same as for the proposal. Contamination from such a spill would persist on the order of weeks to months, for a MINOR effect on LOCAL water quality and a MINOR effect on REGIONAL water quality, the same as estimated under the proposal.

**CONCLUSION:** There would be a MAJOR LOCAL and MINOR REGIONAL effect from the Western Deferral Alternative on marine water quality, the same as for the proposal.

**Cumulative Effects:** Under the Western Deferral Alternative, cumulative effects on marine water quality are expected to be MAJOR LOCAL and MINOR REGIONAL, the same as for the cumulative case under the proposal.

3. **Effect on Marine Plants and Invertebrates and Red King Crab:** The deferral of 19 lease blocks offshore of Nome and west of Cape Nome would reduce potential effects on important red king crab habitat from dredging and resulting sedimentation. This would result in the level of effect being reduced from MODERATE for the proposal to MINOR under the Western Deferral Alternative. A similar reduction is expected for other benthic plants and invertebrates living within the area of this proposed alternative, since the rocky substrate communities of concern in the western part of the sale area are thought not to occur in the eastern area (based on maps of substrate types).

The potential effects on marine plants and invertebrates from exposure to additional trace metals from sediments resuspended by dredging would be reduced within the area deferred by this alternative, but effects of trace metals on marine plants and invertebrates would not be reduced under this deferral alternative and would remain NEGLIGIBLE.

Effects of entrainment, a fuel spill, and noise and disturbance are expected to remain at the same level of effects as for the proposal: MINOR, MINOR, and NEGLIGIBLE, respectively.

**CONCLUSION:** The effect of the Western Deferral Alternative on red king crab, as well as other marine plants and invertebrates, is expected to be MINOR.

**Cumulative Effects:** Under the Western Deferral Alternative, cumulative effects on other marine plants and invertebrates are likely to remain MODERATE, the same as for the cumulative case under the proposal. Effects on red king crab are expected to be MINOR, since nearshore habitats are not apparently as critical as the band within the deferred area, and the effects would rest on results of dredging activities in State waters as well as in the eastern portion of the sale area.

4. **Effect on Fishes:** The concentration of dredging activities in the eastern part of the sale area, as would occur under the Western Deferral Alternative, is not expected to change the effect levels for fishes compared to the proposal (Alternative I), since most fishes in the Norton Sound area are very mobile and have broad distributions within the Sound. The major demersal species, which are the fishes most likely to be affected by alteration of the benthic environment and reductions in benthic prey, are not known to be tied to specific sites and do not show concentrated distributions in either the eastern or western parts of the proposed sale area. Therefore, under the Western Deferral Alternative, the effects on fishes are expected to remain MODERATE, the same as for Alternative I.

**CONCLUSION:** The effect of the Western Deferral Alternative on fishes is expected to remain MODERATE, the same as for the proposal.

**Cumulative Effects:** Under the Western Deferral Alternative, cumulative effects on fishes are expected to be the same as for the cumulative case under the proposal--MAJOR.

**Cumulative Effects on Migratory Species:** The cumulative effects of Alternative V on migratory fish species are expected to be similar to the cumulative effects on migratory fish species associated with the proposal (Alternative I)--MAJOR.

5. **Effect on Marine and Coastal Birds:** The deferral of 19 lease blocks offshore of Nome and west of Cape Nome could reduce noise and disturbance effects and short-term water-turbidity and habitat-alteration effects on small numbers of marine and coastal birds that occur in the Nome area. However, seabirds that nest at Bluff, Safety Sound, and other colonies east of Cape Nome are still likely to be affected by mining activities under this alternative (see Fig. III-17). Noise and disturbance of some seabirds, waterfowl, and shorebirds is still likely to occur from helicopter traffic to and from Nome and lease blocks east of Cape Nome. Physical alteration of primary seabird foraging habitat from water turbidity of the dredge plume and some mercury and other trace-metals released from the sediments through dredging could occur under this alternative. A fuel spill from the dredge could still occur and affect birds that use Safety Sound (MINOR effect). No significant increase in mercury bioaccumulation is expected to occur as under the proposal. Local seabird populations at Safety Sound, Bluff, and other nesting colonies east of Cape Nome are not expected to be affected by trace metals under this alternative if mercury and other trace-metal levels measured under Stipulation No. 1 do not exceed EPA water-quality criterion.

**CONCLUSION:** The effect of the Western Deferral Alternative on marine and coastal birds is expected to remain MINOR, the same as for the proposal.

**Cumulative Effects:** Cumulative effects on marine and coastal birds under the Western Deferral Alternative are expected to be essentially the same as those discussed under cumulative effects with the proposal--MODERATE.

**Cumulative Effects on Migratory Species:** The cumulative effects of Alternative V on migratory bird species are expected to be similar to the cumulative effects on migratory bird species associated with the proposal (Alternative I)--MAJOR.

6. **Effect on Nonendangered Marine Mammals:** The deferral of 19 lease blocks offshore of Nome and west of Cape Nome could avoid further noise and disturbance of seals, walruses, and belukha whales frequenting coastal habitats west of Cape Nome (from that level of disturbance they are presently exposed to) and would avoid further alteration of local benthic feeding habitats of walruses and bearded seals in this area. A potentially smaller increase in mercury levels in the ecosystem and less bioaccumulation might occur in marine habitats west of Cape Nome, but potential increases in mercury or other trace metals are expected to be insignificant. However, bearded and spotted seals, walruses, and belukha whales that occur in habitats east of Cape Nome and offshore of Safety Sound are still likely to be temporarily affected by noise and disturbance from air traffic and dredge noise from mining activities in lease blocks east of Cape Nome (a MINOR effect).

**CONCLUSION:** The effect of the Western Deferral Alternative on nonendangered marine mammals is expected to remain MINOR, the same as for the proposal.

**Cumulative Effects:** Cumulative effects on nonendangered marine species under the Western Deferral Alternative are expected to be essentially the same as those discussed under the cumulative effects with the proposal--MINOR.

**Cumulative Effects on Migratory Species:** The cumulative effects of Alternative V on migratory nonendangered marine mammals are expected to be similar to the cumulative effects on migratory nonendangered marine mammals associated with the proposal (Alternative I)--MODERATE.

7. **Effect on Endangered and Threatened Species:** This alternative would defer 19 lease blocks west of Cape Nome and south of Nome. The deferral would essentially eliminate disturbance, habitat alteration, turbidity, and trace-metal effects to the few gray whales frequenting the western area. However, gray whales would still be subject to the effects described for the proposal in the area east of Cape Nome; therefore, deferral of this area is expected to have overall effects on gray whales similar to those for the proposal (MINOR).

Only two of the six arctic peregrine falcon nest sites near the proposed sale area would have reduced effects. Under this deferral, the major seabird and aquatic bird concentration areas would receive effects as described in the proposal (see Sec. IV.F.5.), and the remaining four peregrine falcon nest sites near the Western Deferral Alternative would likewise experience effects similar to those for the proposal. A potential risk for reduction of the local peregrine nesting population from toxic trace metals would still exist. However, no significant release of toxic trace metals (especially mercury) nor increases in the bioaccumulation of trace metals within the food chain is expected to occur, the same as in the proposal.

**CONCLUSION:** The effect of the Western Deferral Alternative is expected to remain MINOR for the gray whale and the arctic peregrine falcon, the same as the proposal.

**Cumulative Effects:** The cumulative effects for the Western Deferral Alternative are expected to remain MINOR for the gray whale and the arctic peregrine falcon, the same as for cumulative effects under the proposal.

**Cumulative Effects on Migratory Species:** The cumulative effects of Alternative V on migratory endangered and threatened species are expected to be similar to the cumulative effects on migratory endangered and threatened species associated with the proposal (Alternative I)--MINOR.

8. **Effect on the Economy of Nome:** The scenario for the Western Deferral Alternative is not expected to differ from the proposal; the base case assumes one dredge operating in the sale area. Therefore, the effect on the economy of Nome for this alternative is expected to be the same as described in Section IV.B.8--increases in employment are expected to be approximately 6 percent and the overall effect on the economy would be MINOR.

**CONCLUSION:** The effect of the Western Deferral Alternative on the economy of Nome is expected to remain MINOR, the same as for the proposal.

**Cumulative Effects:** Cumulative effects under the Western Deferral Alternative would be the same as discussed for the proposal. The cumulative projects in combination with the proposal are expected to have a MODERATE effect on the economy of Nome.

9. **Effect on Commercial Fisheries:** The Western Deferral Alternative is expected to reduce potential harm to the important red king crab habitat south of Nome because dredging would occur instead east of Safety Sound. The effect of dredging and resulting sedimentation would be reduced from MINOR for the proposal to NEGLIGIBLE for the red king crab fishery under this deferral alternative.

Dredging within the area of the alternative (the eastern portion of the proposed sale area) would reduce the potential harm to the winter red king crab fishery, but only because there is less crab fishing activity in this area. The effect on the winter commercial king crab fishery would be reduced from MODERATE for the proposal to MINOR. The effect of a fuel spill on commercial salmon and herring fisheries under this alternative would remain the same as described for the proposal, MODERATE.

**CONCLUSION:** The effect of the Western Deferral Alternative on the winter commercial fisheries is expected to be reduced from MINOR for the proposal to NEGLIGIBLE. However, because of the potential harm from a fuel-oil spill on commercial salmon and herring fisheries, the effect remains MODERATE.

**Cumulative Effects:** Cumulative effects under the Western Deferral Alternative would be the same as discussed for the proposal. That is, current mining operations in State waters in conjunction with the proposal would harm crab habitat. Cumulative offshore dredging projects with the proposal are expected to have a MODERATE effect on commercial crab fishing.

**Cumulative Effects on Migratory Species:** The cumulative effects of Alternative V on migratory commercial salmon and herring fisheries are expected to be similar to the cumulative effects associated with the proposal (Alternative I)--MODERATE.

10. **Effect on Subsistence-Harvest Patterns:** Under the Western Deferral Alternative, dredging would only occur in the eastern portion of the sale area and industrial activities would occur at the same level as under the proposal. Thus, all causal agents for effects on subsistence would occur on the same scale as the proposal (habitat alteration, repartitioning of mercury and other metals, noise and disturbance, a fuel spill, and increased human population). The difference between effects on subsistence-harvest patterns from the Western Deferral Alternative when compared to the proposal would be the elimination of habitat alteration, noise and disturbance, and a fuel-oil spill occurring in the area west of Cape Nome. With a monitoring program in place, the MINOR effect expected from the proposal on subsistence-harvest patterns would still be expected under this alternative due to effects from habitat alteration, noise and disturbance, a fuel spill, and increased excavation and deposition of sea-bottom material and sediments which would mobilize and repartition mercury and other trace metals into the water column.

The biological effect level from habitat alteration on red king crab would be reduced under this alternative from MODERATE to MINOR because red king crab are concentrated off the coast between Nome and Cape Nome in the deferral area deferred under this alternative. However, habitat alteration was only expected to have a MINOR effect on subsistence harvests of red king crab since the harvests occur within approximately 3 mi of the shore--outside of the sale area. Harvests of all marine resources in the eastern portion of the sale area may experience short-term disruptions, hunters may have to harvest outside of the sale area and travel farther and longer for a successful harvest, and harvests may be reduced, but no harvest would not occur as a result of effects from these causal agents.

**CONCLUSION:** The effect of the Western Deferral Alternative on subsistence- harvest patterns is expected to remain MINOR, the same as for the proposal.

**Cumulative Effects:** The effects of the Western Deferral Alternative on subsistence-harvest patterns in the cumulative case are expected to be MODERATE, as discussed under the cumulative case analysis with the proposal in Section IV.B.10.

11. **Effect on Sociocultural Systems:** Deferring the western portion of the sale area would not alter the scenario assumed for the proposal; thus, effects from industrial activities, population, and employment would remain the same as for the proposal. Effects on subsistence harvests would continue to be MINOR (see Sec. IV.F.10). There would be no difference between effects on sociocultural systems from the eastern deferral when compared to the proposal. Industrial activities, changes in population and employment, and effects on subsistence-harvest patterns would have short-term effects on the social organization, cultural values, and well-being of Nome.

**CONCLUSION:** The effect of the Western Deferral Alternative on sociocultural systems is expected to remain MINOR, the same as for the proposal.

**Cumulative Effects:** The effects of the Western Deferral Alternative on sociocultural systems in the cumulative case are expected to be MAJOR, as discussed under the base-case analysis in Section IV.B.11.

12. **Effect on Archaeological Resources:** Activities affecting offshore archaeological resources are exploration activities, dredging, oil spills, and the discharge plume of sediments and rocks from dredging. Since there are no landforms in the lease area of the Western Deferral Alternative, there would be no reduction of effects by deferring this area. There are some shipwrecks recorded in this area. Deferral of this area (Fig. II-7) west of Cape Nome would mean a reduction in the adverse effects due to dredging and deposition on offshore archaeological resources.

Activities affecting onshore archaeological resources are not expected to change visitor population and numbers of employees on the dredge. These activities would not be decreased under the Western Deferral Alternative. Visitor populations have influenced the cleanup of beaches at Nome and probably caused the disappearance of the MV Donaldson--a National Historic Site. The effect of no reduction in the number of employees with the adoption of this alternative would therefore not reduce the effects on onshore archaeological sites.

**CONCLUSION:** The effect of the Western Deferral Alternative on archaeological resources is expected to remain NEGLIGIBLE, the same as for the proposal.

**Cumulative Effects:** The effects of the Western Deferral Alternative on archaeological resources under the cumulative case are expected to be MINOR, the same as for the cumulative case under the proposal.

13. **Effect on Recreation and Tourism:** Activities affecting offshore recreation and tourism resources are exploration activities, dredging, oil spills, and the discharge plume of sediments and rocks from dredging. Since there is recreational fishing and crabbing in the area west of Cape Nome, there would be a slight reduction (less than one effect level) of effects on these activities by deferring this area.

**CONCLUSION:** The Western Deferral Alternative on recreation and tourism resources is expected to remain MINOR, the same as for the proposal.

**Cumulative Effects:** The effects of the Western Deferral Alternative on recreation and tourism under the cumulative case are expected to be MINOR, the same as for the cumulative case under the proposal.

14. **Effect on Land Use Plans and Coastal Management Programs:** With the western area deferred, dredging would not occur in prime red king crab habitat. As a result, potential effects on this resource and the associated commercial fishery would be reduced. This reduction in effects would reduce the MODERATE potential for conflict with the ACMP statewide standard and district policies for the offshore environment to MINOR. Reducing these effects to MINOR would minimize the potential for conflict with the statewide standard for mining and mineral processing that requires projects to conform with all the statewide standards and district policies.

For all other resources, the types and levels of effects are the same for the Western Deferral Alternative as for the proposal. As a result, potential conflicts with the statewide standards for overall, offshore, and wetland habitats; water quality; and subsistence, and district policies of the BSCMP related to offshore mining and arctic peregrine falcons would be similar to those in the proposal (see Sec. IV.B.14).

**CONCLUSION:** Under the Western Deferral Alternative, potential conflict with the ACMP is expected to be reduced from MODERATE for the proposal to MINOR.

**Cumulative Effects:** As noted in the cumulative analysis for the proposal, cumulative effects primarily reflect the effects of offshore mining in both State and Federal waters. Deferring the western portion of the sale area precludes mining activity in that portion of the OCS. However, activity in State waters west of Nome still would occur. Although effects on red king crab in State waters are less and negative effects on commercial fishing for crabs are reduced, effects on birds, water quality, and subsistence remain. Therefore, cumulative effects for the Western Deferral Alternative would be comparable to those of the proposal--MODERATE.

15. **Effect on Human Health:** Under the Western Deferral Alternative, dredging would occur only in the eastern portion of the sale area and industrial activities would occur at the same level as under the proposal. Potential repartitioning of mercury and other metals is expected to occur at the same scale under this deferral alternative as under the proposal. The effect of this alternative on human health is expected to be NEGLIGIBLE due to the very low levels of mercury and other trace metals likely to be excavated from the seabottom material as is apparent from current dredging activities. Levels of mercury and other trace metals in the water column are not expected to exceed EPA water-quality criteria. Even though levels of mercury in some Nome residents might be near or at threshold levels, particularly for pregnant women (see Secs. III.D and IV.B.15), the levels of mercury in seafood are generally low in the Nome area (see Sec. IV.B.15). With Stipulation Nos. 1 and 3 in place, no significant increases in the bioaccumulation of mercury in the food chain are expected to occur and would not be expected to pose a serious threat to human health in the Nome area.

**CONCLUSION:** The effect of the Western Deferral Alternative on human health is expected to be NEGLIGIBLE, the same as for the proposal.

**Cumulative Effects:** The effect of the Western Deferral Alternative on human health in the cumulative case is expected to be the same as the proposal in the cumulative case--MODERATE.



#### **IV.G. Analysis of the Potential Effects Resulting from the High Case**

As described in Section II.A.2, the scenarios for the OCS Mining Program Norton Sound Lease Sale are based on the mining of 530,000 troy ounces of gold--the base-case resource estimate. For a high case, MMS estimates the amount of gold to be mined in the lease-sale area to be 1,060,000 troy ounces--twice the amount of gold estimated for the base case. Because the estimates are pre-liminary, as noted in Section II.A.2, it is assumed that the level of mining activities associated with the high case would be two times that of the base case. Thus, two dredges would be used instead of one, an estimated 2,600 acres would be mined in place of 1,300 acres, and an estimated 40 million m<sup>3</sup> of sediment would be excavated and processed rather than 20 million m<sup>3</sup>. The amount and rates of material processed for the high case are shown in Table II-3. The types of mining operation for the high case are expected to be similar to those estimated for the base case. Bucket-ladder dredges would be used for excavating the placer deposits and a gravity-concentration process would be used to recover and concentrate the gold. Also, the level of support activities for the high case is estimated to be double that of the base case--Table II-3.

The level of exploration activities is based on the size of the proposed lease-sale area and the level of mining activities--Table II-3. The size of the area for both the base and high cases is the same; thus, the level of seismic exploration activities for both cases is estimated to be similar. However, because the level of mining activities for the high case is estimated to be twice that of the base case, high-case exploration-sampling activities are estimated to be about double those of the base case.

1. **Effect on Air Quality:** The high-case scenario includes two dredges and attendant support activities for offshore mining. The dredges could be operated as close as approximately 2 km from each other 5 km offshore. Table IV-13 lists estimated uncontrolled pollutant emissions for peak years. Since the estimated maximum annual uncontrolled NO<sub>x</sub> emissions would exceed 250 tons per year, under the Federal and State of Alaska PSD regulations, the lessee would be required to reduce NO<sub>x</sub> emissions. In addition, the lessee would have to employ BACT to the emission sources to reduce CO, SO<sub>2</sub>, and TSP because these emissions would exceed the de minimis levels. An air-quality analysis performed using the OCD Model for air pollutants emitted in the high case due to the Norton Sound Lease Sale showed that maximum NO<sub>x</sub> concentrations, averaged over a year, would be 0.22 μ/m<sup>3</sup> at the shoreline, which is 0.1 percentiles of the available Class-II increment for NO<sub>x</sub>. Results are summarized in Table IV-14.

The existing ambient concentration is not known, but because of limited emissions sources they are expected to be near the lower limits of detectability (very clean air with respect to NO<sub>x</sub>) onshore. The PSD Class II increment and ambient air-quality standard for NO<sub>x</sub> would be maintained with a substantial margin. The health-based air-quality standards are expected to be maintained by a wide margin.

The effects of air quality not addressed by air-quality standards are discussed in Section IV.B.1.b. The discussion accounts for the emissions from the high case as well as the base case, and concludes that the effects of air quality (other than relative to the health-based standards) are not expected to be detectable with respect to acidification of coastal tundra, and short-term with respect to emissions from accidental burning of spilled petroleum products.

In summary, the concentrations permitted by national ambient air-quality standards, including the PSD Class II increment, would not be approached. The pollutant concentration over land under the high case would not be sufficient to cause temporary or long-term harm to tundra vegetation or to acidify the coastal tundra; therefore, a MINOR effect on onshore air quality would be expected.

**CONCLUSION:** The effect of the high case of the proposed sale on onshore air quality with respect to health-based standards and effects of air quality not addressed by standards are expected to be MINOR.

2. **Effect on Water Quality:** In the high case, increased turbidity would be evident over twice the area affected by the base case but would still be a MINOR LOCAL and NEGLIGIBLE REGIONAL effect, the same as for the base case. The area affected by metals discharge to the water column would be twice that of the base case but would still be a MAJOR LOCAL and NEGLIGIBLE REGIONAL effect on water quality, the same as for the base case.

**Table IV-13**  
**Estimated Uncontrolled Emissions for Offshore Mining**  
**in the Norton Sound Lease-Sale Area**  
**High-Case Scenario**  
**(metric tons per year)**

	Pollutant <sup>1/</sup>				
	CO	NO <sub>x</sub>	TSP <sup>2/</sup>	SO <sub>2</sub>	VOC
<b>High Case<sup>3/</sup></b>	123	474	45	54	13

- <sup>1/</sup> CO = Carbon Monoxide.  
NO<sub>x</sub> = Nitrogen Oxides (assumed predominately NO<sub>2</sub>).  
TSP = Total Suspended Particulates (including most particulate matter less than 10 micrometers in aerodynamic diameter).  
SO<sub>2</sub> = Sulfur Dioxide.  
VOC = Volatile Organic Compounds (excluding nonreactive compounds such as methane and ethane).

<sup>2/</sup> Includes PM<sub>10</sub>.

<sup>3/</sup> Assumes two dredges of approximately 7,000 hp operating 150 days per year with 20-percent downtime (open-water season) plus support boats and exploration activities. Computed from scenarios and emission factors in Form and Substance and Jacobs Engineering Group, Inc. (1983).

**Table IV-14**  
**Comparison of Modeled Air-Pollutant Concentrations with Regulatory Limitations**  
**for the High-Case Scenario**  
**(measured in micrograms per cubic meter)**

Averaging Times	PSD Class II Increment <sup>1/</sup>	Maximum Modeled Concentration Over Land <sup>3/</sup>	Air-Quality Standards
<b>High Case NO<sub>x</sub></b>			
annual	25	0.22	100 <sup>4/</sup>
24-hour	-- <sup>3/</sup>	--	--
8-hour	--	--	--
3-hour	--	--	--
1-hour	--	--	--

<sup>1/</sup> Increment above ambient concentration allowed in a designated PSD area. Ambient-baseline concentration for PSD not established for this area.

<sup>2/</sup> Projected concentrations attributable to the proposal as modeled by the Offshore and Coastal Dispersion Model.

<sup>3/</sup> No value has been established.

<sup>4/</sup> Annual arithmetic mean.

Gold dredges are not expected to significantly deplete oxygen concentrations in the cold, high-oxygen waters of the sale area. Therefore, the effect of oxygen depletion in the high case is the same as estimated for the base case, a NEGLIGIBLE LOCAL or REGIONAL effect.

One major fuel spill is assumed in the high case. Contamination from such a spill would persist on the order of days to weeks. The likelihood of such a spill is unknown, but, on a relative basis, it would be twice as likely in the high case as in the base case. The effect of such a spill on water quality would be the same as estimated for the base case, a MINOR LOCAL and REGIONAL effect. In summary, under the high case, the areal extent of elevated turbidity and trace-metal contamination would be doubled, and the likelihood of a fuel spill (but not its effect) would be doubled.

**CONCLUSION:** There would be a MAJOR effect on LOCAL water quality and a MINOR effect on REGIONAL water quality in the high case, the same as found for the base case.

3. **Effect on Marine Plants and Invertebrates and Red King Crab:** In the high case, two dredges are assumed to operate, resulting in a doubling of the estimated dredged area (from 1,300 to 2,600 acres, Table II-2). Bathymetric surveys indicate that the area affected by mining may be at least 2.6 to 3.7 times larger than the excavated area; the affected area includes the excavated area as well as the area in which the material processed on the dredge is discharged (Sec. II.A.2.d(2)). Thus, in the high case, 6,760 to 9,620 acres would be affected. An even greater area would be affected by sedimentation of resuspended materials (see Sec. II.A.2.d(2) and Sec. IV.B.2.a). In the high case, an area equivalent to the entire sale area (147,050 acres) could be affected over the 14-year production period.

The increase in the area of benthic habitat affected by dredging and sedimentation increases the likelihood of higher order effects (MODERATE to MAJOR) on red king crabs since a higher proportion of a high-density area used year-round could be affected, presumably for a number of years. Alteration of gravel or cobble habitat, especially in the trench area, that may be important to juvenile and possibly adult king crabs contributes to determining a MODERATE effect under the high case. Monitoring could limit the effect to MODERATE; without such monitoring, effects would be expected to be MAJOR. The effect of habitat alteration on other marine plants and invertebrates is expected to be elevated to MODERATE under the high case, due to the increased area affected by dredging.

Although the volume of water used in processing sediments would double under the high-case scenario, the effect on marine plants and invertebrates is expected to remain the same level as for the mean case, MINOR. This assessment is based primarily on the broad distributions of adults giving rise to planktonic larvae, the naturally high mortality of planktonic forms, and the assumption that entrainment would affect only some portion of the larval output of a species in the area.

The effects of trace metals and noise and disturbance are expected to remain NEGLIGIBLE, and the effect of a fuel spill is expected to remain MINOR, the same levels as under the base case.

**CONCLUSION:** The effect of the proposal on red king crab, as well as other marine plants and invertebrates, under the high-case scenario is expected to be MODERATE.

4. **Effect on Fishes:** Habitat alteration could affect the physical structure of the benthic environment, as well as the distribution and abundance of invertebrates taken as prey by fishes. Even with local depressions in the invertebrate fauna, benthic feeding fishes may not be greatly affected, due to their mobility and opportunistic or generalized diets (Feder and Jewett, 1981; Jewett and Feder, 1980). Local reductions in invertebrate populations would be expected to affect fish populations only if food is limiting to benthic feeding fishes. The effect of habitat alteration on fishes under the high-case scenario is not expected to be different than that under the base case, MINOR.

The doubling of the volume of water used in the processing of sediments would lead to more fish (primarily eggs, larvae, and juveniles) becoming entrained in the dredging operation and would result in the death of greater numbers of these fishes. Of concern would be the entrainment of clumped cohorts of eggs, larvae, and juveniles. The effect under the high case is not expected to be qualitatively different than under the base case, and is expected to remain MINOR.

The effects of trace metals, noise and disturbance, and a fuel spill also are not expected to change in effects level from those expected under the base case and should remain NEGLIGIBLE, MINOR, and MODERATE, respectively.

**CONCLUSION:** Under the high-case scenario, the effect of the proposal on fishes is expected to be MODERATE.

5. **Effect on Marine and Coastal Birds:** A twofold increase in mining activities is assumed in the high case. From May to November, up to 600 helicopter flights per season between Nome and the two dredges operating in the sale area could disturb and briefly displace some marine and coastal birds (perhaps a few hundred to a few thousand) in and adjacent to the sale area. On occasion, some of these helicopter flights would likely pass near seabird colonies or waterfowl and shorebird concentrations briefly (a few minutes), thus disturbing and displacing local assemblages of marine and coastal birds. The doubling of air traffic in support of the two dredges is not likely to significantly increase the number of disturbance events (helicopters flying near coastal seabird colonies and waterfowl/shorebird coastal concentrations) because most air traffic would fly directly offshore between the two dredges and Nome. Thus, the effect of air-traffic disturbance on marine and coastal birds in the high case is expected to be MINOR, the same as in the base case.

Under the high-case scenario, the two dredges would excavate 10.5 km<sup>2</sup> of benthic sediments and alter approximately 21 to 42 km<sup>2</sup> of benthic habitat near mining operations, representing about 4 to 8 percent of the sale area benthic habitat. Although two turbidity plumes originating from each of the two dredges could adversely affect seabird-foraging success within a few kilometers of the two dredges under the high-case scenario, the availability and abundance of primary pelagic food sources of seabirds, such as sandlance and cod (that occur through Norton Sound), are not likely to be affected by dredging because these highly mobile prey are likely to avoid adverse contact with the dredge plumes. Seabird food-source abundance and distribution beyond a few kilometers of the two dredges (no more than 4-8% of the sale area) are not likely to be affected. Thus, a NEGLIGIBLE effect on the availability of seabird food sources is expected under the high-case scenario.

The excavation, deposition, and resuspension of 40 million m<sup>3</sup> (vs. 20 million m<sup>3</sup> in the base case) of seafloor sediments are sufficient to mobilize and repartition some additional mercury and other trace metals present in sediments and into the water column and onto the benthic surface where this mercury could be ingested, and/or absorbed, and bioaccumulate in marine organisms and seabirds. However, no significant increase in mercury or other trace metal bioaccumulation is expected (see Sections II.F.1 and IV.B.5.). The effect of the fuel spill on birds is expected to be the same as under the base case (MONOR).

In summary, with two dredges operating in the sale area, the level of mining activity that could have effects on birds is assumed to be double that of the base case. Turbidity from the two dredge plumes is likely to have a minimal effect on local distribution of seabirds and seabird food sources. Occasional aircraft disturbance of local populations or assemblages of birds is likely to occur. The effect of the proposal is expected to remain local under the high-case scenario. A greater effect on marine and coastal birds could occur if the size of the proposed sale area was expanded to include a much larger part of the Norton Basin Planning Area. The effect of the fuel spill is expected to be MINOR.

**CONCLUSION:** The effect of the proposal under the high-case scenario on marine and coastal birds is expected to be MINOR.

6. **Effect on Nonendangered Marine Mammals:** A twofold increase in mining activities is assumed in the high case. From May to November, up to 600 helicopter flights per season between Nome and the two dredges operating in the sale area could disturb and briefly displace some seals, walrus, and belukha whales (perhaps a few hundred to several hundred) in and adjacent to the sale area. On occasion, some of these helicopter flights would likely pass near coastal seal-haulout areas and feeding concentrations of belukha whales and walrus briefly (few minutes), thus disturbing and displacing local assemblages of seals, walrus, and belukhas. The doubling of air traffic in support of the two dredges is not likely to significantly increase the number of disturbance events (helicopters flying near coastal seal-haulout areas and walrus and belukha whale coastal concentrations) because most air traffic would fly directly offshore between the two dredges and Nome. Thus, the effect of air-traffic disturbance on seals, walrus, and belukha whales in the high case is expected to be MINOR, the same as in the base case.

Under the high case the two dredges would excavate 10.5 km<sup>2</sup> of benthic sediments and alter approximately 21 to 42 km<sup>2</sup> of walrus and bearded seal benthic feeding habitat near mining operations, representing about 4 to 8% of the sale area total benthic habitat. Although the abundance of walrus and bearded seal prey organisms

would be greatly reduced within a few kilometers of the two dredges and within excavation and deposition sites, the loss of benthic food sources within this comparatively small area is not likely to have an appreciable effect on the availability of benthic food organisms to local groups of walruses and bearded seals that feed seasonally within the sale area and throughout Norton Sound. Walruses and bearded seals are highly mobile and opportunistic foragers capable of feeding elsewhere if local numbers of benthic prey organisms are reduced. Thus, local reduction in benthic prey organisms due to mining activities is not likely to be greater than natural differences in the availability of prey within the seasonal ranges of walruses and bearded seals that occur within the sale area. Thus, a NEGLIGIBLE effect on the availability of walrus and bearded seal food sources is expected under the high-case scenario.

The excavation, deposition, and resuspension of 40 million m<sup>3</sup> (vs. 20 million m<sup>3</sup> in the base case) of seafloor sediments are sufficient to mobilize and repartition some additional mercury or other trace metals present in sediments and into the water column and onto the benthic surface where this mercury could be ingested, and/or absorbed, and bioaccumulate in marine organisms including seals, walruses, and belukha whales. No significant additional increase in the bioaccumulation of mercury in local assemblages of marine mammals that forage in the sale area is expected to occur (see Sections II.F and IV.B.6.). The effect of the fuel spill on nonendangered marine mammals is expected to be the same as under the base case (MINOR).

In summary, with two dredges operating in the sale area, the level of mining activity that could have effects on nonendangered marine mammals is assumed to be double that of the base case, and would affect 21 to 42 km<sup>2</sup> of seafloor (4 to 8% of the sale area), and is likely to have a minimal effect on the abundance and availability of walrus and bearded seal benthic food sources. Occasional aircraft disturbance of local concentrations of seals, walruses, and belukhas is likely to occur. No significant increase in the bioaccumulation of mercury in seals, walruses, and belukha whales that forage in the Nome-Safety Lagoon area is likely to occur under the high case. The effect of the proposal is expected to remain local under the high-case scenario. More widespread changes in benthic habitat and some reduction in benthic prey species could occur if the size of the proposed sale area was expanded to include a much larger part of Norton Basin Planning Area. The effect of the fuel spill is expected to be MINOR.

**CONCLUSION:** The effect of the proposal under the high-case scenario on nonendangered marine mammals is expected to be MINOR.

7. **Effect on Endangered and Threatened Species:** The OCS dredging/mining activity is assumed to double in the high-case scenario--2 dredges, 720-900 helicopter support flights annually, 200 acres mined annually, and 2,600 acres mined for the expected 14-year life of the proposed project.

The overall effects from the high-case scenario on the gray whale and the arctic peregrine falcon from habitat alteration, turbidity, noise and disturbance, trace metals, and fuel spills are expected to remain local and not significantly raise the effect levels for regional populations above those described for the proposal (base case) (see Sec. IV.B.7). Additional dredging/mining operations would increase the possibility of interaction and effects on the gray whale, but, since few whales frequent the area, the effect is expected to remain the same as the proposal (base case). The doubling of excavation, deposition, and resuspension of marine sediments (40 million m<sup>3</sup> vs. 20 million m<sup>3</sup> for the base case) could release additional mercury and other trace metals into the marine system and increase the risk and extent of potential bioaccumulation in the food chain. However, no significant increase of mercury and other trace metals is expected (the same as the proposal) (see Secs. II.F.1 and IV.B.7).

**CONCLUSION:** Overall effects from the high-case scenario are expected to be the same as the proposal (base case)--MINOR for the gray whale and the arctic peregrine falcon.

8. **Effect on the Economy of Nome:** For the high case, it is estimated that two dredges would be operating rather than the one in the base case. The differences between the two cases are seen during the production phase starting in 1995. Additional employment from OCS mining activities is expected to be 162 FTE mining-related jobs in the high case. (Appendix C, Tables 1 and 4). Because of the multiplier effect, this translates into an approximate 250 FTE jobs in the Nome economy during the period of production. This is an average of 15 percent for the high case above the no-sale alternative (Appendix C, Tables 3 and 5). A comparison of projected no-sale employment and projected employment with the sale is shown in Figure IV-5.

For the base case, an estimated 4 million (1988 dollars) in wages and salaries would be paid yearly by OCS mining companies during the production period. In addition, \$1 million to \$2 million (1988 dollars) would be

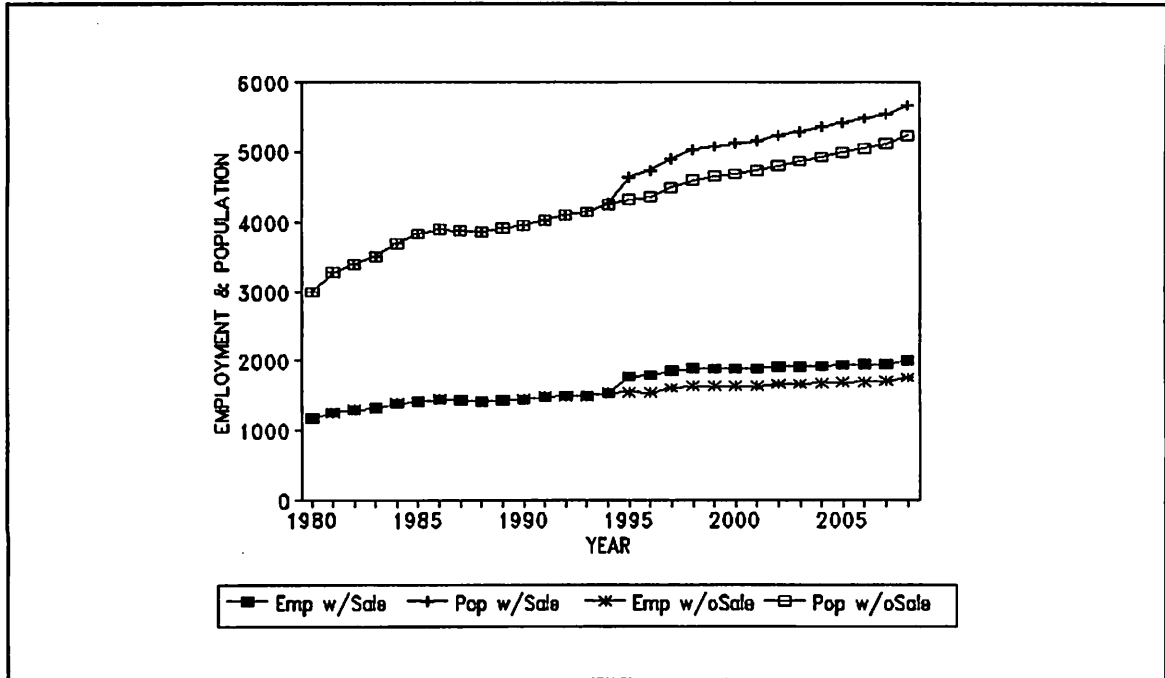


FIGURE IV-5 HIGH-CASE POPULATION AND EMPLOYMENT PROJECTIONS WITH AND WITHOUT THE SALE

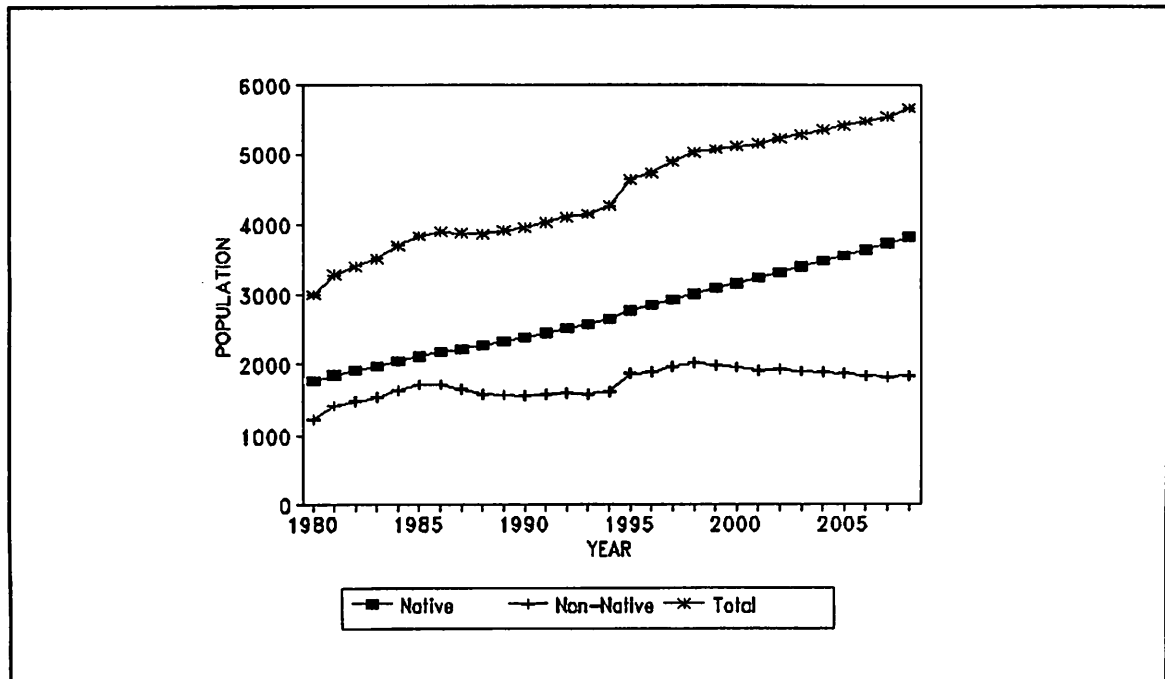


FIGURE IV-6 HIGH-CASE POPULATION PROJECTIONS WITH THE SALE

spent per year by the industry in Nome for goods and services. Nearly twice this amount is projected to be spent in the high case.

**Population:** The 1987 Nome population was estimated to be 3,872 (Appendix C, Tables 3 and 5). The population is expected to increase beginning in 1993 as a result of the OCS mining program. For the high case, population is expected to range from 396 to 436 above the projected Nome population in the absence of the sale; this is an average of 9 percent above the no-sale case. Projected high-case-population trends are illustrated in Figures IV-5 and IV-6. Native and non-Native population trends are also shown.

In summary, employment resulting from OCS mining activity in the high case is expected to average approximately 10 percent above the no-sale alternative. An estimated 40 percent of direct OCS mining jobs will go to area residents. This is expected to improve unemployment and income conditions within the local economy.

**CONCLUSION:** The effect of the proposal on the economy of Nome is expected to be MODERATE in the high case.

9. **Effect on Commercial Fisheries:** Commercial fisheries in the area of the proposal include red king crab, salmon, and herring. The red king crab fishery could be affected by dredging, sedimentation, and the resuspension of mercury during dredging. A fuel spill could affect the salmon and herring fisheries.

The Effect on Commercial Fisheries section depends heavily on the analysis presented in Section IV.B.3, Effect on Marine Plants and Invertebrates (Including Red King Crab) and Section IV.B.4, Effect on Fishes. The reader should refer to these sections for more detail.

The winter red king crab harvest is generally within 5 miles of Nome, and the summer harvest has, in recent years, been at a minimum approximately 18 miles south of Sledge Island. Potential harm to the crab habitat could result from the actual excavation of the environment and, in addition, from sedimentation that results from dredging (see Sec. IV.B.3). As indicated in Section IV.B.3, crab prefer a cobble habitat to sand. Of prime concern is the loss or alteration of cobble habitat that is potentially critical for juveniles and possibly females. The cobble habitat is altered by direct dredging and by sedimentation, resulting in sites dominated by sands and silt.

As discussed in Section IV.B.3, cobble, boulder, or gravel substrate is known to be important to juvenile king crabs. Studies in other areas indicate that the distribution of young-of-the-year red king crab is generally limited to coarse substrates such as boulders, gravel, cobble, and shell debris with attached epifauna (Jewett and Onuf, 1988, citing Powell and Nickerson, 1965b; Tsalkina, 1969; Sundberg and Clausen, 1977; and McMurrey et al., 1984). Young crabs are dependent on an environment that provides both adequate food and refuge from predators such as demersal fish. Females and juveniles show a clumped distribution; while males, particularly larger ones, migrate both in- and offshore farther than females and, thus, have a broader pattern of distribution. The more clumped distribution of juveniles and females may be related to the distribution of cobble habitat. Rocks may provide important protection to females while they are soft following molting and during subsequent mating. Recently molted crabs, in general, are more vulnerable to predators, and are readily taken by walrus (see Sec. IV.B.3).

There are conflicting reports concerning the effect dredging has had on red king crab habitat. Some observations by Nome area crab fishermen have been made. The new Nome causeway presumably has caused the ice near Nome to fracture differently than in the past, forcing winter crab fishermen into an alternate site which has been dredged by the Bima. Fishermen report that this dredged area, formerly a productive crab fishing site, is relatively barren of crab (Lean, 1988, oral comm.). On the other hand, in studies associated with the Bima monitoring program, crab pots were set in both dredged and nondredged areas in March and no significant difference in catch among the areas was reported (see Sec. IV.B.3). The possibility exists that dredging affects males differently than juveniles and females and that the catch of crabs (primarily the more mobile males) in previously dredged areas will not reflect the true effects of dredging on the population, which will not show up until a later time.

The settling of dredged material may further harm crabbing sites. The two dredge in the high case has the potential of affecting an area equivalent to the entire sale area with silt and sand sedimentation over the life of the project. As discussed in Section IV.B.3, the effect of sedimentation depends on the depth and and type of sediment deposited. Sand deposition could become a relatively permanent alteration of habitat (see Sec.



IV.B.3). Areas outside the actual dredged sites that were excavated 1.5 years ago by the Bima have boulder areas covered by 6 in of sand (see Sec. IV.B.3). Dredging in the proximity of commercial crab fishing sites could cause significant localized-habitat alteration and affect future generations of red king crab. The analysis of Section IV.B.3 finds the effect of dredging and sedimentation on red king crab is estimated to be MAJOR. This is based on the assumption that the red king crabs in Norton Sound are a discrete population; that the alteration of benthic habitat could last for a number of years in some areas; that a high proportion of cobble or boulder habitat that is directly dredged would be reduced in quality; and that gravel, cobble, or boulder habitat is critical for the survival of young-of-the-year red king crabs. Cobble and boulder habitat also may be preferred by older juvenile red king crabs and by females. General information on the life history and biology of the red king crab, the scale of projected activities, and information from dredging activity in State waters support the conclusion that effects from habitat alteration under the proposal are likely to affect the red king crab population for more than one generation and to affect subsequent recruitment or the success of juveniles (see Sec. IV.B.3). However, the monitoring program is expected to mitigate these effects and the effect on the commercial red king crab fishery is expected to be MODERATE.

If the mercury level in waters near the area of dredging operations were found to exceed the EPA chronic criterion, then the State of Alaska DEC would test the edible portions of the commercial seafood catch, including red king crab. If the concentrations exceeded FDA action levels, then the ADF&G would close the fishery, either because of a threat to human health or because of the threat to the species population. The closure of the fishery for one or more years would be a MAJOR effect on the red king crab fishery. There is no clear evidence concerning the susceptibility of red king crab to bioaccumulation of mercury. Furthermore, existing data of measured levels of mercury in the muscle tissue and the hepatopancreas of red king crab have shown generally very low values for mercury (see Sec. IV.B.3).

Mercury concentrations measured downcurrent of the Bima using state-of-the-art methodology show an average increase of 0.0004 ppb, with the highest downcurrent concentration reading 0.0014 ppb (Table IV-6a). These numbers are considerably less than other measurements that have been made (see discussion in Sec. IV.B.2). These new low numbers are below the EPA chronic criterion of 0.025 ppb, and, based on the setting of that standard, suggest that this amount of elevation of mercury should pose little threat to marine plants and invertebrates. Although there are no specific studies of mercury effects on red king crabs, the literature reviewed in Sec. IV.B.3 suggests that the concentrations of mercury more recently measured pose no apparent threat to red king crab. Elevated copper levels actually pose a greater threat and may have the potential to cause a MINOR effect (see Sec. IV.B.3). The effect of elevated trace metals due to dredging activities on the red king crab is not expected to exceed MINOR.

The current offshore dredging operation in Norton Sound carries approximately 6,000 bbl of diesel fuel. Diesel fuel has a greater concentration of aromatic hydrocarbons than does crude oil, and these are generally more toxic to organisms. A large spill would be most likely to occur during fall storms (see Table IV-10 for details of the area and weathering of such a spill), which could result in the grounding of a dredge and the spilling of some or all of its stored fuel oil. For this analysis we assume that, in the event of a spill, only a portion of the vessel's fuel is lost, that is we assume a spill of 3,500 bbl. As discussed in Section IV.B.4, the probability of an offshore spill versus one occurring in nearshore areas is not known, but for the sake of analysis, since some fishes in nearshore waters are more vulnerable, a spill in nearshore waters will be assumed. In the event of a fuel spill, harm to the commercial fishery could occur. Fishes gathering to spawn or spawning in coastal areas are vulnerable to the effects from a fuel spill. Commercial species of importance that fall into this category include salmon and herring (see Sec. IV.B.4). The effects of spilled crude oil on fishes in the Norton Basin area have been considered in the Sale 100 FEIS (USDOI, MMS, 1985a), and that information is incorporated herein.

According to Section IV.B.4, the widespread distributions of fish species in the Norton Sound area generally make them less vulnerable to effects from spilled fuel. However, salmon and herring are vulnerable during the time they are gathering to spawn or are spawning in coastal areas. Eggs and developing larvae of herring are especially vulnerable since they are found in the intertidal and shallow subtidal adjacent to land. During the open-water season, a fuel spill that occurred within the offshore sale area has an estimated 32-percent or greater chance of contacting land within 3 days of the spill (see Sec. IV.B.4). In coastal regions near the sale area, salmon return to spawn and, later, smolts leave the rivers. Because of this, it has been determined that a fuel spill that occurred and contacted the nearshore region in the open-water season when spawning fish, eggs, larvae, or smolts were present, is likely to result in a MODERATE effect to fishes, since multiple year-classes could be affected or effects on a single year-class could be felt for more than one generation. For these reasons, it is likely that a fuel spill will have a MODERATE effect on commercial fisheries.

**SUMMARY:** The commercial fisheries in the vicinity of Nome include harvests of red king crab, salmon, and herring. Red king crab habitat is expected to be disrupted by dredging and the sedimentation from dredging, although this would be mitigated by a monitoring program and would result in a MODERATE effect on the fishery. Dredging is expected to cause resuspension of naturally occurring mercury into the water column. Measured levels of mercury in the water column do not exceed the Federal water-quality criteria. If increased levels of mercury in the water column were to occur, this could cause the closure of the commercial crab fishery for 1 or more years, although a well designed monitoring program should prevent this from happening and the effect on the commercial crab fishery would be MINOR. The effect of a fuel spill on the commercial salmon and herring fisheries is expected to be MODERATE. The effect of the proposal on commercial fisheries in the Nome area is expected to be MODERATE in the high case.

**CONCLUSION:** The effect of the proposal on commercial fisheries is expected to be MODERATE.

10. **Effect on Subsistence-Harvest Patterns:** The increase in dredging activity under the high case would cause greater effects on subsistence-harvest patterns through the following: twice as much habitat would be altered, approximately double the amount of mercury and other trace metals would be repartitioned into the water column, noise and disturbance would double, the chance of a fuel spill would be doubled (although the amount of fuel spilled at one time would remain the same), and increases in the population would approximately double (see Appendix C, Table 4). In the base case, MINOR effects are already expected on subsistence-harvest patterns (see Sec. IV.B.10 for the analysis of effects). The MINOR effect in the base case on subsistence-harvest patterns is a result of effects from habitat alteration; increased excavation and deposition of sea-bottom material and sediments that would mobilize and repartition mercury and other trace metals into the water column; noise and traffic disturbance; and effects from a fuel spill. The acceptable level of increase of mercury into the water column and consequently into the food web has not been defined because at this point, without knowing how much seafood Nome residents consume, it is impossible to determine what degree of an increase in trace metals would be dangerous to human health. There have been no baseline studies of consumption of seafood by Nome residents to determine more precisely how much and what types of seafood are consumed by Nome residents. Thus, it is not known what levels of mercury in subsistence resources consumed by humans would keep the allowed daily intake (ADI) of mercury in humans at or below the level recommended by the WHO (see Secs. IV.B.11 and 15 for this discussion). With adequate monitoring of fishes and shellfish under Stipulation No. 1, Environmental Survey and Monitoring Program and Operation Management, as well as monitoring of levels of mercury in humans, all marine subsistence resources should be protected from levels of trace metals exceeding EPA criteria. Doubling the dredging activity in the high case would not increase the MINOR level of effects expected in the high case; however, the effects probably would be intensified. Perceived effects or a fear of mercury contamination of subsistence resources also would be intensified in the high case. Thus, MINOR effects are expected on subsistence-harvest patterns in the high case, the same as in the base case.

**CONCLUSION:** In the high case, the effect of the proposal on subsistence-harvest patterns is expected to be MINOR.

11. **Effect on Sociocultural Systems:** As in the base case, industrial activities, population and employment, and effects on subsistence-harvest patterns are the causal agents of effects on sociocultural systems. The increase in dredging activity under the high case would cause greater increases in population growth and employment, as well as cause greater effects on subsistence-harvest patterns (see Sec. IV.I.10). In the high case, the population is expected to increase 425 (8.3%) above the projected total Nome population without the sale (see Appendix C, Table C-5), compared to an increase of 199 (3.8%) in the total population in the base case by the year 2008 (Appendix C, Table C-3). More than twice as many additional people are expected in Nome in the high case compared to the base case. By the year 2008, the Native population will only have grown by 108 residents in the high case, compared to 37 in the base case (Appendix C, Table C-7). While more than twice the number of people are expected to be living in Nome as a result of the high case, the percentage of growth still would not be significant enough to cause more than the expected MINOR level of effects from population growth in the base case.

Subsistence is central to the Yup'ik and Inupiat sociocultural system. In the high case, MINOR effects are expected on subsistence-harvest patterns (see Sec. IV.I.10), the same as in the base case. As in the base case (see discussion in Sec. IV.B.11), MINOR effects on the subsistence-harvest patterns would cause disruptions to the social organization and cultural values and increase levels of stress in the community (see Secs. IV.B.11.b[1] and IV.B.11.b[2]). A MINOR effect on subsistence-harvest patterns would double in the high case. With Stipulation Nos. 1 through 3 in place, the effects would not be expected to be higher than MINOR, but the

effects would be intensified. Thus, the effect on sociocultural systems in the high case as a result of the MINOR effect on subsistence-harvest patterns also would be MINOR, the same as for the base case.

**CONCLUSION:** The effect of the proposal in the high case on sociocultural systems is expected to be MINOR.

12. **Effect on Archaeological Resources:** Effects on shipwrecks and archaeological landforms would be increased by a factor of two under the high case. No significant landforms exist in the proposed sale area, but records of shipwrecks indicate that there are some shipwrecks in the lease area. Because the effect of the high case would be doubled, this would result in the nearly doubling of the assumed contacts with shipwrecks; however, the number of resources affected would not change and the number of archaeological resources in the contact area is low. This would result in a modest effect on the resources.

**CONCLUSION:** The effects of the high case on landforms and archaeological sites (including shipwrecks) would be MODERATE.

13. **Effect on Recreation and Tourism:** It is expected that recreation and tourism resources would be visited more frequently because of the increased activity shown in the high-case scenario. The amount of increase in employees and tourists would have a slightly significant adverse effect on the recreation and tourism, and aesthetic resources. The activity would slightly increase the economic expenditures of recreation and tourism because of interested visitors. Such increased tourism and recreation would last for more than 4 years. Increased expenditure for more than 4 years would result in an increased effect greater than the proposal.

**CONCLUSION:** The effect of the high case on recreation and tourism is expected to be MODERATE.

14. **Effect on Land Use Plans and Coastal Management Programs:** In the high case, the types and levels of effects associated with changes in the benthic environment, resuspension of toxic trace metals, and excessive turbidity are comparable to those identified in the base case of the proposal, although typically they are intensified or more likely. Increases in mining employment (162 full time equivalent positions during production, see Appendix C, Table 4) also remain well under the threshold of 212 persons (5% of the no-sale population for 1995) that would trigger the NCMP policy concerned with community growth.

Increases in disturbances of habitat raise the levels of effects for red king crab, although monitoring prevents potential MODERATE effects from raising to MAJOR. This disturbance creates a potential for conflict with both the overall and the offshore habitat standard of the ACMP. Therefore, potential conflict with the statewide standard for offshore habitat, and by extension the statewide standard for mining and mineral processing, that were noted for the proposal remains.

**CONCLUSION:** MODERATE conflict with the ACMP is expected to occur as a result of activities associated with the high case of this lease sale.

15. **Effect on Human Health:** Under the high case, the increase in dredging activity could potentially increase the resuspension of mercury and other trace metals into the water column. However, in the base case, the effect on human health is expected to be NEGLIGIBLE (see Sec. IV.B.15 for this analysis) and the doubling of dredging activity is not likely to significantly increase the amount of mercury in the water or increase the bioaccumulation of mercury or other trace metals in the food chain. The levels of mercury measured in seawater in the Nome area are low and well below EPA criteria and mercury levels are generally low in marine subsistence foods (such as salmon 0.01 ppm). Exposure levels in Nome women are very low (average of about 1.0 ppm hair-mercury level). Thus, the effect of mercury under the high case on human health is expected to be NEGLIGIBLE.

**CONCLUSION:** In the high case, the effect of the proposal on human health is expected to be NEGLIGIBLE.

#### **IV.H. Unavoidable Adverse Effects**

1. **Air Quality**: An increase in emissions of air pollutants would occur as a result of the proposed sale. Much of the emissions could be reduced by application of existing control technologies. Unavoidable MINOR degradation of air quality is expected from the proposal with respect to standards and effects not addressed by standards.

2. **Water Quality**: The unavoidable adverse effect on water quality anticipated from the proposed action would be limited to high turbidity and trace-metal concentrations within the 34 km<sup>2</sup> surrounding the dredge during active dredging (MAJOR LOCAL), and from temporary (MINOR LOCAL and REGIONAL) degradation from an accidental fuel spill.

3. **Marine Plants and Invertebrates**: Unavoidable adverse effects on marine plants and invertebrates from the dredging activities projected for this lease sale would include effects from the excavation, processing, and discharge of seafloor materials and associated flora and fauna; increased turbidity; the release of trace metals associated with excavated depths; entrainment of water column organisms; and accidental fuel spills. The details of these effects are described in Section IV.B.3. With the monitoring program in place, the effect of habitat alteration is expected to be MODERATE; the effect from increased turbidity, MINOR; the effect from release of trace metals, NEGLIGIBLE; the effect of entrainment, MINOR; and the effect of an accidental fuel spill, MINOR. In general, unavoidable adverse effects include both lethal and sublethal effects on marine plants and invertebrates ranging from destruction and alteration of habitat with the concomitant death of many of the associated organisms, possible bioconcentration of trace metals, and death of some organisms due to entrainment and/or a fuel spill. The overall effect on marine plants and invertebrates is expected to be MODERATE.

4. **Fishes**: Unavoidable adverse effects on fishes from the dredging activities projected for this lease sale would include both lethal and sublethal effects from the excavation, processing, and discharge of seafloor materials; increased turbidity; the release of trace metals associated with excavated depths; entrainment of water column organisms; and accidental fuel spills. The details of these effects are described in Section IV.B.3. The effect of habitat alteration is expected to be MINOR; the effect from increased turbidity, MINOR; the effect from release of mercury and other trace metals, NEGLIGIBLE; the effect of entrainment, MINOR; and the effect of an accidental fuel spill, MODERATE. The overall effect on fishes is expected to be MODERATE.

5. **Marine and Coastal Birds**: Some bioaccumulation of mercury and other trace metals in marine organisms and in seabirds is considered unavoidable. However, significant increases in mercury and other trace metals in marine and coastal birds would be avoidable under the proposal. A fuel spill and most disturbance of marine and coastal birds are considered avoidable although some temporary disturbance and local displacement of seabirds within a few kilometers of dredging operations would be unavoidable (MINOR effect).

6. **Nonendangered Marine Mammals**: Some bioaccumulation of mercury and other trace metals in marine organisms and in seals, walruses, and belukha whales is considered unavoidable under the proposal. However, significant increases in mercury or other trace metals would be avoidable under the proposal. Some temporary disturbance and local displacement of marine mammals within a few kilometers of the dredging operation would be unavoidable (MINOR effect).

7. **Endangered and Threatened Species**: The possibility of some bioaccumulation of mercury and other trace metals in the marine ecosystem is considered unavoidable. However, detrimental levels of mercury and other trace metals in the marine ecosystem would be avoidable in the proposal. Some short-term disturbance of nesting peregrine falcons and gray whales, as well as some local displacement of a few gray whales within a few kilometers of the mining operation would also be unavoidable.

8. **The Economy of Nome**: With respect to the economy of Nome, there would be a slight unavoidable adverse effect in the form of short-lived price inflation.

9. **Commercial Fisheries**: Unavoidable adverse effects on the commercial fishery from the dredging activities projected for this lease sale would include effects from the excavation, processing, and discharge of seafloor materials and associated flora and fauna; the release of trace metals associated with excavated depths; and accidental fuel spills. The details of these effects are described in Section IV.B.9. With

the monitoring program in place, the effect of habitat alteration is expected to be MODERATE; the effect from release of trace metals, MINOR; and the effect of an accidental fuel spill, MODERATE. In general, unavoidable adverse effects include both lethal and sublethal effects on red king crab, herring, and salmon ranging from destruction and alteration of habitat with the concomitant death of many of the associated organisms, possible bioconcentration of trace metals, and death of some organisms due to a fuel spill. The overall effect on commercial fisheries is expected to be MODERATE.

10. **Subsistence-Harvest Patterns:** With a monitoring program (Stipulation Nos. 1 and 3) in place, adverse effects on subsistence harvests from habitat alteration and increased levels of trace metals in subsistence resources should be avoided. Noise and traffic disturbance and fuel spills could cause subsistence hunters and fishermen to harvest fewer resources and to travel farther for the harvests, but subsistence resources should still be available.

11. **Sociocultural Systems:** Effects on subsistence-harvest patterns would be reduced (MINOR effect) with a monitoring program in place (see Sec. IV.B.10). Effects on subsistence-harvest patterns would be short term, and should not cause any adverse effects on sociocultural systems. Tensions in the community from additional temporary workers would also be unavoidable.

12. **Archaeological Resources:** The risk of dredging up a portion and even a whole shipwreck or parts of an old historic dredge is unavoidable because there is no present requirement for monitoring for wood during the dredging operation. Some disturbance to shipwrecks or old dredges will occur.

13. **Land Use Plans and Coastal Management Programs:** Monitoring is expected to moderate many biological and social effects. The remaining effects are considered unavoidable. As a result, the MODERATE potential for conflict with the statewide standards and district policies of the ACMP noted for the proposal in Section IV.B.14 is considered unavoidable.

14. **Human Health:** No unavoidable adverse effects are expected on human health as a result of dredging activities from the proposed lease sale.

#### **IV.I. Relationship Between Local Short-Term Uses and Maintenance and Enhancement of Long-Term Productivity**

In this section, the short-term effects and uses of various components of the environment of the Norton Sound area are related to long-term effects and the maintenance and enhancement of long-term productivity. The effects of the proposed action would vary in kind, intensity, and duration, beginning with preparatory activities (seismic data collection and exploratory drilling) of offshore mineral development and ending when natural environmental balances might be restored.

Temporary LOCAL and REGIONAL degradation of water quality could occur during active mining and in the case of a major fuel spill. There would be no long-term contamination of water quality after mineral extraction ends.

Some biological productivity would be lost in the short term on all seafloor areas that were excavated by dredging operations and those benthic habitats exposed to sediment turbidity and resettlement. Recovery of communities to their previous state may or may not occur, depending on the degree of change in the physical environment and which species recolonize. Some species may have difficulty repopulating and could be displaced. Recolonization of affected areas could take years, and, as stated above, recovery of communities to their previous states may not occur. Of particular concern would be the alteration or destruction of what may be critical red king crab habitat. This could result in a long-term decline of a species that figures importantly in both commercial and subsistence fisheries.

Seasonal short-term increases in air pollutants may occur. However, the pollutant concentrations would be well within the health-based regulatory limitations. Accumulation of acidified precipitation over a period of several years may have a localized effect on near-shore tundra vegetation.

Some of the effects discussed in Section IV are considered to be long term such as habitat alteration. Habitat alteration in Norton Sound could cause adverse effects on all components of the marine ecosystem, including fisheries. While restoration may allow fisheries production to regain original levels, any reduced annual harvests during the life of the project would be irretrievably lost. The extent is not presently known, but the potential must be recognized.

Trace-metal contamination from mining activities could be a long-term (several generation) effect on some seabird populations and the local arctic peregrine falcon population. However, the incorporation of Stipulation Nos. 1 and 2 should mitigate and prevent any substantial long-term accumulation of trace metals within the marine ecosystem.

Some biota could be threatened in the short term by potential fuel pollution. Disturbance effects could be significant through the combined effects of harassment by humans and the increased volume and frequency of noise from vessel traffic or overflying aircraft. In the long term, such disturbances could alter behavior patterns and could drive fauna away from traditional feeding and breeding grounds or to other habitat areas within their range, perhaps reducing species populations somewhat over a long period of time.

Habitat destruction (from dredging) could cause a reduction in subsistence-commercial species, such as king crab, which could affect the regional economy. Overall wilderness value of the coast may decrease from increased land use. Increased human populations in the short term could change the regional Native culture in the long term. The subsistence way of life could be modified and population shifts could occur. The overall changes cannot be termed positive or negative, except by those affected.

Archaeologic and historic values discovered during development would enhance long-term knowledge. Mining activity may help to locate other sites, but in the unlikely event artifacts were present and destroyed by dredging, this would represent long-term losses.

Economic benefits from the proposal would accrue to the Federal government in the form of rentals and royalties, to the Nome economy through increased employment opportunities, industry spending in the economy, and to the mining companies by way of profits. These benefits would exist for the life of the proposal. A longer term benefit may be the development of the Nome infrastructure, which could expand Nome's role as a regional service center.

Mineral development in these areas may cause long-term harm to the commercial red king crab fishery. The maintenance and enhancement of long-term productivity of the fisheries would be threatened by the proposal.

#### **IV.J. Irreversible and Irretrievable Commitment of Resources**

1. **Minerals Resources:** The base-case resource estimate for the proposed action is 530,000 troy ounces of gold. As noted in Section II.A.2.b, gold is considered to be the only marketable product that presently can be economically recovered from the proposed OCS Mining Program Norton Sound Lease Sale area. This resource is irretrievably committed to removal from the resources of the region.

2. **Biological Resources:** Any reduced population levels (particularly of benthic organisms) could become irretrievable if permanent alterations to the environment and habitat were created. Of particular concern would be alteration or destruction of what may be critical red king crab habitat. This could lead to a long-term decline in an important commercial and subsistence species.

3. **Endangered and Threatened Species:** Effects of the proposal could reduce population levels of the threatened arctic peregrine falcon. This could become irretrievable if permanent alterations to the environment and habitat were created.

4. **Social Systems:** Effects of the proposal would force some degree of adjustment and change, which would represent irreversible and irretrievable losses to Inupiat and Yup'ik society. A lack of consideration by incoming workers for traditional Inupiat and Yup'ik culture and society may mean irretrievable loss to their sociocultural systems.

5. **Archaeology:** Material products of prehistoric culture such as onshore archaeological sites may be lost through looting and indiscriminate or accidental activity on known and unknown sites. Consultation with the State Historic Preservation Officer (SHPO) on what resources exist and how to protect them reduces the effects. However, in spite of consultation, some irretrievable losses are likely.

6. **Commercial Fishing:** Losses of commercial fishing incomes attributable to this proposal would be irretrievable. Commercial finfish and shellfish that become polluted would be irretrievably lost to the economy.

7. **Human Health:** The potential effect of the proposal on human health could be generally irreversible and irretrievable, particularly on developing fetuses. Neurological impairment of human development is not reversible; some postnatal effects from mercury poisoning have lessened, but never with developing fetuses (Marsh, as cited in USDOJ, MMS, 1989). However, due to the low levels of mercury recently measure in the environment and the low levels found in Native women (mercury-hair levels), no irreversible and irretrievable effects are expected.



**SECTION V**

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**REVIEW  
AND  
ANALYSIS  
OF  
COMMENTS  
RECEIVED**

V. REVIEW AND ANALYSIS OF COMMENTS RECEIVED

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## V. REVIEW AND ANALYSIS OF COMMENTS RECEIVED

### A. Introduction

During the second DEIS comment period, comments and testimony were received from a diverse group of individuals; groups; organizations; companies; and local, State, and Federal agencies. Comments ranged from support of the EIS and the proposal to support of various deferral alternatives to postponement or withdrawal of the proposal, and to requests for revision of the EIS.

Correspondence was received from 6 Federal agencies, 1 State agency, 1 local and regional organization, 1 environmental organization, and 1 individual. A public hearing was held in Nome, Alaska, with a total of 4 people testifying.

Throughout the development of the EIS, the Coordination Team has made continuing suggestions during the internal review process and these suggestions have been informally addressed by MMS. Formal comments received from Coordination Team members on the second DEIS may be found in the following section.

Major concerns of those commenting were the status and adequacy of baseline information in the sale area; effects of mercury on the environment including human health; the configuration of and need for a monitoring program to address information needs; the effects of habitat alteration on red king crab; mitigating measures; deferral alternatives; the development scenario; and analysis of effects on biological resources.

This volume contains reproductions of all letters received in comment and oral testimony given during the public hearing on the second DEIS. Specific comments are bracketed, and responses follow the comments. Where comments warranted changes in the text of the EIS or presented new, substantive information, the EIS was revised accordingly. Reference to the revised sections is made in the responses to specific comments.

Few substantial changes have been made in the text of the FEIS that differ greatly from the second DEIS. Changes were made in the following mitigating measures: Stipulation No. 1 has been amended to include the arctic peregrine falcon as a result of the biological opinion from FWS; Stipulation No. 5 on protection of the arctic peregrine falcon has been dropped as a potential mitigating measure; ITL No. 3 has been amended to clarify subsistence-harvest seasons; and ITL No. 5, Information on Postlease Norton Sound Review Team, has been added. In addition to changes in mitigating measures, the FEIS includes missing and updated information that was not available in the DEIS.

### B. Letter and Public Hearing Comments and Responses

The following section presents reproductions of all letters and oral testimony received during the second DEIS comment period. Specific comments in each letter are bracketed and numbered, and MMS responses follow the comments. The names of those who commented on the second DEIS are listed below and show the order in which the letters will appear.

Those that are or have representatives on the Coordination Team are followed by (CT). Those that are observers or received a courtesy copy of the EIS during CT reviews are also indicated.

#### Federal Agencies

Department of Commerce National Oceanic and Atmospheric Administration (NOAA) (CT)  
Department of Health and Human Services, Public Health Service (PHS)  
Department of the Interior - Bureau of Mines (BOM) (CT)  
Department of Transportation - U.S. Coast Guard (CT)  
Environmental Protection Agency (EPA) (CT)  
Marine Mammal Commission (MMC)

#### State Government

State of Alaska Division of Governmental Coordination (STATE) (CT)

**Local and Regional Organizations**

Sitnasuak Native Corporation (SNC) (CT)

**Environmental Organizations**

Natural Resources Defense Council (NRDC)

Includes: Friends of the Earth and Trustees for Alaska (CT-Courtesy Copy)

**Individuals**

Dan Levinson (LEV)

**Public Hearing**

Nome (NOME)



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
Office of the Chief Scientist  
Washington, D.C. 20230

August 3, 1990

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION  
PROPOSED 1991 OUTER CONTINENTAL SHELF MINING  
PROGRAM LEASE SALE IN NORTON SOUND

The Ocean Minerals and Energy Division (OMED), Charting and Geodetic Services (C&GS), and the Alaska Office Staff of the National Ocean Service (NOS) have reviewed the subject document and offer the following comments.

General Comments

The OCS mining program proposed in the DEIS does not pose wide-ranging environmental consequences but the few it does can be very harmful. The introduction of new and remobilization of existing toxic metals deposited on the sea bed, notably mercury, pose a potential health problem. The effects of mercury on the environment should be given more attention. A more comprehensive review of mercury concentration and toxicity data on marine fish, birds and mammals would be helpful.

NOAA-1

The impact upon nearshore navigation from seafloor mining projects is extremely important and should be discussed within the DEIS.

In addition to the dredging equipment which will be in place, there may be an impact on the safety of navigation in the affected area caused by the creation of dredged sediment mounds in the area. While most of the dredged material will be discharged into the same area from which it was previously removed, causing minimal change, a portion at the beginning of each course will be deposited on undisturbed sediment.

NOAA-2

Section II-12 states that the tailing berm at the start of each course ranges from 1.2 m to 8.5 m above the seafloor. C&GS' Nautical Charting Program is very interested in the bathymetry of this area and how the mining operation may change the information presented on nautical charts and bathymetric maps. Since the existing nautical charts are based upon data taken as far back as the year 1900, C&GS should be provided copies of any post-operation seafloor surveys for comparison with existing bathymetry of the area and incorporation onto revised editions of nautical charts and bathymetric maps.

NOAA-3

Page II-14

The DEIS mentions that dredges usually are built for specific types of mining operations and that the Bima was modified after operating for part of a season off Nome where it is mining placer deposits in State of Alaska waters. We feel that an alternative discharge system is technically feasible and could be designed into a new dredge or as a modification to an existing one.

NOAA-4

Mr. Alan D. Powers  
Regional Director  
Minerals Management Service  
Alaska Region  
949 East 36th Avenue  
Anchorage, Alaska 99508-4302

Dear Mr. Powers:

Enclosed are comments to your Draft Environmental Impact Statement for the proposed 1991 Outer Continental Shelf Mining Program Lease Sale in Norton Sound. We hope our comments will assist you. Thank you for giving us an opportunity to review the document.

Questions about the environmental and procedural concerns should be directed to Dr. Jawed Hameedi at (907) 271-3033 or Mr. James Lawless at (202) 673-5121. Questions about the navigation aspects should be directed to Mr. Erich Frey at (301) 443-8742.

Sincerely,

*Donna Whiting for*

David Cottingham  
Director  
Ecology and Environmental  
Conservation Office

Enclosure

cc: Director, MMS  
George Valiulis, MMS

RECEIVED

AUG 9 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA



The C&GS response dated January 9, 1989, to the first EIS draft was not included in the comments section of the second draft (see copy attached). Several environmental and procedural concerns were mentioned in C&GS' first draft response which have not been addressed by the second draft. These comments should be included in the response to the second draft.

Specific Comments

Page xviii

The "trench area" alluded to at the end of the first paragraph of Section C has not been identified or described. As it is not a particularly well known area, this should be clarified. ] **NOAA-6**

Page II-7

The suggestion submitted by OMED on December 23, 1988 to the first EIS draft regarding loss of the cobble substrate habitat of the red king crab was not acknowledged or addressed in this latest draft. ] **NOAA-6**

The loss of the cobble substrate habitat of the red king crab seems to result from the assumed discharge from the dredge of a heterogeneous mixture of tailings into areas previously excavated. A dual discharge could be considered which would dump the fine material immediately behind the dredge while the coarse material would be discharged well astern on top of the earlier discharged fines. ] **NOAA-7**

Page II-11

The last full paragraph again refers to the "coastal trench." This is an unfamiliar formation. ] **NOAA-8**

Page II-14, paragraph 2

The "dynamic nature" of the sedimentary environment is not at all indicated by the occurrence of (1) storm surges, ..., (4) bottom currents.... This paragraph should be reworded since the implied cause and effect is not apparent. ] **NOAA-9**

Page IV-B-2, base case

The second to last sentence contains a double negative that is probably unintended. ] **NOAA-10**

Page IV-B-32, middle of last paragraph.

The reference to movement of silts due to winter storms is puzzling. This implies open water rather than ice-covered conditions. Should this be fall storms? ] **NOAA-11**

Page IV-B-35, bottom of page

The stated reduction of effects on benthos from Moderate to Minor through the use of a monitoring strategy seems tenuous. It assumes that the monitoring will provide statistically defensible data that can be used for decisions concerning the geographic ] **NOAA-12**

disposition of dredging activities. Given the usual heterogeneity and large natural variability of benthic communities, the acquisition of solid data will require an investment of time (years) and money that is greater than seems plausible given the scale of the proposed activities. ] **NOAA-13**

Page IV-G-1, paragraph 1

Change 40 m<sup>3</sup> and 20 m<sup>3</sup> to 40 million m<sup>3</sup> and 20 million m<sup>3</sup>, respectively.

Bibliography

Full citations are missing for ENSR Consulting and Engineering, 1990; Larsen et al., 1981; and NOAA, 1983. Missing references: P. IV-B-23 Ellis and Taylor (1988), P. IV-B-37 Tobin (1988), P. IV-V-41 Forstner and Wittman (no date), P. IV-B-104 Charlebois, Rivest, and Nichols (1977). ] **NOAA-14**

JAN 9 1985

2

MEMORANDUM FOR: David Cottingham  
Ecology and Environmental Conservation Office  
Office of the Chief Scientist

FROM: Rear Admiral Wesley V. Hull, ~~NOAA~~ WESLEY V. HULL  
Director, Charting and Geodetic Services

SUBJECT: OCS Mining Program - Norton Sound Lease Sale

The subject Call for Information has been reviewed within the areas of Charting and Geodetic Services' (C&GS) responsibility and expertise and in terms of the impact of the proposed actions on C&GS activities and projects. C&GS has surveyed virtually the entire area of the lease sale seaward of the coast line using conventional hydrographic mapping systems (see bathymetric map blueprint for Nome and topographic/bathymetric map for Solomon, Alaska, both 1:250,000 scale, which are attached).

C&GS has three points of concern:

First, the "models" used to determine the likely environmental impacts of the proposed mining operation follow the approach utilized by the Minerals Management Service (MMS) for the Oil and Gas Leasing Program. While this approach may have limited value in determining some of the first order environmental impacts, it varies significantly with respect to the differences between oil and gas extraction versus seafloor mining. Furthermore, it is unlikely that existing models for nonenergy mining will be applicable to this offshore area since the majority of these models are for deeper waters and utilize different technological approaches. These differences lead to two major shortcomings of this DEIS:

- a. The reference to the Final EIS for Norton Basin Lease Sale 100 has little reference to the proposed seafloor mining sale. An improvement would be to refer to the extensive base of geological and geophysical information for this area. Many of these references are included in the bibliography section of the DEIS. However, OCS Report (MMS 86-0033) titled Geologic Report for the Norton Basin Planning Area, Bering Sea, Alaska was not mentioned in the bibliography. This OCS report contains a comprehensive overview of the geology of the region and includes a section on shallow water geology, geological hazards, and environmental conditions. Included with the report is a detailed bathymetric map with 2-meter contour intervals (figure 39) which

NOAA-15

presents a great deal more detail than shown on figure III-1 in the DEIS.

- b. An expanded monitoring scheme may be required to assure that the terms of the EIS are being followed. Critical factors which may not be applicable to the Oil and Gas Model deal with the continuous surface turbidity plume created by the mining operation as well as the physical disruption of the bottom by the bucket dredge and the platform anchoring systems.

NOAA-16

The second concern relates to access to core and other geological and geophysical data collected by the applicant. Terms should be established between the Government and any prospective bidders to ensure that data collected by them will be transferred to the National Archives soon after an award is made. These data will be extremely useful in determining the overall characteristics and values of the seafloor of the U.S. Exclusive Economic Zone (EEZ). This information will be invaluable for developing scenarios for subsequent EEZ mining operations.

NOAA-17

Finally, it should be reiterated that NOAA is on record as being opposed to MMS' utilization of the Outer Continental Shelf Lands Act's Section 8 (K) for leasing hard mineral sales in the EEZ. This proposed sale would result in the first issuance of a permit for a seafloor mining operation (excluding sulphur) in the EEZ since the President's EEZ Proclamation. No provision has been made for the significant differences between seafloor mining and oil and gas extraction, nor has there been any experience with bidding and royalty stipulations to reflect these differences. Consequently, there may be broad national and international implications given the sensitivity of seabed mining in the Law of the Sea Convention's ongoing deliberations.

NOAA-18

Should you have any need for further information about this response, please contact Mr. Millington Lockwood, Ocean Mapping Section, N/CG224, WSC5, Room 672, Nautical Charting Division, NOAA, Rockville, Maryland 20852, telephone (301) 443-8251.

Attachments

cc:  
F/PR3 - Hall  
N/CG1x9 - D'Onofrio  
N/CG2 - Andraesen  
N/CG221 - Pefe  
N/CG224 - Theberge  
N/CG224 - Lockwood  
N/ORM1 - Lawless

N/CGx11:GTEnglish:443-8536:sw:1/5/88:DEIS Copy 76:CY89A





UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
Office of the Chief Scientist  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

August 28, 1990

Mr. Alan D. Powers  
Regional Director  
Minerals Management Service  
Alaska Region  
949 East 36th Avenue  
Anchorage, Alaska 99508-4302

Dear Mr. Powers:

This letter clarifies the National Oceanic and Atmospheric Administration's (NOAA) August 3, 1990, comments to the 1991 Outer Continental Shelf Mining Program Lease Sale in Norton Sound. We included a January 9, 1989, memo from NOAA's Coast and Geodetic Survey (C&GS) which raised several points, including the issue of regulatory authority. We included those comments to illustrate NOAA's concern that the 1990 DEIS does not include responses to their 1989 comments. However, it is not our intent in the August 3, 1990, comments to challenge MMS regulatory authority under the Outer Continental Shelf Lands Act (OCSLA).

NOAA-19

That issue was raised and commented on in the January 13, 1989, NOAA letter to Tim Holder. We remain concerned that the OCSLA is not the appropriate regulatory regime to lease hard minerals on the seabed, but for reasons outlined in the January 13 letter, we do not oppose MMS holding the lease sale as planned.

I hope that this clarifies our overall position regarding the regulatory program and the specific sale.

Sincerely,

*David Cottingham*

for David Cottingham  
Director  
Ecology and Environmental  
Conservation Office



### **Response NOAA-1**

There is a low potential threat of mercury contamination and biomagnification as suggested by the recent state-of-the-art analyses of water-column mercury values; however, the EIS devotes a large amount of space and effort to this discussion. This is due to the seriousness of the general issue and the concerns expressed throughout our consultation process. The EIS is not the place for a comprehensive review of these issues, but such reviews are referenced in the text.

### **Response NOAA-2**

Nearshore navigation is, in most instances, likely to involve vessels capable of entering and leaving the Nome Harbor; the Coast and Geodetic Survey chart showing the approaches to Nome Harbor (Chart 16206) indicates water depths of about 5 ft at the entrance to the harbor. In addition, there are dredge dump sites located on each side of the entrance in waters as deep as 40 ft.

As noted in the EIS, mining activities that might result from the proposed sale will occur 3 or more nautical miles offshore and in waters that are generally greater than 20-m (about 65 ft) deep. Although mining for gold will alter the bathymetry in some areas, these changes are not expected to affect navigation, especially the operation of vessels in the nearshore area where the depth limitation at the entrance to Nome harbor restricts the draft of vessels that can enter.

The Bima is able to excavate to a depth of about 45 m below the sea surface (Sec. II.A.2.d). Most of the sale area lies in waters 20- to 30-m deep; thus, the maximum depth of sediments that can be excavated ranges from about 15 to 20 m. Dumping of excavated material onto the seafloor is not expected to build a berm that is equal in height to the excavation depth; information presented in the EIS, Section II.A.2.d, indicates for a 10-m excavation depth, there will be a berm that is about 8.5-m high. (The height of the berm is a function of the size of the material being excavated. Manmade islands constructed in the Beaufort Sea by dumping gravel onto the seafloor have sides with a vertical to horizontal slope of about 1:3; if sand is used in the construction of the islands, the slope is about 1:5. The construction of these islands illustrates that material dumped onto the seafloor will spread out and the finer material spreads over greater distance causing a decrease in the potential height of the berm.)

Furthermore, all OCS mineral development and production activities shall be conducted in accordance with a mining plan submitted by the lessee and approved by the Director of MMS (30 CFR 282.24). The mining plan shall include: (1) maps of the lease showing water depths, the outline of the mineral deposit(s) to be mined and the area(s) to be mined each year; (2) a description of any potential conflicts with other uses and users of the area; (3) a description of measures to be taken to avoid, minimize, or otherwise mitigate hazards to navigation; and (4) a detailed description of procedures to be taken to assure that the seafloor is left free of obstructions and structures that present a hazard to other users of the OCS such as navigation or commercial fishing.

These plans would be sent to the State and appropriate Federal agencies, including NOAA and USCG, for review. If changes in the bathymetry of a mining area are a potential threat to navigation or other users, ways to minimize or mitigate the threat(s) can be proposed and the mining plan modified.

### **Response NOAA-3**

See Response NOAA-2.

### **Response NOAA-4**

Before mining can occur, the lessee is required to submit for approval by the Director of MMS a mining plan (30 CFR 282.24). This plan shall include (1) a description of equipment to be used in mining, processing, and transporting the ore; (2) the method of tailings disposal; and (3) the volume of ocean bottom expected to be disturbed each year. As noted in Response NOAA-2, these plans are sent to State and appropriate Federal agencies for review. With site-specific plans available, specific concerns about the mining activities can be noted and alternatives suggested; if technological alternatives are feasible, the plans can be modified.

#### **Response NOAA-5**

The "trench area" alluded to in this section is described in as much detail as we have available. It is defined basically as the area within (deeper than) the 30-m isobath. It tends to run parallel to and south of the Seward Peninsula coast, with another section running south of Sledge Island. This area has been suggested as possibly being of high importance to red king crabs due to the high concentrations of crabs found near or within it.

#### **Response NOAA-6**

In a NOAA letter dated January 13, 1989, a similar comment was made as follows:

"Cobble substrate is important to Red King Crab. The loss of this bottom type seems to be the result of the assumed discharges from the dredge of a heterogeneous mixture of tailings into areas previously excavated (page II-6). Such a technique need not be used. It is technically feasible to arrange for a dual discharge: the fine material can be dumped immediately behind the dredge while the coarse material is discharged well astern on top of the earlier-discharged fines. The MMS might consider such a stipulation."

The MMS appreciates this information but believes that even a stipulation as suggested would not alleviate all the problems associated with the dredging of cobble substrates. Although cobbles would presumably not end up buried, they would still be displaced, could end up inverted (killing attached organisms), and, as noted in studies of Bima dredge results, be removed from the rather hard pavement where they originally occur and, thus, become unstable. Such instability would affect the successful recolonization and growth of organisms on the boulders.

#### **Response NOAA-7**

See Responses NOAA-4 and NOAA-6.

#### **Response NOAA-8**

This concern is addressed in Response NOAA-5.

#### **Response NOAA-9**

The paragraph has been revised.

#### **Response NOAA-10**

The text has been corrected.

#### **Response NOAA-11**

The text has been changed to refer to fall storms.

#### **Response NOAA-12**

The text and bottomline effect have been revised. The bottomline was revised from MINOR to MODERATE.

#### **Response NOAA-13**

The text has been changed to address this concern.

#### **Response NOAA-14**

The citations have been corrected.

### **Response NOAA-15**

The MMS report referenced in the comment, Geological Report for the Norton Basin Planning Area, Bering Sea, Alaska, is one of a series of reports prepared for oil and gas lease sales in the Alaska OCS Region. The information contained in this report does provide a comprehensive overview of the geology of the region, but such information is not necessary for the preparation of an EIS in which the emphasis is on analyzing the effects of a proposed action. The references used to prepare the marine geology, climate and meteorology, physical oceanography, and air- and water-quality descriptions in Section III.A of the EIS are considered to be appropriate for this lease sale; some of the references used to prepare these descriptions are the same ones used in the report noted in the comment.

The bathymetry shown in Figure III-1 of the EIS is appropriate for describing the general bathymetry in and adjacent to the sale area.

### **Response NOAA-16**

As noted in Response NOAA-2, the lessee is required to submit a mining plan for review and approval before mining can begin on a lease. The mining plan shall include a detailed description of measures to be taken to monitor the impacts of the mining activities on the environment in accordance with 30 CFR 282.28:

(c)(1) The lessee shall monitor activities in a manner that develops the data and information necessary to enable the Director to assess the impacts of exploration, testing, mining, and processing activities on the environment on and off the lease; develop and evaluate methods for mitigating adverse environmental effect; validate assessments made in previous environmental evaluations, and ensure compliance with lease and other requirements for the protection of the environment.

(2) Monitoring of environmental effects shall include determination of the spatial and temporal environmental changes induced by the exploration, testing, development, and production, and processing activities on the flora and fauna of the sea surface, the water column, and/or the seafloor.

Comments regarding the adequacy of any proposed monitoring program should be made during the time when the mining plan is being reviewed. Monitoring program(s) can be modified to address specific concerns raised during the review process.

### **Response NOAA-17**

As noted in 30 CFR 281.7, the Secretary of the Interior shall make data and information available to the public in accordance with the requirements and subject to the limitations of the OCSLA, the Freedom of Information Act, and the implementing regulations 30 CFR Parts 280 and 282 and 43 CFR Part 2.

### **Response NOAA-18**

The OCSLA provides a clear legal basis of promulgation of regulations to govern OCS mining. Sections 5 and 8(k) of the OCSLA, in combination with 19 other sections of the OCSLA, which are applicable in whole or in part to minerals other than oil, gas, and sulphur, clearly and specifically grant authority and responsibility to the Secretary of the Interior to prescribe terms and conditions appropriate to the regulation of OCS mining, including prelease prospecting, leasing, and postlease operations. We believe the appropriate course of action is to tailor the implementing regulations in the best fashion available under law to meet the requirements of the OCS mining program under the OCSLA.

The Department of the Interior has final rules for the leasing and operations of minerals other than oil, gas, and sulphur on the OCS (Federal Register 54 FR 2041 and 2057, respectively, January 18, 1989). The proposed OCS Mining Program Norton Sound Lease Sale and postsale mining activities will be governed by these regulations.

### **Response NOAA-19**

See NOAA-18.



Centers for Disease Control  
Atlanta GA 30333  
July 20, 1988

Raymond B. Emerson  
Chief, Arctic Unit  
Environmental Assessment Section  
OC9, Alaska OCS Region  
949 East 90th Avenue  
Anchorage, Alaska 99508-4902

Dear Mr. Emerson:

We have completed our review of the Second Draft Environmental Impact Statement (DEIS) for OCS Mining Program, Norton Sound Lease Sale. We are responding on behalf of the U.S. Public Health Service. Technical assistance for this review was provided by the Environmental Hazards and Health Effects Division, Center for Environmental Health and Injury Control, Centers for Disease Control.

The Department of Interior's study of Metals in Norton Sound and human hair provide data to address questions raised by the Center for Food Safety and Applied Nutrition (FSAN) and Community Health Services Branch (CHSB) to the preliminary final draft EIS. These results show that mercury is not present at health significant concentrations in the waters of Norton Sound. The study found essentially no difference in dissolved mercury concentration between up- and down-current samples from an active dredge in Norton sound. Unfiltered samples, of course, showed the presence of increased sediment load down-current of the dredge. The study showed that other trace metals with potential biological concern did not reach health significant concentrations in the dissolved samples.

The hair study of 200 women of childbearing age showed a low concentration of methylmercury in most women, average 1 ppm, with one percent showing greater than 6 ppm. The World Health Organization considers 10 to 20 ppm as a range of mercury concentration in hair at which there is some risk to prenatal and natal life. These results show that the women tested did not have health significant methylmercury in their diets. The planned follow-up study of Nome women of child bearing age known to eat high levels of seafood is necessary to protect prenatal and natal infants from the possibility of mercury related problems.

The following specific comments are not exhaustive but only indicative of a need to edit the document carefully before its final release.

The comment by FSAN on the previous DEIS about being specific

about the form of mercury being discussed is still valid. When methylmercury is the chemical under discussion the authors should always use this or MeHg in the text. Switching between mercury and methylmercury to refer to the same chemical species, as in hair analysis, leaves the reader wondering what the authors mean.

On page IV-B-159 paragraph (3), the sentence reads "The mean concentration of mercury in blood is 250 times greater than the mean mercury concentration in hair...; a mean blood-to-hair ratio of 300 is also sometimes cited in the literature." However, in several other places the document cites data showing the blood levels in ppb and the hair concentration in ppm. The sentence should state the hair concentration is 250 times the blood concentration and the hair-to-blood ratio is 300. The ratio as stated, blood-to-hair, is 0.00333.

On page IV-B-159 paragraph 3, last sentence reads, "For a level of 10 ppm in hair (the level set by WHO as the lowest level producing effects to developing fetuses), the concentration is (probably should be in) seafood for consumers of 180 g/day is 0.28 ppm in hair." The in hair following 0.28 ppm makes no sense. The in hair value is 10 ppm, already stated, and the concentration in seafood is 0.28 ppm. There are several locations within the document where this "in hair" statement is inappropriately placed.

Thank you for the opportunity to review and comment on this document. Please insure that we are included on your mailing list to receive a copy of the Final EIS, and future EIS's which may indicate potential public health impact and are developed under the National Environmental Policy Act (NEPA).

Sincerely yours,

*Kenneth W. Holt*  
Kenneth W. Holt, M.S.E.H.  
Environmental Health Scientist  
Center for Environmental Health  
and Injury Control

CC:  
Dr. Mark McClanahan

**Response PHS-1**

Mercury is primarily methylated in the hair, and this should be understood in any review of the literature. The form that mercury takes in other tissues varies with the tissue. Whether the mercury is organic or inorganic, the level represents a body-burden of the metal which can be converted to methylated mercury or the more toxic form. Thus, any form of mercury is potentially toxic to the organism and the form that the mercury takes varies and is not always known; therefore, the form is not always mentioned. However, where methylmercury is intended, the text has been changed.

**Response PHS-2**

The text has been changed to address this comment.



United States Department of the Interior

BUREAU OF MINES

SPokane Research Center  
East 315 Montgomery Avenue  
Spokane, Washington 99207

July 19, 1990

Memorandum

To: Tim Holder, CT Coordinator  
Minerals Management Service, Alaska OCS Region

From: Mining Engineer,  
Spokane Research Center, Spokane, WA

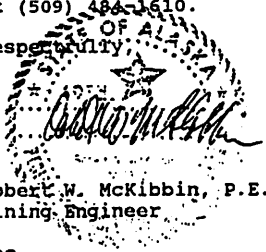
Subject: OCS Mining Program Norton Sound Lease Sale

The Bureau of Mines' Spokane Research Center and Alaska Field Operations Center have completed a review of the subject Lease Sale Second Draft Environmental Impact Statement (DEIS).

The Bureau appreciates the consideration given to its comments submitted on the earlier editions of the DEIS, and notes that many of them were accepted and incorporated into the subject DEIS. However, in the opinion of the Bureau, some points remain unresolved. These points are addressed in detail in the attached lists of comments.

I hope that these comments are of use to MMS in your preparation of the Final Environmental Impact Statement. If you would like any further clarification pertaining to these comments, please call me at (509) 484-1610.

Respectfully,

  
Robert W. McKibbin, P.E.  
Mining Engineer

enc.

c.c.: Paul Gates, OEPR

Comments on Norton Sound Lease Sale Second DEIS  
To accompany memo to Tim Holder, MMS, dtd. July 19, 1990.

Page viii: Under Figure III-10, "...<7mm..." appears to be in error. Do you mean 7cm? **BOM-1a**

Table S-1: Bureau reviewers question whether effects on migratory birds should be ranked as MAJOR for all cumulative-project alternatives, or that effects on migratory marine mammals should be MODERATE for all cumulative-project alternatives. They should be ranked as MINOR for all cumulative-project alternatives, the same as in the proposal (Alternative 1). This apparent overestimate of potential effects could have a significant negative impact on anyone who elects to read only the DEIS executive summary, which ends with Table S-1 "Summary of Effects".

The reasons given for these effect levels (e.g. the birds winter on polluted ranges in California, and the marine mammals compete with the Gulf of Alaska bottom trawl fishery) have nothing to do with mining in Norton Sound. To imply, through Table S-1, that the proposed mining could cause these effects is a distortion. Although this point is clarified after reading pages IV-B-80-82, and IV-B-99-102, the average DEIS reader may not read that far to elucidate the facts. Additional reasoning for this comment will be discussed in the comment for page IV-B-80, et seq.

Page II-4, line 5: "...course-grained..." should be "...coarse-grained..." **BOM-2**

Page III-3, 12 lines from bottom: "...par-ticles..." should be "...particles..." **BOM-3**

Page IV-B-16, middle: "...1.8 X 105..." should read "...1.8 X 10<sup>5</sup> ..." **BOM-4**

Page IV-B-77, line 16: The sentence beginning "The chemical..." implies that mercury is still used onboard dredges in the Nome area, which is untrue. This sentence should be deleted, because the point is adequately addressed in the following sentence. **BOM-4a**

Page IV-B-80, middle; and IV-B-81, bottom: In light of President Bush's "No Net Loss of Wetlands" campaign, the MMS writers may want to reconsider statements regarding loss of wetlands in the lower 48, and projections that losses will continue. If such losses are being slowed or stopped, the effect on migratory birds should be less than MAJOR. **BOM-5**

In any event, Bureau reviewers question whether hunting pressure, habitat loss, and pollution (as they effect migratory birds) in the lower 48 should have a bearing on any development in Alaska, or result in a MAJOR effect rating for this DEIS. The average person who reads the DEIS will read the executive summary and the "Summary of Effects" (Table S-1); they will see the MAJOR effect, and its negative connotation, but may not examine the reasoning behind the



rating. The Alaskan mining industry should not be penalized for the past (or ongoing) mistakes of California land developers. Bureau reviewers believe the effect on migratory birds for all cumulative-project alternatives should be ranked as MINOR, the same as for the proposal.

Page IV-B-100: Bureau reviewers question whether the rapid increase in the bottom trawl fishery in the Gulf of Alaska and southern Bering Sea (as it effects migratory marine mammals) should have a bearing on proposed mining in Norton Sound, or result in a MODERATE effect rating for this DEIS. The reasons for this are stated in the comment for page IV-B-80. Bureau reviewers believe the effect on migratory marine mammals for all cumulative-project alternatives should be ranked as MINOR, the same as for the proposal.

**BOM-6**

Pages IV-C-2, IV-D-3, and IV-E-4: See earlier comments for pages IV-B-80 and IV-B-100.

**BOM-7**

Page IV-I-2, 8 lines from bottom: An important comma is missing. ".royalties to.." should read "royalties, to..".

**BOM-8**

**Response BOM-1a**

Figure III-10, "77 mm" is correct.

**Response BOM-1**

The MMS disagrees with this comment. "Cumulative projects" should not lead the reader to think these effects are solely from mining on the OCS. "Cumulative projects" means exactly what it says--the cumulative effects from all projects or activities. To confine the cumulative case to mining would be artificial and would not accurately reflect effects on organisms that migrate beyond Norton Sound. The footnote has been expanded to clarify this point.

**Response BOM-2**

The text has been corrected.

**Response BOM-3**

The text has been corrected.

**Response BOM-4a**

The text has been modified in response to this comment.

**Response BOM-4**

The text has been corrected.

**Response BOM-5**

The text has been modified in response to the first part of this comment. The loss and degradation of wetlands over the past 10 years in Canada and the U.S. has resulted in population declines of more than 50 percent for some migratory waterfowl species occurring in Norton Sound. This loss and degradation of wetlands is expected to continue. Some of these populations are not expected to recover for several generations, and the declines could continue due to the further loss of wetlands. This loss and degradation of wetlands represents a MAJOR effect regardless of whether the "No Net Loss of Wetlands" campaign is successful (see Sec. IV.B.5) due to the continuing loss of wetlands in Canada and the degradation of some of the remaining wetlands in the US. The effect of wetland loss on waterfowl abundance is often delayed by several years and recent wetland losses in the U.S. and in Canada are expected to result in further reduction in abundance of some waterfowl populations in the future. Under CEQ regulations, the EIS is required to assess past, present, and future development effects on migratory species populations regardless of whether the (projects) sources of the effects are mining, oil and gas, Federal, State, or private sources, and regardless of how severe the total cumulative effect is. The FEIS states that the contribution of the proposal to cumulative effects is expected to be MINOR.

**Response BOM-6**

The EIS is required under CEQ regulations to assess past, present, and future development cumulative effects on migratory marine mammals regardless of whether the projects that cause the effects are from Federal, State, or private companies, regardless of the severity of the total cumulative effect (see Response BOM-5).

**Response BOM-7**

See Response BOM-5.

**Response BOM-8**

The text has been amended to address this concern.

U.S. Department  
of Transportation  
United States  
Coast Guard



Commandant  
United States Coast Guard

Washington, D.C. 20689-0001  
Staff Symbol: G-MPS-1  
Phone: (202) 267-0504

16600  
27 JUL 1990

Mr. Ed Cassidy  
Deputy Director  
Minerals Management Service  
United States Department of the Interior  
Washington, DC 20240

Dear Mr. Cassidy:

This is in response to your letter of May 18, 1990, in which you transmitted the proposed 1991 Outer Continental Shelf Mining Program Lease Sale in Norton Sound for Coast Guard review. We have reviewed the draft Environmental Impact Statement (EIS) and have no comments to offer.

Thank you for providing the opportunity for review of the EIS.

Sincerely,

A handwritten signature in cursive script, appearing to read "D.M. Walden".

Commandant  
United States Coast Guard  
Washington, D.C. 20689-0001

No Response is required.

United States  
Environmental Protection  
Agency

Region 10  
1200 Sixth Avenue  
Seattle WA 98101

Alaska  
Idaho  
Oregon  
Washington



AUG 03 1990

REPLY TO  
ATTN OF: WD-136

Alan Powers  
Regional Director  
Minerals Management Service  
Alaska OCS Region  
949 East 36th Avenue  
Anchorage, Alaska 99508-4302

Dear Mr. Powers:

The Environmental Protection Agency (EPA) has reviewed the Second Draft Environmental Impact Statement (EIS) for the Alaska Outer Continental Shelf (OCS) Mining Program, Norton Sound Lease Sale prepared by the Minerals Management Service (MMS). Our review was conducted in accordance with the National Environmental Policy Act and our responsibilities under Section 309 of the Clean Air Act.

The EIS considers the potential and expected impacts of the dredge mining of seafloor placers of gold-bearing glacial deposits. Marine dredge mining in Norton Sound involves the excavation, discharge and redeposition of large volumes of solids from and to the seafloor (up to 24,000 m<sup>3</sup>/day per dredge), the suspension of turbid plumes of sediments generally rich in concentrations of some trace metals, and the discharge of large volumes of process water (up to 58,000,000 m<sup>3</sup>/day per dredge).

The lease sale area is split into two separate parcels located between 5 and 22 kilometers offshore in Norton Sound, Alaska. The western group of lease blocks consists of 19 whole or partial blocks (83,458 acres) located south of Nome and generally adjacent to a number of nearshore lease blocks, in state waters, currently mined by WestGold. The eastern group of lease blocks consists of 15 whole and partial blocks (63,593 acres) located southeast of Safety Sound.

MMS has considered five alternatives in this second draft EIS of the proposed lease sale:

- (1) Alternative 1: (Proposed Action) - Offer for lease 34 whole and partial blocks (approximately 147,051 acres) south of Nome and southeast of Safety Sound.
- (2) Alternative 2: No sale.
- (3) Alternative 3: Delay the sale for a period of 3 years.
- (4) Alternative 4: (Eastern Deferral) - Offer for lease 19 whole or partial blocks (about 83,458 acres) located south of Nome.
- (5) Alternative 5: (Western Deferral) - Offer for lease 15 whole and partial blocks (about 63,593 acres) located southeast of Safety Sound.

2

The second draft EIS incorporates many changes from the original draft EIS. MMS has sponsored studies to better characterize ambient trace metal concentrations in the lease sale area, has undertaken human health studies to determine levels of mercury and arsenic in local residents, removed six whole and partial blocks from the western parcel of the sale area to protect prime king crab habitat, and incorporated the lease sale stipulations into the evaluation of environmental consequences. These changes represent significant improvements in this second draft EIS. The depth and breadth of the analyses have been increased substantially. The information is well-organized and well-presented. The textual discussion is well-supported by tabular and graphical information.

We are particularly pleased with the change in the decision process. In the past, MMS has committed to lease sale stipulations after the final EIS, at the Notice of Sale stage. No assurances existed, during the review of the draft and final EIS, that mitigating stipulations would actually be incorporated into the terms of the lease sale. The second draft EIS has incorporated mitigation into the analysis of the environmental consequences. This approach will resolve concerns over the potential for a lease sale occurring without mitigation or with only some of the proposed mitigation included.

Based on our review, we are rating the second draft EIS EO-1 (Environmental Objections - Adequate Information). Our environmental objections are based on the draft EIS conclusions that any of the leasing alternatives will result in the exceedance of federal water quality criteria for lead and copper at the edge of the mining zone. The criteria used for determining the rating of a draft EIS are enclosed for your reference. We are also enclosing detailed review comments that discuss EPA's concerns about violation of federal water quality criteria and the selection of a preferred alternative. This rating and a summary of our comments will be published in the Federal Register.

We appreciate the opportunity to review this second draft EIS. We look forward to continued participation in the Coordination Team. If you have any questions about our review comments, please contact Sally Brough in the Environmental Review Section at (206) 442-4012 or (FTS) 399-4012.

Sincerely,

Ronald A. Kreizenbeck  
Acting Director, Water Division

Enclosures

SUMMARY OF THE EPA RATING SYSTEM  
FOR DRAFT ENVIRONMENTAL IMPACT STATEMENTS:  
DEFINITIONS AND FOLLOW-UP ACTION \*

Environmental Impact of the Action

LO--Lack of Objections

The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC--Environmental Concerns

The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA intends to work with the lead agency to reduce these impacts.

EO--Environmental Objections

The EPA review has identified significant environmental impacts that should be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no-action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU--Environmentally Unsatisfactory

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the CEO.

Adequacy of the Impact Statement

Category 1--Adequate

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2--Insufficient Information

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

Category 3--Inadequate

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEO.

\* From EPA Manual 1640 Policy and Procedures for the Review of Federal Actions Impacting the Environment

February, 1987

ENVIRONMENTAL PROTECTION AGENCY  
DETAILED REVIEW COMMENTS  
ALASKA OCS MINING PROGRAM, NORTON SOUND LEASE SALE  
SECOND DRAFT EIS

National Pollutant Discharge Elimination System (NPDES) Permit:

EPA issued the first NPDES permit for dredge mining in state waters in Norton Sound in October 1985. The permit term was three years, however, EPA administratively extended the existing NPDES permit to cover the 1989 and 1990 operating seasons. Information about the existing environment and the effects of dredge mining available at the time the permit was issued has since been augmented. Originally, the BIMA was classified as a "minor" facility. This classification was changed to a "major" facility in April 1989. Major facilities are closely tracked for compliance. Since 1985, a much more comprehensive data base has been developed through the EIS process and the NPDES permit monitoring process.

EPA is in the process of completing a permit reissuance for the Bima activities in state waters. EPA went out for public notice on June 5, 1990 with a draft permit. The comment period was extended from July 5, 1990 to August 20, 1990. Currently, we are still receiving comments on the proposed NPDES permit conditions and environmental monitoring included in the draft permit. A Public Hearing is scheduled for August 16, 1990 in Nome, Alaska. A final permit will not be issued until EPA has considered all comments received on the draft permit.

The draft NPDES permit is significantly different from the original permit issued in 1985. The major changes being considered in the draft permit include:

- a larger mixing zone for suspended solids,
- more stringent effluent limits,
- increased sampling frequency,
- depth limitations in shallow water, and
- expanded environmental monitoring requirements.

The changes being proposed in the draft permit will generate the additional information that will be used to make decisions in the future about the operation and conditions under which dredging can be conducted in an environmentally improved manner. Based on the proposed effluent limits in the draft permit, EPA believes that federal marine water quality criteria for the seven trace metals evaluated in the second draft EIS are not expected to be violated at the edge of the 100 meter mixing zone. This conclusion is based in part on the analysis of dilution which takes into consideration the relationship of the variation of dilution to water depth, the volume of solids processed/discharged, and the effluent flow (discharge rate). Burney Hill can be contacted at (FTS) 399-4012 to discuss the draft permit and the basis for our conclusions.

EPA-1

The evaluation of water quality effects in the second draft EIS is based on limited data gathered by MMS contractors during 1989. For the 1989 operating season

WestGold was operating under the terms of the existing NPDES permit. The sampling and laboratory analyses conducted by the MMS contractors represent a state-of-the-art effort and EPA has confidence in the data gathered. EPA has no additional information to refute the analysis and conclusions for water quality presented in the second draft EIS.

The EIS conclusion that water quality criteria could be potentially exceeded beyond the 100 meter mixing zone for trace metals is the basis for our environmental objections. Since we are in the process of completing a reissuance of the NPDES permit, we are confident that the effluent limits and other permit conditions in our draft NPDES permit will, in the future, reduce the trace metal concentrations to acceptable levels at the edge of the mixing zone. The reissued permit will also provide important information about the operating conditions that must be maintained in order to meet criteria at the edge of the mixing zone.

**Selection of a Preferred Alternative:**

Alternative 1 - Proposed Action

Based on our experience with the operation and discharges of the WestGold BIMA dredge mining vessel in the waters off of Nome, our major concern is with the timing and intensity of mining activity in the lease sale area. Since the private sector is driven by profit motives and market incentives, these factors would dictate both the timing and intensity of placer development. EPA believes that the proposed action, Alternative 1, essentially places the decisions on the timing and intensity of development in the hands of the mining industry.

During the preparation of the NPDES permit for the dredge mining of WestGold's BIMA in the nearshore leases adjacent to Nome, we have discussed the possible development of the dredge mining industry at different gold prices with the current applicant. While alternate futures are both uncertain and complicated, it is clear that at some gold prices offshore mining is not profitable and at other prices it is very profitable. The level of effort and the number and type of dredge mining operations is, in large part, determined by the price of gold. WestGold may increase the number of its dredge mining operations on its present leases in the future, particularly if the company finds that remotely operated underwater vehicles with bucket wheel dredges are suitable and profitable. This same potential exists for the proposed lease sale.

At the "right price" (of gold), Norton Sound could be mined by many more than the two dredges evaluated in the high case scenario and staffed by 100s of full time and seasonal employees. A higher level of activity than was presented in the second draft EIS is possible and, given the behavior of the gold market over the past 15 years, even probable. This constitutes a development scenario entirely beyond the scope of the present draft EIS. The recent state approval of offshore prospecting permits in state waters increases our concern about the level of activity that could occur in the future. Both the natural and cultural environment of Alaska's Norton Sound and its communities could suffer from the "boom and bust" of another gold rush.

EPA-2

Alternative 2 - No Sale

Alternative 2, No Sale, is the alternative of least impact to the environment. However, the analyses conducted to date do not suggest that there are widespread and long-term impacts associated with a judicious and tempered development of offshore placers in the proposed tracts. Further study may, however, indicate that this alternative is the most appropriate choice. As we discussed earlier, the reissued permit will generate the information we will need for further evaluation.

EPA's Preferred Alternative

EPA believes that the appropriate leasing action in the development of these offshore placer deposits is a combination of alternatives 3 and 4. Our preferred alternative would defer leasing activity in the eastern deferral area and incorporate minor modifications to the group of blocks offered in the western lease area.

Based on our review of the second draft EIS and our regulation of the operation of dredging operations in the nearshore waters adjacent to Nome, we believe that the area off of Safety Sound should be withheld from leasing and development due to the potential impacts of dredging and supporting activities on waterfowl and seabirds. The blocks in the eastern deferral area, based on limited geologic and geochemical data, have had limited exposure to "the primary mechanism for transporting particulate gold to the OCS". The eastern deferral area appears to have less resource potential than the western portion of the lease sale area.

EPA-3

With regard to the western portion of the lease sale area, we suggest that block Nos. 600, 601, 602, 644, 645 and 689 should be withdrawn from the lease offering due to the importance of these blocks as red king crab habitat and for fisheries. We acknowledge that MMS has already removed six whole and partial blocks from the western area to protect prime red king crab habitat. The six previously deleted blocks contained 69% of the crab habitat that was in the original western sale area. The current western sale area has crab habitat. The second draft EIS acknowledges that deferring leasing in the eastern portion of the sale area will likely intensify effects on red king crab. Therefore, the six additional blocks listed above should be deleted in order to protect crab habitat. The twelve whole and partial blocks could be offered for lease in the future if, based on environmental monitoring, it can be shown that mining can be conducted without jeopardizing crab habitat and population levels.

EPA-4

Based on our concern about future development of the dredge mining industry, we also recommend that consideration be given to delaying the lease sale in the remaining portion of the western lease sale area (block Nos. 552, 553, 554, 555, 596, 597, 598, 599, 641, 642, 643, 687 and 688) for three years. Combining the potential for substantially larger scales of dredge mining activities in Norton Sound with the uncertainties associated with potential impacts to marine life, waterfowl and marine birds, and socio-cultural systems, it is probable that the levels of environmental impact exceed the estimates of the draft EIS. A delay would allow further study of the individual and cumulative effects of a

EPA-4a

larger number of dredges (operating concurrently) on water quality, marine life and the socioeconomic integrity and stability of the local communities.

EPA-4a

Stipulations

The alternatives to offer blocks of Norton Sound for lease include four stipulations and four requirements for the provision of information to lessees (ITL).

The stipulations include:

- (1) an environmental survey and monitoring program,
- (2) prohibition of the use of mercury and other toxic chemicals in onboard processing
- (3) a mercury-in-humans survey and monitoring program, and
- (4) protection of archaeological resources.

The ITLs include:

- (1) bird and marine mammal protection,
- (2) arctic peregrine falcon protection and study,
- (3) consideration of subsistence hunting and fishing activities, and
- (4) notice of coastal zone management provisions.

The stipulations and ITLs are both reasonable and comprehensive. EPA fully supports the four stipulations and four ITLs. They will provide opportunities to lessen the potential adverse effects.

Potential Impacts to Waterfowl and Seabirds:

The assessment of potential impacts to waterfowl and seabirds considers potential oil spills and metals contamination/bioaccumulation (esp. mercury) and certain noise, disturbance and turbidity effects. The minor effects determination fails to distinguish the difference in the level of impact on the blocks near Safety Sound (esp. Nos. 533, 534, 577, 578 and 621) versus those lease blocks further afield (esp. the western group of lease blocks). It seems that the potential effects on waterfowl and seabirds in the lease blocks near Safety Lagoon and Bluff may well be moderate over time and that this, in conjunction with the uncertainty that there are profitable placer deposits in this area, argues for deferring the leasing of the eastern group of blocks as in Alternative 4.

EPA-5

Potential Impacts to Local Communities:

The assessment of potential impacts to local communities suggests that this assessment may be incomplete. For instance, on page I-12 the draft EIS states that local residents are assumed "to comprise 60% of the mining workforce," while on page II-20 the estimate is that "40% of the direct OCS mining jobs will go to area residents."

EPA-6

The second draft EIS also notes that the probable population increases attending the mining of these leases "would be less than 5 percent of the total population of Nome." It does not consider the consequences of a disproportionate increase of young and middle-aged men in the community. The second draft EIS should specify whether the

EPA-7

characterization of "area residents" describes people who have lived in the Nome area for a year or more or who have grown up there and will remain there after the dredge miners may leave. Both of these considerations are significant, and support Alternative 3 in order to allow further study of the impacts to local communities.



**Response EPA-1**

This concern has been discussed with the EPA (USEPA, 1990d) and has been addressed in Section IV.B.2. The NPDES permit cited by EPA is now final (USEPA, 1990a).

**Response EPA-2:**

The EIS assumes that a one-dredge operation similar to the BIMA would be the most likely scenario in Federal waters. The information used to assess the potential gold resources in the sale area and other factors considered in making this assumption are discussed in Section II.A.2.b of the EIS. The MMS is not able to predict future gold prices and there is no additional information that would warrant revision of our resource estimate, production rates, or expected production period.

**Response EPA-3:**

The DEIS recognizes that the Eastern Deferral, Alternative IV could reduce the chances of adverse effects on seabirds and waterfowl, but assumes Stipulation No. 1 (monitoring program) to be in place under Alternative I and would provide adequate protection to Safety Sound habitats and birds; thus, the effect of both alternatives I and IV would be essentially the same.

**Response EPA-4**

The rationale for the suggestion that blocks No. 600, 601, 602, 644, 645, and 689 be deleted due to their importance for red king crab habitat and for fisheries is not clear. The blocks listed are north or directly west, and two are even further west of the previously deleted blocks. If the trench that runs essentially parallel to the coast south of Nome is prime red king crab habitat, then the blocks suggested for deletion encompass only a portion of that habitat. The overall distribution of red king crab in Norton Sound is quite broad, and, although high densities of crab have been noted near the sale area, the linkage between trench habitat and high densities of crabs is still a working hypothesis. An examination of crab densities from a number of studies indicates some repeatedly high density crab areas south and west of the sale area (more specifically, south and west of blocks 641 and 642). These areas more predictably have higher densities of crab than areas within the sale area. Given the broad distributions of red king crab and the patterns of high density just described, we do not feel it is warranted at this time to delete additional blocks from the sale area. The monitoring program should be able to demonstrate if there is a linkage between trench habitat and high densities of crab, as well as allowing determination of substrate type in relation to crab density, etc. The Director of MMS is responsible for the regulation of activities conducted under a lease and for assuring that lease operations are conducted in a manner that protects the environment--this can include requiring the lessee to modify any plan when it is determined that any activity proposed in the plan would probably cause serious harm or damage to the environment (CFR 282.11 through 15 and 282.25). For example, mining might not be allowed near the trench or in cobble habitat. Monitoring, with dredging modification, would allow more accurate and informed mitigation than, at this point, deleting the remaining trench habitat that occurs within the sale area.

**Response EPA-4a:**

The additional studies accomplished while the Bima was operating in State waters have provided us adequate information to extrapolate to larger scale dredge mining activities. A 3-year delay in the sale process is not likely to substantially change our present knowledge of individual and cumulative effects of a larger number of dredges, especially in view of the cancellation of the 1991 season for the Bima. However, if in the future, the dredge mining industry plans for multiple dredge activities in the Norton Sound area, the effects of each application will be analyzed individually and cumulatively as required by the NEPA process.

**Response EPA-5:**

See Response EPA-3.

**Response EPA-6:**

The statement on page I-12 that "local residents are assumed to comprise 60 percent of the mining work force" is incorrect. It should read 40 percent. The text has been corrected.

**Response EPA-7**

Even if the total increase in population generated by the proposal were young and middle-aged men who came from outside the Nome area, the effects on the economy, sociocultural systems, and recreation and tourism would still be MINOR, as concluded in the second DEIS. The effect on land use and coastal management programs is expected to be MODERATE, as concluded in the second DEIS. The characteristics of young and middle-aged men who come from outside the Nome area are different than those of the "average" Nome household but not sufficiently different to generate other than MINOR effects. Nome has a heterogeneous population, a notable part of which is middle-aged men from outside Nome. A portion of Nome society is static but another significant segment is transient with households of diverse age composition, ethnic makeup, culture, values, and household size immigrating to and emigrating from Nome. Even if the total increase in population generated by the proposal were young and middle-aged men who came from outside the Nome area, assimilation of this group would be similar to what would occur without the proposal.

MARINE MAMMAL COMMISSION  
1825 CONNECTICUT AVENUE, N.W. #512  
WASHINGTON, DC 20009

30 July 1990

Mr. Alan D. Powers  
Regional Director, Alaska Region  
Minerals Management Service  
949 East 36th Avenue  
Anchorage, Alaska 99508-4302

RECEIVED  
AUG 6 1990

REGIONAL DIRECTOR, ALASKA OCS  
MINERALS MANAGEMENT SERVICE  
ANCHORAGE, ALASKA

Dear Mr. Powers:

By letter of 15 June 1990, the Deputy Director of the Minerals Management Service requested comments from the Marine Mammal Commission on the Second Draft Environmental Impact Statement for the proposed 1991 Outer Continental Shelf Mining Program Lease Sale in Norton Sound, Alaska. The Commission, in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the document and offers the following comments and recommendations on its assessment of the possible effects of the proposed action on marine mammals and their habitats in and near the proposed lease sale area.

#### Background

In November 1988 the Minerals Management Service issued a DEIS describing the resource potential and possible environmental consequences of leasing up to 72,148 hectares (40 blocks) of submerged lands in Norton Sound from 5 to 22 kilometers offshore of Nome, Alaska, for mineral exploration and development. The DEIS noted limitations on the types of minerals that might be economically developed and anticipated that only placer deposits of gold would be recovered. The base-case-scenario estimated that 530,000 troy ounces of gold might be recovered from a single dredge and processing operation in the proposed lease sale area at an average rate of 40,000 ounces per year for at least 20 years. The DEIS noted that the State of Alaska currently had 8 offshore leases to mine placer gold deposits and 57 pending offshore permit applications in State waters adjacent to the proposed lease sale area. The Marine Mammal Commission provided comments on the DEIS's assessment of the possible adverse effects of the proposed action on marine mammals by letter of 13 January 1989 (enclosed).

Comments provided by State, Federal, and local government agencies and the general public deemed the information in the first DEIS inadequate, particularly with regard to its assessment of the effect of the proposed action on: the level of mercury that might find its way into in the water column; the possible bioaccumulation of mercury in the marine food chain; levels of

2

mercury that may accumulate in humans in the region; and the possible effect of dredging on benthic habitat, particularly of red king crab. Following a series of studies and workshops designed to address these and other uncertainties, the Minerals Management Service issued the second DEIS which incorporates comments received on the first DEIS and the results of the most recent studies.

The second DEIS indicates that the proposal (Alternative I) offers 34 whole and partial blocks (approximately 59,510 hectares or 147,050 acres) for leasing in Norton Sound. It describes and assesses the resource potential and possible environmental consequences of four alternative actions including a "no lease" alternative. Beneficiation of the ore would be based on gravity concentration techniques; beneficiation with mercury is not anticipated or proposed. The possible effects of the proposed action on five species of non-endangered marine mammal (Pacific walrus, spotted, bearded, and ringed seals and beluga whale) and one endangered cetacean (the gray whale) are assessed. Five stipulations and four information to lessees (ITIs) are included in the proposed action as mitigating measures and to inform lessees about special concerns and legal requirements in and near the lease area.

The DEIS concludes that the effects of the base-case scenario (Alternative I) on non-endangered marine mammals would be MINOR (i.e., "a specific group of individuals of a population in a localized area and/or over a short time period, one generation or less, is affected; the regional population is not affected"), and that the effects on the endangered gray whale would also be MINOR (i.e., "a specific group of individuals of a population in a localized area is affected over a short time period; less than one breeding cycle").

#### General Comments

In preparation for the lease sale, the Minerals Management Service initiated consultations with the National Marine Fisheries Service pursuant to section 7 of the Endangered Species Act. The National Marine Fisheries Service concurred with the Biological Assessment prepared by the Minerals Management Service which found that the proposed action was not "likely to adversely affect" any endangered whales, and specifically for the gray whale it endorsed the Minerals Management Service's conclusion that "[w]ith the consideration and incorporation of the plan for monitoring avoidance behavior in the lease tracts west of 166 degrees West Longitude, the proposed action is not likely to adversely affect the endangered gray whale population." Since the assessment was written, however, the proposed sale area was reduced and now all potential lease blocks are east of 166 degrees West Longitude. We are uncertain if the consultations considered the possible secondary effects due to trace-metal

MMC-1

contamination of gray whale prey as a result of the proposed action.

In addition, since the DEIS was prepared, Steller sea lions have been listed on an emergency basis as threatened under the Endangered Species Act because of a continuing decline throughout their range. The DEIS does not indicate whether consultations with the National Marine Fisheries Service have been undertaken to determine whether the proposed action may adversely affect this species. If the Minerals Management Service has not already done so, the Marine Mammal Commission recommends that consultations be re-initiated to determine whether the proposed mining activity may adversely affect Steller sea lions or gray whale food resources and that the results of these consultations be included in the FEIS.

MMC-2

The DEIS notes on pages III-18 and III-19 that the Nome, Alaska area has a history of placer mining that utilized toxic mercury and that naturally occurring levels of mercury in the area are relatively high compared to other areas. Dredging will disturb sediments that contain toxic mercury and facilitate its entry into marine food chains of which marine mammals are a part. Humans who consume contaminated fish, shellfish, or marine mammals also may be poisoned. Therefore, the Marine Mammal Commission again recommends, as it did in its 13 January 1989 comments on the first DEIS, that the Minerals Management Service take such steps as necessary to obtain reliable baseline information on mercury levels and monitor levels of mercury in human populations and key components of marine food chains that could be affected by the proposed action.

MMC-3

In this regard, we note that the Alaska Department of Fish and Game collects tissue samples from marine mammals killed by hunters in locations throughout the State and that the Minerals Management Service is supporting the National Oceanic and Atmospheric Administration's tissue bank program which includes samples from animals taken in subsistence hunts. Tissues from these sources could be analyzed to obtain baseline levels of trace-metals and other contaminants for comparison with tissues from animals taken in the Norton Sound area.

MMC-4

The DEIS describes (pp. II-9 to II-14) the physical characteristics of the dredged material that would be disturbed during the mining operation, and notes that the sediments "would be discharged through a pipe whose outlet may be located near the sea floor or near the sea surface; the location and configuration of the pipeline-discharge system would be adjusted to minimize water-column turbidity." It also notes that the magnitude of re-suspension of sediments would be dependent upon the magnitude and duration of currents and wave forces. In its January 1989 comments on the first DEIS, the Commission recommended the adoption of an additional stipulation requiring the downshunting

of discharged dredge tailings directly to the sea floor in the area previously disturbed by the dredge to minimize the spreading of fine sediments and dissolved minerals which may affect invertebrates, fish, and marine mammals. As noted below, the DEIS suggests that from 15.5% to 31% of the lease area (approximately 22,792 to 45,584 acres) may receive fallout of disturbed sediments from the dredging operation. In view of the impact this may have on benthic invertebrate, fish and marine mammal populations, the Commission again recommends adoption of measures to minimize the spreading of fine sediments including the downshunting of discharged dredge tailings directly to the sea floor.

MMC-5

In Section IV-B-6-b (page IV-B-86), the DEIS notes that the effects of the proposed action on communities of beluga whale, seal, and walrus prey species may be extensive, and recovery "is likely to be slow and take several years." On page IV-B-32, the DEIS indicates that "[R]ecovery of the community, meaning a return to its previous species composition and relative abundance of species, may not occur, or may take many years." It concludes on page IV-B-95, however, that the impacts from the base case scenario of development on non-endangered marine mammals (i.e., walrus, spotted seal, ringed seal, bearded seal, and beluga whale) would be MINOR. The Marine Mammal Commission recommends that the FEIS be expanded to more completely evaluate: (1) the numbers of marine mammals that could be affected; (2) the proportions of the potentially affected species or populations that could be affected; (3) the extent to which these populations are already being affected by other human activities not associated with the proposed action; (4) how individuals of various species might be affected by the proposed activities; (5) what habitats essential to their welfare and maintenance (e.g., feeding and breeding areas) could be affected; and (6) what measures would be taken to avoid or mitigate these potential impacts.

MMC-6

MMC-7

#### Specific Comments

#### AREA AFFECTED

Section II-A-2, Page II-12, middle paragraph: This paragraph describes simulations of the movement of discharged sediment material in state waters using a model developed by the Army Corps of Engineers. The model indicates "that for a typical dredge course of 130 x 240 m (7.7 acres)... approximately 135 acres of the sea floor could be covered by 1 cm or more of solids settling out of the turbidity plume and the area covered by more than 10 cm would be about 12 acres outside of the dredge course." The total area proposed to be leased is 147,050 acres (page II-1) and total areas to be dredged in the base and high cases (Table II-1) are 1,300 to 2,600 acres respectively. According to the model, the ratio of area affected-to-dredge course area (135

acres/7.7 acres = 17.5) suggests that the total area likely to be affected by siltation of 1 cm or more would be 22,792 to 45,584 acres or 15.5% to 31.0% of the entire lease area. This sediment would then be expected to move over an even larger area due to currents and wave action. The DEIS should be revised to indicate that, the benthic area likely to be affected by the proposed action will be significantly greater than "1.5-1.8 times...the excavated area" as noted on page IV-B-31 and "2-4% of the sale area" noted on page IV-B-86.

MMC-8

Section IV-B-2-a, Page IV-b-9, Paragraph 2 (submerged discharge): This paragraph states that modeling of the discharge of dredge material in State waters indicates that turbidity would be reduced "if the discharge were deeper (e.g., 18-meters) rather than shallower (e.g., 10-meters)." The DEIS notes, however, that the applicability of this model to the marine environment off Nome is questionable because the high clay and silt content of the sediments at most locations may counteract the benefits of a deeper discharge. In view of the potential area that could be affected by discharged material, the Commission recommends that Minerals Management Service undertake studies to verify that bottom discharge would not be beneficial and, as appropriate, require that industry adopt techniques and procedures to minimize the dispersion of waste dredge material on the sea floor.

MMC-9

#### BENTHIC COMMUNITIES AFFECTED

Section III-B-1, Page III-23, Benthic Communities: The DEIS notes that 76 species of mollusks contribute 5.1 % of the invertebrate biomass in Norton Basin. On page III-26, the DEIS notes that *Mya truncata* is a major walrus prey species which is abundant in the proposed lease sale area. On page III-33, it indicates that "the presence of distinct walrus-feeding excavations on the sea floor within the proposed sale area indicates that this area may be important feeding habitat for some walruses." In view of this information, the DEIS should be revised to indicate that the proposed action will likely have a direct effect on walrus prey and subsequently a possible indirect effect on walrus found in the lease sale area.

MMC-10

Section IV-B-3-a, Pages IV-B-31 to IV-B-32, Effect of Offshore Mining on Habitat Alteration: This Section states that: the area to be excavated over the life of the lease sale will be 1,300 acres; the area affected would be 1.5 to 1.8 times the area excavated due to the discharge and outfall of suspended sediments; these activities would result in the deaths of organisms by dredging and by disposal of dredge material; this alteration of the substrate has important implications for recovery of benthic communities; and recovery to previous species composition and relative abundance may not occur or may take many years. It concludes on page IV-B-32 and IV-B-33 that "the potential exists for extremely wide-ranging and significant

MMC-11

effects to the benthos that would far exceed the actual dredged area."

Because benthic invertebrate and fish communities within the lease sale area could potentially be impacted by the proposed action for "many years" and because these communities include walrus and gray whale prey, it seems unlikely that the proposed action would have only MINOR effects on benthic communities (page IV-B-36) and NEGLIGIBLE effects on marine mammals that depend upon on these species (page IV-B-86). As noted above, the DEIS should be revised to indicate the extent to which marine mammals and their primary prey species would be affected by the proposed action.

#### EXPLORATION

Section II-A-2-c, Page II-5, Exploration Activities for the Base Case: This Section indicates that approximately 12,400 line km of seismic surveys during 135 days over the three year exploration period will be required to delineate potential gold placers and an additional 630 line km per year of seismic surveys will be required during the mining/production phase. It also indicates that approximately 17,280 sediment cores would be required to locate and define potential mining areas. The DEIS does not, but should, evaluate the possible adverse impacts of these exploration activities on marine mammals and their primary prey species.

MMC-12

#### NOISE AND DISTURBANCE

Section IV-B-6, Pages IV-B-82 to IV-B-86, Effect on Non-endangered Marine Mammals: This Section states that: "noise and movement of aircraft and support vessels associated with mining operations could temporarily displace some marine mammals"; "[L]ow-flying aircraft are known to panic hauled out seals and walruses..."; "[U]nderwater noise may interfere with or mask reception of marine mammal communication or echolocation signals, or it may interfere with reception of other environmental sounds used by marine mammals for navigation"; and "[F]requent and/or intense noise that causes a flight or avoidance response in marine mammals theoretically could permanently displace animals from important habitat areas." The Section also notes that project specific noise and disturbance effects (including seismic surveys, vessel and dredge noise) are expected to be present during a 3-year exploration period and over the 14-year production period and that the effects of this noise are not well understood (e.g., in the case of the proposed activity, the level of sound transmitted from a large gold dredge is unknown and could influence some beluga whale behavior).

The DEIS does not, but should, note that, in addition to

MMC-13

acute changes in behavior such as flight and interference with communication or echolocation, noise associated with industrial activity may attract marine mammals to the activity and make them more vulnerable to poisoning and cause general annoyance and stress related changes in physiology, survival, and reproduction. Disruption of vital activities in the short-term and possible abandonment of important feeding, breeding or other important areas over the long-term resulting from exposure to noise could potentially affect the stability of some populations. Therefore, the proposed mining action should be accompanied by programs to monitor the distribution, abundance, and vital rates of marine mammals that could potentially be affected by noise from exploration, development, and related activities.

#### MARINE MAMMAL SPECIES ADDRESSED

##### Section III-B-4, Page III-32, Non-endangered Marine Mammals:

This section presents information on species of marine mammals other than endangered whales common to the Norton Sound area (i.e., walrus, ringed seal, bearded seal, spotted seal, and beluga whale) and briefly describes their biology and life history relevant to potential effects of offshore mining activities in the proposed lease sale area. It states that other species such as polar bear, ribbon seal, minke and killer whales and harbor porpoise occur in such low numbers that they are not discussed in the DEIS. The Commission notes, as it did in its comments on the first DEIS, that to be able to judge the likely significance of the possible direct and indirect effects of the proposed action on marine mammals, it is necessary to know, at least in general terms, the number of animals of all species that could be affected, what proportion this is of the potentially affected species or populations, and the extent to which affected populations are already being affected by other human activities not associated with the proposed action, as well as how individuals of various species might be affected by the proposed activities.

MMC-14

To judge the possible significance of indirect, food chain effects, it is also necessary, among other things, to know or to make informed judgements as to: when, where, and how many animals may feed in or near the proposed lease sale area in typical and atypical years; what species of fish, invertebrates, etc. are eaten by the various marine mammal species; how the availability (distribution, abundance, behavior and productivity) of important food species might be affected by dredging, fuel spills, etc.; and how the marine mammal species in question might respond to and be affected by changes in food availability. The Commission therefore recommends that the Minerals Management Service consult with the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and the Alaska Department of Fish and Game to ensure that baseline information and planned monitoring programs are adequate to detect any changes in marine mammal populations

MMC-15

and/or the habitats of which they are a part in time to take steps to mitigate possible impacts of the proposed action on marine mammals and other living marine resources. In this regard, Figure III-18 should be expanded to indicate the distribution, feeding areas, and migration routes of all marine mammal species that are found within the lease sale area.

#### MONITORING

Section II-F-2, Pages II-32 to II-41, MMS Mitigating Measures That are Part of the Proposed Action and Alternatives: This Section states that Stipulations No. 1 and No. 3, which require the lessees to conduct Environmental Surveys and Monitoring Programs, have been adopted as part of the proposed action to "reduce or eliminate potential adverse effects identified in Section IV-B."

The Commission believes that monitoring programs are essential to verify predicted effects, detect any unforeseen effects associated with the proposed action, and provide an informed basis for instituting mitigating measures in a timely manner. Ensuring that monitoring studies are well designed and initiated during the exploration phase is particularly important for making informed management decisions should development occur after the exploration phase. In this regard, the FEIS should provide sufficient information or explain how decisions will be made to evaluate whether these programs will meet their stated objectives. Also, if mining is authorized, the Marine Mammal Commission recommends that the Minerals Management Service, in consultation with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service, establish an outside board of marine mammal and other appropriate experts to review and provide comments on the lessees' proposed Environmental Surveys and Monitoring Programs to insure they are adequate to achieve their goals.

MMC-16

#### CUMULATIVE EFFECTS

Section IV-B-6-d, Pages IV-B-97 to IV-B-98, Overall Cumulative Effect: The DEIS concludes on page IV-B-98 that the overall cumulative effects from (1) potential bioaccumulation of mercury in marine mammals and their habitats, (2) disruption of "5%" of the benthic habitat in Norton Sound, (3) cumulative noise disturbance from "several hundred or more helicopter flights and support-vessel trips per year" for 20 years, and (4) potential oil spill effects from future OCS oil and gas activities and potential fuel spills from Norton Sound mining operations "are all likely to have short-term (less than one generation) MINOR effects on some seals, walrus, and beluga whales that seasonally occur in Norton Sound." As noted above, the information in the DEIS is not adequate to assess the validity of these conclusions. Therefore, the Commission recommends that the

MMC-17

FEIS be expanded to indicate, among other things: (1) the numbers of marine mammals that could be affected; (2) the proportions of the potentially affected species or populations that could be affected; (3) the extent to which these populations are already being affected by other human activities not associated with the proposed action; (4) how individuals of various species might be affected indirectly as well as directly by the proposed activities; (5) what habitats essential to their welfare and maintenance (e.g., feeding and breeding areas) could be affected; and (6) what measures would be taken to avoid or mitigate these potential effects.

Page IV-B-99, Cumulative Effects of Oil and Gas Exploration and Development in the Bering, Chukchi, and Beaufort Seas: The second paragraph on this page states that offshore oil and gas exploration and development activities in the Bering, Chukchi, and Beaufort Seas "are likely to increase in the near future" and "are likely to have some short-term (less than one generation) MINOR effects on the distribution of migratory seals, walruses, and beluga whales during the drilling seasons." Further, this paragraph states that "biological effects of such contact are expected to be sublethal for seals, walruses, and beluga whales, although some very young seals and walruses contaminated by the oil could die from physiological stress or from abandonment by the adult females." The DEIS does not, but should, provide information to support these statements. Similarly, the statement at the top of page IV-B-97 that this "low level of air and vessel traffic and other exploration activity has had a minimal effect on marine mammals in Norton Sound" is not, but should be, supported.

MMC-18

On a related point, the FEIS should note that the National Fish and Wildlife Foundation and the U.S. Fish and Wildlife Service sponsored a "Sea Otter Symposium" in Anchorage, Alaska from 17 to 19 April 1990 to consolidate information on the impact of the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska on sea otters and that papers presented at this symposium described acute gastro-intestinal, respiratory, and other problems observed in sea otters associated with the oil spill which may be useful in predicting and evaluating the potential effects of spilled petroleum on other marine mammals.

MMC-19

Pages IV-B-99 to IV-B-100, Cumulative Effects of Commercial Fishing: This Section states that the potential effects of commercial fishing activities on marine mammals could include direct mortality due to entanglement in gear and/or shooting, competition for prey species, and displacement of marine mammals due to disturbance. It notes, among other things, that: entrapment in bottom trawls is likely contributing to the mortality of seals and sea lions in the Bering Sea and Gulf of Alaska; "there is no question that temporary displacement (minutes to hours to 2-3 days) of seals, walruses, and beluga

whales occurs as a result of vessel and air traffic associated with commercial fishing in Bristol Bay and in Norton Sound"; the amount of commercial fishing activity has increased greatly in the northern Bering Sea and Norton Sound, and migratory marine mammals are exposed to an increasing amount of vessels and air traffic associated with expanding commercial fishing operations"; and "longer displacement (several days to a few months) of some portions of migratory marine mammal populations is probably occurring in areas of intense commercial fishing activity."

The DEIS does not, but should, note that the absence of female seals and sea lions from rookeries during the breeding season can jeopardize the survival of young and that the repeated displacement of animals from haulout sites can result in: the decline of the populations from abandonment of preferred sites; overcrowding at remaining sites; stress; disease; and over exploitation and increased competition for local food resources.

MMC-20

#### Physical Considerations

Section III-A-6-c, Page III-13, Polynyas: The fifth paragraph on this page describes polynyas or large open water areas which occur off the leeward side of east-west-oriented coasts and persist during the winter months and notes that parts of the lease sale area lie within areas where polynyas form. Polynyas are important open water feeding, breeding, and migration areas where some marine mammals concentrate in large numbers during the winter. While marine mammals are concentrated in these areas they may be more vulnerable to disturbance from the activities associated with the proposed action. For example, a fuel spill within a polynya may affect many more animals (e.g., beluga whales or walruses) than if it occurred in open water. The DEIS does not, but should, indicate how the proposed action might affect these polynyas and the marine mammals that use them.

MMC-21

#### SUBSISTENCE USE

Section III-C-3-b, Pages III-45 to III-48, Subsistence Resources Harvested: This section notes that seals and walrus are critical sources of meat, oil, and hides for the people of the Nome area and that from 20-25% of the native households hunt these marine mammals in the spring and summer. It describes the hunt and the uses of the marine mammals taken, noting that the average number of walrus taken from 1980 to 1984 was 554 and in 1985 was 256. Similar data on the number of seals taken are not provided. As noted above, the FEIS should provide additional information on the current status of the marine mammal populations affected by subsistence hunting and the numbers of animals taken for subsistence purposes.

MMC-22

Page III-48, Bear: The DEIS notes in the second full paragraph on the page that Polar bears are harvested by some residents of



the Nome area. The DEIS does not, but should, provide information on the seasonal abundance, distribution, population size, and number of polar bears taken in and near the lease sale area.

MMC-23

Summary and Conclusions

In summary, the DEIS provides an assessment of the ways that marine mammals possibly could be affected by the proposed mining program in Norton Sound. It does not, however, provide a thorough and adequate assessment of all the species and populations of marine mammals that could be affected, and the degree to which they could be affected, if mining exploration and development are allowed to proceed as proposed. Among other things, the FEIS should be expanded to support the contention that insignificant numbers of polar bear, harbor seal, North Pacific fur seal, minke whale, killer whale, and harbor porpoise occur in or near the lease sale area. In view of the recent emergency listing of the Steller sea lion as threatened under the Endangered Species Act, the Minerals Management Service should re-initiate section 7 consultations with the National Marine Fisheries Service to determine whether the proposed action would jeopardize this species or adversely affect habitat critical to its survival.

MMC-24

MMC-25

The Commission notes, as it did in its comments on the first DEIS, that to be able to judge the likely significance of the possible direct and indirect effects of the proposed action on marine mammals, it is necessary to know, at least in general terms: (1) the number of animals, by species, that could be affected; (2) the proportion this is of the potentially affected species or populations; (3) the extent to which affected populations are already being affected by other human activities not associated with the proposed action; and (4) how individuals of various species might be affected by the proposed activities. To judge the possible significance of indirect, food chain effects, it is also necessary, among other things, to know or to make informed judgements as to: (a) when, where, and how many animals may feed in or near the proposed lease sale area in typical and atypical years; (b) what species of fish, invertebrates, etc. are eaten by the various marine mammal species; (c) how the availability (distribution, abundance, behavior and productivity) of important food species might be affected by dredging, fuel spills, etc.; and (d) how the marine mammal species in question might respond to and be affected by changes in food availability.

The Commission notes, as it did in its previous comments, that obtaining all of the information necessary to make these assessments could be prohibitively costly and indefinitely delay decisions on the proposed action. The Commission therefore recommends that, if the proposed mining is authorized, the

MMC-26

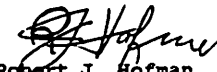
Minerals Management Service consult the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and the Alaska Department of Fish and Game, and based upon these consultations, cooperatively develop and implement monitoring programs to verify the predicted effects and detect any possible unforeseen effects of the proposed action on marine mammals in time to initiate meaningful mitigation measures.

MMC-26a

\* \* \* \* \*

I hope that these comments, recommendations and suggestions are helpful. If you or your staff have questions about any of them, please let me know.

Sincerely,



Robert J. Hofman, Ph.D.  
Scientific Program Director

Enclosure

cc: Director, Minerals Management Service  
Department of the Interior  
Washington, D.C.

MARINE MAMMAL COMMISSION  
1625 EYE STREET, N.W.  
WASHINGTON, DC 20006

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JAN 17 1989

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

13 January 1989

Mr. Alan D. Powers  
Regional Director  
Alaska OCS Region  
U.S. Department of Interior, MMS  
949 E. 36th Avenue  
Anchorage, AK 99508-4302

Dear Mr. Powers:

The Marine Mammal Commission, in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the Draft Environmental Impact Statement (DEIS) on the Alaska Outer Continental Shelf Mining Program Norton Sound Lease Sale, and offers the following comments and recommendations concerning the assessment and mitigation of the possible adverse effects of the proposed action on marine mammals.

General Comments

The DEIS describes and provides an assessment of the resource potential and the possible environmental consequences of a proposal to lease up to 72,148 hectares (40 blocks) of submerged lands in Norton Sound from 5 to 22 kilometers offshore Nome, Alaska, for mineral exploration and development. The DEIS also describes and assesses the resource potential and possible environmental consequences of five alternative actions including a no lease alternative. The DEIS estimates that the remote location of the proposed sale area would limit the types of minerals that might be recovered economically and that only placer deposits of gold (a mean case estimate of 530,000 troy ounces) might be recovered in the proposed lease-sale area. The DEIS notes that the State of Alaska currently has 8 offshore leases to mine placer gold deposits and 57 pending offshore permit applications in State waters adjacent to the proposed sale area.

The DEIS provides a reasonably thorough review and analysis of available information regarding possible impacts from fuel spills, acoustic disturbances, dredging, and other activities associated with the proposed action that could affect endangered

and non endangered marine mammals in the lease sale area. However, it does not provide a complete evaluation of information on the status of all marine mammal species likely to be found in or near the proposed lease sale area. For example, the DEIS notes that five species of non endangered marine mammals (walrus, spotted seal, bearded seal, ringed seal, and beluga whale) and one endangered marine mammal (gray whale) could possibly be affected by the proposed action. As discussed below, the DEIS needs to be expanded to consider the likely effects of the proposed action on other non endangered and endangered marine mammals in the lease sale area.

MMC-27

Although mining activities have been undertaken by the State of Alaska in State waters, activities of the type and scale envisioned in the DEIS have not been conducted previously in the Alaska OCS region or in Federal waters and, as a result, the DEIS identifies a number of potential mitigation measures which would help ensure that possible impacts on marine mammals and other marine resources are detected and avoided. Such measures include four Potential Stipulations and six Potential Information to Lessees. These measures would help reduce potential impacts on marine mammals and the Commission recommends that they be incorporated with the modifications discussed below as part of the Proposed Action and other leasing Alternatives. In addition, the Commission recommends that the Service consider adopting an additional Stipulation to require the downshunting of discharged mine waste materials directly to the seabed in the area previously disturbed by the dredge to protect surface waters in the lease sale area from fine sediment and dissolved metals which may affect fish, marine mammals, and other living marine resources.

MMC-28

Because of uncertainties associated with the mining technology to be used, the operating characteristics of the technology (e.g., the volume of and pollutant levels of mining waste discharges), and the total resource potential of the proposed lease sale area, it is particularly important to ensure that baseline information and monitoring programs as would be initiated when mining operations begin, provide an adequate basis for detecting possible unforeseen impacts and for verifying assessments of predicted levels of expected impacts. The Commission, therefore, recommends that Stipulation No. 1-- concerning the development and implementation of a management related monitoring and studies program to measure: trace metal concentrations in the water and sediments; bioaccumulation of trace metals in selected organisms such as king crab, fish, and marine mammals; turbidity and sedimentation; pre- and postmining contours; and rate of recolonization of benthic communities--be adopted as part of the proposed action. Also, the Commission recommends that, if it has not already done so, the Minerals Management Service consult with the National Marine Fisheries Service and the Fish and Wildlife Service to ensure that baseline information and planned monitoring programs are adequate to detect any changes in time to take steps to mitigate possible impacts on marine mammals and other living marine resources. In this regard,

MMC-29

MMC-30

we note that, between 1976 and 1981, the Alaska Department of Fish and Game collected more than 400 tissue samples from marine mammals killed by hunters in locations throughout the State and that tissues could be analyzed to provide baseline levels of trace metals and other contaminants.

Also, the Minerals Management Service's Regional Environmental Studies Program, which addresses specific research and monitoring needs for Outer Continental Shelf activities, has provided, and should continue to provide, information essential for predicting, detecting and mitigating potential environmental impacts. The Commission, therefore, recommends that the DEIS be expanded to identify and describe the types of monitoring programs that will be undertaken by the Alaska Regional Studies Program as well as by the lessee during the post-lease sale period to ensure detection and mitigation of possible unforeseen effects.

MMC-31

Specific Comments

Page I-2 (Background of the Proposed Action): The third paragraph in this section notes that "industry interest in OCS mining has been focused on eight heavy metal placers, strategic minerals, sand and gravel, and phosphorite." It also notes that gold is being mined in State waters near Nome, Alaska. While the proposed action provides for leasing of submerged lands for exploration and development of all "minerals" except oil, gas, and sulphur, the DEIS only considers likely environmental effects of possible gold mining activities. Unless there is virtually no possibility of exploring for or developing other minerals in the Norton Sound area, the possible effects of other mining activities should be considered in the Final Environmental Impact Statement. Alternatively, the FEIS should indicate that a Supplemental EIS would be done before exploration or development of minerals other than gold would be authorized.

MMC-32

Page I-11 (Alternatives Suggested During the Scoping Process): The first paragraph of this section discusses a suggestion to defer several areas from the lease sale. The last sentence notes that two deferral alternatives are analyzed in the DEIS and refers the reader to Figures I-2 and I-3 (also Figures II-6 and II-7). The two figures appear to be reversed.

MMC-33

Page II-2 (Resource Estimates and Basic Assumptions): The third paragraph of this section indicates it is assumed that exploration and development activities would take place during the ice-free months (approximately from June through November), mining would be conducted by vessels that mechanically excavate and process sediments, and the operational period would range from 120 to 150 days. The next paragraph notes, however, that the mining system chosen will depend on the volume and grade of the ore reserves, as well as a number of other factors. Also, on pages II-11 through II-15, additional processing scenarios are discussed. Given the uncertainty of the volume of gold in and

MMC-34

grade of deposits and the relative uncertainty concerning possible strategies to be used to explore, assess, mine, and process possible placer gold deposits in the proposed sale area, the assumption that mining activities will be similar to those currently undertaken in State waters may not be accurate or appropriate. This uncertainty should be noted in the FEIS.

Page II-4 (Exploration Activities for the Mean Case): The DEIS describes the possible environmental effects from development activities but does not discuss the possible effects from exploration activities as identified in this section. For example, the DEIS notes that approximately 12,400 line kilometers of seismic surveys and approximately 17,280 sediment cores would be required to delineate mining areas but does not describe the possible adverse impacts of these activities on marine mammals, their food resources, or the habitat of which they are a part.

MMC-35

Pages II-8 through II-11 (Tailings Disposal): Although the proposed mining activities probably would not be influenced by sea-ice, since mining would occur during ice-free periods, mining activities could increase the amount of suspended particles in the water column and affect the formation, development and possibly the extent of seasonal sea-ice, which in turn could indirectly affect marine mammals by altering their habitat. The DEIS does not but probably should describe the possible effects of increased sedimentation on ice formation as a result of tailings disposal.

MMC-36

Page II-15 (Scenario Options): The DEIS describes the various techniques available for recovering gold, including the use of mercury to beneficiate placer gold. As described in more detail below, the possibility of a mercury spill or slow bioaccumulation of mercury in marine mammals, fish and other species could have serious effects on those species and on humans who consume them. Therefore, as noted above, the Commission recommends that the Service adopt Stipulation No. 2 on the Prohibition of Use of Mercury or Other Toxic Substances in Processing as part of the Proposed Action and other leasing Alternatives.

Page II-26 (Purpose of Stipulation No. 3): Stipulation No. 3 would prohibit the discharge of mercury into the marine environment. One of the reasons given for this Stipulation is that "two out of the last three dredging vessels that have operated in Norton Sound since 1969 have been lost." This, therefore, appears to be an important Stipulation which should be adopted. This is an important point since fuel as well as mercury spills could occur.

Pages II-30 through II-31 (ITL No. 1. Information on Bird and Marine Mammal Protection): This ITL specifies the responsibilities of the leaseholders pursuant to, among others, the Marine Mammal Protection Act and the Endangered Species Act. To ensure that leaseholders are fully aware of their

MMC-37

responsibilities, a definition of "harass" should be added to the second paragraph. The following wording could be used: "The term "harass" includes any activity, either accidental or intentional, that disturbs or affects the behavior of a marine mammal."

Endangered whales as well as other marine mammals may be affected by aircraft and vessels. Therefore, the words "and migrating or feeding whales" should be added to the last sentence of the first complete paragraph on page II-31 ending with "marine mammal haulout areas and breeding areas." Also, the words "non endangered" should be inserted between the words "and" and "marine" in the first sentence of the next paragraph of this section on page II-31.

Page III-13 (Polynyas): Polynyas are important open water feeding, breeding, and migration areas for some marine mammals. The DEIS notes that relatively large, recurring polynyas form south of St. Lawrence Island, along the south coast of the Seward Peninsula between Cape Prince of Wales and Cape Nome, and in the northeastern part of Norton Sound. The DEIS does not, but should, indicate how the proposed action might affect these polynyas and the marine mammals that rely on them.

Pages III-33 through III-35 (Nonendangered Marine Mammals): The first sentence of this section notes that the description of non endangered marine mammals "... (1) emphasizes species of marine mammals other than endangered whales common to the Norton Sound area and (2) briefly describes their biologies and life histories relevant to potential effects of offshore mining activities in the proposed sale area." With respect to the first item, the DEIS should list all marine mammals likely to be found in or near the proposed lease sale area, as well as specify the species of special concern (common species). In this regard, Figure III-18 should be expanded to include graphic representations of the distribution, feeding areas, and movements of all marine mammal species found in or near the proposed lease sale area. In addition, the FEIS should provide data or documentation supporting the contention that insignificant numbers of polar bear, ringed seal, minke whale, killer whale and harbor porpoise occur in or near this lease sale area. Also, the plural "biologies" is not commonly used and should be replaced by the singular "biology".

In general, this section (pages III-33 through III-35) needs to be expanded to provide a more complete description of the natural history, demography, essential habitats, and diets of marine mammal species and populations that possibly could be affected by the proposed action. To be able to judge the likely significance of the possible direct and indirect effects of the proposed action on marine mammals, it is necessary to know, at least in general terms, the number of animals that could be affected and what proportion this is of the potentially affected species or populations, and the extent to which affected populations are already being affected by other human activities not associated with the proposed action, as well as how individual

MMC-38

MMC-39

MMC-40

animals of various species might be affected by fuel spills, disturbance, tailings disposal, etc. To judge the possible significance of indirect, food chain effects, it also is necessary, among other things, to know or to make informed judgments as to: when, where, and how many animals may feed in or near the proposed lease sale area in typical and atypical years; what species of fish, invertebrates, etc. are eaten by the various marine mammal species; how the availability (distribution, abundance, behavior and productivity) of important food species might be affected by dredging, fuel spills, etc.; and how the marine mammal species in question might respond to and be affected by changes in food availability. With respect to the last point, for example, it is possible that decreases in food availability in one area could cause animals, such as beluga whales, to move to adjacent already occupied areas, increasing the number of animals feeding in those areas, and causing increased competition for food, depletion of food resources, and mortality or malnutrition of more animals than may have been affected directly by the impacting agent.

The last sentence of the second paragraph in this section on page III-33 should be moved to the end of the first paragraph since it refers to the distribution of marine mammals in the area as presented in Figure III-18 not the protection afforded marine mammals under the Marine Mammal Protection Act as described in the previous sentences. Also, with regard to Figure III-18, because the proposed mining activity would take place during "ice-free" periods (approximately from June through November), thereby encompassing a longer period than "summer", the figure should be modified to include the distribution and movements of marine mammals during the entire period of activity, from June through November.

Page III-49 (Bear): The DEIS notes that polar bears as well as brown bears are hunted by a few Native residents but does not provide information on the polar bear population in or near the proposed lease sale area or an assessment of the possible effects of the proposed action on polar bears.

Page IV-A-3 and Pages IV-B-12 through IV-B-13: The fourth paragraph on page IV-A-3 notes that:

"[t]he current offshore-mining operation uses no beneficiation chemicals and yet appears to be exceeding EPA National Pollutant Discharge Elimination System (NPDES) limitations for two trace metals (mercury and nickel) and turbidity in the water column."

Pages IV-B-12 through IV-B-13 also note that "levels of mercury in tissues of marine mammals in Norton Sound are above the level of 1.1 ppm of freshwater considered presumptive evidence of an environmental mercury problem." Given these statements and other evidence presented in the DEIS (page IV-B-16), there is cause for concern that additional dredging in the area, especially

MMC-41

MMC-42

if beneficiation chemicals (mercury) are used, might have adverse effects on marine mammal prey species, marine mammals, and humans that consume either fish or marine mammals in large quantities, if the activities were to increase significantly the levels of mercury in the marine environment. Therefore, if the proposed activity is authorized, the Commission recommends that the Service develop and implement a program to determine and monitor the amount of mercury in selected key marine mammals (e.g., walrus and bearded seals) and prey species (e.g., saffron cod).

MMC-43

Page IV-B-23 (Cumulative Effects): The statement on page IV-B-17 that "ambient regional water quality already averages 0.6 ppb mercury, 24-fold greater than the chronic EPA criterion, and gold dredging is estimated to increase mercury concentrations in the effluent an average of 0.06 ppb mercury"--appears contrary to the statement on page IV-B-23 that "[t]he proposed action would add little to an already existing situation." Consequently, the conclusion that the cumulative effect of the proposed action on regional water quality would be "moderate" does not appear to be justified.

MMC-44

Pages IV-B-24 through IV-B-27 (Effect on Marine Plants and Invertebrates): The DEIS states that "the potential exists for extremely wide-ranging and significant effects to the benthos that would far exceed the actual dredged area" and that "dredging would result in major alteration of the habitat and death of many or most of the associated benthic habitats." The DEIS concludes that the "effect of habitat alteration on marine plants and invertebrates is most likely to be moderate." Because the long-term effects of these changes on the marine food chain and ecosystem(s) in and near the proposed sale area are unknown, the justification for this conclusion is not self-evident.

MMC-45

Pages IV-B-59 (Effect on Nonendangered Marine Mammals): As discussed above, the DEIS should indicate the possible effects of the proposed action on all non endangered marine mammals that could be affected by the proposed lease sale.

MMC-46

The last sentence of the first paragraph indicates that the analysis assumes that a biological monitoring program would not be conducted to detect and determine the possible effects of the proposed action on non endangered marine mammals. As noted above, the development and implementation of a monitoring program, including one or more marine mammal "indicator" species, appears necessary to detect and determine the significance of the direct and indirect effects of the proposed action on marine mammals and the ecosystem(s) of which they are a part and should be incorporated as part of the proposed action.

MMC-47

Page IV-B-60 (Effects of Noise and Disturbance): The opening sentence of this section does not, but should, mention the possible effects of disturbance resulting from seismic surveys.

MMC-48

Page IV-B-60 (Airborne Noise): Because helicopters will be used extensively, the phrase "especially helicopters," should be inserted between the words "aircraft" and "and high-speed" in the first sentence. The remaining discussion requires further expansion to describe more completely all possible effects of aircraft traffic on marine mammals. For example, the effect of aircraft traffic on marine mammals can depend, among other things, on the time of day and year and the reproductive status of the animals. Also, aircraft traffic in the vicinity of walruses and sea lions with calves may cause them to flee into the water, potentially resulting in injury or abandonment of calves.

MMC-49

Page IV-B-60 (Waterborne Noise): The conclusion in the last paragraph of this section that harbor seals and beluga whales "can tolerate fairly high levels of noise and industrial activity" is based on the assumption that noise levels from commercial fisheries and industrial activity are comparable. Because this hypothesis has not been verified, the long-term effects of noise disturbance on marine mammals should be one of the things considered in a monitoring program.

MMC-50

Page IV-B-63 (Site-Specific Dredging Effects): This paragraph notes that walruses are opportunistic feeders and capable of feeding in other areas if their food supply is depleted in one area. On page IV-B-25, the DEIS states that dredging activities could have potentially significant effects on benthic organisms (e.g., bivalve molluscs), the primary prey of walruses, thereby having the effect of forcing walruses to move to other, possibly less desirable feeding areas. These statements appear contradictory. Further, if walruses are forced to move to alternative feeding areas and these areas have less food or haul-outs, the food is less accessible, or the area is already occupied by walruses, the effects could be substantial.

MMC-51

Page IV-B-63 (Effect of Trace Metals): Although the statement in the first paragraph that "[h]igh levels of mercury and cadmium in arctic marine mammals and in their food sources are believed to be of natural geologic origin rather than a result of industrial pollution" appears true for most areas in the Arctic, the DEIS states elsewhere (page IV-B-12) that the high level of mercury in the Norton Sound area is a result of both natural and human-related activities. Consequently, this discussion should be revised accordingly.

MMC-52

Page IV-B-70 (Effects of Offshore Mining): The third paragraph in this section evaluates the possible effects of 360 to 450 helicopter flights per mining season on marine mammals in the proposed lease sale area. As noted above, a parallel may not be appropriately drawn between the effects of noise from commercial fishing activities and noise from industrial activities. Similarly, there could be a threshold effect of noise on behavior. Therefore, as noted above, determining the long-term cumulative effects of noise on population dynamics and behavior of marine

MMC-53

mammals in the proposed lease sale area should be part of a monitoring program.

Page IV-B-72 (Effect of OCS Oil and Gas Activities): The second sentence states that "exploration activity has had a minimal effect on marine mammals in Norton Sound," but provides no data or analyses to support the statement. As a related matter, because the long-term indirect and direct effects of oil and gas activities have not been evaluated or assessed completely to conclude that "OCS oil and gas exploration has had a negligible effect on nonendangered marine mammals," the word "oil-spill" should indicate between the words "negligible" and "effect". Further, the fact that there have been no spills to date does not necessarily mean that future exploration and development will not result in spills such that the oil spill effects of future exploration would be "negligible".

MMC-54

Page IV-B-73 (Effect of Onshore and Coastal Development): This paragraph states that "[e]levated mercury levels could be present in some of the 5,000 or more walrus, seals, and beluga whales that summer in the Nome area." Rather than estimating the total number of marine mammals in the Nome area likely to be affected, this statement should be revised to indicate the number of potentially affected animals of each species.

MMC-55

Page IV-B-75 (Effects on Gray Whales): This section describes, among other things, the possible effects of trace metals on gray whales. The discussion includes a statement that "[h]igh levels of mercury and cadmium found in marine mammal tissue are thought to be of natural origin and not attributable to pollution (Risebrough, 1978)." As noted above, while generally true for Arctic species, the statement may not be true for all marine mammals or for the Norton Sound area. Therefore, this sentence should be deleted or revised.

MMC-56

Although only a small segment of the regional population of gray whales is likely to feed in the proposed lease sale area and encounter toxic metals, individual whales could be greatly affected if they feed in highly toxic areas. Also, it is unclear whether the same proportion of the population will be affected over the long-term. Therefore, the conclusion would be better stated as: "[c]onsequently, the increase of toxic trace metals (especially mercury) in the proposed sale area is expected to have a negligible effect on the regional population of gray whales, though it could have a significant effect on individual whales and, over the long-term, affect an unknown proportion of the total population."

MMC-57

Page IV-B-93 (Effects on Subsistence Resources: Seal and Walrus): High levels of toxic trace metals (e.g., mercury) could pose serious health hazards to humans consuming seals or walrus that have high levels of trace metals in their tissues. The DEIS notes that such high level contamination could result in the termination of the subsistence hunt for these species for

MMC-58

approximately one year to determine whether the resources were fit for consumption and, therefore, concludes that this would have a major effect on the subsistence harvest of seals and walrus. Given the fact that mercury contamination may persist for years (IV-H-1), the Commission, as noted earlier, recommends that the Service develop and implement a program to determine and monitor the levels of mercury and other possible harmful contaminants in shellfish, fish, and marine mammals so as to detect possible health hazards and impacts on affected marine mammals and other organisms in time to ensure that they do not become significant problems.

Page IV-B-113 (Habitats): Benthic habitat can be adversely affected by both direct (e.g., scouring) and indirect (e.g., sedimentation) effects of dredging. The DEIS notes that "[i]t is not possible to say if or when benthic communities would recover from this alteration of offshore habitat." The DEIS concludes that the proposed action would have a "moderate" effect on the benthic and epibenthic invertebrates in the proposed lease sale area. These statements appear to be contradictory.

MMC-59

Page IV-B-116 (Mining and Mineral Processing): Some of the policies and procedures used in mining activities in State waters are described in this section. It notes, for example, that dredge spoils are discharged directly on the seabed in the area previously disturbed by the dredge. Unless studies being conducted in State waters indicate a better method for disposing of dredge wastes than the one described, the Commission, as noted earlier, recommends that the Service develop an additional Stipulation requiring downshunting of discharged mine waste materials to protect surface waters in the lease sale area from fine sediment and dissolved metals which may affect fish, marine mammals, and other living marine resources. The Stipulation should stipulate that prior to beginning any discharge operation, the Regional Manager may require the lessee to: provide information on the nature and quantity of discharge as may be needed to determine the effects on the marine environment; obtain samples of the discharge associated with such operations; and collect and analyze samples of biota in the discharge area to detect and determine levels of heavy metals.

MMC-60

Page IV-G-2 (Analysis of Potential Effects of Offshore Gold Processing with Mercury): The DEIS concludes that the use of mercury in offshore beneficiation of gold would result in a "major" effect on water quality only if a mercury spill were to occur. On page IV-G-1 the DEIS states that "[o]ver the 100 to 120 days of actual mining each season, and assuming a 5-percent loss of mercury...about 230 to 1,100 kilograms more mercury would be lost to the environment from a dredge..." Also, the DEIS notes on page III-10 that the waters in the eastern part of the Sound do not mix without activity generated by storms, thereby suggesting that mercury lost to the environment may not disperse readily in this part of Norton Sound. As described, the effects of mercury processing on water quality could be "major" and,

MMC-61

therefore, the words "if a mercury spill occurred" probably should be deleted from the conclusion.

Summary and Conclusions

In summary, the DEIS provides a thorough assessment of the ways that marine mammals possibly could be affected by seismic operations, sediment coring, vessel and aircraft traffic, dredging, fuel spills, and other activities associated with the proposed mining program in Norton Sound. It does not, however, provide a thorough and adequate assessment of all--and the degree to which specific species and populations of--marine mammals could be affected if mining exploration and development activities are allowed to proceed as proposed. Among other things, the Environmental Impact Statement should be revised or expanded to document the contention that insignificant numbers of polar bear, ringed seal, minke whale, killer whale, and harbor porpoise occur in or near the lease sale area.

MMC-62

While the State of Alaska has mined placer gold deposits in State waters, there has been no mining activity for gold in the offshore waters in Alaska or in other Federal waters and, consequently, it is important to proceed with caution. Among other things, the Commission therefore recommends that the Service adopt the mitigation measures described as Potential Stipulations and Potential Information for Lessees and develop and adopt an additional Stipulation requiring downshunting of dredge spoils into the seabed, as part of the Proposed Action and other leasing Alternatives.

MMC-63

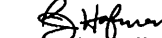
Also, it is unlikely, as noted earlier, that available information will be adequate to assess fully and accurately both the direct and indirect effects of the proposed action on marine mammals and the ecosystems of which they are a part. Obtaining all information necessary to make complete and accurate assessments could be prohibitively costly and indefinitely delay deciding whether to authorize, modify, or cancel the proposed action. The Commission therefore recommends that the Minerals Management Service, consult the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and the Alaska Department of Fish and Game, and based upon these consultations cooperatively develop and implement, as appropriate, monitoring programs to verify the predicted effects and detect the possible unforeseen effects of the proposed action on marine mammals in time to take meaningful mitigation measures.

MMC-64

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I hope that these comments, recommendations and suggestions are helpful. If you or your staff have questions about any of them, please let me know.

Sincerely,



Robert J. Hofman, Ph.D.  
Scientific Program Director

cc: Mr. Robert E. Kallman



### Response MMC-1

The MMS determined that there was "little or no potential for bioaccumulation of the trace metals in the prey" for gray whales and notified NMFS (see Appendix B; September 28, 1988, letter) of this conclusion and that there was no need for formal Section 7 consultation.

### Response MMC-2

A July 26, 1990 letter to NMFS requested their review of our conclusion that reinitiation of Section 7 consultation for the Steller (northern) sea lion would not be required for the proposed sale. The October 25, 1990, letter from NMFS concurred with the MMS conclusion (see Appendix B).

### Response MMC-3

See also Response NRDC-11. Section IV.B.2 states that elevated levels of mercury in the water column have not been found nor are they expected to occur as a result of mining activities. We agree that there should be monitoring of human health if baseline levels of mercury are high and the mining contributes to the elevated level, which is why the Director of MMS has chosen to include this stipulation (and others) as part of the proposal.

### Response MMC-4

The MMS, in cooperation with the NOAA tissue bank program, plans to measure mercury, other trace metals, and contaminants in seal tissues collected in Norton Sound.

### Response MMC-5

Dredge-plume analyses conducted for the Bima indicated that near-surface or mid-depth discharges would be more effective than bottom discharge to minimize turbidity (Sec. IV.B.2.a[4]). The best depth to discharge dredged material to minimize turbidity depends on operational parameters of the dredge, sediment silt content, and the depth-varying ocean currents. This evaluation is best made during NPDES permitting, when site-specific information would be available, rather than during the sale EIS stage. See also Response EPA-1.

The benthic prey of walrus and bearded seals (in this case clams and perhaps crabs) are the primary food items that could be affected by the dredge excavation. These benthic prey species would only be affected on a long-term basis within the area affected by the dredging. Such a loss of available prey items is not likely to be significant compared to the natural variation in availability of these prey species to walrus and bearded seals. Pelagic prey of belukha whales and fish-eating seals would not be affected by the dredging. Fish may suffer some displacement due to turbidity or alter normal migration movements, but the effects are not expected to be great. Turbidity is expected to have only MINOR effects on fishes (see Sec. IV.B.3).

### Response MMC-6

The text cited from page IV-B-32 is from a general discussion of types of effects possible from habitat alteration. Although the statement is correct, the more site-specific discussion that follows suggests differential recovery rates for sand and cobble substrates. In sand habitats, recolonization has progressed much better than in cobble areas. For marine mammals that feed on infaunal or epibenthic prey (namely walrus and bearded seals) the recolonization of sandy areas is not significant in terms of potential effects from dredging on marine mammals. As stated in the DEIS on page IV-B-34, in sandy habitat in 1989, there was a large increase in mollusks from the previous year. Thus, although recolonization or recovery of communities on rocky substrates has not progressed very far, sand habitats are showing much better recolonization. For more detailed discussion of effects on nonendangered marine mammals, the commenter is referred to Sec.IV.B.6.b.

### Response MMC-7

In reply to (1) and (2), the estimated numbers of each species of nonendangered marine mammal and the proportions of the species' populations that could be exposed to the dredging activities are discussed in Section III.B.4.a. through e. In reply to (3), the extent to which these populations (or species) are affected by human activities not associated with the proposal are evaluated under the cumulative effects on migratory species in Section IV.B.6. (All marine mammals in the sale area are considered migratory.) In reply to (4) and (5), the

effects on individuals of each species of nonendangered marine mammal and the effects on their habitats are discussed in Section IV.B.6.a. through e. in the DEIS. In reply to (6), the mitigating measures and stipulations proposed to minimize these potential effects are discussed at the beginning of Section IV.B.6. and in Section II.F.

#### **Response MMC-8**

On page IV-B-31 in the second DEIS, the 1.5-1.8 times figures relate to expected changes in bathymetry due to deposition of coarse-grained material. These figures are also found in Section II.A.2.d.(4) in the paragraph below the numbers given for the model (and cited by the Marine Mammal Commission [MMC]). The discussion on page IV-B-31 referenced the numbers cited by the MMC for expected changes due to sedimentation by fine-grained material, the text in Sec IV.B.6.b.(1) now has been revised. See also Response MMC-5.

#### **Response MMC-9**

The EPA, in its comments on the second DEIS, has indicated that this issue would be similarly evaluated prior to issuance of a NPDES permit for any mining in Federal waters.

#### **Response MMC-10**

The DEIS recognizes that the sale area is feeding habitat for some walrus (1,000-2,000) but they represent less than 1 percent of the population (see Sec. III.B.4.a.). The effects of dredging on walrus through direct effects on prey are discussed in Section IV.B.6.b.

#### **Response MMC-11**

The expected effect on marine plants and invertebrates has been elevated from MINOR to MODERATE. Please see the revised text in Section IV.B.3.(a). See also Response MMC-5 for the effects on marine mammals.

#### **Response MMC-12**

Effects of seismic surveys on marine plants and invertebrates are discussed in Section IV.B.3.(e). Evaluation of sediment coring has been added to Section IV.B.3.(a).

The DEIS does assess the effects of seismic surveys and of sediment core drilling on marine mammals. See Section IV.B.6.a.(3).

#### **Response MMC-13**

Although some seals and walrus could be attracted to the dredge, the exposure of these marine mammals to mercury and other trace metals would come through the food chain rather than through direct contact with the metals in the water column as has been demonstrated in the literature. See discussion under Section IV.B.6.c.(1) through (6). The monitoring of marine mammal distribution, abundance, and "rates of numbers affected" could be included in the monitoring program under Stipulation No. 1 if NMFS and FWS (who both have management authority for these species) recommend these measures (both agencies have had representatives on the Coordinating Team for the OCS Mining Program Norton Sound Lease Sale. See also Response MMC-26.

#### **Response MMC-14**

See Response MMC-7.

#### **Response MMC-15**

See Responses MMC-7 and MMC-8 in regard to effects on the availability of benthic prey. Figure III-18 shows distribution, habitat use (that includes feeding areas), and migration movements (routes) of species groups occurring in the actual sale area, rather than all marine mammal movements and presence throughout the Norton Basin as shown in proposed OCS oil and gas lease Sales 57 and 100 EIS's. The MMS has been and will consult with the FWS and NMFS through their membership on the EIS Coordinating Team, their membership on the Postlease Review Team, and their review of the monitoring program and results of the monitoring studies.

#### **Response MMC-16**

The FWS and NMFS have representatives on the OCS Mining Program Norton Sound Lease Sale Coordination Team. The MMS is establishing a Postlease Review Team to advise the RS/FO of issues associated with the environmental monitoring program. The FWS and NMFS will have the opportunity to review and provide comments on the monitoring program and biological surveys as representatives on the Postlease Review Team. Through this postlease review process, monitoring studies should be well designed and initiated during the exploration phase. The monitoring team will assure that good scientific research is conducted and any effects associated with the dredging should be detected. See also Responses NRDC-20 and -26.

#### **Response MMC-17**

See Response MMC-7.

#### **Response MMC-18**

The level of vessel and air traffic (1-2 trips/day) for only one or two seasons for past Bering Sea exploration indicates that such effects on marine mammals were short term and, therefore, MINOR. The conclusion of MINOR effects for oil and gas exploration and development in the Beaufort and Chukchi Seas is based on the same logic used in the assessment of the proposal (see Sec. IV.B.6.a.-d.). The incremental effects of additional air and vessel traffic and oil spills at different locations and affecting different populations or segments of marine mammal populations are not likely to result in long-term effects. The DEIS provides information to support the conclusion of MINOR effects from oil spills on nonendangered marine mammals (see Sec. IV.B.6., oil-spill effects).

#### **Response MMC-19**

The information on oil ingestion effects on sea otters is not useful in assessing potential effects on seals, walruses, and belukha whales occurring in the proposed mining area because the latter species are not likely to ingest or inhale oil as the sea otters do because they do not groom themselves when their skin and hair becomes contaminated. Studies on the oiling of seals (see Sec. IV.B.6.d.) indicate a lesser effect occurs as a result of oil contamination to seals, walruses and belukha whales than to sea otters.

#### **Response MMC-20**

The short-term (few minutes to no more than a few hours) and infrequent displacement of female seals and sea lions from rookeries that might occur in association with OCS activities is not likely to jeopardize the survival of young other than causing injuries due to trampling (as described in Sec. IV.B.6.a.[3]). Females frequently leave the rookeries for several days to search for food as a natural behavioral activity. The occasional disturbance incident is not likely to significantly contribute to the natural stress on the young that normally occurs when they are left on the rookeries by the mother during searches for food. There is no documented evidence to support the contention that repeated exposure (or disturbance) to air or boat traffic will result in the abandonment of rookeries by seals or sea lions. In fact, the past overharvesting of these species in the early 1900's for seal oil attests to the fidelity of seals and sea lions to rookeries and haulouts from which sealers could reliably come back to time and again and slaughter many seals and sea lions. If the slaughter of cohorts and the associated severe disturbance did not result in abandonment of rookeries and haulout sites, the exposure of seals and sea lions to relatively benign air and boat traffic is not likely to cause any permanent abandonment of these areas.

#### **Response MMC-21**

The proposed dredging operations would only occur during the open-water season and, therefore, no effects or interactions with polynyas are expected to occur.

#### **Response MMC-22**

Unfortunately, these data are not available for all subsistence resources. Harvest data have been included in this FEIS when available. These data are considered reliable.

### Response MMC-23

Polar bears do not occur within the sale area during the open-water season--the time when mining/dredging is assumed to occur. Polar bears are only harvested occasionally by Nome residents and are insignificant to their subsistence foods. Effects are not anticipated on the subsistence harvest since polar bears are not in the sale area during open water. Thus, polar bears were not described in detail.

### Response MMC-24

An extensive review of documented sightings, accounts, and observations of marine mammals occurring in Norton Sound indicate that polar bears, northern (Stellar) sea lions, northern fur seals, harbor seals, minke whales, killer whales, and harbor porpoise are uncommon or rare in abundance in or near the proposed sale area (Frost, Lowry, and Burns, 1982). Polar bears are uncommon in the Sledge Island area (more than 10 mi west of the proposed sale area) during the winter and early spring ice season. A few bears have been seen in this area during that season and polar bears do not occur in the sale area during the open-water dredging season (Nelson, 1990, oral comm.).

### Response MMC-25

See Response MMC-2.

### Response MMC-26

The information for assessment on the marine mammal species and numbers potentially affected by the proposal is discussed in Section IV.B.6. Further information on potential and actual effects is expected to be gathered under Stipulation No. 1 with the biological monitoring program (see Response MMC-7).Response MMC-26a

### Response MMC-26a

The MMS has consulted with NMFS and FWS through their roles on the OCS Mining Program Norton Sound Lease Sale Coordination Team and through their review of the first and second DEIS's. Monitoring plans required under Stipulation No. 1 would be reviewed by appropriate State and Federal agencies (including FWS and NMFS) as part of the postlease review of plans submitted by lessees. Also, under Stipulation No. 1, an annual review of the monitoring would be required.

### Response MMC-27

The EIS analyzes the effects of the proposal on nonendangered and endangered marine mammals which commonly occur within the proposed sale area. Other species of nonendangered and endangered marine mammals not considered in the analysis, such as bowhead whales and polar bears, have never been documented or unofficially reported to occur within the sale areas; thus, the proposed action is not likely to affect individual polar bears or individual bowhead whales let alone populations of these species. Other species not considered in the analysis, such as the minke whale or harbor porpoise, are uncommon or rare visitors to Norton Sound and the sale area proper, and when these species have been observed in Norton Sound only a few individuals (1-3) were recorded. Therefore, populations and individuals of these species are not likely to be affected by the proposal.

In addition, MMS has been and continues to coordinate with NMFS and FWS through the Coordination Team (CT) and other mechanisms on these issues. Both NMFS and FWS have representatives on the CT who have been reviewing the EIS and attending CT meetings. Both agencies will be involved in the review of the monitoring program. See also Responses MMC-7 and MMC-14.

### Response MMC-28

The EPA has established water-quality criteria with regard to suspended solids and trace-metals concentration according to their National Pollution Discharge Elimination System permit. The EPA establishes regulations which require the application of the "best available control technology economically achievable" for point-source discharges. The technologies and operating procedures used to meet these criteria guidelines are determined by the lessee. The MMS does not propose to write regulations or stipulations that require lessees to use specific procedures or technologies to meet the criteria guidelines.

The EPA permit (USEPA, 1986b) for the WestGold dredging in State waters has required that tailings be discharged to the dredged trench. A similar EPA requirement is anticipated for dredging in Federal waters. An MMS stipulation requiring this procedure would be duplicative of EPA responsibilities. WestGold has also been investigating discharge configurations with the goal of minimizing turbidity and trace metals in surface and deeper waters. Requiring discharge near the ocean bottom could be counter to the stated goal of clean surface waters. A preliminary analysis in Rusanowski, Gardner, and Jewett (1988b) indicated that under some expected operating conditions in Norton Sound that surface discharge, in part because of a "bounce" problem with the bottom-turbidity plume. Which configuration and depth of discharge are most effective are site and dredge specific, and are best decided during the NPDES permit process. See also Response MMC-5.

#### **Response MMC-29**

This comment applied to the first DEIS, but does not apply to the second DEIS.

#### **Response MMC-30**

Proposed monitoring plans required under Stipulation No. 1 would be reviewed by appropriate State and Federal Agencies (including FWS and NMFS) as part of the postlease review of testing and mining plans submitted by lessees. Also under Stipulation No. 1, an annual review of the monitoring program would be required.

In addition, MMS has been and continues to coordinate with NMFS and FWS through the Coordination Team (CT) on these issues. Both NMFS and FWS have representatives on the CT who have been reviewing the EIS and attending CT meetings and will be asked to participate on the Postlease Review Team. See Responses MMC-4, MMC-13, and MMC-26.

#### **Response MMC-31**

The Alaska Regional Studies Program presently is not planning studies done specifically for the proposed lease sale area, although many of MMS' studies would be relevant. It is expected that studies such as those the commenter suggests will be conducted by the lessee through the postlease monitoring program as required in Stipulation No. 1. The types of monitoring recommended are listed in Stipulation No. 1. Tissue analysis may be considered by MMS in the future to establish a baseline for Norton Sound food-chain monitoring.

#### **Response MMC-32**

The EIS does consider the environmental effects of mining activities other than gold. The concept of ocean mining using various mining technologies as described in the EIS would include all minerals that could be extracted using these or similar ocean-mining technologies. An example of a mineral excluded from the environmental review would be geothermal and geopressured resources. In addition, there would be additional environmental review once a lessee submitted a delineation, testing, or mining plan for a targeted mineral. The lessee's submission would be the subject of an environmental assessment (EA). Once the EA is completed, a decision will be made regarding what, if any, further environmental decision documents including a possible supplemental EIS would be necessary. It should be noted, however, that at this time gold is the only economic mineral in Norton Sound.

#### **Response MMC-33**

The titles and legends of Figures I-2, I-3, II-6, and II-7 have been clarified in response to this comment.

#### **Response MMC-34**

The assumption that mining activities will be similar to those that are presently occurring on nearby State of Alaska leases is considered to be appropriate for it is based on (1) known operations and strategies occurring in an environment that is similar to the proposed lease sale area and (2) a mining scenario proposed by the U.S. Bureau of Mines (USDOI, BOM, 1987) for the area off Nome, Alaska.

The uncertainty of the types of activities associated with the proposed lease sale is noted in Section II.A.2.b by the following statements: "the strategies used to explore, assess, mine, and process the potential resources in the

proposed sale area may vary. These variations are the result of uncertainties with regard to the resources and operational conditions unique to each leaseholder or operator."

#### **Response MMC-35**

The effects of exploration activities associated with the proposal on marine mammals are analyzed in Section IV.B.6 under Project-Specific Noise and Disturbance Effects. See also Response MMC-12.

#### **Response MMC-36**

The principal water-quality factor controlling the formation of sea ice is the concentration of dissolved substances. The effect of variations in the concentration of suspended sediment particles on the formation of sea ice is unknown. As ice forms, suspended particles are incorporated into the sea-ice matrix along with dissolved substances. This action reduces the concentration of suspended particles in the layer of water subject to freezing and thus would reduce any effects the suspended particles might have.

The Norton Sound area provides examples of sea-ice formation in areas where there are naturally occurring, relatively high concentrations of suspended sediments. The sea ice that occurs along the coast is a combination of ice that forms in place or ice that has formed in other areas and has been transported into the coastal areas by winds and currents. Wave action in the nearshore environment would resuspend fine-grained particles and increase the concentration of suspended particles above that which may be found in areas farther from shore. Also, sea ice forms along the shores of the Yukon River Delta where there are naturally occurring, relatively high concentrations of suspended sediment particles.

As noted in Section III.A.6, the sea-ice regime in Norton Sound is dynamic. Depending on their direction, winds and currents may transport ice in either a clockwise or counterclockwise direction in Norton Sound. The winds and currents also may transport ice out of or into Norton Sound. Sea ice that started forming in an area affected by mining might be transported to other areas during the period between freezeup and breakup.

Mining operations in Norton Sound probably would stop before sea ice begins to form or is carried into the Norton Sound from other areas. The fine-grained material in the discharge may: (1) remain in suspension and be transported away from the mined area and become more widely dispersed; or (2) settle to the seafloor and then be resuspended by waves and currents during subsequent storms and transported by currents to other areas. Thus, by the time sea ice begins to form, much of the fine-grained sediments that were mined may be widely dispersed. As noted in Section III.A.3, currents transport much of the fine-grained sediments from the Yukon River out of Norton Sound, past the Bering Strait, and into the Chukchi Sea.

#### **Response MMC-37**

The term "harass" is defined as a form or type of disturbance in the first sentence of the second paragraph in ITL No. 1, Information on Bird and Marine Mammal Protection (see Sec. II.G). The endangered species (gray whale and arctic peregrine falcon) are either marine mammals or birds. Therefore, they are included in the discussion of ITL No. 1. The word "nonendangered" has been added as recommended.

#### **Response MMC-38**

The EIS describes polynyas as part of the oceanography of the sale area but does not imply or suggest that polynyas or the ice formation in the polynyas would be affected by the proposed action; thus, marine mammals associated with polynyas would not be affected. See Response MMC-21 also.

#### **Response MMC-39**

The species of nonendangered marine mammals likely to be found within or near the sale area are the species listed in Section III.B.4 (see also Sec. IV.B.6, Effect on Nonendangered Marine Mammals). Figure III-18 includes the distribution, feeding areas, and movements of all nonendangered marine mammals likely to be affected by the proposal. Other species of nonendangered marine mammals uncommon or rare in Norton Sound are not likely to be affected in any way by the proposal and, thus, are not included in Figure III-18. The Frost, Lowry, and Burns (1982) citation has been added to Section III.B.4 to support the contention that insignificant numbers of polar bear, ringed seal, minke whale, killer whale, and harbor porpoise occur in or near the lease sale area. The text has been changed regarding the last point in the comment. See also Response MMC-15.

#### **Response MMC-40**

The EIS gives, in general terms, the numbers of animals of each marine mammal species that could be potentially affected by the proposal, in comparison to the regional populations of each species. For example (Sec. III.B.4), "about 80 percent of the world population of walrus (250,000-300,000) occur seasonally in the Bering Sea. . . . During the summer season, more than 1,000 walruses (mostly adult males) frequent coastal haulout sites . . ." and occur in or near the sale area. The extent to which affected species or populations are already being affected by other human activities is discussed in the Cumulative Effects section (Sec. IV.B.6). The effects of fuel-oil spills, disturbance, and dredging on individual marine mammal species, the effects on the food chain, and the judgments on numbers of animals in or near the sale area are discussed in Sections IV.B.6, 7, and 15 (see Response MMC-25a).

In regard to the last part of this comment, there is no known scientific information/data on marine environments to support or suggest the possibility that decreases in food availability in one area could result in an increased competition for food, depletions of food resources, mortality, etc. as a result of dredging/turbidity, oil spills, or any other impacting agent associated with the proposal or associated mining activities.

#### **Response MMC-41**

The text in Section III.B.4 and Figure III-18 have been revised in response to this comment.

#### **Response MMC-42**

Although polar bears have been harvested by Nome residents, only 5 bears were reported to have been harvested over the past 10 years and none of these bears were harvested within 25 miles of the proposed sale area. Thus, polar bear occurrence in or near the proposed action is rare or nonexistent; thus, polar bears are not likely to be affected by the proposal. See also Response MMC-23.

#### **Response MMC-43**

The EIS proposes a monitoring program to monitor mercury levels in marine mammals and other organisms in the marine environment. See Stipulation No. 1, Section II.G.2.

#### **Response MMC-44**

This comment applied to the first DEIS, but does not apply to the second DEIS.

#### **Response MMC-45**

The conclusion of effects is based on the scale of both spatial and temporal effects to populations. While the temporal effects may be long lasting, in the scenario proposed in the EIS, the spatial scale expected to be affected was sufficiently small relative to the distributions of the populations as to render a MODERATE conclusion most likely.

#### **Response MMC-46**

See Response MMC-24.

#### **Response MMC-47**

The second DEIS does assume that a biological monitoring program would be part of the proposal. Per Stipulation No. 1, representative marine mammals will be considered as potential species to be included in the environmental monitoring program.

#### **Response MMC-48**

The effects of noise from seismic surveys is discussed under Project-Specific Noise and Disturbance Effects in Section IV.B.6.



**Response MMC-49**

The type and amount of aircraft traffic and a more detailed discussion of the specific noise and disturbance effects of the proposal are discussed under Project-Specific Noise and Disturbance Effects (Sec. IV.B.6). Sea lions do not occur in or near the sale area; thus, discussion of the species is not relevant to the EIS.

**Response MMC-50**

Large trawlers, dredges, and oil rigs all use diesel generators which are the primary noise sources. These noise sources, some of which are mobile and some of which are stationary, all are comparable.

**Response MMC-51**

The benthic habitat alteration discussed in Section IV.B.3 does not state nor imply any large scale destruction or reduction of clam populations in the sale area. The analysis indicates that local, benthic community organisms would be affected but not to an extent that the availability of clams for feeding walrus would be reduced. The MODERATE effect level applies to any one species of marine plant or invertebrate species that would be affected for more than one generation, not all species of clams are food items of walrus.

**Response MMC-52**

The statement on mercury and cadmium levels in arctic marine mammals applies to those marine mammals living in the Arctic Ocean not those in Norton Sound.

**Response MMC-53**

Available data do not suggest an ability to determine a "threshold effect;" indeed, some behavioral observations of marine mammals and other wildlife strongly suggest that these animals habituate or become less reactive to noise disturbance sources with increased frequency of exposure. See also Responses MMC-13 and MMC-50.

**Response MMC-54**

There have been no documented or observed changes in the distribution or abundance of marine mammals in Norton Sound associated with the 2 years of oil and gas exploration (1-2 drill rigs) associated with Sale 57 leases. Thus, the effect is likely to have been minimal. The probability of future oil spills associated with exploration are very low and the lack of sensitivity to oil spills of marine mammals that occur in the sale area indicates that effects are likely to be NEGLIGIBLE. See also Response MMC-18.

**Response MMC-55**

The text has been revised in response to this comment, but actual numbers of seals and walrus likely to be affected would be low and the degree of effect would not be significant to local or regional assemblages or populations.

**Response MMC-56**

The text in Section IV.B.7.a.(2) has been amended to address this concern.

**Response MMC-57**

This comment applied to the first DEIS, but does not apply to the second DEIS.

**Response MMC-58**

This comment applied to the first DEIS, but does not apply to the second DEIS.

#### **Response MMC-59**

The MODERATE effect reached by the analysis is based on the inclusion of a monitoring program in the proposal. As detailed in Section IV.B.3.a, recovery of cobble communities has not yet taken place, although recolonization has increased. This uncertainty about the temporal scale involved in recovery led to the statement quoted. The monitoring program, as discussed in Section IV.B.3, should allow for the identification of habitat types within proposed dredge areas and the ability to limit the extent of effects to particular communities by restricting or controlling the location of dredging.

#### **Response MMC-60**

No stipulation discharge configuration is necessary because discharges will be evaluated on an individual basis by the EPA. In addition, 30 CFR 282.12, which governs OCS mining operations, requires that the Director assure operations are conducted in a manner that protects the environment. The MMS regulations also require the lessee to provide sufficient data and information on the discharge, so the Director can determine its effect on the marine environment.

If one discharge configuration is clearly superior to other configurations or methods of disposal, then that discharge method would be required. WestGold conducted a study during the 1988 mining season to determine the effectiveness of tailings discharge configurations in controlling turbidity. Four configurations were tested, ranging from a discharge pipe extending 1.5 meters below the water surface to a discharge pipe extending 7.0 meters below the water surface with deflector plates installed 500 millimeters below the bottom of the pipe. These tests indicated that no pipe configuration resulted in substantially lower turbidity. However, turbidity levels in 1988 were substantially lower than in 1987, primarily due to the elimination of entrained air in the effluent discharge. This was achieved by reducing the diameter of the discharge pipes.

Some of the concerns expressed in this comment are more appropriately addressed when mining plans are submitted for review and comment. The Governor, other Federal agencies, and other interested parties have the opportunity of review and provide comments and recommendations on any of the activities described in the plan.

The environmental protection measures are developed to avoid, minimize, or otherwise mitigate any potential adverse environmental effects. The lessee shall monitor activities in a manner that develops the data and information necessary to enable the Director of MMS to (1) assess the effect of mining activities on the environment on and off the lease; (2) develop and evaluate methods for mitigating adverse environmental effects; (3) validate assessments made in previous environmental evaluations; and (4) ensure compliance with lease and other requirements for the protection of the environment.

The MMS does not consider it necessary to propose a downshunting stipulation as suggested in this comment.

Requirements for measuring chemical composition of discharged materials and biota in the vicinity of the discharge are already included in Stipulation No. 1 and would also be required by the EPA NPDES monitoring program which EPA proposed in its comments on the DEIS.

#### **Response MMC-61**

This comment applied to the first DEIS, but does not apply to the second DEIS.

#### **Response MMC-62**

See Responses MMC-24, MMC-39, and MMC-46.

#### **Response MMC-63**

This comment applied to the first DEIS, but does not apply to the second DEIS.

#### **Response MMC-64**

See Responses NRDC-20, MMC-25a and MMC-26.

STEVE COWPER, GOVERNOR

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July 31, 1990

Mr. Alan D. Powers  
Regional Director  
Alaska OCS Region  
Minerals Management Service  
949 E. 36th Avenue, Room 110  
Anchorage, AK 99508-4302

RECEIVED

AUG 2 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

Dear Mr. Powers:

SUBJECT: SECOND DEIS  
NORTON SOUND OCS MINERALS LEASE SALE  
STATE I. D. NO. AK900614-16A

The State of Alaska has completed its review of the Second Draft Environmental Impact Statement (DEIS) prepared by the Minerals Management Service (MMS) in support of the proposed Norton Sound Outer Continental Shelf (OCS) Minerals Lease Sale. The state response includes comments from the Departments of Commerce and Economic Development, Environmental Conservation, Fish and Game, and Natural Resources.

The DEIS addresses the concerns raised previously by the state regarding the relationship of mercury and human health, the inclusion of stipulations to minimize adverse effects, and the Coastal Zone Management Act (CZMA). The state is particularly pleased that the revised Information to Lessees No. 4 of the DEIS reflects the recent Solicitor's Opinion on the applicability of the CZMA.

The state is very encouraged by the success of the Coordination Team process in identifying and resolving issues of state and mutual concern prior to the DEIS stage of a proposed OCS lease sale. This success is reflected in reviewer's comments on the DEIS which identified only minor points needing clarification or correction and not substantive issues requiring resolution. The

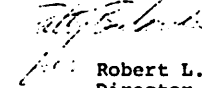
Mr. Alan D. Powers 2 July 31, 1990  
Norton Sound OCS Minerals Lease Sale - Second EIS  
State I. D. No. AK900614-16A

state is hopeful that this process can be used as a model for continued participation of state agencies in the Norton Sound Minerals Lease Sale activities as well as for review of future OCS lease sales.

Attachment 1 includes brief page-specific comments on the DEIS. The state is presently reviewing the Proposed Leasing Notice for the sale and will provide comments shortly.

Please call if you have questions on these comments.

Sincerely,



Robert L. Grogan  
Director

cc: Distribution List

July 31, 1990

DISTRIBUTION LIST

July 31, 1990

ATTACHMENT I

Page-Specific Comments

Pages IV-B-9 to IV-B-26, Trace Metals: This section discusses chromium, copper, lead, zinc and arsenic as they might pertain to bioaccumulation. Ions of these metals can be preferentially absorbed on clay particles, and this is the basis for stream-sediment geochemical prospecting. These ions are however not necessarily available for bioaccumulation, since a hot acid digestion is required to liberate the metal. Filtering the samples prior to digestion for analysis would remove this "bound" component of the metals.

The DEIS also states that many of these metals covary with the gold content of the sediments. This is to be expected, because the sulphides of these metals, sometimes combine with iron, are the common associated minerals of the gold veins from which the gold placer deposits are derived. These relatively inert sulphide minerals (eg. chalcopyrite, bornite, sphalerite, galena and arsenopyrite) generally have specific gravities greater than 4.0, and therefore tend to become concentrated along with gold and the heavy silicate minerals (garnet, pyroxene and amphibole) in the sluice boxes on a dredge. It would be relatively easy to collect these trace metal sulphides from the dredges for transport to a shore-based facility for separation.

Page IV-B-125, Third Paragraph, Second Sentence: 'Cornelius 1990' is cited, but is missing from the bibliography--unless 'Cornelius' is supposed to be "Creceilius."

STATE-1

STATE-2

- [1435] 501 W. Northern Lights Blvd, Suite 203 , Alaska Miners Association, Anchorage
- [1073] Ms. Joyce Beelman, Department of Environmental Conservation Northern Regional Office, Fairbanks
- [1419] Mr. Tom Bundtzen, Dept. of Natural Resources, Fairbanks
- [1415] Mr. Paul Cunningham, Dept. of Community & Regional Affairs, Juneau
- [1322] Mr. Chuck Degnan, Bering Straits CRSA, Unalakleet
- [1444] Mr. David Densmore, U. S. Fish & Wildlife Service, Fairbanks
- [1383] Mr. Joe Drechsler, U. S. Environmental Protection Agency, Anchorage
- [1440] Mr. Robert Fagerstrom, Sitnasuak Native Corporation, Nome
- [1446] Mr. Tony Giardano, Minerals Management Service, Vienna
- [1400] Mr. Eric Hansen, Department of Natural Resources, Fairbanks
- [1401] Mr. Terry Haynes, Department of Fish and Game, Fairbanks
- [1421] Mr. Ray Highsmith, University of Alaska Institute of Marine Science, Fairbanks
- [1443] LCDR W. J. Hutmacher, U. S. Coast Guard, Anchorage
- [1438] Mr. Matthew Iya, Kawarak, Inc., Nome
- [1418] Ms. Katherine Kelly, Dept. of Health & Social Services, Juneau
- [1047] Mr. Donby Lloyd, Office of the Governor, Juneau
- [341] Mr. Jim Magdanz, Department of Fish and Game, Kotzebue
- [1417] Mr. Simon Mawson, Dept. of Environmental Conservation, Nome
- [1416] Mr. Pete McGee, Dept. of Environmental Conservation Northern Regional Office, Fairbanks
- [1442] Mr. Robert McKibbin, U. S. Bureau of Mines, Anchorage, AK 99501
- [1404] Mr. Mac McLean, Department of Fish and Game, Fairbanks
- [1447] Mr. Perry Mendenhall, Nome Eskimo Community, Nome
- [1439] Mr. Roger Mercer, National Marine Fisheries Service, Anchorage
- [1423] Alaska Friends of the Earth, Anchorage
- [1441] Mr. Robert Oja, U. S. Army Corps of Engineers Regulatory Branch, Anchorage
- [608] Mr. Al Ott, Department of Fish and Game, Fairbanks
- [1405] Mr. Judd Peterson, Department of Natural Resources, Anchorage
- [1422] Ms. Polly Prechal, City of Nome, Nome
- [1437] Mr. Thomas Pungak, City of Golovin, Golovin
- [1414] Mr. Dick Swainbank, Dept. of Commerce & Economic Development, Fairbanks
- [1445] Mr. Jonah Tokienna, Eskimo Walrus Commission, Wales
- [1436] Mr. John Zuck, Bering Sea Fishermen's Ass'n, Anchorage

### **Response STATE-1**

The use of the total-recoverable-metals fraction to compare against Federal water-quality criteria is discussed in Sec. IV.B.2.b. Comparison of criteria and standards with the total-recoverable component of the total metals present is required by both EPA and State water-quality regulations. Recent EPA water-quality criteria documents suggest that a weak-acid extraction might provide a better estimate of the bioavailable metal pool, but that an acceptable weak-acid method has yet to be identified and approved by EPA. Based on measurements in several locations, about 50 percent of lead, 60 percent of zinc, and 50 percent of copper are solubilized in weak-acid extractions of marine sediments (Luoma and Bryan, 1981; Luoma, 1990). The current EPA methodology for total-recoverable metals probably solubilizes 75 to 100 percent of the total metal.

The EPA has allowed some compromises which make the criteria for trace metals easier to meet. WestGold is currently allowed to use a state-of-the-art oceanographic technique for mercury rather than the harsher, EPA-approved total-recoverable procedure. In this case, the EPA procedure was considered inadequate to consistently measure ambient levels of mercury. Another compromise made by EPA for drilling mud discharges in Alaskan waters is the use of dissolved- or estimated dissolved-metal concentrations in lieu of total-recoverable-metals data for making comparisons with criteria levels (e.g., Jones and Stokes Associates, 1989, 1990). A similar compromise is possible in the future for offshore mining (USEPA, 1990d). The EPA Standards Branch (USEPA, 1990c) is "considering explicitly telling the Regions and States that expressing standards for most metals in terms of dissolved metal is acceptable, although not as safe as total recoverable." The reissued NPDES permit for the Bima (USEPA, 1990a) for State waters requires measurement of both total-recoverable and dissolved metals.

The Federal water-quality criteria and State standards are triggers for environmental concern: concentrations below these levels are considered a priori evidence of no significant chemical effects, while concentrations above these levels indicate potential for environmental damage. Use of total-recoverable metals as a trigger may be overly conservative but use of dissolved concentrations could underestimate potential availability and toxicity of the metals. Waterborne, particulate trace metals are not necessarily strongly bound nor biologically unavailable. Stream or otherwise freshwater-sorbed trace metals are desorbed when the freshwater particulates are mixed with seawater, and this desorption may contribute to metal depletion in estuarine sediments (Luoma, 1990). Phytoplankton and bacteria communities have demonstrated the ability to take up trace metals and nutrients from suspended particulates. Particulate metals can also be solubilized in the gut of filter feeders such as mussels.

The gold concentrate collected by the Bima does include elevated concentrations of several trace metals which appear to be present as heavy minerals. The analysis of water quality is based on measured concentrations in the effluent plume of the Bima, and, therefore, explicitly takes into account any capture of heavy metals in the gold concentrate. Whether the recovery of other heavy metals in the gold concentrate could be deliberately and sufficiently increased to lessen water-quality problems is untested but seems unlikely. In addition, not all of these heavy, sulfide metals are necessarily inert. Dissolved-arsenic concentrations in elutriate tests are directly proportionate to the total-arsenic concentration of the sediment, even though the sediment arsenic is thought to be predominately arsenopyrite (Sec. IV.B.2.b).

### **Response STATE-2**

"Creceilius" is correct. The text has been changed accordingly.

**Sitnasuak  
Native Corporation**

RECEIVED  
AUG 2 1990  
REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

Post Office Box 905 • Nome, Alaska 99762 • (907) 443-5296

July 30, 1990

Irven F. Palmer, Jr.  
Deputy Regional Director  
Federal Co-Chairman - Coordination Team  
Minerals Management Service  
949 E. 36th Avenue, Room 110  
Anchorage, Alaska 99508-4302

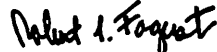
Dear Mr. Palmer,

Enclosed please find our comments on the Draft Environmental Impact Statement for the Norton Sound Lease Sale.

Thank you for your staff's work on this complicated process.

We have enjoyed the Coordination Team process, it seems to work to get everyone together to discuss the issues.

Respectfully,



Robert L. Fagerstrom  
President

RLF/IA/ia  
Enc: as stated

**Sitnasuak  
Native Corporation**

Post Office Box 905 • Nome, Alaska 99762 • (907) 443-5296

**SITNASUAK NATIVE CORPORATION'S COMMENTS ON THE  
OCS MINING PROGRAM NORTON SOUND LEASE SALE  
SECOND DRAFT ENVIRONMENTAL IMPACT STATEMENT  
JULY 30, 1990**

Sitnasuak Native Corporation has followed the entire process of this program since its inception in early 1988.

We represent 2,173 shareholders of the village corporation of Nome, Alaska as established under PL 92-203, the Alaska Native Claims Settlement Act. We currently have title to 155,664 acres surrounding the community, and expect to receive title to approximately 58,000 more acres.

The Corporation is formed as a profit corporation and has paid out a total of \$2,000,000 of dividends to our shareholders since 1979.

Our philosophy on resource development in rural Alaska, is that development should occur if it can be done in an environmentally safe manner, and if it can directly benefit residents (and shareholders of corporations) of rural communities.

We believe that the Proposed Action, Alternative I - The Proposal of the Norton Sound Lease Sale as written in the SECOND DRAFT ENVIRONMENTAL IMPACT STATEMENT, would be of benefit to our shareholders and community in general. We believe that the safety factors have already been built into the program through the Stipulations.

In reference to Stipulation No. 1, the Environmental Protection Act (EPA) and the State of Alaska determining regulatory action: we have seen some coordinated efforts between State and federal agencies to work with the mining community; however, the "turf" battles continue. Some of the agencies want more control, and the agency people seem to forget that regulations and implementation of regulations and laws are to be "as appropriate".

One point that was brought up during the writing of the First Draft Environmental Impact Statement was that EPA does not use scientific methods in their water quality testing. MMS authorized water quality testing which did not follow the methods of water quality testing methods required by EPA, the mining companies would need to follow the methods of testing as required by the outdated criteria established by EPA.

SNC-1

SITNASUAK NATIVE CORPORATION'S COMMENTS ON THE  
OCS MINING PROGRAM NORTON SOUND LEASE SALE  
SECOND DRAFT ENVIRONMENTAL IMPACT STATEMENT  
JULY 30, 1990  
PAGE TWO

EPA has not even responded to the MMS letter of May 21, 1990 regarding the use of "state-of-the-art procedures" for testing water quality.

When any agency recommends operating criteria without following scientific methods of testing or evaluating information, the permit requirements may become unrealistic.

Who will monitor the State and the federal agencies, and the mining operator, as being "appropriate"? Will MMS monitor the agencies involved with the process of implementing the program? How will the local groups be involved in monitoring?

In reference to Stipulation No. 3, we believe that there isn't a mercury or arsenic problem with women of childbearing age in Nome. We have been working on the plan for another study for the fall of 1990. We would not recommend study-after-study year-after-year if this 1990 study shows no problem. We expect that the staff of MMS will use their best technical judgement to modify or eliminate this aspect of the program, if no problems are shown.

SNC-2

**Response SNC-1**

This concern is addressed in Response STATE-1. In addition, Stipulation No. 1 requires that MMS coordinate actions resulting from the environmental monitoring program with other agencies. The MMS is establishing a coordination process for postlease activity which will provide for distribution of plans to Federal and State agencies and local interests and exchange information and recommendations for the environmental survey and monitoring program. The coordination process will be established prior to publication of the Final Leasing Notice. The EPA generally conducts public hearings--if there is interest--on its proposed NPDES permits and included monitoring requirements. See Responses NOME-2 and NRDC-18.

**Response SNC-2**

The MMS agrees. As long as levels of methylmercury in the hair of Nome women of childbearing age are not high enough to cause concern and the environmental monitoring program per Stipulation No. 1, does not show increases of methylmercury in the marine environment, MMS does not expect to conduct further monitoring of human health in Nome.





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JUL 30 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

July 27, 1990

Regional Director  
Minerals Management Service  
Alaska Region  
949 East 36th Avenue  
Anchorage, AK 99508-4302

Dear Sir:

I enclose the comments of the Natural Resources  
Defense Council and others on the Second DEIS for the  
proposed Norton Sound Lease Sale under the Alaska OCS Mining  
Program. We welcome the opportunity to comment on the DEIS.

Yours sincerely,

*William J. Schrenk*  
William J. Schrenk  
Consulting Attorney

Encls.

CC

VIA FEDERAL EXPRESS

COMMENTS  
of the  
NATURAL RESOURCES DEFENSE COUNCIL

and  
FRIENDS OF THE EARTH

and  
TRUSTEES FOR ALASKA  
on the  
SECOND DRAFT ENVIRONMENTAL IMPACT STATEMENT  
ALASKA OUTER CONTINENTAL SHELF  
OCS MINING PROGRAM  
NORTON SOUND LEASE SALE

July 27, 1990

RECEIVED  
JUL 30 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

Prepared by

William Schrenk,  
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Robert Adler,  
Senior Attorney

Natural Resources Defense Council

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The Natural Resources Defense Council, Friends of the Earth and Trustees for Alaska submit the following comments on the second draft environmental impact statement ("Second DEIS") prepared by the Minerals Management Service ("MMS") of the Department of Interior for the Alaska Outer Continental Shelf ("OCS") Mining Program, Norton Sound Lease Sale (the "Proposed Sale"). We have had a long standing interest in OCS leasing activities off Alaska's coast, and we welcome the opportunity to comment on the Second DEIS.

The Proposed Sale would be the first under MMS's proposed OCS Minerals Leasing Program. The Proposed Sale would offer approximately 147,050 acres in northwestern Norton Sound, located 5 to 22 kilometers offshore in waters 20 to 30 meters deep near Nome, Alaska, for lease for gold and other hard minerals mining. Gold is presently the only marketable mineral that can be recovered economically from the lease area. Placer mining operations would dredge 12,500 - 15,000 cubic meters per day of sediment (to an average depth of 3.6 meters) and would pump 58 million gallons per day of seawater onto the dredge for treatment of the dredged sediment. A substantially equal volume of seawater and tailings would then be discharged together into the water without treatment. MMS has estimated that total gold production for the "base case" (i.e., with one dredge in operation) could be 530,000 troy ounces -- and double

that amount for the "high case" (with two dredges). The proposed lease term is 20 years and thereafter so long as the lessee complies with the lease.

Very briefly summarized, our principal comments are that further legislative action is necessary before the proposed sale, and the proposed national OCS mining program itself, are commenced; that the DEIS is so seriously deficient in so many respects as to preclude the "meaningful analysis" required by the National Environmental Policy Act ("NEPA"); that operation of the dredge in the manner proposed would violate the standards and criteria of the Clean Water Act; and that - above all - the dangers to human health and the environment posed by the Proposed Sale are so clear and grave as to make "No Sale" the only acceptable alternative.

We refer to the comments made by NRDC and the Oceanic Society under date of January 17, 1989 and April 10, 1989 on the original draft environmental impact statement for the Proposed Sale published in November 1988 ("Original DEIS").

Our comments in detail are as follows:

- I. DOI Should Not Embark on an OCS Mining Program Having Massive Environmental Impacts without Adequate Congressional Direction and Authorization.

We believe that the Outer Continental Shelf Lands

NRDC-1

Act ("OCSLA") provides an inadequate basis for a marine minerals leasing program and that new legislation is required if such a program is to be undertaken in an environmentally sensitive manner, with opportunity for full involvement by the public and the affected coastal states and communities. Key provisions were adopted by amendment in 1978 to correct serious deficiencies in the original OCSLA by providing essential safeguards for the environment and greater opportunity for involvement of the public and state and local governments. However, those changes and reforms were made applicable only to oil and gas activities. The provisions of OCSLA that remain applicable to other mineral resource development on the OCS are the original provisions of a law enacted in 1953--outdated and inadequate to provide the necessary controls.

We further question DOI's authority to establish an OCS mining program, and to conduct the proposed Norton Sound mining sale, on the limited statutory basis provided by OCSLA as now in effect. We also question the wisdom of embarking on such an important program with potentially massive environmental impacts with so little Congressional

direction. <sup>1/</sup> The U.S. marine mining industry is in its infancy, and there are high risks from adverse conditions in regions such as offshore Alaska. We strongly recommend that MMS withdraw its proposal to conduct the Norton Sound lease sale until adequate statutory authority for OCS minerals mining is forthcoming from Congress.

#### II. Deficiencies in the DEIS.

The Second DEIS fails to provide adequate data, discussion, analysis and other information, as required by law, regarding the effects of the sale on human health and the environment, and its failure in this regard renders it "so inadequate as to preclude meaningful analysis."

40 C.F.R. §1502.9(a).

- A. Failure to adequately evaluate the impact of the proposal on levels of mercury and other toxic trace-metals in water, sediments, biota and humans.

The Council on Environmental Quality's regulations (the "CEQ Regulations") implementing NEPA require that an

<sup>1/</sup> NRDC's position on this subject is stated in detail in its "Comments on DOI's Proposed Regulations Governing the Leasing of Minerals, Other Than Oil, Gas and Sulphur in the OCS and Governing Operations in the OCS for Minerals Other Than Oil, Gas and Sulphur" dated November 2, 1988. A copy of those comments was Attachment 1. to our comments of January 17, 1989 on the Original DEIS. We request that both these sets of our comments, as well as the present comments, be included in the administrative record for the Proposed Sale.

NRDC-2

NRDC-3

NRDC-4

environmental impact statement provide "full and fair discussion of significant environmental impacts" and that it be "supported by evidence that the agency has made the necessary environmental analyses." 40 C.F.R. §1502.1. Further, "NEPA procedures must ensure that environmental information is available... The information must be of high quality. Accurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA." 40 C.F.R. §1500.1(b). These requirements apply to the DEIS as well as to the final statement: "The draft statement must fulfill and satisfy to the fullest extent possible the requirements established for final statements ..." 40 C.F.R. §1502.9(a). As detailed below, these basic requirements have not been satisfied in the Second DEIS.

The Natives of the region, Inupiat and Yu'pik, have a "subsistence" way of life that depends upon harvesting marine resources for basic food requirements. This way of life is vitally important to Native cultural values and social organization, as well as to their food supply, and is protected by Federal and State laws. The Proposed Sale area is heavily used by subsistence hunters and includes some of the highest biomasses of fish in the Norton Basin, as well

as large numbers of seal, walrus and beluga whale. <sup>2/</sup> The Proposed Sale area also contains prime habitat for seabirds and red king crab. All of these resources are of great importance to Native subsistence. The area also includes commercial red king crab fisheries.

As the Second DEIS makes clear, contamination by mercury and other trace-metals and their effects on water quality, invertebrates, fish, waterfowl, marine mammals, subsistence hunting, and, above all, human health are among the most vital concerns raised by the Proposed Sale. The toxic effects of mercury are irreversible; they persist for many years; they are selective to the nervous system; they particularly affect women and infants and the unborn. Mercury is a hundredfold more toxic than other trace metals. It is consistently biomagnified within the food chain, so that its concentration increases in organisms at higher trophic levels -- ultimately in humans -- where it can accumulate and become concentrated as methylmercury, its most toxic form. It is covariant with gold -- higher concentrations of gold can be expected to be accompanied by higher concentrations of mercury.

NRDC-5

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<sup>2/</sup> Dredge mining can only be carried on during the open-water season, when subsistence hunting occurs.

Mercury concentrations are of special concern in the Proposed Sale area. Dangerously high levels of mercury have been found in marine resources and in Arctic peoples elsewhere who subsist on diets assumed to be similar to that of Natives of the Nome area. Since the last century, the marine environment of the Nome area has been exposed to mercury contamination from gold mining and processing through runoff from contaminated soils and from streams where gold dredging has occurred. And as a result of the Proposed Sale, bioaccumulation of mercury in the marine environment of the Nome area could occur. The consequences of additional mercury contamination in the sale area are potentially very severe.

NRDC-5a

NRDC-6

Additional contamination of the marine environment by other trace-metals as a result of the Proposed Sale could dangerously affect marine organisms for many years.

NRDC-7

1. Data on water. During and after the period of dredge mining, marine organisms may be exposed to increased concentrations of trace-metals in the water-column resulting from the release of metals in the dredged sediments and tailings during dredging and the disposal of dredged spoils. Exposure to trace-metals can result in their uptake by marine organisms where they may cause lethal and sublethal effects, including effects on growth, reproduction, photosynthesis and productivity.

The Original DEIS included data on mercury in the water column that were obtained in the past few years from the monitoring program on the bucket-ladder dredge Bima (the "Bima Data"), which is operated under a gold-mining lease from the State of Alaska in State waters adjacent to a portion of the Proposed Sale area. <sup>3/</sup> The Bima Data indicated dangerously high mercury contamination in the ambient water and dredge effluent, at levels exceeding Federal criteria and Bima's NPDES permit restrictions.

NRDC-7a

Since the Original DEIS, MMS has obtained limited new data on trace-metal concentrations in the water column, using sampling and analytical procedures described as "state-of-the-art", and it is now ready to consider the sale in reliance on the new data--rejecting the Bima Data. The new trace-metal water column data comes from samples taken on three days in June and September 1989. They indicate that downcurrent of the Bima copper at all times exceeds the EPA acute criterion, and they suggest that EPA's chronic criterion is exceeded for lead and nickel. For mercury, the new data show a "several-hundredfold decrease" in levels from the earlier data. The Second DEIS states that the new

NRDC-7b

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<sup>3/</sup> One of the key assumptions made in the DEIS is that mining operations under the Proposed Sale would occur from a dredge similar to the Bima.

water data are insufficient to detect seasonal and interannual variations or the effects of storms and that such information is important in predicting the likelihood or frequency of exceeding water-quality criteria.

2. Data on Sediments. The data for trace-metal concentrations in the sediments to be dredged are even more limited. Trace metals within only the upper few centimeters of sediment have been measured in a few locations in the sale area and inshore locations. The data indicate that "elevated levels" and "very high anomalies" of trace metals are possible. 4/ Other testing has indicated that the sediments of northwestern Norton Sound including the Proposed Sale area are already heavily polluted by arsenic, chromium, lead, zinc, cadmium, copper and nickel. Arsenic and cadmium are exceptionally high.

According to the Second DEIS, predictions of the amount of trace metals to be released during dredging requires data over the entire sediment column to be dredged, not just its surface. Thus, with the meager data now in hand, such a prediction is not possible for the dredging operations contemplated by the Proposed Sale. The Original

4/ The quoted terms are not defined in the DEIS in terms of their environmental effects. They are examples of the deplorable use of undefined impact terminology.

NRDC-8

Draft stated that several "tens of samples" would be necessary to evaluate releases of trace metals from dredging activities, but these samples have not been gathered and the necessary information is not contained in the Second DEIS. MMS unjustifiably assumes, in proposing the lease sale, that the few surface measurements reflected in the Second DEIS represent the trace-metal content of the entire substratum to be dredged.

3. Marine Organisms. If EPA criteria are exceeded, as will occur according to the Second DEIS, marine organisms and their use may be unacceptably affected, with ecosystem recovery taking more than three years. Yet little effort to document effects on marine organisms has been made. 5/ Tissue taken from three seals was found to contain more than double the "action" level for mercury of the Food and Drug Administration. High mercury concentrations in walrus have been reported. This is evidence of a mercury problem that requires much more data and analysis.

NRDC-8a

NRDC-9

5/ The Fish and Wildlife Service, in considering the proposed mining operations, has stated that it is "essential" for the protection of the peregrine falcon, a threatened species found in the area, that Federal water quality chronic criteria for mercury and cadmium not be exceeded. As required by Section 7 of the Endangered Species Act, FWS will furnish a biological opinion on the danger to the peregrine falcon population. The conclusions reached in this opinion should be included in the DEIS as part of the "full and fair discussion" of this issue.

NRDC-10

4. Human Health. Human health is one of the most important environmental issues raised by the Proposed Sale. Dangerously high levels of mercury have been found in marine resources and in Arctic peoples who subsist on diets assumed to be similar to that of natives of the Nome area, including mothers and infants of the Yukon-Kuskokwim Delta near Norton Sound. According to the Second DEIS, it was expected that levels of mercury in Nome residents would be comparable.

But despite this expectation, the prospect of increased mercury levels resulting from mining operations, the presence of very high concentrations of mercury in soils in the Nome area, and the fact that an increase in bioaccumulation of mercury in marine organisms in the Nome area could pose a serious health threat to prenatal life and young infants--MMS has still failed to collect the adequate and reliable information required by law.

There is no information regarding the diets of Nome residents. Some preliminary data has now been gathered and reported on the presence of mercury and some other trace-metals in hair samples from about 22% of the women of child bearing age in the Nome area. They show results that are said to be "extremely low" for a coastal human population--several times lower than the levels measured in other Arctic peoples based on tests of umbilical cord blood,

NRDC-11

placenta, maternal blood, hair and milk of maternal-infant pairs.

But the preliminary and limited data now included in the Second DEIS were not gathered from women selected for high consumption of seafood. Even so, however, they indicate mercury levels above 6 ppm in some hair samples tested. A recent study of mothers who ate fish more than three times a week during pregnancy and their children showed that children of mothers with mercury levels above 6 ppm have deficiencies in their development more than twice as common as children of mothers with lower hair mercury levels and have more deficiencies in neurological functions. (Kjellstrom et al., Physical and Mental Development of Children with Prenatal Exposure to Mercury from Fish, National Swedish Environmental Protection Board, 1986). <sup>6/</sup>

MMS states that it plans a study to sample Nome women of child-bearing age who are known to consume high levels of seafood, to make a segmental analysis of hair in order to measure seasonal variations in mercury levels, and to make the necessary dietary studies. These studies should

NRDC-12

<sup>6/</sup> Based on oral communication from the World Health Organization, MMS expects WHO to announce during 1990 that a level of 10 ppm is the lowest that may result in retardation. MMS should include WHO's findings in the DEIS after they are published, so they may be reviewed and assessed.

be made now, before proceeding any further with the proposal, by reliable independent experts, and the results included in a revised DEIS.

The Second DEIS finds that the human health cumulative effects of the Proposed Sale would be "moderate". That term is defined to mean hair-mercury levels between 6 and 10 ppm--a level at which experts have found double the incidence of deficiencies in young children. Such an effect is surely "major" or worse by any proper standard--and should be disclosed as such.

Moreover, the limited data in the Second DEIS makes this assessment little more than guesswork, not the rigorous scientific analysis required under NEPA. MMS has failed to quantify the risks to humans and marine organisms of the levels of mercury it projects may occur. Statistical means of assessing the risk to populations exposed to particular pollutants must be employed so that the number of children, pregnant women and others who can be expected to suffer significant effects from exposure to mercury as a result of the proposal can be assessed.

NRDC-13

NRDC-14

Reliable, sufficient and site-specific data on baseline trace-metal concentrations in the water column, the

NRDC-15

sediment, the marine organisms consumed by people of the area and those people themselves, as well as data on the effect of dredging on those concentrations, are essential before any meaningful analysis can be made regarding the impacts of additional mining operations in the Proposed Sale area or any part of it. Further, this data should be reviewed by impartial outside scientific and public health experts, whose reports should be included in the DEIS, as recommended by the U.S. Arctic Research Commission in their report of December 1989. Such information is absolutely critical to an informed decision on whether or not to proceed with the Proposed Sale and, if so, how to proceed. It is clear that the cost of obtaining adequate information relevant to the Proposed Sale is not exorbitant and that the means of obtaining it are well-known. In commenting on the Original Draft, the U.S. Public Health Service stated that the information essential for consideration of potential public health impacts of the Proposed Sale can be obtained by known means, without exorbitant cost. (Furthermore, PHS would be willing to help to develop the requisite data.) Accordingly, this data must be included in the DEIS. 40 C.F.R. §1502.22(a).

This information is not only essential for consideration of the Proposed Sale. It is also vitally



important as baseline data for an effective monitoring program.

The absence of this information fatally flaws the Second DEIS. The CEQ Regulations provide that "[i]f a draft statement is so inadequate as to preclude meaningful analysis, the agency shall prepare and circulate a revised draft of the appropriate portion." 40 C.F.R. §1502.9(a). MMS must prepare a revised draft that includes the above information and analysis and corrects other deficiencies in the Second DEIS, discussed below.

**B. Failure to provide adequate information on effects of turbidity and habitat alteration.**

It is a particular characteristic of dredge mining for gold that due to its low concentration immense quantities of sediment must be dredged, processed and discharged. The impacts of the resulting turbidity and habitat alteration raise serious environmental issues.

Present dredge mining in adjacent State waters has resulted in violations of the NPDES limit and State standards for turbidity, producing "extremely high turbidity values" at 0.5 km. from the dredge. <sup>7/</sup> For the Proposed

<sup>7/</sup> According to the Second DEIS, turbidity created by the Bima averaged more than double the State standard at 600 meters downcurrent. Then, in 1989, the Bima's owner received a second permit for shallow dredging inshore from the Bima, allowing a one kilometer distance downstream to

NRDC-16

Sale, average turbidity greater than chronic Federal and State criteria is expected to occur over an area of up to 34 square km., possibly extending into State waters. High turbidity can have significant adverse effects on marine organisms, including inhibition of reproduction and photosynthesis. The DEIS must disclose how these organisms would be affected by dredging and how long it would take them to recover.

Dredging results in total disruption of the sea bottom, major alteration of the habitat and loss of many or most of the associated benthic inhabitants. Up to 2,300 acres would be directly affected. The destruction of the cobble habitat that is critical for the red king crab is a prime example of destruction of vital habitat. The Proposed Sale and other nearby dredging could change the abundance or distribution of the red king crab--one of the most important commercial and subsistence resources in the area--over more than one generation.

The Second DEIS states that only "spotty" information is available on composition of benthic communities and distribution of habitats; and that there is no information

NRDC-17

meet the State standard--and still it is indicated that the State standard will be exceeded, but "occasionally rather than usually".

on how communities would be affected by dredging. The effect of habitat alteration on organisms could be "major", it is said, if a great many of them live within the sale area--but we do not know if they do. The DEIS must contain reliable and specific information on existing habitat, and the effects of its alteration on benthic organisms and on the people who use them for subsistence and commercial purposes.

C: Improper Reliance on Assumptions and Lessee Monitoring--a "Best-Case" Analysis.

The Second DEIS makes what can fairly be called a "best-case" analysis, asserting in substance that it does not matter if many essential facts are unknown. The DEIS assumes that the unknown facts would not be adverse or that adverse effects presently anticipated would be swiftly eliminated or mitigated pursuant to a monitoring program to be devised by MMS after a lease has been awarded.

As stated above, unsupported assumptions of fact regarding trace metal concentrations in the water-column and sediments are made in the Second DEIS that are crucial to any decision regarding the Proposed Sale. Such unsupported assumptions are improper. They may not be substituted for the information of high quality required by NEPA. They "preclude meaningful analysis". They cannot be substituted

NRDC-18

for complete data that can be obtained by known means without incurring exorbitant costs.

The Second DEIS attempts to fortify its case with a further unsupported assumption--also improper--to the effect that the serious adverse environmental effects of the Proposed Sale that are otherwise projected to occur will be swiftly and substantially mitigated or eliminated by reason of a monitoring program. Under that program monitoring, to be conducted by the lessee, would be relied on to establish levels of trace-metals in waters and organisms and in the human population, the effects of mining on those levels and other essential environmental information relating to turbidity, benthic habitat and other matters. That program would provide for the possibility of unspecified action by an MMS official to order unspecified modification or suspension of mining activities if monitoring indicates unspecified adverse environmental effects. 8/

Throughout the Second DEIS, MMS relies on its assumptions regarding the effectiveness of this monitoring program as a basis to change its forecast of the environmental effects of the Proposed Sale from Major or Moderate to Minor or Negligible--including effects on turbidity, trace-

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8/ Any order suspending mining operations would be subject to OCSLA and its regulations. See note 9.

metal levels, habitat, endangered species and consistency with land use plans. MMS's reliance on future monitoring and subsequent unspecified action by one of its officials as a substitute for essential information required to be included in the DEIS is wholly without legal basis. Under NEPA, a decision on the Proposed Sale must be made on the basis of an environmental impact statement that contains a "full and fair discussion of significant environmental impacts," with data of high quality, and not on the basis of assumed facts and unspecified assumed actions pursuant to an undefined monitoring program. <sup>9/</sup>

Yet, even with these assumptions, MMS acknowledges that a monitoring program would only lessen the frequency of the violation of water quality criteria--it would, for example, only prevent "continuous violation" of turbidity limits; it would not reduce copper levels below EPA's acute criterion.

NRDC-19

<sup>9/</sup> Under the Outer Continental Shelf Land Act and regulations thereunder, once a mining lease has been entered into, a mining plan thereunder may be disapproved by the Government for environmental reasons only if there is probable cause of serious harm to the environment and the advantages of cancellation outweigh the advantages of continuing the lease. There are similar requirements for cancellation of the lease and for an order requiring suspension of mining. It is particularly noteworthy that no lease has ever been cancelled under OCSLA for environmental reasons.

Such a monitoring program would, furthermore, permit mining to continue while the lessee surveys and monitors, gathers and analyzes samples, and prepares and files its annual reports; and while MMS studies the reports, consults with State and Federal agencies, makes determinations, and issues and then seeks to enforce compliance orders. And monitoring cannot correct harm already done--toxic substances already added to water, sediments and organisms; habitats destroyed. AS EPA points out in its comments, monitoring detects problems after they occur--it does not prevent their effects. Present gold mining operations in adjacent State waters are an example of the ineffectiveness of monitoring. Those operations have been going on for several years. Criteria, standards and limits have been and are being exceeded. A compliance order has been issued. Yet, no change in operations has occurred, and those mining operations will continue to pollute Norton Sound unacceptably. In fact, it is expected that they will increase.

D. Failure to provide an adequate monitoring program.

For any mining program on the OCS, a post-lease monitoring program is of course essential, to assure compliance with limits and standards and to discover unforeseen problems. To be effective, a monitoring program must contain specific and sufficient provisions regarding

methods, frequency of sampling and reporting and performance standards. Adequate baseline data must be provided, as well as clear, quick and direct means to stop harmful activities. These terms cannot be left to the discretion of an MMS official, as would be done under the Proposed Sale. They must be included in the DEIS, where their environmental effectiveness can be assessed as a part of the review of environmental impacts required by NEPA.

Further, monitoring should be conducted and the results evaluated, at lessee's expense, by independent outside experts of established reputation, and their work should be subject to independent peer review.

It is altogether unsuitable for a lessee to monitor and report on its own activities. Its conflicts of interest are obvious. Data gathered by the operator of the Bima (likely to be the lessee under any OCS mining lease in the Nome area), now rejected by MMS as grossly wrong, illustrate the dangers of lessee monitoring.

The measures outlined above are particularly necessary for the mining operations contemplated by the Proposed Sale, where concern for toxic trace-metals and human health is so important.

NRDC-20

E. Failure to include opinions and analysis of experts in medicine and public health (including U.S. Public Health Service).

The Second DEIS is also fatally defective by reason of its omission of opinions and analysis by agencies or professional persons possessing special expertise in medicine and public health. Such opinions and analysis are essential for the necessary environmental assessment and the "accurate scientific analysis" required by the Act and the CEQ Regulations. 40 C.F.R. §1500.1( b). The disciplines of the preparers of the DEIS (oceanographers, biologists, a geologist, an anthropologist, a physical scientist, economists, social scientists) are not "appropriate to the scope and issues" (40 C.F.R. §1502.6) that must be covered by the DEIS, including the effect of increased contamination of the food chain on human health. 40 C.F.R. §§1502.16(a) and 1508.8. MMS has failed to use the "special expertise" of other agencies regarding human health impacts "to the maximum extent possible consistent with its responsibility as lead agency" as required by 40 C.F.R. §1501.6(a).

Dr. David Marsh, (an expert on mercury contamination from the University of Rochester Medical School), and other experts took part in workshops sponsored by MMS to discuss medical and public health issues, but it does not appear that they or any other qualified persons reviewed and affirmed the data, opinions and analysis in the Second DEIS.

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Dr. Marsh stated that trace-metal levels in seafood should be ascertained, that information regarding the amounts and types of seafood consumed by Nome residents should be obtained and that segmental sampling of hair should be done to measure seasonal variations. His advice has not been disclosed in the Second DEIS and has been ignored in preparing it.

The United States Public Health Service, Department of Health and Human Resources, commented on the Original DEIS. In their opinion it omitted data essential for a sound decision regarding the significant environmental impacts of the Proposed Sale--including hair and blood data of Nome residents, accurate dietary data, careful analysis of mercury content in subsistence species (now and over time). That data, except for limited information on hair samples, has still not been provided. In the opinion of the Public Health Service, this information is essential to the consideration of potential public health impacts that must precede a decision regarding the Proposed Sale. The PHS has stated that the cost of obtaining this information is not exorbitant and that the means to obtain it are known. Further, the PHS is willing to help in developing the requisite data. These opinions and comments have not been disclosed in the Second DEIS and have been ignored in preparing it.

F. The method of presenting cumulative effects conceals their true magnitude.

The DEIS is required to provide information and analysis regarding the cumulative impacts of the Proposed Sale, together with other past, present and reasonably foreseeable future actions, to the same degree as is required for the sale alone. 40 C.F.R. §1508.7. The cumulative impacts are critically important because they include actual conditions, present and potential, and not merely the effects of the proposal considered in isolation.

In the Second DEIS, the past, present and future actions reflected in the cumulative discussion include other offshore placer mining for gold in State waters, onshore mining and mineral processing that contribute to the contamination of the marine environment, and annual dredging of the Nome harbor. <sup>10/</sup> The total area dredged in the cumulative case would be more than four times that dredged under the Proposed Sale.

Offshore dredge mining operations presently being conducted in State waters adjacent to the Proposed Sale area

<sup>10/</sup> Several existing OCS oil and gas leases are included in the cumulative case, but their effects are largely dismissed because only exploratory wells have been drilled to date. Possible future oil exploration and development impacts are given only cursory treatment. This section must be expanded.

NRDC-21a

alone exceed the amount forecast for the proposal. During 1989, two additional dredges were to be brought into operation in those waters under existing State leases. <sup>11/</sup> There are a number of State prospecting permits which may lead to new mining leases in the near future in nearby coastal waters. There are also a number of onshore gold mines, including some engaged in dredge mining of riverbeds. The annual dredging of Nome harbor is another source of contamination.

The Second DEIS concludes that the effect on local water quality of the Proposed Sale, considered alone, would be "major". The cumulative effect is simply stated to be also "major." (In the case of a number of other matters, the "moderate" effect of the proposal alone is increased to "major" for the cumulative effect.) Since "major" is the most serious category of adverse effects used in the DEIS, the discussion of the cumulative case thus reaches no meaningful conclusion as to the increase in these effects resulting from that case. This omission conceals the severe aggravation of those effects that must in fact result in view of the relative magnitude of the other activities

<sup>11/</sup> The Second DEIS states in passing that the water quality effect of each of three dredges mining gold in State waters is "major"--three major altogether, that is, not even counting the Proposed Sale.

NRDC-22

included in the cumulative case. The cumulative effect as stated is not even close to an accurate projection. This comment is equally applicable to the DEIS analysis of the potential effect resulting from the "high case" (i.e., the operation of two dredges rather than one) as compared with the "base case."

The conclusions on environmental effects must be spelled out in a manner that discloses the comparative effects of the high case, base case, cumulative case, and non-cumulative case.

G. The Second DEIS fails to consider other reasonable alternatives.

The CEQ Regulations, 40 C.F.R. §1502.1, state that one of the primary purposes of the DEIS is to "inform decision makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment." This discussion of alternatives is the "heart of the environmental impact statement." 40 C.F.R. §1502.14.

As alternatives to the proposed sale, the Second DEIS considers the following: no sale; a three-year delay in the sale; and two alternative reduced sale areas. Further alternatives must be considered.

The DEIS must discuss and consider alternative mining technologies that incorporate recycling, treatment,

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NRDC-24

and/or disposal of tailings onshore or at offshore sites where environmental harm will be minimized. Alternative discharge technologies must also be considered, as well as limits on dredge type and size and production and discharge rates.

The DEIS rejects transportation of tailings for discharge at a distance from the mining site because of cost, vessel traffic and creation of sediment mounds in areas otherwise unaffected by mining operations. Alternative discharge technologies were also rejected because of cost. However, under the Clean Water Act, 33 U.S.C. §1251 et seq., cost is not relevant in setting effluent limitations in NPDES permits that are necessary to meet water quality standards. As discussed below, the information and analyses in the Second DEIS for the method of discharge contemplated by the Proposed Sale show that the lessee might be unable to meet the requirements of the Clean Water Act for a NPDES permit. Accordingly, it is essential that the DEIS consider the alternative methods necessary in order for mining operations to qualify for the required permit.

H. The Second DEIS fails to discuss adequately conflicts with coastal management programs and State laws.

The CEQ Regulations, 40 C.F.R. §1506.2(d), require the DEIS to discuss any inconsistency of a proposed action

with any approved State or local plan and laws. "Where an inconsistency exists, the statement should describe the extent to which the agency would reconcile its proposed action with the plan or law."

The Second DEIS concludes that "major" conflicts would exist between the Proposed Sale and the Alaska Coastal Management Program ("ACMP")--then makes the assumption that future monitoring and subsequent unspecified action would reduce those conflicts to "moderate". The ACMP requires that the coastal zone and offshore areas be managed "so as to maintain or enhance the biological, physical and chemical characteristics of the habitat which contribute to its capacity to support living resources" and "so as to maintain or enhance the State's sport, commercial and subsistence fishery."

NRDC-24a

The Proposed Sale would also conflict with the district programs of the City of Nome and the Bering Straits Coastal Resource Service Area. The Nome program requires that "mining shall not occur in commercial and subsistence fishing areas during the open fishing periods." The Bering Straits program requires that offshore mining "avoid significant adverse impacts to important and essential habitats, commercial fishing activities, subsistence harvest activities and navigation."

NRDC-25

Section 307 of the Coastal Zone Management Act requires that any activity conducted or supported by a Federal agency within, or directly affecting, a State's coastal zone must be consistent with any approved State management program for that zone. The ACMP, which incorporates local coastal plans promulgated pursuant to it, is such a program. MMS must determine the extent to which the Proposed Sale is consistent with the ACMP, and the State must review and certify that determination.

The U.S. Supreme Court's decision in Secretary of the Interior v. California, 464 U.S. 312 (1984), concluded that an OCS oil and gas lease sale was not subject to the consistency requirements of Section 307, under the circumstances of that case. Subsequently, in testimony before a Congressional committee, a representative of the U.S. Department of Justice stated that it was the Administration's position that the Supreme Court decision was narrow in scope and did not exempt Federal activities other than those relating to oil and gas lease sales. This testimony was at least in part responsible for Congress' decision not to amend Section 307 in response to the Supreme Court decision. In line with the Administration's position, the National Oceanic and Atmospheric Administration amended its regulations to exempt only oil and gas lease sales. The Administration's position would be contravened, and Section

307 violated, if CZMA's consistency requirements were not applied to the Proposed Sale. 12/

The Proposed Sale would also be inconsistent with laws of the State of Alaska if, as indicated in the Second DEIS, violations of State water quality standards within State waters may result from the proposed mining operations carried on near these waters. The DEIS must include a specific discussion of these violations and the consequences.

- I. The Second DEIS fails to discuss adequately permits and licenses that would be needed by the lessee under the Proposed Sale.

The CEQ Regulations, in 40 C.F.R. §1502.25(b), require the DEIS to "list all Federal permits, licenses, and other entitlements which must be obtained in implementing the proposal."

In order to conduct mining operations, the lessee under the Proposed Sale would have to obtain a National Pollutant Discharge Elimination System (NPDES) permit under the Clean Water Act from the Environmental Protection Agency, authorizing and regulating discharges of effluent, consisting of saltwater and tailings. The information and conclusions contained in the Second DEIS show that the

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12/ The State of Alaska has notified MMS that "consistency certification and review should be required."

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lessee may be unable to meet the requirements of the Clean Water Act for the issuance of such a permit, as discussed below.

In addition to the NPDES permit, mining operations pursuant to the Proposed Sale would require a water quality certification from the State of Alaska under CWA §401, because the Second DEIS indicates that those operations, although carried on in OCS waters, may result in pollution that would violate State water quality standards in nearby State waters. The Second DEIS does not discuss this question.

Neither does the Second DEIS discuss the necessity for a permit under CWA §404, generally required for the discharge of dredged material.

J. The Revised DEIS fails to discuss aboriginal subsistence rights.

Since the preparation of the Original DEIS, the U.S. Court of Appeals for the Ninth Circuit has held that aboriginal subsistence rights on the Outer Continental Shelf have not been extinguished by the Alaska Native Claims Settlement Act or by the Federal government's paramount interest in the OCS. <sup>13/</sup> MMS has conceded that this

<sup>13/</sup> The Village of Gambell et al. v. Hodel et al.,  
F.2d \_\_\_\_\_ (9th Cir., 1989).

NRDC-27

decision may have an effect on its OCS mining program, Norton Sound lease sale, in regard to subsistence uses. The Second DEIS must discuss the aboriginal rights of the native population of the Nome region, in light of this decision, the extent to which the Proposed Sale may be inconsistent with those rights and the manner in which the Proposed Sale would be reconciled with those rights.

III. The Operation of the Dredge in the Manner Proposed Would Violate the Standards and Criteria of the Clean Water Act.

The information and conclusions contained in the Second DEIS show that lessees may be unable to meet the requirements of the Clean Water Act ("CWA") for NPDES permits for the following reasons.

First, CWA §403(c)(2) prohibits issuance of an NPDES permit "where insufficient information exists on any proposed discharges to make a reasonable judgment on any of the guidelines..." As stated above in these comments, the information contained in the Second DEIS is "so inadequate as to preclude meaningful analysis" -- that information would likewise be insufficient for purposes of the NPDES permit. Under certain conditions, the regulations under CWA (the "CWA Regulations") provide an exception to the statutory requirement and authorize issuance of a permit without sufficient information (40 C.F.R. §125.123(c)). We believe that this regulatory exception is inconsistent with CWA.

NRDC-28

Second, even accepting the validity of the above exception, the conditions specified in the CWA Regulations will not be met because water quality criteria will be violated. CWA §402(a) requires that NPDES permits ensure compliance with (among other provisions) §301(b)(1)(C), which requires treatment adequate to meet water quality standards. The Second DEIS makes clear that Federal chronic and acute criteria for certain trace metals and the chronic criterion for turbidity would be violated. <sup>14/</sup> Water quality standard violations outside permissible mixing zones (discussed below) may not be condoned, whether or not local.

NRDC-29

Third, CWA §402(a) also requires that NPDES permits ensure compliance with the guidelines that must be met by the discharge to which the permit would relate. In the case of the Proposed Sale, the discharge would fail to meet those guidelines because, first of all, Federal water quality criteria would be violated--a per se violation of the guidelines. Moreover, discharge would cause unreasonable degradation of the marine environment (a violation of the guidelines) within the meaning of the CWA Regulations (40 C.F.R. §125.122(a)).

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<sup>14/</sup> As discussed above, while the Second DEIS now indicates that mercury is not a problem, we believe the data is too limited to draw such a conclusion.

Fourth, if (as seems distinctly possible) the lessee under the present State mineral lease were to be the successful bidder in the Proposed Sale, it would be inappropriate, because of the lessee's numerous and chronic violations of its existing NPDES permit, for EPA to issue a new NPDES permit (or for MMS to recommend permit issuance or to select the Proposed Sale as the preferred alternative) unless new conditions were imposed that would ensure compliance with the new permit. From the data presented and conclusions reached in the Second DEIS, it may be impossible to ensure compliance with any permit issued in accordance with CWA.

NRDC-31

The Second DEIS discussion assumes a 100 meter mixing zone in its analysis of environmental effects and assumes that contamination within that 100 meter zone is permissible. This is not correct. CWA Regulations, 40 C.F.R. §125.121(c) require a more restrictive mixing zone if it is determined that such a zone would be appropriate. A more restrictive zone would be appropriate for the proposed operations. See EPA Water Quality Standards Handbook (December 1983) at 2-7 to 2-9. Moreover, mixing zones are allowed only for chronic criteria; acute criteria should apply even within the mixing zone. Id.

NRDC-32

The analysis and conclusions contained in the Second DEIS and the selection of a preferred alternative to

NRDC-33

be made by MMS must conform to the CWA requirements discussed above.

IV. The Lease Term Should Be Much Less Than 20 Years.

As we state below, we find it clear that the only acceptable alternative under the Second DEIS is "No Sale". If, however, a lease were to be entered into, a 20-year term would be much too long. The Proposed Sale involves many risks, known and unknown, of serious environmental consequences. As discussed above (see note 9), while an OCS lease is in effect, the Government's right to cancel the lease or to order a suspension of mining for environmental reasons is severely limited. In fact MMS has never cancelled an OCS lease for environmental reasons. To protect the human population and marine environment of the Nome region, as well as the public interest, MMS must not bind the Government for an initial lease term that covers more than five years of mining operations, the typical lease term under the OCS oil and gas program. If all goes well, a renewal lease can be considered (subject to NEPA procedures).

V. The Second DEIS Should Recommend the "No Sale" Alternative.

An environmental impact statement is more than a disclosure document. It is to be used in planning actions

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and making decisions. 40 C.F.R. §1502.1. It should indicate the agency's preferred alternative, if one exists. 40 C.F.R. §1502.14(e). In the present case, a preferred alternative should be stated: "No Sale."

The Second DEIS reaches the conclusions that the Proposed Sale, either alone or cumulatively, would have "major" effects on local water quality, fishes (including migratory species--salmon and herring), migratory waterfowl and sociocultural systems. In addition, the Second DEIS relies on improper assumptions regarding the effectiveness of future monitoring programs, only vaguely outlined in the DEIS, to reduce to "moderate" or "minor" its forecasts of effects on other matters including turbidity, trace-metals, habitat, endangered species and consistency with land use plans.

Moreover, the "moderate" effect on human health, as defined in the Second DEIS, means that mercury levels of pregnant women would be elevated to 6-10 ppm in hair--a level at which, according to a recent study, children born to such women have been found to have development deficiencies more than twice as common as those found in children of mothers with lower mercury levels--and have more deficiencies in neurological functions. Such a "moderate" effect is certainly unacceptable. Other effects that are found

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"major" or "moderate" are likewise not worth risking for the sake of the Proposed Sale.

Future dredge mining in waters adjacent to the Proposed Sale area is "assumed to increase". Three dredges were to be in use during 1989, dredging 300 acres per season. Mining operations pursuant to the Proposed Sale cannot be safely added.

The only alternative considered in the Second DEIS that copes with these environmental problems is "No Sale".

Thank you for considering these comments.



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January 17, 1989

Regional Supervisor,  
Leasing and Environment,  
Minerals Management Service  
949 East 36th Avenue, Room 110  
Anchorage, Alaska 99508-4302

Attention: Mr. Ray Emerson

Dear Mr. Emerson:

Our comments on the proposed Norton Sound Lease Sale under the Alaska OCS Mining Program are enclosed herewith. We welcome the opportunity to comment on the proposal. A copy of our comments has been sent to you today by facsimile transmission.

Yours sincerely,

William Schrenk  
Consulting Attorney

WS:ag  
Encl.

COMMENTS  
of the  
NATURAL RESOURCES DEFENSE COUNCIL  
and  
THE OCEANIC SOCIETY  
on the  
DRAFT ENVIRONMENTAL IMPACT STATEMENT  
ALASKA OUTER CONTINENTAL SHELF  
OCS MINING PROGRAM  
NORTON SOUND LEASE SALE

January 17, 1989

Prepared by

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The Natural Resources Defense Council and the Oceanic Society (hereafter, "NRDC") submit the following comments on the draft environmental impact statement ("DEIS") prepared by the Minerals Management Service ("MMS") of the Department of Interior for the Alaska Outer Continental Shelf ("OCS") Mining Program, Norton Sound Lease Sale (the "Proposed Sale"). NRDC has had a long standing interest in OCS leasing activities off Alaska's coast and elsewhere, and we welcome the opportunity to comment on the DEIS.

The Proposed Sale would be the first under MMS's proposed OCS Minerals Leasing Program. The Proposed Sale would offer approximately 178,282 acres in northwestern Norton Sound, located 5 to 22 kilometers offshore in waters 20 to 30 meters deep near Nome, Alaska, for lease for gold and other hard minerals mining. Gold is presently the only marketable mineral that can be recovered economically from the lease area. Placer mining operations would dredge 12,500 - 15,000 cubic meters per day of sediment (to a depth of more than six meters) and would pump 47.8 million gallons per day of seawater onto the dredge for treatment of the dredged sediment. A substantially equal volume of seawater and tailings would then be discharged together into the water without treatment. MMS has estimated that total gold production for the "mean case" (i.e., with one dredge in operation) could be 530,000 troy ounces -- and double that amount for the "high case" (with two dredges). The proposed lease term is 20 years and thereafter so long as the lessee complies with the lease.

Very briefly summarized, NRDC's principal comments are that further legislative and regulatory action are necessary before the proposed sale, and the proposed national OCS mining program itself, are commenced; that the DEIS is so seriously deficient in so many respects as to "preclude meaningful analysis"; that operation of the dredge in the manner proposed would violate the standards and criteria of the Clean Water Act; and that - above all - the dangers to human health and the environment posed by the Proposed Sale, especially those arising from mercury contamination, are so clear and grave as to make "No Sale" the only acceptable alternative. MMS should not risk another Minimata tragedy for 530,000 ounces of gold.

Our comments in detail are as follows:

I. DOI Should Not Embark on an OCS Mining Program Having Massive Environmental Impacts without Adequate Congressional Direction and Authorization.

NRDC believes that the Outer Continental Shelf Lands Act ("OCSLA") provides an inadequate basis for a marine minerals leasing program and that new legislation is required if such a program is to be undertaken in an environmentally sensitive manner, with opportunity for full involvement by the public, and

the affected coastal states and communities. We question DOI's authority to establish an OCS mining program, and to conduct the proposed Norton Sound mining sale, on the limited statutory basis provided by OCSLA as now in effect. We also question the wisdom of embarking on such an important program with potentially massive environmental impacts with so little Congressional direction. NRDC strongly recommends that MMS withdraw its proposal to conduct the Norton Sound lease sale until adequate statutory authority for OCS minerals mining is forthcoming from Congress.

II. DOI Should Not Embark on an OCS Mining Program until its Regulations Governing Leasing and Mining for Hard Minerals on the OCS Are In Effect.

DOI's proposed regulations governing leasing and mining operations on the OCS for minerals other than oil, gas and sulphur are in the "comment" stage. NRDC has submitted comments on them (Attachment 1). It is not clear when final regulations will be issued.

MMS has erred in publishing the DEIS for the Proposed Sale prior to the issuance of final regulations. A proper analysis of the environmental impacts of the Proposed Sale can be made only in the light of the final regulations, which will presumably set requirements and standards to protect the environment. The nature and extent of those regulations will profoundly influence the level of impact that will result from the Proposed Sale. It is entirely inappropriate for MMS to publish a DEIS that purports to assess impacts before final environmental standards and requirements have been promulgated.

In no event should MMS conduct the proposed Sale or commence the OCS mining program before the final regulations are adopted and in effect. There are no emergency conditions that would justify proceeding with the Proposed Sale before the new regulations are promulgated. To the contrary, the potential for serious environmental harm presented in the DEIS, as well as the inadequacy of available information, make clear the necessity to proceed with particular care and caution.

1. NRDC's position on this subject is stated in detail in its "Comments on DOI's Proposed Regulations Governing the Leasing of Minerals, Other Than Oil, Gas and Sulphur in the OCS and Governing Operations in the OCS for Minerals Other Than Oil, Gas and Sulphur" dated November 2, 1988. A copy of those comments is attached hereto as Attachment 1.

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**III. Deficiencies in the DEIS.**

The DEIS fails to provide adequate data, discussion, analysis and other information, as required by law, regarding the effects of the sale on human health and the environment, and its failure in this regard renders it "so inadequate as to preclude meaningful analysis." 40 C.F.R. §1502.9(a).

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**A. Failure to provide adequate data on mercury.**

The Council on Environmental Quality's regulations (the "CEQ Regulations") implementing the National Environmental Policy Act ("NEPA") require that an environmental impact statement provide "full and fair discussion of significant environmental impacts" and that it be "supported by evidence that the agency has made the necessary environmental analyses." 40 C.F.R. §1502.1. Further, "NEPA procedures must ensure that environmental information is available... The information must be of high quality. Accurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA." 40 C.F.R. §1500.1(b). These requirements apply to the DEIS as well as to the final statement: "The draft statement must fulfill and satisfy to the fullest extent possible the requirements established for final statements..." 40 C.F.R. §1502.9(a). As detailed below, these basic requirements have not been satisfied in the DEIS.

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The Natives of the region, Inupiat and Yu'pik, have a "subsistence" way of life that depends upon harvesting marine resources for basic food requirements. This way of life is vitally important to Native cultural values and social organization, as well as to their food supply, and is protected by Federal and State laws. The Proposed Sale area is heavily used by subsistence hunters and includes some of the highest biomasses of fish in the Norton Basin, as well as large numbers of seal, walrus and beluga whale. The Proposed Sale area also contains prime habitat for seabirds and red king crab. All of these resources are of great importance to Native subsistence. The area also includes commercial red king crab fisheries.

As the DEIS makes clear, mercury contamination and its effects on water quality, invertebrates, fish, waterfowl, marine mammals and, above all, human health are the most vital concerns

raised by the Proposed Sale.<sup>2</sup> The toxic horrors of mercury are also made clear: its effects are irreversible; they persist for many years; they are selective to the nervous system; they particularly affect women and infants and the unborn. Mercury is a hundredfold more toxic than other trace metals. It is consistently biomagnified within the food chain, so that its concentration increases in organisms at higher trophic levels -- ultimately in humans -- where it can accumulate and become concentrated as methylmercury, its most toxic form. It is covariant with gold -- the Bima Data indicate that mercury content of sediments where gold is mined in Norton Sound was found to be "severalfold" greater than elsewhere.

Mercury concentrations are of special concern in the Proposed Sale area because: 1) very high mercury levels are already present in adjacent waters; 2) the covariance of high-mercury and high-gold concentrations in offshore placer deposits means that already high levels of mercury would increase as a result of dredging; and 3) dangerously high levels of mercury have been found in marine resources and in Arctic peoples elsewhere who subsist on diets similar to that of Natives of the Nome area. Since the last century, the marine environment of the Nome area has been exposed to mercury contamination from gold mining and processing through runoff from contaminated soils and from streams where gold dredging has occurred.

The consequences of additional mercury contamination in the sale area are potentially very severe. Nevertheless, the information in the DEIS on mercury contamination in the Proposed Sale area is very far below the high quality required by the CEQ Regulations. Water column concentrations of mercury and other

NRDC-40

2. In addition to mercury contamination, other impacts, particularly turbidity and habitat alteration, raise serious environmental concerns. The Bima Data, mentioned below, show that present dredge mining in the area results in violations of the NPDES limit and State standards for turbidity, producing "extremely high turbidity values" at 0.5 km. from the dredge. For the Proposed Sale, average turbidity greater than chronic Federal and State criteria are expected to occur over an area of up to 32 square km. High turbidity can have significant adverse effects on marine organisms, including inhibition of reproduction and photosynthesis.

The Proposed Sale and other nearby dredging would have a "major" effect on the red king crab, one of the most important commercial and subsistence resources of the area, largely as a result of alteration of benthic habitat by dredging. According to the DEIS, the red king crab population would be reduced in number to a point from which it would not recover for several generations.

trace-metals over most of the Norton Basin are said by the DEIS to be "poorly known." Some data are presented for the waters of northwestern Norton Sound, the region in which the Proposed Sale area is located, but these data are said by the DEIS to be "confused." No data exist for mercury concentrations in suspended sediments in the Norton Basin.

The DEIS includes some mercury data that were obtained in the past few years from the monitoring program on the dredge Bima (the "Bima Data"), which is operated under a gold-mining lease from the State of Alaska in State waters adjacent to a portion of the Proposed Sale area. But the DEIS indicates that the Bima Data is meager in many respects and of doubtful quality. Although the DEIS states that the Bima Data on mercury concentrations in the water column are "confused," they are called the "most valid estimate" for the Sale area. Though "confused," the Bima Data indicate background mercury concentrations in the water column averaging 0.6 ppb, ranging up to 1.8 ppb -- 24 times to 72 times the Federal chronic criterion for mercury of 0.025 ppb (a limit allowed to be reached only once in three years for a four-day period).

The Bima Data on the release of mercury in sediments into the dredge effluent as a result of dredging operations indicate a maximum increase of 4.7 ppb of mercury from influent to effluent on the dredge, measured over a four-day period. The Bima Data also show that the Bima exceeded its NPDES permit restrictions (0.875 ppb) for discharge of mercury 15% of the time -- and at times substantially exceeded the Federal acute criterion of 2.1 ppb at the edge of the mixing zone and beyond, a limit allowed to be reached only once in three years for a one-hour period. The DEIS estimates, "taking the quality of the existing monitoring [Bima] data into account," that for the Proposed Sale the Federal chronic criterion for mercury would always be exceeded and that dredging operations would result in a 10% or more increase in mercury concentrations at the edge of the mixing zone up to 40% or more of the time and would cause the Federal acute criterion to be exceeded on the order of once a month "by a few

3. One of the key assumptions made in the DEIS is that mining operations under the Proposed Sale would occur from a dredge similar to the Bima.

4. The DEIS strongly suggests that those permit restrictions are too weak, due to underestimates of background mercury concentrations in the waters. Permit restrictions for nickel contamination and for turbidity were also exceeded.

5. The DEIS states that several "tens of samples" would be necessary to evaluate releases of mercury from dredging activities.

ppb" up to 500 meters from the dredge. Concentrations of cadmium, copper and nickel would also exceed Federal acute criteria within 500 meters of the dredge. Since the dredge moves slowly, these levels might persist for weeks or months in a particular place.

Major adverse effects on marine organisms and humans that consume them could logically be expected to result from such severe mercury pollution. Yet remarkably little effort to document effects on marine organisms and humans from past Bima operations appears to have been made. The Bima Data include some tissue samples taken from invertebrates, very few from fish, and none from waterfowl. Tissue taken from three seals, the only mammal tested, was found to contain nearly half the amount said to be lethal to humans and more than double the level of mercury considered by the Fish and Wildlife Service to be presumptive of an environmental mercury problem. This latter level is based on assumed consumption of seafood 100 times less than the level of consumption by Natives in the Proposed Sale area.

No data whatsoever are provided regarding mercury levels among the Natives living in the vicinity of the Proposed Sale area.

Reliable, sufficient and site-specific data on baseline mercury concentrations in the water column, in the marine organisms consumed by people of the area and in those people themselves; as well as data on the effect of dredging on those concentrations, are essential before any meaningful analysis can be made regarding the impacts of additional mining operations in the Proposed Sale area or any part of it. Such information is absolutely critical to an informed decision on whether or not to proceed with the Proposed Sale and, if so, how to proceed. Because the cost of obtaining adequate information relevant to mercury contamination is not exorbitant, and the means of obtaining it are well-known, it must be included in the DEIS. 40 C.F.R. §1502.22(a).

6. The Fish and Wildlife Service, in considering the proposed mining operations, has stated that it is "essential" for the protection of the peregrine falcon, a threatened species found in the area, that Federal water quality chronic criteria for mercury and cadmium not be exceeded. Because it is clear that these criteria would be exceeded, and because additional nesting sites have been found in the area, MMS recently initiated formal consultation with FWS, as required by Section 7 of the Endangered Species Act, and FWS will furnish a biological opinion on the danger to the peregrine falcon population. The conclusions reached in this opinion should be included in the DEIS as part of the "full and fair discussion" of this issue.



The absence of this information fatally flaws the DEIS. The CEQ Regulations provide that "[i]f a draft statement is so inadequate as to preclude meaningful analysis, the agency shall prepare and circulate a revised draft of the appropriate portion." 40 C.F.R. §1502.9(a). MMS must prepare a revised draft that includes the above information and analysis and corrects other deficiencies in the DEIS, discussed below.

**B. Failure to provide analysis by experts in medicine and public health.**

The DEIS is also fatally defective by reason of its omission of any discussion or analysis by agencies or professional persons possessing special expertise in medicine and public health regarding health effects from contamination by mercury and other trace metals. Without the involvement of such agencies and persons, the DEIS fails to make the necessary environmental assessment and the "accurate scientific analysis" required by the Act and the CEQ Regulations. 40 C.F.R. §1500.1(b). The disciplines of the preparers of the DEIS (oceanographers, biologists, a geologist, an anthropologist, a physical scientist, an economist, social scientists and supporting staff) are not, in a crucial respect, "appropriate to the scope and issues" (40 C.F.R. §1502.6) that must be covered by the DEIS, one of which is the effect of increased contamination of the food chain on human health. 40 C.F.R. §§1502.16(a) and 1508.8. It additionally appears that MMS failed to use the "special expertise" of other agencies regarding human health impacts "to the maximum extent possible consistent with its [MMS'] responsibility as lead agency" as required by 40 C.F.R. §1501.6(a).

**C. Failure to include specific conclusions on human health.**

Human health is one of the most important environmental issues raised by the Proposed Sale. Remarkably, human health was not fully recognized in the scoping process, which produced a list of issues in which "human health" is only one of the several components of the "socioeconomic" issue. Human health must be treated not merely as a part of the socioeconomic issue. It is a medical and public health issue of the very first magnitude.

Even the subsidiary treatment given by the DEIS to human health in the scoping process is not adequate. For each of the other components of the socioeconomic issue, a formal conclusion is reached in which the effect of the Proposed Sale on the particular component is found to be major, moderate, minor or negligible. This conclusion is a very important part of the guidance to the Secretary provided by the EIS.

The portion of the DEIS dealing specifically with human health reaches no such conclusion. The characteristics of

mercury and the fearful consequences of mercury poisoning are explained. There is a confusing presentation of information on mercury levels and consumption. But there is no site-specific data regarding background mercury levels in the Native population in the vicinity of the Proposed Sale area, and no projection of further contamination or other damage to that population that may occur as a result of the Proposed Sale. There is no judgment or analysis of health impacts by anyone with special expertise. The DEIS's limp conclusion is that "it might not take much of an increase in mercury levels in the water column in the sale area before these higher levels of mercury bioaccumulate in the food webs and finally affect the human population more than might already be occurring without the sale" -- and that, because of the threat to human health, the consumption and harvesting of marine mammals and fish might cease.

This analysis is oblivious to the most vital question: what would be the effect on human health if hunters do not cease to hunt, or if women and children do not cease to eat, in the vicinity of the Proposed Sale area or even further away in regions where contaminated marine resources may find their way? This is very far from the "full and fair discussion" and meaningful analysis required by the CEQ Regulations. 40 C.F.R. §1502.1. MMS must prepare and circulate a revised DEIS that corrects the grossly deficient discussion of human health impacts in order to allow a reasoned choice among alternatives. 40 C.F.R. §1502.9(a).

**D. The method of presenting cumulative effects conceals their true magnitude.**

The DEIS is required to provide information and analysis regarding the cumulative impacts of the Proposed Sale, together with other past, present and reasonably foreseeable future actions, to the same degree as is required for the sale alone. 40 C.F.R. §1508.7. The cumulative impacts are critically important because they include actual conditions, present and potential, and not merely the effects of the proposal considered in isolation.

In the DEIS, the past, present and future actions reflected in the cumulative discussion include other offshore placer mining for gold in State waters, onshore mining and mineral processing that contribute to the contamination of the marine environment,

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and annual dredging of the Nome harbor.<sup>7</sup> The total area dredged in the cumulative case would be more than four times that dredged under the Proposed Sale (and it is not clear that this includes the harbor dredging).

Offshore dredge mining operations presently being conducted in State waters adjacent to the Proposed Sale are about equal in extent to the amount forecast for the proposal. In the near future, two additional dredges are expected to be brought into operation in those waters under existing State leases. There are a number of State prospecting permits which may lead to new mining leases in the near future in nearby coastal waters. There are also a number of onshore gold mines, including some engaged in dredge mining of riverbeds.

The annual dredging of Nome harbor and offshore discharge of the dredge spoils is another source of mercury contamination that can be expected to contribute to the cumulative effects. No information whatever is provided regarding the scope or effects of such dredging, except for the statement that, because of the known mercury contamination of the Snake River watershed near Nome, this activity "may add some additional risk of mercury pollution." (The 1983 EIS for this harbor dredging and spoil discharge did not even evaluate the effects of trace metals.)

Few data, none for some activities, are presented for the cumulative cases. The discussions and analyses are perfunctory in most cases. For example, it is stated that the cumulative effect of offshore mining could result in an increase of "a few ppm" in the mercury in tissue of "1,000 to 5,000 or more walrus, bearded seals, spotted seals and beluga whales" -- an astonishing statement, considering that the Fish and Wildlife Service has set 1.1 ppm freshwater as the level of mercury in tissues of marine mammals that is presumptive evidence of an environmental mercury problem, and that daily consumption of fish containing 5 to 6 ppm of mercury has been said to pose a lethal threat to humans.

In the case of the five environmental issues in which the DEIS concludes that the Proposed Sale, considered alone, would

7. Harbor dredging is included in the cumulative water quality discussion in the DEIS. It does not appear to be included in the cumulative cases for other environmental effects. This should be corrected in the FEIS.

Several existing OCS oil and gas leases are included in the cumulative case, but their effects are largely dismissed because only exploratory wells have been drilled to date. Possible future oil exploration and development impacts are given only cursory treatment. This section must be expanded.

have a "major" effect (local water quality, commercial fisheries, subsistence-harvest patterns, sociocultural systems, and coastal management programs), the cumulative effect is simply stated to be also "major." (In the case of invertebrates and red king crab, the "moderate" effect of the proposal alone is increased to "major" for the cumulative effect.) Since "major" is the most serious category of adverse effects used in the DEIS, the discussion of cumulative cases thus reaches no conclusion as to the increase in these effects resulting from those cases. This omission conceals the severe aggravation of those effects that must in fact result in view of the relative magnitude of the other activities included in the cumulative case. This comment is equally applicable to the DEIS analysis of the potential effect resulting from the "high case" (i.e., the operation of two dredges rather than one) as compared with the "mean case."

The meager portions of the DEIS relating to cumulative environmental effects do not meet the requirements of the Act and the Regulations. More data and analysis are required and MMS' basis for its conclusions on environmental effects must be spelled out in a manner that discloses the comparative effects of the high case, mean case, cumulative case, and non-cumulative case.

E. The DEIS fails to consider other reasonable alternatives.

The CEQ Regulations, 40 C.F.R. §1502.1, state that one of the primary purposes of the DEIS is to "inform decision makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment." This discussion of alternatives is the "heart of the environmental impact statement." 40 C.F.R. §1502.14.

As alternatives to the proposed sale, the DEIS considers the following: no sale; a three-year delay in the sale; and two alternative sale areas, one reduced from 40 blocks to 25 blocks, the second from 40 to 15 blocks. Further alternatives must be considered.

The DEIS must discuss and consider alternative mining technologies that incorporate recycling, treatment, and/or disposal of tailings onshore or at offshore sites where environmental harm will be minimized. Alternative discharge technologies must also be considered, as well as limits on dredge type and size and production and discharge rates.

The DEIS rejects transportation of tailings for discharge at a distance from the mining site because of cost, vessel traffic and creation of sediment mounds in areas otherwise unaffected by mining operations. Alternative discharge technologies were also rejected because of cost. However, under the Clean Water Act, 33

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U.S.C. §1251 et seq., cost is not relevant in setting effluent limitations in NPDES permits that are necessary to meet water quality standards. As stated in Section IV below, the information and analyses in the DEIS for the method of discharge contemplated by the Proposed Sale show that the lessee would be unable to meet the requirements of the Clean Water Act for a NPDES permit. Accordingly, it is essential that the DEIS consider the alternative methods necessary in order for mining operations to qualify for the required permit.

F. The DEIS fails to discuss adequately conflicts with coastal management programs and State laws.

The CEQ Regulations, 40 C.F.R. §1506.2(d), require the DEIS to discuss any inconsistency of a proposed action with any approved State or local plan and laws. "Where an inconsistency exists, the statement should describe the extent to which the agency would reconcile its proposed action with the plan or law."

The DEIS concludes that "major" conflicts would exist between the Proposed Sale and the Alaska Coastal Management Program ("ACMP"). That Program requires that the coastal zone and offshore areas be managed "so as to maintain or enhance the biological, physical and chemical characteristics of the habitat which contribute to its capacity to support living resources" and "so as to maintain or enhance the State's sport, commercial and subsistence fishery." According to the DEIS, at least four State standards set by ACMP would be violated by the proposal.

The Proposed Sale would also conflict, according to the DEIS, with the district programs of the City of Nome and the Bering Straits Coastal Resource Service Area. The Nome program requires that "mining shall not occur in commercial and subsistence fishing areas during the open fishing periods." The Bering Straits program requires that offshore mining "avoid significant adverse impacts to important and essential habitats, commercial fishing activities, subsistence harvest activities and navigation."

Section 307 of the Coastal Zone Management Act requires that any activity conducted or supported by a Federal agency within, or directly affecting, a State's coastal zone must be consistent with any approved State management program for that zone. The ACMP, which incorporates local coastal plans promulgated pursuant to it, is such a program. MMS must determine the extent to which the Proposed Sale is consistent with the ACMP, and the State must review and certify that determination.

The U.S. Supreme Court's decision in Secretary of the Interior v. California, 464 U.S. 312 (1984), concluded that an OCS oil and gas lease sale was not subject to the consistency requirements of Section 307, under the circumstances of that

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case. Subsequently, in testimony before a Congressional committee, a representative of the U.S. Department of Justice stated that it was the Administration's position that the Supreme Court decision was narrow in scope and did not exempt Federal activities other than those relating to oil and gas lease sales. This testimony was at least in part responsible for Congress' decision not to amend Section 307 in response to the Supreme Court decision. In line with the Administration's position, the National Oceanic and Atmospheric Administration amended its regulations to exempt only oil and gas lease sales. The Administration's position would be contravened, and Section 307 violated, if CZMA's consistency requirements were not applied to the Proposed Sale.<sup>8</sup>

The Proposed Sale would also be inconsistent with laws of the State of Alaska if, as indicated in the DEIS, violations of State water quality standards within State waters would result from the proposed mining operations carried on near these waters. The DEIS must include a specific discussion of these violations and the consequences.

G. The DEIS fails to discuss permits and licenses that would be needed by the lessee under the Proposed Sale.

The CEQ Regulations, in 40 C.F.R. §1502.25(b), require the DEIS to "list all Federal permits, licenses, and other entitlements which must be obtained in implementing the proposal."

In order to conduct mining operations, the lessee under the Proposed Sale would have to obtain a National Pollutant Discharge Elimination System (NPDES) permit under the Clean Water Act from the Environmental Protection Agency, authorizing and regulating discharges of effluent, consisting of saltwater and tailings. The information and conclusions contained in the DEIS show that the lessee would be unable to meet the requirements of the Clean Water Act for the issuance of such a permit, as discussed below under the next heading.

In addition to the NPDES permit, mining operations pursuant to the Proposed Sale would require a water quality certification from the State of Alaska under CWA §401, because the DEIS indicates that those operations, although carried on in OCS waters, would result in pollution that would violate State water quality standards in nearby State waters. The DEIS does not discuss this question.

8. The State of Alaska has notified MMS that "consistency certification and review should be required."

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Neither does the DEIS discuss the necessity for a permit under CWA §404, generally required for the discharge of dredged material.

IV. The Operation of the Dredge in the Manner Proposed Would Violate the Standards and Criteria of the Clean Water Act.

The information and conclusions contained in the DEIS show that lessees would be unable to meet the requirements of the Clean Water Act ("CWA") for NPDES permits for the following reasons.

First, CWA §403(c)(2) prohibits issuance of an NPDES permit "where insufficient information exists on any proposed discharges to make a reasonable judgment on any of the guidelines..." As stated above in these comments, the information contained in the DEIS is "so inadequate as to preclude meaningful analysis" -- that information would likewise be insufficient for purposes of the NPDES permit. Under certain conditions, the regulations under CWA (the "CWA Regulations") provide an exception to the statutory requirement and authorize issuance of a permit without sufficient information (40 C.F.R. §125.123(c)). We believe that this regulatory exception is inconsistent with CWA.

Second, even accepting the validity of the above exception, the conditions specified in the CWA Regulations will not be met because water quality criteria will be violated. CWA §402(a) requires that NPDES permits ensure compliance with (among other provisions) §301(b)(1)(C), which requires treatment adequate to meet water quality standards. The DEIS makes clear that Federal chronic and acute criteria for mercury, as well as criteria for certain other trace metals, would be violated by the proposed mining operations. Water quality standard violations outside permissible mixing zones (discussed below) may not be condoned, whether or not local.

Third, CWA §402(a) also requires that NPDES permits ensure compliance with the guidelines that must be met by the discharge to which the permit would relate. In the case of the Proposed Sale, the discharge would fail to meet those guidelines because, first of all, Federal water quality criteria would be violated -- a ~~per se~~ violation of the guidelines. Moreover, discharge would cause unreasonable degradation of the marine environment (a violation of the guidelines) within the meaning of the CWA Regulations (40 C.F.R. §125.122(a)) for numerous reasons, including the potential impacts on human health, the bioaccumulation and persistence of the pollutants, the effect on endangered species and spawning sites, the effect on commercial and subsistence fishing and conflicts with the Alaska Coastal Management Program.

Fourth, if (as seems distinctly possible) the lessee under the present State mineral lease were to be the successful bidder in the Proposed Sale, it would be inappropriate, because of the lessee's numerous and chronic violations of its existing NPDES permit, for EPA to issue a new NPDES permit (or for MMS to recommend permit issuance or to select the Proposed Sale as the preferred alternative) unless new conditions were imposed that would ensure compliance with the new permit. From the data presented and conclusions reached in the DEIS, it would be impossible to ensure compliance with any permit issued in accordance with CWA.

The DEIS discussion assumes a 100 meter mixing zone in its analysis of environmental effects and assumes that contamination within that 100 meter zone is permissible. This is not correct. CWA Regulations, 40 C.F.R. §125.121(c) require a more restrictive mixing zone if it is determined that such a zone would be appropriate. A more restrictive zone would be appropriate for the proposed operations because of the bioaccumulation and persistence of the pollutants; because mixing zones should not present barriers to migratory fish passage or other aquatic habitat; and because mixing zones should be as small as possible, using end-of-pipe dispersion technology or other means. See EPA Water Quality Standards Handbook (December 1983) at 2-7 to 2-9. Moreover, mixing zones are allowed only for chronic criteria; acute criteria should apply even within the mixing zone. *Id.* Yet the DEIS applies both acute and chronic criteria for mercury at the edge of the mixing zone.

The DEIS argues that because the chronic mercury criterion is already violated in ambient waters of the Proposed Sale area, that violation is no longer an appropriate consideration; instead, the DEIS selects a criterion of 10% increase in mercury concentration in the discharge. This is not permissible under CWA. Where violations of criteria already occur, a NPDES permit must not allow any additional pollutant loads from any point source.

The analysis and conclusions contained in the DEIS and the selection of a preferred alternative to be made by MMS must conform to the CWA requirements discussed above.

V. Any Lease or Other Action Should Prohibit the Use of Mercury in the Recovery of Gold.

The Proposed Sale contemplates the possibility that a lessee might use mercury for the onboard recovery of gold from mined ore. Such a possibility should be absolutely and totally excluded.

Onboard use of mercury would require the use and storage on

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the dredge of large quantities of mercury. Much of this mercury, up to 25% according to the DEIS, may be lost in the ordinary course of operations. Historically, the DEIS states, as much mercury is lost as gold is recovered. Furthermore the possibility of a total mercury spill exists in the case of the loss of the dredge -- and two of the last three dredges operating in this area, one of heavy storms, have been lost at sea.

The use of mercury in processing ore would aggravate well beyond the already excessive levels the adverse environmental effects of the Proposed Sale. Downstream from the dredge, mercury concentrations would exceed the Federal acute criterion for tens of kilometers, reaching 10 to 60 ppb in the effluent.

According to the DEIS, it is unlikely that mercury would be used in connection with mining operations in the Proposed Sale area. Any lease or other action should ensure that it is not used.

#### VI. The DEIS Should Recommend the "No Sale" Alternative.

An environmental impact statement is more than a disclosure document. It is to be used in planning actions and making decisions. 40 C.F.R. §1502.1. It should indicate the agency's preferred alternative, if one exists. 40 C.F.R. §1502.14(e). In the present case, a preferred alternative should be stated: "No Sale."

The DEIS reaches the conclusions that the Proposed Sale would have "major" effects on local water quality, invertebrates and red king crab, commercial fisheries, subsistence-harvest patterns, sociocultural systems and coastal management programs. The DEIS reaches no specific conclusion whatever as to effects on human health, but these effects would surely be "major" or worse. The cumulative effect of the Proposed Sale and other present and future activities would, as discussed above, be surely even worse than "major" on many issues, if adequately considered.

Some of the "moderate" effects described in the DEIS seem to call for an even more serious classification. For example, the DEIS states that "cumulative effects for toxic trace metals (especially mercury) could result in severe effects and declines of the local peregrine falcon [a threatened species] population that would require several generations for recovery" -- then concludes that the Proposed Sale would have "moderate" effects on the regional populations. Clearly the effect on the local population, if expressed, would be "major." See Note 6 above regarding the pending consultation by the Fish and Wildlife Service on the danger of the Proposed Sale to the peregrine falcon population.

The DEIS states that if Stipulation No. 1 were made a term of the Proposed Sale, providing for environmental surveys and monitoring, the effects would in nearly all cases be reduced from "major" to "minor," because the Regional Supervisor, Field Operations ("RSFO") of MMS would have authority to order modification or suspension of mining operations, as "appropriate" to protect biological resources. The purpose of the Stipulation would be, it is said, to "ensure" that exceedances of Federal criteria and State standards for turbidity and trace metal concentrations would be detected and corrected. But Federal criteria for mercury (among other metals) and State standards and NPDES limits applicable to present mining operations in adjacent State waters are already being exceeded. It is clear according to the DEIS, that the Proposed Sale would lead to substantial increases in existing exceedances. What is the use of a survey and monitoring program that will confirm environmental calamities already known or anticipated with certainty -- a program that if fully and effectively applied would require mining operations to cease as soon as they begin? Such a program would serve only to permit mining to continue while the lessee surveys and monitors, gathers and analyzes samples, and prepares and files its annual reports; and while RSFO studies the reports, consults with State and Federal agencies, makes determinations, and issues compliance requests.

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Present gold mining operations in adjacent State waters are a good example of the ineffectiveness of limits on operations. Those operations have been going on for several years. Criteria, standards and limits have been and are being exceeded, and EPA has issued a compliance order to the lessee under its NPDES permit. Yet apparently no change in operations has occurred. In fact, according to the DEIS, it is expected that those operations will continue to pollute Norton Sound unacceptably.

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The alternatives considered in the DEIS -- a three-year delay in the sale and alternative sale areas of reduced size -- do not cope with these environmental problems. The three-year delay does not change any of the conclusions as to effects of the Proposed Sale on environmental issues according to the DEIS. The two alternatives of reduced sale areas are found in one case to reduce the effects on seabirds and peregrine falcons from "moderate" to "minor" and, in the other case, to reduce the effects on red king crab and commercial fisheries to "minor" and "moderate" -- the "major" effects are unaltered except in the case of commercial fisheries.

According to the Bima Data, mercury concentrations in State waters adjacent to the Proposed Sale area have reached 1.8 ppb, a level within the range reached in Minimata Bay, in Japan, where 8,000 people contracted mercury poisoning in a major epidemic. It is clear that the DEIS should recommend the "No Sale" alternative.

Thank you for considering these comments.



ATTACHMENT 1

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COMMENTS ON

DOI'S PROPOSED REGULATIONS GOVERNING THE  
LEASING OF MINERALS, OTHER THAN OIL, GAS & SULPHUR

IN THE OCS (53 Fed. Reg. 31424-31440)

AND

GOVERNING OPERATIONS IN THE OCS FOR MINERALS  
OTHER THAN OIL, GAS, & SULPHUR (53 Fed. Reg. 31442-31466)

November 2, 1988

Prepared by

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The Natural Resources Defense Council (NRDC) submits the following comments on the Department of Interior's proposed rules governing leasing and operations for minerals other than oil, gas and sulphur on the OCS.\* NRDC believes that the Outer Continental Shelf Lands Act (OCSLA) provides an inadequate basis for a marine minerals leasing program and that new legislation is required if such a program is to be undertaken in an environmentally sensitive manner with opportunity for full involvement by the public, the affected coastal states and communities. The Interior Department essentially relies on a single sentence in OCSLA, §8(k), as a basis for its promulgation of these detailed and extensive regulations. We question the Department's authority to establish such an extensive regulatory program on such a limited statutory basis. We also question the wisdom of embarking on such an important program with potentially massive environmental impacts with so little Congressional direction.

Congress found in 1978 that the OCSLA was an inadequate vehicle for regulating the exploration for and commercial recovery of oil and gas on the OCS. As a consequence, the OCSLA was extensively amended to provide greater safeguards for the environment and greater opportunity for input into the leasing process from affected coastal states, local governments and the public. However, when Congress undertook these revisions it was

\* NRDC also incorporates by reference the earlier comments submitted by the Oceanic Society on NRDC's behalf concerning DOI's mineral leasing program, dated August 19, 1985 and June 24, 1987.

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concerned with oil and gas activities only. As a result, the significant changes and reforms in the legislation were made applicable only to oil and gas activities and have no applicability to other marine minerals. For example, key provisions of the 1978 Amendments which are restricted to oil and gas activities include the following:

- the findings and purposes section of the Act;
- §8(a) establishing bidding systems;
- §11 establishing requirements for submission of exploration plans and setting the standards for the content of such plans and disapproval of such plans;
- §18 requiring the development of a 5-year oil and gas leasing program;
- §20 requiring the conduct of environmental studies;
- §25 setting out the requirements for the submission and approval of development and production plans and the cancellation of oil and gas leases where a development and production plan is disapproved;
- §26 establishing an OCS oil and gas information program;
- Title III establishing an offshore oil spill pollution fund; and
- Title IV establishing a fishermen's contingency fund providing compensation to fishermen due to activities related to oil and gas exploration, development and production.

There is thus no requirement, for example, that there be a 5-year program for mineral leasing which would help affected

states and local communities plan and would give direction to the Department's environmental studies program. Nor is there a pollution fund to cover clean-up costs and environmental damages resulting from mining activities.

What remains applicable to mineral resource development on the OCS then are the original provisions of the 1953 Act, provisions outdated and inadequate to provide the necessary controls over mineral resource activities. Because of the inadequacies of the current law, we strongly recommend that the Interior Department delay its promulgation of regulations and its implementation of a marine minerals leasing program until new legislation is enacted which is specifically designed to cover non-oil and gas marine minerals.

Having made this basic point, NRDC makes these specific comments regarding the proposed regulations.

#### The Role of the States in Mineral Leasing and Operations

We are concerned that the regulations give inadequate weight to affected coastal states in decisions regarding mineral leasing and operations. If Interior is truly interested in a cooperative relationship with the states, as the preamble to the regulations suggests, then it should be willing to afford the states an important decisionmaking role in the program. However, the regulations only give coastal governors the right to comment and have those comments considered by the Secretary of the Interior. See S.G., §281.16 ("Written comments of the Governor(s)...shall

be considered by the Secretary." ). In addition, the preamble states that federal consistency review is not applicable to mineral lease sales. (page 31429). Finally, the proposed regulations governing operations do not clearly state that Section 307(c)(3) applies to the approval of delineation, testing and mining plans.

NRDC recommends that Interior Department commit to a positive and cooperative working relationship with affected coastal states by doing three things. First, the Interior Department should apply the requirements of §19 of OCSLA to mineral leasing and the approval of testing and mining plans. Admittedly, it is not altogether clear whether §19 applies to minerals other than oil and gas. (Section 19(a) imposes a general requirement for state consultation, without reference to any particular mineral; however, §19(c), in defining the national interest refers specifically to oil and gas.) Rather than utilizing this ambiguity to avoid the application of §19 to the marine minerals program, Interior should instead embrace this section and apply it both at the lease sale stage and to development and production of marine minerals. This would have the effect of giving greater weight to a state's recommendations than is currently provided in the proposed regulations.

Second, rather than broadly construing the Supreme Court decision in Secretary of the Interior v. California, 464 U.S. 312 (1984), Interior should narrowly construe that decision to exempt only OCS oil and gas leasing from consistency. The holding of

that case is limited to oil and gas leasing only. Furthermore, the administration specifically committed to a narrow interpretation of that court decision. Testimony of Assistant Attorney General Carol Dinkins before the House Subcommittee on Oceanography, 98th Cong., 2d Sess. (1984). And NOAA's regulations exclude only OCS oil and gas lease sales, nothing else, from the federal consistency requirement. 15 C.F.R. 930.33(c) (1985). In the spirit of that commitment and in compliance with NOAA's regulations, Interior should recognize the applicability of consistency to mineral leasing.

Third, the preamble to the regulations governing operations should make absolutely clear that Interior recognizes that §307(c)(3) of the Coastal Zone Management Act (CZMA) applies to Interior Department's approval of delineation, testing and mining plans.

#### Opportunity for Public Review and Comment

NRDC believes there is inadequate opportunity provided for public review and comment upon delineation, testing and mining plans prior to their approval. As currently drafted there is no explicit provision for public notice of such plans and designated time periods for submission of comments. The same opportunities for review and comment provided to the states in the proposed regulations (see §282.5(b)-(d)) should be provided to the public.



#### Environmental Impact Statements

NRDC strongly urges the Department to commit to preparing an environmental impact statement for each lease sale of minerals rather than for only the first lease sale in an area. Virtually every OCS oil and gas lease sale is accompanied by an EIS.\* NRDC believes the same practice should exist with respect to mineral lease sales as well. Preparing an EIS on each new sale would permit DOI to update the information on environmental effects, something particularly important because of the newness of the program and the new and different technologies employed. For similar reasons, we also strongly recommend that the Interior Department commit to the preparation of EIS on each mining plan.

#### The OCS Marine Minerals Covered by a Lease

NRDC strongly recommends that the Interior Department reconsider its proposal to issue mineral leases for all minerals rather than specifying which minerals may be mined. Through prospecting, companies and the Interior Department should be able to determine which areas should be leased for what minerals. Different minerals require widely differing mining techniques and have significantly different environmental impacts. Knowing in advance and specifying in the lease which minerals may be mined will assist in the preparation of the pre-lease EIS and the collection of environmental data. It will also allow Interior to

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\* The only exceptions are supplemental sales.

attach the appropriate mitigation measures and conditions to the lease. It is difficult to see how the pre-lease EIS and data gathering can be very focused or useful if the lease is completely open-ended. If through additional prospecting or through operations on an existing lease, it is determined that other minerals exist, then another lease sale can be held in that region.

The Secretary's flexibility to deny access to certain areas for environmental reasons is much more limited once a lease has been issued than before. For example, the authority to cancel leases for environmental reasons is very limited and compensation must be provided to the lessee in the event of such cancellation. See §281.47. Therefore, it is desirable to know as much as possible before leasing about the minerals to be explored for and developed and their environmental impacts.

The issuance of such open-ended leases also raises questions about fair market value requirements. How can the Secretary ensure that fair market value is being obtained for these public resources if he leases them without any knowledge or information about what minerals are present.

#### Lack of Clear Environmental Standards

One of the real deficiencies of the regulations and one which we think reflects a deficiency in the current law is the lack of clear environmental standards to govern the Secretary's decision regarding which tracts to lease and when to approve or

disapprove post-leasing plans. No standard at all is set forth to guide the Secretary's decision regarding which tracts to offer. The standard for disapproving a testing or a mining plan is much too stringent. See §282.12(c) and (d). The Director must determine that exceptional circumstances exist, that implementation of the plan would probably cause serious harm to the environment, will not disappear or decrease to an acceptable extent within a reasonable time and the advantage of disapproving the plan outweighs the advantage of proceeding with the plan. The standard set out in §282.28 (environmental protection measures) is also totally inadequate. It provides that testing, development, production and processing activities would only be approved on the determination that the adverse impacts can be "avoided, minimized or otherwise mitigated." This is too vague and undefined a standard to provide sufficient protection or predictability.

We favor a more rigorous environmental test, one which would require that the Secretary find in writing, before issuing a lease or approving a subsequent plan, that the authorized activity cannot reasonably be expected to result in a significant adverse effect on the marine or coastal environment. Such a standard would provide greater protection for the environment as the Department proceeds with the program.

#### Inadequacy of Existing Laws

The preamble asks whether commenters believe that the existing laws are inadequate to protect the environment. In our view, the National Environmental Policy Act (NEPA) provides inadequate protection because it has been interpreted essentially as a procedural statute which, while providing important information to the decisionmaker, does not necessarily guarantee that he or she will actually use it and make an environmentally sound decision. The Endangered Species Act deals only with the protection of endangered and threatened species. The CZMA, as interpreted by DOI, does not even apply to mineral leasing. And OCSLA provides no environmental standards or controls for marine mineral leasing specifically.

In conclusion, a stringent environmental mandate is not provided by OCSLA nor other environmental laws which would ensure that the Interior Department administers this program with maximum concern for environmental safety and protection.

Thank you for this opportunity to comment.

### **Response NRDC-1**

We believe the OCSLA provides a clear legal basis for OCS hard minerals leasing. Sections 5 and 8(k) of the OCSLA, in combination with 19 other sections of the OCSLA, which are applicable in whole or in part to minerals other than oil, gas, and sulphur, clearly and specifically grant authority and responsibility to the Secretary of the Interior to prescribe terms and conditions appropriate to the regulation of OCS mining, including prelease prospecting, leasing, and postlease operations.

The Department of the Interior promulgated, without legal challenge, final rules under the OCSLA in 1988 and 1989 governing prospecting, leasing, and development of minerals other than oil, gas, and sulphur. These regulations tailor implementation of the OCSLA to the OCS hard minerals leasing, providing effective environmental safeguards and for full involvement of the coastal states, local communities, and the general public. The proposed OCS Mining Program, Norton Sound Lease Sale, and postlease mining activities will be governed by these regulations.

### **Response NRDC-2**

The EIS provides a thorough and adequate assessment of the potential effect of methylmercury on human health (see Sec. IV.B.15). Health experts (D. Marsh and T. Kosatsky) at the MMS Workshop to Design Baseline and Monitoring Studies for the OCS Mining Program, Norton Sound, Alaska (USDOI, MMS, 1990), agreed that mercury is the only trace metal found in association with the proposed mining that potentially poses a health risk to the human population through dredging activities. Therefore, no lengthy discussion of other trace metals was included in the analysis of effects of the proposal on human health.

The EIS contains extensive revisions that adequately evaluate the impact of mercury and other toxic trace metals associated with the dredging on the environment with a detailed discussion and assessment of each of the toxic metals present in the sediments and in the seawater (see Sec. IV.B.2., Effects on Water Quality). The EIS thoroughly evaluates the potential effects of each of these trace metals on marine plants and invertebrates (Sec. IV.B.3.), on fishes (Sec. IV.B.4.) on marine and coastal birds (Sec. IV.B.5.), on nonendangered marine mammals (Sec. IV.B.6.) and on endangered species (Sec. IV.B.7.). The MMS has carried out timely studies on trace-metal analysis of seawater associated with the dredging and has conducted a baseline methylmercury-hair study of Nome women to evaluate the risk of mercury and arsenic exposure in the Nome population. The results of these studies as well as the results of the mercury and monitoring workshops conducted by MMS in 1988 and 1989 have been incorporated into the EIS (USDOI, MMS, 1989, 1990).

### **Response NRDC-3**

This EIS does provide a full and fair discussion of significant environmental impacts and has made the necessary environmental analyses of the effects of the proposal on the environment, including water quality, invertebrates, fishes, waterfowl, marine mammals, subsistence hunting and fishing, and human health (see Sec. IV.). This EIS uses currently available information to present descriptions of the environment, alternatives including the proposed action, and environmental consequences of those alternatives. Prior to publication of the second DEIS, MMS collected additional critical information on water quality and levels of mercury in Nome women of childbearing age--data that were previously considered inadequate. Subsequent to the first DEIS, stipulations and information to lessees were included as part of the proposal. These monitoring programs will require that additional information be provided--information that will be essential in analyzing effects. Review has been sought from expert agencies and the public (see Sec. V.A. for a listing of those who responded to the EIS).

### **Response NRDC-4**

These comments have been included. Most of the comments are no longer relevant to the second DEIS because of results from recent water sampling which indicated that mercury levels were below the EPA water-quality criteria, thus decreasing the concern regarding bioaccumulation of mercury in the food chain. Many of the other comments on the previous draft have been resubmitted as new comments.

### **Response NRDC-5**

The commenter's concerns regarding potential contamination by mercury and other trace metals is reflected in the EIS. Recent data obtained by MMS offshore of Nome suggests that the water concentrations of mercury are much less than previously indicated by the Bima monitoring program. As summarized in Section IV.B.2,

three analysis procedures--based on measured downcurrent concentrations, elutriate test results, and extrapolation of total mercury concentrations in the sediment--suggest that mercury concentrations in the water at the edge of the (100-m) mixing zone will not exceed acute or chronic EPA criteria for the proposed action. The validity of this conclusion will be tested by the monitoring required under Stipulation No. 1. These data have been discussed in the EIS and have been used as the basis for revised analysis. The preliminary results of the analysis of these data indicated low levels of methylmercury in Nome women (see Response NRDC-11). The legitimate and serious concern about potential effects of mercury on humans has led to an additional study of mercury levels in the hair of women of childbearing age in Nome. Results of this study will not be available until 1991. Mitigating measures (Stipulation Nos. 1, 2, and 3) are incorporated as part of all the proposals to protect the environment from mercury accumulation and protect human health.

#### **Response NRDC-5a**

The MMS also has been concerned about the levels of methylmercury in Nome residents who consume large quantities of marine mammals and fish because of the known high levels of methylmercury in some Canadian Natives. It was this concern that caused MMS to work with the Norton Sound Health Corporation in conducting a study of methylmercury levels in Nome women of childbearing age (see Sec. IV.B.15). These levels were quite low; only two of the women had levels at 6 ppm or higher. In October of 1990, MMS, in conjunction with the Norton Sound Health Corporation, began conducting a second hair study of women of childbearing age in Nome who are "heavy consumers" of subsistence foods. See also Response NRDC-11.

#### **Response NRDC-6**

The second DEIS recognizes and assesses the consequences of additional mercury contamination from existing as well as the proposed mining (see cumulative effects of other projects under Secs. IV.B.3, 4, 5, and 15). See Response NRDC-5.

#### **Response NRDC-7**

The concerns regarding potential contamination by other trace metals have been addressed in the text of the EIS. Concentrations measured in conjunction with the Bima monitoring program suggest that lethal and sublethal effects to marine plants, invertebrates, and fishes could occur, but, in general, these are expected to be localized and short term in nature. Other trace metals in addition to mercury will be monitored by the same mitigating measures (Stipulation No. 1) specified in Response NRDC-5.

#### **Response NRDC-7a**

This concern is addressed in Section IV.B.2.b. Those Bima data for mercury were considered erroneous.

#### **Response NRDC-7b**

This concern is addressed in Section IV.B.2.b.

#### **Response NRDC-8**

The "elevated levels" and "very high anomalies" of trace metals that are possible, although not necessarily probable, are based on the suite of sediment data compiled from all available sources in Table III-3. These sources presumably include the unreferenced "other testing" of NRDC. However, note that only some high mercury values in the sediment--and not the highest values--have been attributed to possible mercury pollution in the Table III-3 studies. The highest mercury concentrations and the high concentrations of the other metals are attributable to natural sources and are not evidence of manmade pollution. This natural origin of the metals, however, would not necessarily limit contamination caused by the stirring of these metals into the water column during mining. In the discussion of the effects on water quality for each metal in Section IV.B.2, terms such as "elevated levels" and "anomalies" are quantified. For example, for arsenic, "anomalous, and an order of magnitude higher, concentrations of arsenic" are identified as being "up to 3,000 ppm." An estimate is provided for each metal of how much of an anomalous sediment concentration of metal would increase plume concentrations at the edge of the mixing zone and whether this increase would exceed water-quality criteria.

There are four lines of reasoning supporting the EIS approach of using surface sediment chemistry to project the effects from dredging deeper sediments. First, there is a small data set for metal from eight deep (2-to-

7-m) sediment samples at one dredge site in State waters (Table E-6 in Jewett et al., 1990). The mean concentrations of seven metals (mercury, arsenic, chromium, lead, zinc, copper, and nickel) in these deeper sediments were not significantly different ( $p = 0.05$ ) than the mean of all (pre) dredge-site samples ( $n=50$ , including the eight deeper samples). The eighth metal, cadmium, was significantly (fivefold) lower in concentration in the deeper sediment. That some deeper sediment data exist for inshore waters has been clarified in Section IV.B.2.b. The second line of reasoning supporting the EIS approach is the similarity of trace-metal chemistry for surface tailings and predredging surface sediments in State waters (Tables E-6 and E-7 in Jewett et al., 1990). In line with what was found for surface versus deeper sediments, only the cadmium concentrations differ between the two data sets; this time being almost sixfold lower in the surface tailings than in the undisturbed surface sediments. The third line of reasoning is the recommendation of the MMS Workshop to Design Baseline and Monitoring Studies for the OCS Mining Program, Norton Sound Lease Sale (Hood, in press). This recommendation stated that MMS should concentrate on postsale monitoring of tailings chemistry to quantify potential trace-metal effects because the demonstrated heterogeneity of Nome-area sediments and the targeting of yet unidentified, metal-rich, auriferous deposits by miners made the alternative procedure of presale-sediment coring for this purpose infeasible. The fourth line of reasoning is the incorporation of the monitoring program as part of the proposed sale (Stipulation No. 1) which will enable MMS to verify whether effects are at the level projected in the EIS.

#### **Response NRDC-8g**

The FEIS has used the available information to document levels of trace metals observed in marine organisms in Norton Sound and has combined this information with dose-related effects of trace metals on marine organisms to project the types and extent of effects likely under the proposal. The monitoring program is designed, at least in part, to track trace-metal concentrations in the water column and selected organisms in order to address concerns identified in the EIS.

#### **Response NRDC-9**

The high levels found in seals were taken from liver tissues in which most of the mercury is in an inorganic (far less toxic) form rather than as methylated mercury (far more toxic). High concentrations of cadmium, not mercury, were reported in walrus. The monitoring program under Stipulation No.1 would acquire more data and result in further analysis of mercury and of other trace metals associated with the proposed mining.

#### **Response NRDC-10**

The FWS completed a second biological opinion (dated June 26, 1990) based on the new trace-metal data (especially mercury) concerning mercury levels in water and organisms in Norton Sound. The information and recommendations from the second opinion, as well as the first opinion (June 7, 1989), have been incorporated into the text of the FEIS (see Appendix B for the biological opinions and other consultation documentation).

#### **Response NRDC-11**

It is unknown how many of the sample of 200 women from Nome (about 22% of the women of childbearing age) were from high seafood consumers since no dietary survey was performed with the sampling. Only two of the women had levels at 6 ppm or higher. In October of 1990, MMS, in conjunction with the Norton Sound Health Corporation, conducted a second hair study of women of childbearing age in Nome who are "heavy consumers" of subsistence foods. A segmental analysis of hair will be done to determine the monthly level of methylmercury exposure. The final report should be available sometime in the middle of 1991. While the results of this study were not available for this FEIS, they will be used to provide a baseline of levels of methylmercury of women in Nome. The results of this study also will indicate whether the lessee will need to pursue further human health monitoring as required in Stipulation No. 3.

Discussions with Dr. David Marsh, an international expert on effects of methylmercury on developing fetuses, revealed that there were some problems with the Kjellstrom report cited and some division in the WHO regarding the Kjellstrom study. For this reason, there was some disagreement among the WHO committee members regarding what level of methylmercury in pregnant women would cause low level effects to developing fetuses. A compromise was reached and the WHO decided on a range of 10 to 20 ppm, but decided against setting a "safety level" until further studies could be conducted and the Kjellstrom findings verified.

### Response NRDC-12

Mining production is assumed to begin in 1995. This would allow for evaluation of results of the hair sampling study conducted in October 1990. If levels in this study were considered high (over 10 ppm), MMS would consider seeking Office of Management and Budget (OMB) approval to conduct a dietary survey and further hair sampling. The OMB approval would take a year, possibly more. In any case, there would be sufficient time to do further studies prior to production if there were a need to do so.

### Response NRDC-13

The WHO does not recognize 6 ppm to less than 10 ppm methylmercury as a level where neurological deficiencies in young children are likely to occur. Six ppm of methylmercury in the hair has been noted in the past by WHO as the "safety level" of methylmercury in adults. Ten to 20 ppm is the level of concern for developing fetuses. The MODERATE definition (Table S-2) refers to one or more women in which methylmercury hair levels are between 6 and 10 ppm (see also Response NRDC-11).

### Response NRDC-14

The MMS has quantified the risks of mercury contamination to humans and marine organisms. The recent MMS study of mercury levels in seawater associated with the current dredging indicate there is only a slight increase of mercury (0.4 ppt) at the dredge mixing zone (Creelius, Apts, and Lasora, 1990), resulting in a total mercury level (background level of 1 ppt) of 1.4 ppt which is well below the EPA chronic criterion level (25 ppt; see Sec. IV.B.2). This represents a very low or insignificant risk to marine organisms. The MMS study on methylmercury hair levels in Nome women of childbearing age indicated that methylmercury hair levels are very low (an average of 1 ppm) and well below the threshold level of 10 ppm at which there is a small risk of neural impairment to the fetuses of women with this methylmercury hair level. This study included the use of rigorous scientific statistical analysis that was reviewed and approved by the U.S. Public Health Service (PHS). The PHS provided no adverse comments.

In October 1990, the MMS initiated a follow up hair sampling in order to conduct a segmental hair analysis to determine if there were any seasonal variations of mercury exposure in Nome women of child bearing age who are high seafood consumers. This will be examined to verify the results of the previous study. The monitoring program required under Stipulation No. 1 will monitor mercury and other trace metals in the marine environment and is expected to assure that any changes in mercury or other trace-metal levels associated with the proposed action will be detected and that appropriate measures will be taken to prevent any significant risk to the marine environment. Under Stipulation No. 3, further study of methylmercury levels in the human population will be conducted, if necessary, to further quantify the risk of methylmercury exposure in the Nome population.

### Response NRDC-15

Recent measurements of trace-metal concentrations near the Bima dredging operation analyzed with state-of-the-art methodology have led to the reevaluation of the potential effects of trace metals. This reevaluation is reflected in the second DEIS. These data, in conjunction with literature reviews of the dose-related effects of trace metals on organisms, and results that were obtained from a study of the levels of mercury in the hair of women of childbearing age in Nome, provide a sufficient base for analysis of potential effects. Although one concerned about the potential biomagnification of mercury might argue for the analysis of tissues of organisms all the way up the trophic pathways, it is reasonable and parsimonious to sample top-level consumers, such as humans and peregrine falcons, for indications of such biomagnification. Data concerning mercury levels in the local arctic peregrine falcon population have been collected and presented in the FWS June 26, 1990, biological opinion. This information has been included in the text for the FEIS. This will provide baseline information on mercury levels in peregrine falcons for any future monitoring that is required under Stipulation No. 1. Under Stipulation No. 1, the monitoring program is expected to gather sufficient baseline (control) and test (dredging-area) data on trace-metal levels in water and sediments and in marine organisms, including subsistence species. If mercury levels are high in the subsistence species, the U.S. Public Health Service would be involved in the further testing and monitoring of mercury levels in the human population. Current levels being measured, in association with present dredging in State waters, indicate that mercury levels are low and within normal environmental levels and pose no risk to human health. If the monitoring program indicates an increase in mercury levels above normal, further evaluation could lead to the decision to restrict or shut down operations in order to prevent any increased risk of mercury exposure or bioaccumulation in the human population of Nome.

The PHS does not anticipate adverse effects on human health (see the PHS letter in this section). See also Response NRDC-8.

#### **Response NRDC-16**

This concern is addressed in Response EPA-1. Based on the new NPDES permit for the Bima, turbid waters should not extend beyond the edge of the mixing zone (1,000 m in State waters, presently 100 m in Federal waters). The effects of turbidity on marine and coastal birds, nonendangered marine mammals, and endangered and threatened species are assessed in Sections IV.B.5, IV.B.6, and IV.B.7. Effects of turbidity on marine organisms have been discussed in the appropriate sections of the EIS. In particular, effects on marine plants and invertebrates are discussed in Section IV.B.3.b.

#### **Response NRDC-17**

The concern regarding red king crab reiterates part of the discussion of effects of habitat alteration on red king crab, which appears in Sec. IV.B.3.a. As regards the scanty information for other benthic marine organisms, substrate composition, and community dynamics within the proposed sale area, that also is discussed in Sec. IV.B.3.a. The commenter's partial rendering of the concern and how it may be dealt with does not accurately reflect the discussion. We have gained considerable knowledge about substrate types, benthic communities, and the consequences of dredging in somewhat shallower waters from the monitoring program associated with the Bima operations, specific knowledge is not available for the proposed sale area. The Bima monitoring program allowed definition of potential problem areas that should be addressed in the proposed monitoring program. These include: the extent of cobble substrate within the proposed sale area, identification of any restricted or unique communities, including areas of high densities of red king crab, and recovery rates of disturbed cobble communities. Thus, sufficient information has been obtained to make a reasonable analysis and come to a conclusion of the reasonable, foreseeable effects of the proposal. The monitoring program that is associated with the proposal should be able to provide essential information that would allow the level of effect to benthic organisms to be controlled. See Response NOME-4 also.

#### **Response NRDC-18**

The EIS provides for a full and fair discussion of significant environmental effects using currently available information to present descriptions of the environment and alternatives, including the proposed action, and environmental consequences (effects of turbidity, trace metals, and habitat destruction on marine plants and invertebrates [Sec. IV.B.3], on fishes [Sec. IV.B.4], on marine and coastal birds [Sec. IV.B.5], on nonendangered marine mammals [Sec. IV.B.6], on endangered species [Sec. IV.B.7] and the effects of trace metals on human health [Sec. IV.B.15]; see also Response NRDC-3). The original water-quality data around which the first draft EIS was written were shown to be erroneous by more state-of-the-art water-quality testing. The second draft EIS was not based on unsupported assumptions but on the results of trace-metal investigations in Nome waters done with state-of-the-art methods. These numbers have been replicated with additional testing and are the numbers used in this FEIS.

The Bima NPDES permit reissued by EPA in October 1990 (USEPA, 1990a; see Appendix E) is designed to assure that water quality criteria are not exceeded at the edge of the mixing zone. Monitoring is required under the EPA NPDES permit as well as under MMS regulations (30 CFR 282.21 and 282.28), and therefore monitoring is assumed as part of the proposal and provided under Stipulation No. 1, on Environmental Survey and Monitoring and Operations Management and Stipulation No. 3, on Monitoring in Humans. The Environmental Survey and Monitoring and Operations Management stipulation would, in part, provide a baseline of environmental data prior to the commencement of mining. The baseline data would then be used as an indicator from which to identify changes in the biological environment, including trace-metal bioaccumulation, turbidity, and habitat destruction and provide a basis for the Regional Supervisor, Field Operations (RS/FO) to take additional mitigative actions if appropriate. Stipulation No. 3 requires lessees to monitor mercury levels in humans if certain conditions are met (see Sec. II.F).

The EPA letter dated August 3, 1990 (USEPA, 1990b; see letter in Sec. V), states: "The changes being proposed in the draft permit will generate the additional information that will be used to make decisions in the future about operation and conditions under which dredging can be conducted in an environmentally approved manner. Based on the ...effluent limits in the...permit, EPA believes that federal marine water criteria for the seven trace metals...are not expected to be violated at the edge of the 100 meter mixing zone." The EPA (USEPA, 1990d) concluded that cupreous-sediment discharge from the proposed sale, as estimated in the EIS, would have

negligible effect on water quality. The monitoring program will be reviewed by the Postlease Review Team (see Response NRDC-20), which EPA is expected to be a member of. This Review Team is expected to assure that state-of-the-art methods are used and that an adequate monitoring program is conducted. If the Postlease Review Team determines that modifications to the dredging operation are necessary (see Response EPA-4) to protect the environment, it is the responsibility of the Director of MMS to ensure that these modifications occur. According to regulations, additional mitigating measures may be adopted and imposed at any time during the term of lease.

The concern regarding EIS assumptions on effectiveness of stipulations also has been partially addressed in Responses NRDC-8 and EPA-1. Without Stipulation No. 1, the effect of turbidity on water quality would have been a MODERATE LOCAL effect (rather than MINOR), but still a NEGLIGIBLE REGIONAL effect. The effect of trace-metal discharges on water quality without Stipulation No. 1 would have remained a LOCAL MAJOR effect and a NEGLIGIBLE REGIONAL effect.

#### **Response NRDC-19**

Stipulation No. 1 requires that the lessee notify the RS/FO within 24 hours of becoming aware of measured concentrations exceeding water-quality criteria. Thus, the RS/FO could take corrective action in a much shorter timeframe than is indicated by the annual reporting requirement. The effects of likely turbidity and trace-metals contamination are not permanent, although the EIS has estimated a MAJOR LOCAL effect on water quality as a result of likely occasional exceeding of the acute copper criterion. The ecosystem recovery period for exposure to trace-metal concentrations, in terms of exceeding EPA criteria, is estimated to 3 years by EPA (USEPA, 1986a). Based on the EIS data, the EIS analysis, and expected NPDES discharge limitations, the EPA has called the effect of the proposal on water quality both acceptable (USEPA, 1990b) and negligible (USEPA, 1990d). See also Response EPA-1.

That (1) MMS has acknowledged and identified problems encountered in the monitoring program in State waters in both the first and second DEIS's and that (2) MMS has included stipulations such as the monitoring stipulation (No. 1) as part of the proposed action should be taken as evidence of serious intent to protect the sale area environment.

#### **Response NRDC-20**

The MMS is scheduled to develop a postlease coordination process prior to publication of the Final Leasing Notice. The lessee will propose a monitoring program, which would be reviewed by the Postlease Review Team. The Postlease Review Team will consist of MMS, appropriate State and Federal agencies, and others. The Postlease Review Team will advise the MMS Regional Supervisor of Field Operations (RS/FO) of issues associated with mining and will provide appropriate review of the exploration and mining plans and the monitoring program, including aspects such as what to monitor, how to monitor, and also would provide technical review of studies to assure that the monitoring is done with the best scientific methodologies and technologies. The MMS believes that postlease coordination will help ensure the highest standards in the monitoring program.

#### **Response NRDC-21**

The opinions and analyses of medical and health experts have been included in the extensive review of the literature on effects of mercury on human health (see Sec. IV.B. 15.c.[1] and [2]). The opinions of Drs. Marsh and Kosatsky as published in the Mercury and Monitoring Workshops (USDOI,MMS, 1989, 1990) also were directly used in the second DEIS. The second DEIS also was reviewed by the U.S. Public Health Service and their comments are included in this FEIS; the first DEIS was reviewed by the U.S. Public Health Service, Indian Health Service, Drs. Marsh and Kosatsky, and the Norton Sound Health Corporation. The preparers, particularly the wildlife biologist and social scientist have a broad background of knowledge and experience not listed in the DEIS that includes training and education in medical technology and health services. The followup study of mercury levels in Nome women will include segmental sampling of the hair for seasonal variations in mercury levels.

#### **Response NRDC-21a**

Since the publication of the second DEIS, all of the existing oil and gas leases (Sale 57) in the Norton Sound region have been relinquished and have been eliminated from the cumulative discussion.



### Response NRDC-22

This concern is addressed in the EIS by dividing effects on water quality into LOCAL and REGIONAL effects. A increasing effect on water quality in the EIS is denoted by both magnitude of effect (NEGLIGIBLE to MAJOR) and area affected (LOCAL to REGIONAL). Since "MAJOR" is defined in Table S-2 as a toxic concentration (acute EPA criterion), a more severe effect level--more than toxic--is unreasonable. In addition, cumulative activities will usually effect a specific LOCAL area only in terms of superposition of REGIONAL degradation of water quality on that LOCAL area. The only MAJOR effect for water quality is over a very limited extent, from increased copper concentrations within about 3 km of dredging. Other activities in the cumulative case, including multiple dredges, are unlikely to significantly increase turbidity or trace-metal levels with the same 3-km distance from the first active dredge. Multiple effects on different multiple LOCAL waters are quantified in the analysis of REGIONAL water quality. In this EIS, cumulative activities are estimated to be insufficient to increase the effects level for REGIONAL water quality from the MINOR for the proposal.

### Response NRDC-23

Comparative effect levels of base case, cumulative case, and the alternatives are presented in Table S-1. Comparisons to the base case are presented in the text of the analyses of effects in the cumulative case, high case, and of the alternatives.

### Response NRDC-24

As noted in CEQ Regulations, 40 CFR 1502.4, agencies, when preparing statements on broad actions may find it useful to evaluate the proposal(s) in one of the following ways: (1) geographically, including actions occurring in the same general location, such as a body of water, region, or metropolitan area; (2) generically, including actions which have relevant similarities, such as common timing, impacts, alternatives, method of implementation, media, or subject matter, or (3) by state of technological development, including Federal or federally assisted research, development or demonstration programs for new technologies (which, if applied, could significantly affect the quality of the human environment).

For the OCS Mining Program Norton Sound Lease Sale, the proposal is a broad action that involves leasing a geographical area for possible mineral exploitation. As noted above, such an evaluation may be accomplished in one of several ways. The MMS believes its evaluation responsibilities under NEPA and CEQ Regulations are fulfilled by comparing the proposed action with the proposed geographical and timing alternatives.

An evaluation of the proposed action based on the technical considerations noted in the comment assumes the proposed action involves a specific mining proposal on leases that have been granted. This is not the case. No lease sale has been approved, no leases have been granted to exploit minerals other than oil and gas in the Norton Sound area, nor is MMS proposing a specific type of mining operation.

However, to evaluate the potential environmental effects of the proposed action, possible mining scenarios have been developed for both base- and high-case-resource estimates. The types and levels of activities associated with these scenarios are based on the resource estimates and examples of similar types of operations in other area--principally the gold placer mining operation that is presently being conducted on nearby State of Alaska leases. As noted in Section II.A., the strategies used to explore, assess, mine, and process the potential resources in the proposed sale area may vary. These variations are the result of uncertainties with regard to the resources and operational conditions unique to each leaseholder or operator. Also, as noted in this section of the EIS, the strategies and technologies discussed in the scenarios are hypothetical and used to identify general types and levels of activities that might occur as a result of the lease sale; they do not represent a recommendation, preference or endorsement by the USDO. Furthermore, the technical considerations noted in the comment are the types of factors that are evaluated in mining plans if a sale is held and leases granted. The Governor, lessees and operators, other Federal agencies, and other interested parties will have the opportunity to review the proposed plans and provide comments and recommendations on any activities described in the plans.

As noted in 30 CFR Part 282, Operations in the Outer Continental Shelf for Minerals Other Than Oil, Gas and Sulphur; Final Rule: all OCS mineral development and production activities shall be conducted in accordance with a mining plan submitted by the lessee and approved by the Director of MMS. The mining plan shall include: (1) the volume of ocean bottom expected to be disturbed (area and depth of disturbance) each year; (2) all activities of the mining cycle from extraction through process and waste disposal; (3) a description of equipment to be used in the mining, processing, and transporting of the ore; (4) a description of potential

conflicts with other uses and users of the area; (5) a detailed description of the cycle of all materials including samples and wastes, the method of discharge and disposal of waste and refuse and the chemical and physical characteristics of the waste and refuse; (6) a detailed description of the method of transporting the produced OCS minerals from the lease to shore and adequate maps showing the locations of pipelines, conveyors, and other transportation facilities and corridors; (7) a detailed description of measures to be taken to monitor the effects of the proposed mining and processing activities on the environment in accordance with paragraph 282.28(c), Environmental Protection Measures, of this part; (8) steps to be taken to assure that mined areas or tailing deposits do not pose a threat to the environment and that the seafloor is left free of obstructions and structures that present a hazard to other users or uses of the OCS such as navigation or commercial fishing; and (9) alternative sites and technologies considered by the lessee and the reasons why they were not chosen.

The environmental protection measures are developed to avoid, minimize, or otherwise mitigate any potential adverse environmental effects. The lessee shall monitor activities in a manner that develops the data and information necessary to enable the Director of MMS to: (1) assess the effect of mining activities on the environment on and off the lease; (2) develop and evaluate methods for mitigating adverse environmental effects; (3) validate assessments made in previous environmental evaluations; and (4) ensure compliance with lease and other requirements for the protection of the environment.

#### **Response NRDC-24a**

This citation (CEQ Regulations, 40 CFR 1506.2[d]) forms the basis for the analysis of the ACMP standard on habitats (Sec. IV.B.14.c[1]). The MODERATE conclusion reflects the effects of mining on the benthic habitat that could affect the red king crab and the red king crab fishery. Recent amendments to the Federal Coastal Zone Management Act ensure that OCS lease sales will be consistent with a State's coastal program to the maximum extent practicable.

#### **Response NRDC-25**

These policies are identified in the analysis of potential conflicts of offshore mining with district coastal programs. As noted in the previous response, the current offshore mining program in State waters is consistent with the ACMP of which these district programs are a part. The State and coastal districts will have the opportunity to review plans submitted for activities on the Federal leases to ensure consistency with the ACMP. Recent amendments to the Federal Coastal Zone Management Act ensure that OCS lease sale will be consistent with a State coastal program to the maximum extent practicable.

#### **Response NRDC-26**

The laws listed on page I-8 of the second DEIS serve to address 40 CFR 1502.25(b) in that those laws establish the regulatory regime for permits that may be required. The EPA (1990b) and the FEIS anticipate that NPDES permits would be granted for the proposed sale and that mining operations would meet the permit restrictions (see Response EPA-1).

The Corps of Engineers has informed MMS that a CWA 404 permit would not be needed.

#### **Response NRDC-27**

It is the position of the Federal Government that the village does not have aboriginal title to the Norton Sound area. Legal proceedings are pending on aboriginal subsistence rights related to Norton Basin Oil and Gas Lease Sale 57. Subsistence-use issues have always been addressed through the NEPA process in OCS environmental documents and will continue to be so addressed. The second DEIS has extensive analysis on the subsistence-harvest patterns of communities adjacent to the sale area (Sec. IV.B.10).

#### **Response NRDC-28**

The concern regarding adequacy of water-quality information is addressed in Response NRDC-8. The information base in the EIS is similar and in many aspects identical to that provided by WestGold in their request for a reissue of its NPDES permit in State waters. Their reissued NPDES permit (USEPA, 1990a) is more restrictive than the original permit. A discussion of the reissued NPDES permit has been added to Section IV.B.2. The tightened discharge limitations in the new permit are a result of the current information database being much greater than what was originally available when the initial NPDES permit was granted to WestGold's

predecessors. The EPA anticipates placing similar discharge restrictions on any OCS mining (USEPA, 1990b).

**Response NRDC-29**

This interpretation of what the CWA requires is not consistent with the interpretation of EPA (see USEPA, 1990d).

**Response NRDC-30**

Exceeding a water-quality criterion does not equate with "unreasonable degradation." For the proposal, the occasional exceeding of the acute criterion for copper at the edge of the mixing zone by total-recoverable copper is considered by EPA to be a negligible effect on water quality (USEPA, 1990d).

**Response NRDC-31**

The EPA has reissued the NPDES permit for the WestGold dredge Bima (USEPA, 1990a) and has stated that EPA expects to issue a similar permit for any mining in Federal waters resulting from the proposed Sale (USEPA, 1990b). This concern is also addressed in Response EPA-1 and in Response NRDC-28.

**Response NRDC-32**

The EPA has already determined that a more restrictive mixing zone is not required for these trace metals in prior NPDES discharge permits for Norton Sound, including the reissued permit for the Bima (USEPA, 1990a). The interpretation of the CWA by the commenter is at variance with the practices of the EPA. The EPA allows mixing zones for both chronic and acute criteria. The permit for the Bima is an example of such a case.

**Response NRDC-33**

These concerns regarding CWA requirements relate to NPDES permits. As such, these concerns would be more appropriately addressed by the EPA and the lessee after the proposed sale, when a detailed mining plan is submitted. See Response EPA-1.

**Response NRDC-34**

This is not an issue relevant to the second DEIS; therefore, it will not be responded to directly in the FEIS. This comment will be fully considered by the Director of MMS in making his final determination on the lease terms and conditions to be issued in the Final Leasing Notice.

**Response NRDC-35**

The MMS would agree that levels as high as 10 ppm could be unacceptable and certainly could warrant monitoring. The MMS also would not pursue an action that would cause harm to developing fetuses which is why we have included Stipulation No. 3 to monitor human health. Per Stipulation No. 3, if baseline levels were elevated and if monitoring under Stipulation No. 1 indicated that the mining operation was causing an increase in the levels of mercury into the environment, then it would be necessary to monitor methylmercury levels in humans. At this point, recent data indicate that levels of methylmercury released into the water column are not of concern to human health. The 1989 human health study in Nome indicated levels of methylmercury below 8 ppm.

**Response NRDC-36**

See Response NRDC-1.

**Response NRDC-37**

This comment applied to the first DEIS, but does not apply to the second DEIS.

**Response NRDC-38**

See Response NRDC-2.

**Response NRDC-39**

See Response NRDC-3.

**Response NRDC-40**

See Response NRDC-6 and 15.

**Response NRDC-41**

See Response NRDC-10.

**Response NRDC-42**

See Response NRDC-11. Also, it should be noted that the second DEIS was reviewed by the PHS (see the letter in this section).

**Response NRDC-43**

This comment applied to the first DEIS, but does not apply to the second DEIS.

**Response NRDC-44**

This comment applied to the first DEIS, but does not apply to the second DEIS.

**Response NRDC-45**

This comment applied to the first DEIS, but does not apply to the second DEIS.

**Response NRDC-46**

This comment applied to the first DEIS, but does not apply to the second DEIS.

**Response NRDC-47a**

This comment applied to the first DEIS, but does not apply to the second DEIS.

**Response NRDC-47b**

The basis for not emphasizing oil and gas development lies in lack of industry interest in the area and a viable scenario upon which to base effects. All leases from Sale 57 have been relinquished, Sale 100 was cancelled, and Sale 120 prompted no industry interest in the 1988 or 1989 Requests for Interest. The fact that only exploration wells have been drilled to date helps explain the lack of interest, but this is not the basis for the decision to identify (and at the same time not overemphasize) the potential for oil and gas development in Norton Sound.

**Response NRDC-48**

See Response NRDC-24.

**Response NRDC-49**

See Response NRDC-25.

**Response NRDC-50**

See Response NRDC-26.

**Response NRDC-51**

See Response NRDC-28.

**Response NRDC-52**

See Response NRDC-29.

**Response NRDC-53**

See Response NRDC-30.

**Response NRDC-54**

See Response NRDC-31.

**Response NRDC-55**

See Response NRDC-32.

**Response NRDC-56**

This comment applied to the first DEIS, but does not apply to the second DEIS.

**Response NRDC-57**

See Response NRDC-33.

**Response NRDC-57a**

This comment applied to the first DEIS, but does not apply to the second DEIS.

**Response NRDC-58**

This comment applied to the first DEIS, but does not apply to the second DEIS.

**Response NRDC-59**

This comment applied to the first DEIS, but does not apply to the second DEIS.

**Response NRDC-60**

This comment applied to the first DEIS, but does not apply to the second DEIS.

DAN LEVINSON  
General Delivery  
Nome, Alaska  
99762

Nome, Alaska

July 19, 1990

Gentlemen:

I recently received a proposed lease notice from Minerals Management Service for the Norton Sound Lease Area. After reading this over two major recommendations come to mind:

First, to simply strip mine the area guarantees the most damage. I propose a checker-board approach to strip mining so we don't maximize habitat destruction of marine flora and fauna.

Second, I think there should be a requirement that mine tailings be "tapped off" if they are below the 5.00 level of the water surface. This would reduce navigation hazards similar to those experienced in recent summers by small craft. Further, I think those miners could at least leave slope areas that pose navigation hazards. Damage done to those small craft could have been avoided. No one expects to see rocks around a mile off shore! The notion that storm action is sufficient to moderate this problem shows indifference to people living here. I think the language of 14 b 4 is clear enough in providing us protection.

LEV-1

Sincerely,

Dan Levinson

**LEV-1:**

The placer gold deposits that are likely to be exploited probably will be irregularly distributed in the sale area; such a distribution may not be conducive to a "checkerboard" mining pattern.

For a response to the comment on navigational hazards, see Responses NOAA-2 and NOAA-3.

1 U.S. DEPARTMENT OF THE INTERIOR  
2 MINERALS MANAGEMENT SERVICE

3  
4  
5 OCS MINING PROGRAM  
6 NORTON SOUND LEASE SALE  
7 SECOND DRAFT ENVIRONMENTAL IMPACT STATEMENT

8  
9  
10 PUBLIC HEARING  
11 OFFICIAL TRANSCRIPT OF PROCEEDINGS

12  
13  
14  
15  
16 Held At:  
17 NOME, ALASKA  
18 Mini-Convention Center  
19 Wednesday, July 18, 1990  
20 7:00 o'clock p.m.

21  
22  
23  
24 Proceedings recorded by electronic sound recording  
25 and transcript produced by:

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4 and Environment  
5 GEORGE VALIULIS Offshore Environmental Assess-  
6 ment Division of MMS in  
7 Washington, D.C.  
8 BARRY BOUDREAU Deputy Regional Supervisor for  
9 Field Operations in Anchorage  
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11 Alaska OCS Office in Anchorage  
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18 Executary Court Reporting

19 PUBLIC PARTICIPANTS

20	<u>NAME</u>	<u>AGENCY</u>	<u>PHONE NUMBER</u>
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24	RICHARD GARNETT	West' Gold	(907) 561-1855
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HOME, ALASKA - JULY 18, 1990

(Tape No. 1 of 1)

HEARING OFFICER BROCK: I'd like to welcome you to the hearing on the second Draft of the Environmental Impact Statement on the OCS Mining Program, Norton Sale -- Norton Sound Lease Sale. This lease sale is for the leasing of submerged federal lands in Norton Sound for the recovery of gold and any other minerals recovered with that gold.

My name is Bob Brock; I'm the Regional Supervisor for Leasing Environment with the Regional Office of the Alaska OCS, Minerals Management Service. Other panel members are Irv Palmer on my immediate left, who's the Deputy Regional Director for the Alaska Region of Minerals Management Service. On the far right is Barry Boudreau. He's the Deputy Regional Supervisor for Field Operations in the Alaska Region. And on my immediate right is George Valiulis. He's the -- from the Office of Offshore Environmental Assessment Division of MMS in Washington, D.C.

This will be the only hearing held on this lease sale. The purpose of this hearing is to receive views, comments, and suggestions of interested individuals and representatives of local government and organizations on the second draft of the environmental impact statement.

Before we start, I'd like to give you just a little

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1 bit of background. As I said, this is the second DEIS. In  
 2 November 1988, the first Draft Environmental Impact Statement  
 3 was issued, and in January of the next year, we held a public  
 4 hearing here in Nome. At that time, major effects were  
 5 anticipated for water quality, commercial fishing, subsistence  
 6 harvest, and the sociocultural systems. The proposal did not  
 7 include any mitigating measures. The State, federal, and local  
 8 government agencies, as well as members of our coordination  
 9 team and the public expressed concern that the lack of  
 10 information for the -- of the first draft EIS was inadequate to  
 11 make the proper analysis and decisions. The concern was over  
 12 the mercury level in the water column, the bio-accumulation of  
 13 mercury in the food chain, levels of mercury in humans, and the  
 14 effect of dredging on the King crab habitat.

15 The MMS sponsored a workshop to determine what kind  
 16 of studies were best for monitoring water quality, habitat  
 17 alteration, and the human health concern. MMS coordinated with  
 18 the Indian Health Service and Norton Sound Health Corporation  
 19 to obtain hair samples to be analyzed for levels of mercury and  
 20 Battelle Northwest to analyze those hair samples. Sampling  
 21 results showed that the methylmercury content in the hair  
 22 samples was below average for Native coastal North American  
 23 communities. To verify these levels of mercury, further  
 24 research is being conducted right here this fall.

25 MMS also sponsored studies to obtain additional trace

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1 metal data for water in the sale area and in the  
 2 in-shore/near-shore areas. The sampling results showed that  
 3 the levels of mercury in the water column did not exceed EPA  
 4 criteria, and it appears that there is likely no significant  
 5 mercury contribution to the water column from the dredging  
 6 action.

7 How, this is the second draft EIS, which includes  
 8 stipulation on baseline and monitoring studies on human -- on  
 9 the mercury levels in humans. The DEIS includes a stipulation  
 10 requiring monitoring programs to be conducted to determine if  
 11 lease operations are resulting in significant effects to the  
 12 environment, and in December 1989, MMS deleted six blocks from  
 13 the proposal for the protection of the king crab habitat. And,  
 14 in addition to that, this DEIS makes eight mitigating measures,  
 15 four stipulations, and four ITLs as part of the proposal.

16 Adding to this, MMS has in place a host of  
 17 regulations and operating rules that are designed to make  
 18 offshore operations safe and clean. There's a host of laws  
 19 that are being -- that we enforce on this, the OCS Lands Act,  
 20 the National Environmental Policy Act, the Endangered Species  
 21 Act, the Marine Mammal Protection Act, the Clean Water Act, the  
 22 Occupational Safety and Health Act, and the Coastal Zone  
 23 Management Act. And we have a set of regulations for offshore  
 24 mining which is different than the oil and gas and sulphur  
 25 regulations.

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1 If a sale is held and leases are awarded, lessees  
2 cannot just begin dredging. There are many environmental and  
3 State requirements in place to assure all operations proceed in  
4 an environmentally safe and acceptable manner. The lessees  
5 have to prepare detailed plans which are reviewed by a large  
6 variety of State and federal agencies before MMS approves them.  
7 The State's Coastal Zone Consistency certification is also  
8 necessary. When actual dredging begins, a permit is required,  
9 and an inspector will be on the dredge or nearby at all times.  
10 And each one of these steps requires another environmental  
11 review.

12 The Environmental Impact Statement is a very  
13 important element in the decision process, and the Director of  
14 the Minerals Management Service will make the final decision  
15 whether or not to proceed with the lease sale. The  
16 coordination team, of which some of you are members, was made  
17 up of State and federal agencies, village representatives, the  
18 Mining Association, and an environmental group, and which has  
19 been very valuable throughout this entire process.

20 Now, we'll start with calling the first speaker. I'd  
21 like you to state your name, your address, and whom you  
22 represent so we'll have this for the recorder. Please try to  
23 keep your comments to about 10 minutes, although with no more  
24 people than there are here, I'm not going to worry about the  
25 time. If you have prepared testimony, please give the copies

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1 to the Court Reporter on my far right, and if you wish to  
2 submit additional comments, you can do that also. An official  
3 Court Reporter will make a verbatim transcript of this hearing.  
4 Everything spoken while the hearing is in session will be  
5 recorded, and copies of this transcript are available through  
6 Executary Depositions. They are not available through MMS. So  
7 if you'd like a copy of the transcript, you can make  
8 arrangements with Rich Carl sitting over there right after the  
9 hearing to get a copy of the transcript.

10 This is not an adversary proceeding; no one will be  
11 placed under oath. However, we would like your presentations  
12 to be relevant and supported by data because the purpose of  
13 this hearing is to improve the quality of the Draft  
14 Environmental Impact Statement. Speakers will not be  
15 questioned unless there's a member of the panel wishes to  
16 clarify some facts or to obtain additional information. We are  
17 most interested in understanding the views of all interested  
18 parties about this Draft Environmental Impact Statement.

19 The comment period for this Draft Environmental  
20 Impact Statement closes July 30th, 1990. Until that time, MMS  
21 will accept written comments and statements from anyone who  
22 would prefer to make written instead of oral comments, or in  
23 addition to. These written comments and statements should be  
24 addressed to:

25 The Minerals Management Service

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1 Regional Director  
2 Alaska OCS Region  
3 Box.....

4 That's not the right box number, what I had written down here.  
5 Hang on just a minute and let me get the -- I don't have  
6 anything with the -- what is our address? Helen, do you know  
7 right off -- it's 949.....

8 MS. ARMSTRONG: 949 East 36th Avenue, Room 110

9 HEARING OFFICER BROCK: Okay. 949 East 36th Avenue,  
10 Suite 110, Anchorage, Alaska

11 MR. BOUDREAU: Want the zip.

12 HEARING OFFICER BROCK: 99508.

13 MR. BOUDREAU: 08.

14 HEARING OFFICER BROCK: Yes, 99508 is the zip.

15 MR. BOUDREAU: 4302.

16 HEARING OFFICER BROCK: All -- remember, all written  
17 comments received by July 30th will be included as part of the  
18 hearing record.

19 And I think the first person registered is Matthew  
20 Iya. So we'll get on with him. And we -- if you have to leave  
21 to go cheer your son on, well, you're -- you can feel free to  
22 do that when you get finished.

23 PUBLIC TESTIMONY OF MR. MATTHEW IYA

24 My name is Matthew Iya, P.O. Box 948, Nome, Alaska  
25 99762, telephone number, 443-5231. In this capacity, I'm

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1 representing Kawerak, Incorporated, a regional nonprofit  
2 corporation for the Bering Straits. I thank you for making  
3 this opportunity to comment on the second draft of the  
4 Environmental Impact Statement for the OCS Mining Program  
5 Norton Sound Lease Sale.

6 My name is Matthew Iya, and I work for Kawerak,  
7 Incorporated, which represents 18 villages in the Norton Sound,  
8 as a Director for Natural Resources, Eskimo Walrus Commission,  
9 and the Housing Improvement Program.

10 Kawerak is in favor of Alternative IV, the eastern  
11 deferral alternative. This would defer 15 whole or partial  
12 blocks that would equate to about 63,593 acres. You would  
13 still have the western blocks and still have 83,458 acres. The  
14 reasoning behind this, that we have asked WestGold to work --  
15 before that -- they used to be exploration mines -- to work on  
16 their far western blocks, which are the State's leases, to see  
17 how environmentally sound their operation would be. It also  
18 makes the local community see how they operate and answers a  
19 lot of 'if's' instead of theoretical hypotheses. **NOME-1**

20 Since the leases are going to be in deeper water of  
21 20 to in excess of 30 meters deep, and this is going to be a  
22 frontier exploration and production, we would like the industry  
23 to work these leases and see the end results, as BIMA has done.  
24 Safety Sounds have a very diverse biological productive area of  
25 various species; we need to know how it is going to be

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1 affected. The State of Alaska has deferred approximately the  
2 same areas in the Safety Sound lease sales. The present State  
3 leases are near Nome, and this would be a good starting point.

NOME-1

4 We are wholeheartedly supporting Stipulations 1 to 4  
5 and information to lessees ITLs 1 to 4. We would ask you --  
6 ask that you modify the proposed action by included Stipulation  
7 No. 5, Arctic Peregrine Falcon Monitoring Program. Out of  
8 known 20 nests sites in Norton Sound, 5 nest sites are located  
9 near the sale area. The monitoring for trace metal  
10 bio-accumulation, especially mercury, is very important. This  
11 bird would be a very good indicator since they are feeding on  
12 marine birds that feed from the sale area. We would recommend  
13 that one or two species of marine birds be included in the  
14 monitoring program for trace metals. The marine birds are the  
15 first order to feed on marine organisms and fish from the lease  
16 area. Also, murre and seagull eggs are collected and consumed  
17 by the local residents in the spring from near the lease area.

NOME-2

NOME-3

18 Although dredging poses unavoidable effects on  
19 habitat alteration, such effects can be mitigated. In December  
20 1989, Minerals Management Service deleted only six blocks from  
21 the proposal for the protection of red king crabs. This  
22 deletion represents 68 percent of the crab habitat that was  
23 contained within the original lease sale area. Although  
24 Stipulation No. 1 will monitor the rest of the 32 percent, we  
25 are requesting that the 32 percent be identified and be

NOME-4

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1 deferred at this time. This would mitigate the protection of  
2 the resources and uses by the local people.

3 On Information to Lessees No. 1, we are advising the  
4 industry to get a proper permit from the U.S. Fish and Wildlife  
5 Service and National Marine Fishery Service. There is an  
6 existing problem with the Shell exploratory program in the  
7 Chuckchi Sea and that would -- behooves the industry to avoid  
8 any conflicts.

NOME-4a

9 On Information to Lessees No. 2, we recommend that  
10 aircraft maintain an altitude of 1,500 feet and a one-mile  
11 buffer from haul-out areas and rookeries, when safety is not  
12 the factor, to avoid disturbances.

NOME-4b

13 On Information to Lessees No. 3, we are submitting  
14 the following information for corrections on page ii-39:

15 From beginning of October through May, tom cods and  
16 arctic cods are harvested along the coast adjacent to the  
17 entire sale area. This was not in the DEIS. ITL No. 3.2, From  
18 the beginning of December to the end of June and from the  
19 beginning of mid-August to October, seals are harvested in the  
20 entire sale area. ITL No. 3.3, Walruses are not harvested from  
21 the beginning of September through early November. This needs  
22 to be deleted. They only hunt during the springtime.

NOME-5

23 On page I-14c, we are requesting that subsistence  
24 hunting for marine mammals be inserted in lieu of subsistence  
25 fishing. There was a clause there for subsistence fishing, but

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1 affected. The State of Alaska has deferred approximately the  
2 same areas in the Safety Sound lease sales. The present State  
3 leases are near Nome, and this would be a good starting point.

4 We are wholeheartedly supporting Stipulations 1 to 4  
5 and information to lessees ITLs 1 to 4. We would ask you --  
6 ask that you modify the proposed action by included Stipulation  
7 No. 5, Arctic Peregrine Falcon Monitoring Program. Out of  
8 known 20 nests sites in Norton Sound, 6 nest sites are located  
9 near the sale area. The monitoring for trace metal **NOME-2**  
10 bio-accumulation, especially mercury, is very important. This  
11 bird would be a very good indicator since they are feeding on  
12 marine birds that feed from the sale area. We would recommend  
13 that one or two species of marine birds be included in the  
14 monitoring program for trace metals. The marine birds are the  
15 first order to feed on marine organisms and fish from the lease **NOME-3**  
16 area. Also, murre and seagull eggs are collected and consumed  
17 by the local residents in the spring from near the lease area.

18 Although dredging poses unavoidable effects on  
19 habitat alteration, such effects can be mitigated. In December  
20 1989, Minerals Management Service deleted only six blocks from  
21 the proposal for the protection of red king crabs. This  
22 deletion represents 68 percent of the crab habitat that was **NOME-4**  
23 contained within the original lease sale area. Although  
24 Stipulation No. 1 will monitor the rest of the 32 percent, we  
25 are requesting that the 32 percent be identified and be

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1 deferred at this time. This would mitigate the protection of  
2 the resources and uses by the local people.

3 On Information to Lessees No. 1, we are advising the  
4 industry to get a proper permit from the U.S. Fish and Wildlife **NOME-4a**  
5 Service and National Marine Fishery Service. There is an  
6 existing problem with the Shell exploratory program in the  
7 Chuckchi Sea and that would -- behooves the industry to avoid  
8 any conflicts.

9 On Information to Lessees No. 2, we recommend that  
10 aircraft maintain an altitude of 1,500 feet and a one-mile  
11 buffer from haul-out areas and rookeries, when safety is not **NOME-4b**  
12 the factor, to avoid disturbances.

13 On Information to Lessees No. 3, we are submitting  
14 the following information for corrections on page ii-39:

15 From beginning of October through May, tom cods and  
16 arctic cods are harvested along the coast adjacent to the  
17 entire sale area. This was not in the DEIS. ITL No. 3.2, From  
18 the beginning of December to the end of June and from the **NOME-5**  
19 beginning of mid-August to October, seals are harvested in the  
20 entire sale area. ITL No. 3.3, Walrus are not harvested from  
21 the beginning of September through early November. This needs  
22 to be deleted. They only hunt during the springtime.

23 On page I-14c, we are requesting that subsistence  
24 hunting for marine mammals be inserted in lieu of subsistence  
25 fishing. There was a clause there for subsistence fishing, but

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1 this should have been subsistence marine mammal hunting. The  
 2 lease area is beyond the use area for subsistence fishing. We  
 3 are requesting if there is ice present in the lease area,  
 4 subsistence hunting for marine mammals have priority since it  
 5 is a traditional activity. As long as the ice is not present,  
 6 then the industry can have use of the area. You might want to  
 7 see the historical records and existing scenarios as to  
 8 determine the start-up dates. National Weather Service do have  
 9 imagery of the lease area, and this mitigating measure would  
 10 protect the industry from the force of ice.

11 We are also recommending that you incorporate and see  
 12 the implication of the temporary subsistence management  
 13 regulations for public lands in Alaska, final temporary rule by  
 14 the Department of Agriculture and Department of Interior,  
 15 published June 29, 1990, where it says subsistence have the  
 16 highest priority use on all federal lands and waters. On the  
 17 end-of-the-season operations, we are requesting that you  
 18 research the historical ice formation in the lease area and  
 19 remove the dredges before they are iced over for safety  
 20 reasons.

21 On page XV, I guess 15, you have predicted recovering  
 22 40,000 ounces of gold per year for a period of 14 years using  
 23 (indiscernible) 30,000 ounces of gold to be recovered. The  
 24 existing operations of BIMA recovered 36,000 ounces in 1987,  
 25 35,500 in 1988, and 30,661 in 1989. With the existing recovery

NOME-6

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1 program, you might want to predict 15 to 17 years usage of the  
 2 area.

3 On water -- on air and water quality, we want the  
 4 industry to meet the State and EPA guidelines. I would safely  
 5 say that a well-tuned and maintained piece of machinery not  
 6 only will run better but will have a negligible effect on air  
 7 quality. On water quality, discharge and reclamation, the  
 8 industry and the federal Corps of Engineers have to find a way  
 9 to mitigate habitat alteration for recolonization of the  
 10 bottom-dwelling organisms. There must be a way where we can  
 11 avoid siltation, gullies, and hills created by discharge. Help  
 12 nature have an effect reclamation.

NOME-6a

13 I-12 2. Issue not analyzed in EIS, a. Polar Bears.  
 14 We are suggesting that you get a copy of the studies done by  
 15 the Alaska Department of Fish and Game that suggested that they  
 16 have a lot of sighting of polar bears east, west, and south of  
 17 the Sledge Island in the winter and early spring.

NOME-7

18 On page ii-37, who is going to be reporting the  
 19 violations? Are the industries required to get permits for  
 20 this incidental take?

NOME-8

21 On page iii-34, take out the word 'relative.' During  
 22 the last few years, bearded seals have been the major take of  
 23 the Nome community. It was a misstating (sic) sentence. One  
 24 says 'relative,' and then finally, when you find that one, then  
 25 it says 'a very important specie.'

NOME-9

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1 Is there any studies done on mollusks and where their  
2 main concentrations are? If so, we would have some -- we  
3 should have some mitigating measures because they are the main  
4 food of walrus, bearded seals, red king crabs, and other  
5 organisms, who have the existing use now.

NOME-10

6 Finally, we would recommend that legislation be  
7 enacted for impact assistance for the local communities. We  
8 would also recommend that in lieu of absence of legislation,  
9 money be deposited for this purpose.

NOME-11

10 We are advocating that the hair studies of 80 women  
11 that are of a child-bearing age that is going to be conducted  
12 by Norton Sound Health Corporation for mercury detection be  
13 incorporated as an addendum to the final EIS.

NOME-12

14 We are requesting -- finally, we are requesting  
15 Minerals Management Services that the coordinating team be  
16 retained and see the successes of WestGold that has appointed  
17 us as a review committee to oversee their overall operations  
18 and make recommendations to their environmental monitoring  
19 program. We feel that we are contributing and helping with a  
20 safer operation.

NOME-13

21 Thank you very much for the testimony, and I'll be  
22 glad to answer any questions for clarification.

23 HEARING OFFICER BROCK: Any questions?

24 MR. BOUDREAU: No questions.

25 HEARING OFFICER BROCK: Okay. Thank you, Matthew.

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1 Chuck.

PUBLIC TESTIMONY OF MR. CHUCK DEGNAN

3 I am Chuck Degnan, Director of the Bering Straits  
4 Coastal Resource Management Program. Our office is based in  
5 Unalakleet. We've -- I've been a member of the coordinating  
6 team for the Minerals Management Service.

7 Our board has a very high concern for subsistence;  
8 it's an established traditional gathering of natural resources  
9 by local Alaska Natives and the residents of the area. In  
10 reviewing your draft EIS, the second one, there are  
11 stipulations which address this, but one of the prime concerns  
12 is the actual benefit that go to the subsistence users from the  
13 area before the disturbance or any development activities needs  
14 to be analyzed further and a way for subsistence users to be  
15 compensated if there is damage to the environment and, thus,  
16 damage to the subsistence resource. It is a very difficult  
17 concept to implement because you have the need to identify the  
18 user groups, the -- and identify the species that go through  
19 the sale area. But it's a very important -- an important  
20 concept to the local people who are dependent on the  
21 subsistence resources. And there's a wide variety of  
22 resources that are harvested.

NOME-14

23 It is relatively recently where the federal and state  
24 governments have been documenting usage of subsistence  
25 resources. Historically, the Alaska Natives have used these

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1 resources, and they're the only ones that really know what is  
2 available, when it's available, and in transition of cultures,  
3 it's very difficult to convey and document and show other  
4 cultures how the changes occur and what -- there is a -- what  
5 do you call it? -- a difference of opinion on what is the cause  
6 and effect on when a resource declines.

7 So this needs to be considered very carefully and  
8 make sure that there is a way, when a user group is impacted,  
9 that they're not ignored and their concerns are addressed. And  
10 the way the different cultures address that, there needs to be  
11 a mutually agreed mechanism to take care of that problem. Some  
12 people do not see it as a problem, but the people that have  
13 been dependent on subsistence resources see it as a threat on a  
14 way of life, and there needs to be some sort of way to  
15 compensate those individuals that have been highly dependent on  
16 those resources.

17 And thank you very much for the opportunity to  
18 testify.

19 HEARING OFFICER BROCK: On the compensation, I'm --  
20 are you saying -- are you suggesting some type of a -- in other  
21 words, if there was a drop in the subsistence use, that there  
22 would be a compensation either by the lessor or the federal  
23 government? Is that what.....

24 MR. DEGNAN: Yes.

25 HEARING OFFICER BROCK: ...you're suggesting?

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1 MR. DEGNAN: Yes. And you may want to look at other  
2 mechanisms. That is one way, but there is other ways to do it,  
3 but they're difficult to lay out, and there may be other  
4 technical difficulties that we run into because of other  
5 federal regulations. But the basic idea is to make sure that  
6 the user group that has access to the resource historically,  
7 and have used it historically, as a way of sustaining their  
8 families, they should have consideration when that is changed  
9 by the governmental unit and the industry that wants to extract  
10 the resource.

11 HEARING OFFICER BROCK: The -- presently, there are  
12 some records of that, or would that -- in the State Fish and  
13 Game, I believe.

14 MR. DEGNAN: Yes. There.....

15 HEARING OFFICER BROCK: And places like that. And  
16 that's where one would have to go to find the record; is that  
17 correct?

18 MR. DEGNAN: You'd have to go to that, and it  
19 would -- for where there's usage of areas that there are no  
20 record of usage. There have -- where there have not been  
21 studies done, then you'd have to go to the local Native groups  
22 to document where those resources were harvested.

23 HEARING OFFICER BROCK: Any other questions?

24 MR. PALMER: Chuck, you don't think that during --  
25 way back during the scoping phase that the people came forward

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1 and identified all of the resources and sensitive areas for us  
2 so that we could address those in the EIS?

3 MR. DEGNAN: Well, it's very difficult to get local  
4 people to come to hearings and public hearings because that's  
5 not a way of doing business in this area. I mean, it's your  
6 cultural -- what do you call it? -- background to have these  
7 democratic hearings. And they're good. And it's really hard  
8 to meet the transition. I'm not saying that we haven't  
9 identified all the areas; I'm just saying that, in the event  
10 that there is a lease sale, and in the event that the -- we  
11 don't expect the resource to diminish -- but in case it  
12 does.....

13 MR. PALMER: Mm hmm (affirmative).

14 MR. DEGNAN: .....through no fault of all the  
15 hearings you have held and all the studies we've done, there  
16 should be a provision where -- there should be some sort of  
17 compensation for those individuals that are affected.

18 One of the things I've noticed throughout my lifetime  
19 is that as cultures change, ways of doing things change, the --  
20 it's very difficult for local people to get jobs, even though  
21 they may be qualified to have them. And the traditional  
22 practice of companies and family groups and corporations, as  
23 they evolved, have their own people that they trust, and it's  
24 the way of doing business. I mean, it's traditional. And  
25 that's the way businesses survive. So they watch out for their

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1 own self-interest, get theirs -- their job done, and move out.  
2 And so all I'm saying is that the people that live here plan to  
3 stay here and have historically stayed here; there should be  
4 some way to address that. And I don't think it has been  
5 addressed properly throughout American history, particularly in  
6 the state of Alaska.

7 HEARING OFFICER BROCK: Mm hmm (affirmative). Okay.  
8 Thank you. Paul. Oh, there you are. Okay. Thank you.

PUBLIC TESTIMONY OF MR. PAUL RUSANOWSKI

9 My name is Paul Rusanowski. I am the Manager of  
10 Environmental Affairs for West Gold. My address is 184 East  
11 53rd Avenue, Anchorage 99518. I'd like to speak to a couple of  
12 different issues than the previous speakers.

13 One, I'd like to call your attention to the fact that  
14 any exploration activity for gold in the federal waters is  
15 extremely speculative and very high-risk. The EIS utilizes a  
16 figure of 530,000 ounces of gold in its base case and  
17 approximately twice that in an optimal case. There is no hard  
18 scientific or geological or other evidence to support these  
19 numbers. They are speculative in nature, and that introduces a  
20 security in the efforts, which is not truly warranted for this  
21 operation. So I think we have to bear in mind that we are  
22 dealing with a very high-risk type of operation.

23 The same holds true for the resources at risk, that,  
24 again, we are dealing with potential damages, potential  
25

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**NOME-14a**

1 impacts, based on things that could happen but with a very low  
2 probability or certainty of occurring. So while we're dealing  
3 with a complete accounting of potential impacts, we are not  
4 dealing with an accounting of actual or expected impacts. I  
5 think this needs to be born in mind in proceeding with the  
6 study.

7 Specifically, with respect to the leasing operations,  
8 I'd like to raise three points. One, you have a bonus bid  
9 specification of \$10 per hectare. While we do not object to a  
10 bonus bid arrangement, we do feel that there should be some  
11 mechanism in place to recover that bonus bid should we be  
12 successful in actually mining offshore. We would like to see  
13 that credited against advance royalty should we actually go  
14 into operation to provide an opportunity to recover those  
15 monies as a royalty.

16 Second point we'd like to make is that you have  
17 specified a 5-percent gross production royalty. Again, we feel  
18 that this is excessive considering the high risk, the capital  
19 investment, and the extremely harsh environment where one would  
20 be operating and the fact that there is not a proven  
21 economically viable technique that would be usable in these  
22 offshore areas. We feel that a 2-percent production royalty  
23 would be a better choice or conversion to a net profits  
24 interest basis as opposed to a gross production royalty.

25 Three, we feel that the area that you have selected

NOME-15

NOME-16

NOME-16a

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1 in the east and west regions already reflects a very major  
2 concern for the environmental resources and potential risks and  
3 that you have already balanced those risks against development,  
4 production, exploration and that it is unwarranted this time to  
5 reduce the acreage being offered. This would be decreasing the  
6 attractiveness of the sale and decreasing the potential areas  
7 one would explore and where the resources might occur. Again,  
8 we lack the geological data to evaluate properly where one  
9 should be looking at this time. So by reducing this acreage at  
10 the exploration stage, you are decreasing the industry interest  
11 in the whole project.

12 Last point I'd like to make concerning the EIS  
13 itself, there has been considerable controversy throughout the  
14 process concerning the quality of the mercury trace metal data,  
15 particularly in the water values. And there have been several  
16 recent studies conducted, some work done by WestGold itself,  
17 other work done by the University of Alaska and Battelle  
18 Northwest labs, and this has produced conflicting information.  
19 And within the EIS, this is not reflected that recent studies  
20 and high resolution studies have produced different data  
21 concerning the concentrations of mercury in the environment and  
22 whether there is or is not elevated mercury, and I think this  
23 should be called out in the discussion and tables in a manner  
24 that makes it clear to the reader that the actual  
25 concentrations present in the water column are of questionable

NOME-17

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1 value in some of the data and may be consistent with general  
2 oceanographic regions in other areas, as well as the potential  
3 that there may be some elevated mercury readings in this area.  
4 So I think that needs to be brought out clearer to the  
5 non-scientific reader.

6 Thank you.

7 HEARING OFFICER BROCK: Yeah, just one question on  
8 the -- you made the comment about the 'Don't decrease the  
9 area.' You mean don't decrease it any more than what it's  
10 already been decreased. I mean.....

11 MR. RUSANOWSKI: That's right.

12 HEARING OFFICER BROCK: Okay. 'Cause I was going to  
13 say, there's no way we can add it back in. So -- at this  
14 point. So that you weren't suggesting that, I -- that's --  
15 you're just saying don't decrease it any more.

16 MR. RUSANOWSKI: We'd like to do that too.

17 HEARING OFFICER BROCK: Well (laughter), okay. I  
18 just wanted to make it clear what you meant.

19 MR. RUSANOWSKI: Yes.

20 HEARING OFFICER BROCK: All right. Any other  
21 questions?

22 MR. PALMER: No.

23 MR. BOUDREAU: No.

24 HEARING OFFICER BROCK: Thank you. We have one more,  
25 and I'm just going to leave it with 'Johnson.' I'm not going

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1 to try that last name (laughter).

2 PUBLIC TESTIMONY OF MR. JOHNSON ENINGOWUK

3 Thank you. My name is 'Johnson Eningowuk. I'm from  
4 Shishmaref, and I would like to thank you for this opportunity  
5 to make this presentation to you. I'm the Chairman of the  
6 Bering Straits Coastal Management Program, and currently, I  
7 represent three villages: The village of Shishmaref, Diomede,  
8 and Wales. We have several board directors that each represent  
9 at least three villages, and in my presentation, I would like  
10 to say that I make my presentation as Chairman of the Board for  
11 this organization.

12 Although Minerals Management Services states that it  
13 is extremely difficult to pinpoint a single development as  
14 causing sociocultural change when so many factors influence  
15 sociocultural systems, MMS and the State of Alaska need to  
16 protect Alaska Native sociocultural systems in a way that  
17 permits Alaska Natives to participate in the economic  
18 development while protecting their subsistence activities as  
19 defined by each Alaska Native group.

20 An example of impact on subsistence is currently  
21 being held in Prince William Sound: the Exxon oil spill. We  
22 do not expect the same type of damage from offshore mining;  
23 however, some provisions must be made as a safety net for those  
24 groups who are dependent on subsistence resources in the sale  
25 area.

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MMS needs to consider the relationship of Alaska Native citizens compared with non-Native citizens in regard to the impact created by the sale. For Alaska Native citizens primarily dependent on subsistence activities, any activity which would have a detrimental effect on subsistence gathering would have a distinct effect on Alaska Natives. Conversely, historically, employment opportunities have favored non-Native citizens as a matter of fact. This factor needs to be considered very seriously, and methods must be found to compensate Alaska Natives who are dependent on subsistence resources in some way that is meaningful.

Ideally, a joint effort by the successful bidders, MMS, the Bureau of Indian Affairs, and the State of Alaska should:

1. Compensate those deprived or displaced by the effects of the lease sale and development.
2. Train local residents to fulfill (sic) available jobs and actually hire local Alaska Natives.

Our Bering Straits Coastal Management Program favors Alternative No. IV, the eastern deferral alternative.

I have some additional comments which I do not have here.

Mr. Paul Rusanowski referred to some very high risk factors. I'd like to also refer to some very high risk factors in our subsistence hunting, in our subsistence lifestyle.

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NOME-18

We've gone through some very hardships (sic) in living our lifestyle. We've hunted, we've fished, and we've gone through some very high risk factors, and I would like to convey that to you.

Thank you for this opportunity to make this presentation to you.

HEARING OFFICER BROCK: Thank you. Any questions?

(Whispered comment)

MR. PALMER: Our proposal, of course, is for federal mining out beyond three miles. Have you noticed any degradation in your subsistence activities as a result of the mining operation in State waters?

MR. ENINGOWUK: No, but in our subsistence lifestyle, there's no boundaries out there. We go hunting for along many miles. We go out into some very unsafe ice conditions; we go out in some very unsafe waters. If our hunting is not successful, we go out probably beyond twelve miles. But in our area, we are just -- our Natives are, you know, out there hunting, and it's our lifestyle, and it's just a real big garden of lifestyle out there for us. And even though there's -- had been no actual effect that -- of development that occurs out there, that we sure would like that area to be protected.

HEARING OFFICER BROCK: Okay. Thank you.

(Pause)

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1 HEARING OFFICER BROCK: That's all I have registered.

2 Is there anybody else that's here that would like to make a  
3 comment?

4 (No response)

5 HEARING OFFICER BROCK: Okay. It's now about 8:10.

6 We will close the public hearing. Thank you all for coming.

7 If anybody has any questions, we'll be glad to try to answer  
8 them.

9 (No response)

10 (Whereupon, the proceeding in the above-entitled  
11 matter was adjourned at approximately 8:10 o'clock  
12 p.m.)

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OCS MINING PROGRAM  
NORTON SOUND LEASE SALE

1 U.S. DEPARTMENT OF THE INTERIOR

2 MINERALS MANAGEMENT SERVICE

3  
4  
5 OCS MINING PROGRAM  
6 NORTON SOUND LEASE SALE  
7 SECOND DRAFT ENVIRONMENTAL IMPACT STATEMENT

8  
9  
10 PUBLIC HEARING

11 Held At:

12 NOME, ALASKA

13 Mini-Convention Center  
14 Wednesday, July 18, 1990  
15 7:00 o'clock p.m.

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18 E X H I B I T S

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25  
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Thank you for making this opportunity to comment on the second draft environmental impact statement for the OCS Mining Program Norton Sound Lease Sale. My name is Matthew Iya and I work for Kawerak, Inc., which represent 18 villages, as a Director for Natural Resources, Eskimo Walrus Commission and Housing Improvement Program

We are in favor of Alternative IV, the eastern deferral alternative. This would defer 15 whole or partial blocks that would equate to about 63,593 acres. You would still have the western blocks and still have 83,458 acres. The reasoning behind this that we have asked WestGold to work on their far western blocks (state leases) to see how environmental sound their operations could be. It also makes the local community see how they operate and answered a lot of "if's" instead of theoretical hypotheses. Since the leases are going to be in deeper waters of 20 to 30 meters deep and this is going to be a frontier exploration and production, we would like the industries to work these leases and see the end result, as BIMA has done. Safety Sound have a very diverse, biological productive area of various species, we need to know how it is going to be affected. The State of Alaska has deferred approximately the same areas in the Safety Sound. The present State leases are near Nome and and this would be a good starting point.

We are wholeheartedly supporting stipulations 1 to 4 and Information to Lessees 1 to 4. We would ask that you modify the proposed action by including stipulation number 5, Arctic Peregrine Falcon Monitoring Program. Out of known 20 nest sites in Norton Sound, 6 nest sites are located near the sale area. The monitoring for trace metal bioaccumulation (especially mercury) is very important. This bird would be very good indicator since they are feeding on marine birds that feed from the sale area. We would recommend that one or two species of marine birds be included in the monitoring program for trace metals. The marine birds are the first order to feed on marine organisms and fish from the lease area. Also, murre and seagull eggs are collected and consumed by the local residents in the spring from near the sale area.

Although dredging poses unavoidable effects on habitat alteration, such effects can be mitigated. In December 1989, MMS deleted only six blocks from the proposal for the protection of red king crabs. This deletion represents 68% of the crab habitat that was contained within the original sale area. Although stipulation number one will monitor the rest of the 32%, we are requesting that the 32% be identified and be deferred at this time. This would mitigate the protection of the resources and uses by the local people.

On information to lessees number one, we are advising the industry to get a proper permit from the U.S. Fish and Wildlife Service and National Marine Fisheries Service. There is an existing problem with the Shell exploratory program in the Chukchi Sea and they would benched the industry to avoid any conflicts.

On information to lessees number two, we recommend that aircraft maintain an altitude of 1,500 feet and a one mile buffer from haul out areas and rookeries when safety is not the factor to avoid disturbances.

On information to lessees number three, we are submitting the following information for corrections on page II-39. From beginning of October through May, tom cods and arctic cods are harvested along the coast adjacent to the entire sale area. ITL No. 3. 2. From the beginning of December to end of June and from the beginning of mid-August to October: seals are harvested in the entire sale area. ITL No. 3.3. Walrus are not harvest from the beginning of September through early November. This needs to be deleted.

On page I-14 c, we are requesting that subsistence hunting for marine mammals be inserted in lieu of subsistence fishing. The lease area is beyond the use area for subsistence fishing. We are requesting if there is ice present in the lease area, subsistence hunting for marine mammals have priority, since it is a traditional activity. As long as the ice is not present, then the industry can have use of the area. You might want to see the historical records and the existing scenario as to determine the start-up dates. National weather services do have imagery of the lease area and this mitigating measure would protect the industry from the forces of ice. We are also recommending that you incorporate and see the implications of the temporary subsistence management regulations for public lands in Alaska; final temporary rule by the Department of Agriculture and the Department of the Interior published June 29, 1990. On the end of the season operations, we are requesting that you research the historical ice formation in the lease area and remove the dredges before they are iced over for safety reasons.

On page XV, you have predicted recovering 40,000 ounces of gold per year for a period of 14 years. The existing operations of BIMA recovered 36,000 ounces in 1987, 35,500 in 1988, and 30,661 in 1989. With the existing recovery program, you might want to predict 15-17 years usage of the area.

On air and water quality, we want the industry to meet the State and EPA guidelines. I would safely say that a well tuned and maintained piece of machinery not only run better but will have negligible effect on air quality.

On water quality, discharge and reclamation, the industry and the Federal Corp of Engineers have to find a way to mitigate habitat alteration for recolonization of the bottom dwelling organisms. There must be a way where we can avoid siltation, gullies and hills created by discharge. Help nature have an effective reclamation.

I-12.2. Issue not analyzed in EIS a. polar bears. We are suggesting that you get a copy of the studies done by the Alaska Department of Fish and Game that suggested that they have a lot of siting of polar bears east, west, and south of Sledge Island during the winter and early spring.

On page II-37, who is going to be reporting the violations. Are the industry required to get permits for this "incidental take"?

On page III-34. Take out the word "relatively". During the last few years, bearded seals have been the major take of the Nome community.

Is there any studies done on mollusks and where their main concentrations are? If so, we should have some mitigating measures because they are the main food of walrus, bearded seals, red king crabs, and other organisms, who have the existing use.

Finally, we would recommend that legislation be enacted for impact assistance for the local communities. We would also recommend that in lieu of absence of legislation, monies be deposited for this purpose.

We are advocating that the hair studies of 80 women that are of child bearing ages that is going to be conducted by Norton Sound Health Corporation for mercury detection be incorporated as an addendum to the final EIS.

We are requesting MMS that the coordination team be retained and see the successes of WestGold that has appointed us as a review committee to oversee their overall operations and make recommendations to their environmental monitoring programs. We feel that we are contributing and helping with a safer operation.



BERING STRAITS COASTAL MANAGEMENT PROGRAM

P.O. Box 10  
Unalakleet, Alaska 99684  
(907) 624-3062

17 July 1990

Public Hearing on DEIS  
Alaska Outer Continental Shelf  
OCS Mining Program  
Norton Sound Lease Sale  
18 July 1990  
Nome, Alaska

Although MMS states that "It is extremely difficult to pinpoint a single development as 'causing' sociocultural change when so many factors influence sociocultural systems...", MMS and the State of Alaska need to protect Alaska Native sociocultural systems in a way that permits Alaska Natives to participate in economic development while protecting their subsistence activities as defined by each Alaska Native group.

An example of impact on subsistence is currently being felt in Prince William Sound: the Exxon Valdez oil spill. We do not expect the same type of damage from offshore mining. However, some provision must be made as a "safety net" for those groups who are dependent on subsistence resources in the sale area.

MMS needs to consider the relationship of Alaska Native citizens compared with non-Native citizens in regards to the impact created by the sale. For Alaska Native citizens primarily dependent on subsistence activities, any activity which would have a detrimental effect on subsistence gathering would have a distinct effect on Alaska Natives. Conversely, historically, employment opportunities have favored non-Native citizens as a matter of fact. This factor needs to be considered very seriously and methods must be found to compensate Alaska Natives who are dependent on subsistence resources in some way that is meaningful.

Ideally a joint effort by the successful bidders, MMS, the Bureau of Indian Affairs, and the State of Alaska should

1. Compensate those deprived or displaced by the effects of the lease sale and development.
2. Train local residents to fill available jobs and actually hire local Alaska Natives.

BSCMP favors Alternative IV - Eastern Deferral Alternative.

*Johnson Eninowok*

*Chairman BSCMP*

*Very High Risk Factor in Subsistence Lifestyle of Native People*

Shishmaref, Wales, Diomede, Brag Mission, Teller, "Nome West", King Island, White Mountain, Golovin, Selkirk, Council, "Nome East", Elm, Koyuk, Shastooka, Unalakleet, Seldovia, St. Michael, Gambell, Savoonga

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CERTIFICATE

I hereby certify that the foregoing is a correct transcript from the record of proceedings in the above-entitled matter.

*Cindy S. Carl*  
Cindy S. Carl, CCR

7/25/90  
Date

EXECUTARY  
626 Cordova, Suite 104  
Anchorage, AK 99501  
Phone: (907) 272-4084

#### **Response NOME-1**

The commenter's position has been noted and will be included in the information used to select alternatives in this sale.

#### **Response NOME-2**

The June 26, 1990, biological opinion (Appendix B) from FWS recommends the inclusion of the arctic peregrine falcon in Stipulation No. 1 as a species to monitor for mercury accumulation. Stipulation No. 5 is no longer needed since the FWS no longer considers that an incidental take of peregrine falcons will occur due to the new (lower) mercury data presented in the second DEIS. Stipulation No. 1 has been modified to include the arctic peregrine falcon and Stipulation No. 5 is no longer considered as a potential mitigating measure.

#### **Response NOME-3**

The EIS recognizes and discusses the uptake of mercury and other trace metals in marine birds (see Sec. IV.B.5.c.[2]). The measuring of mercury and other trace metals in seabird eggs and in seabird chicks could be included in the monitoring program as recommended in the Workshop on Mercury in the Marine Environment (USDOI, MMS, 1989) and in the Workshop to Design Baseline and Monitoring Studies for the OCS Mining Program, Norton Sound, Alaska (USDOI, MMS, 1990). The Postlease Review Team would carefully consider whether or not to conduct such monitoring and would make a recommendation to the RS/FO.

#### **Response NOME-4**

As discussed in the Proposed Action and Alternative Memorandum (PAAM), the deletion of the six blocks from the original sale area, in combination with the distribution of trench habitat outside the sale area, resulted in a total of about 68 percent of the trench habitat occurring outside the proposed sale area. This trench habitat is presumed to be prime red king crab habitat. Very high densities of red king crab have been noted in the area deleted or just outside of the deleted blocks. The overall distribution of red king crab in Norton Sound is quite broad, and, although high densities of crab have been noted near the sale area, the linkage between trench habitat and high densities of crabs is still a working hypothesis. An examination of crab densities from a number of studies indicates some repeatedly high density crab areas south and west of the sale area. These areas more predictably have higher densities of crab than areas within the sale area. Given the broad distributions of red king crab and the patterns of high density just described, we do not feel it is warranted at this time to delete additional blocks from the sale area. The monitoring program should be able to demonstrate if there is a linkage between trench habitat and high densities of crab, as well as allowing determination of substrate type in relation to crab density, etc. Mitigation could then be applied as appropriate; for example, mining might not be allowed near the trench or in cobble habitat. Monitoring, with appropriate mitigation, would allow more accurate and informed mitigation than, at this point, deleting the remaining trench habitat that occurs within the sale area.

#### **Response NOME-4a**

As specified in ITL No. 1, paragraph 5, lessees are advised that Letters of Authorization must be obtained concerning the incidental take of marine mammals and endangered species from one of the appropriate agencies, either FWS or NMFS. It is industry's responsibility to determine if a take permit under the Marine Mammal Protection Act is needed in regard to their activities.

#### **Response NOME-4b**

The recommended 1-mile and 1,500-foot distances for aircraft are covered in ITL No. 1. The commenter's position has been noted.

#### **Response NOME-5**

Only those species harvested during the open-water season were listed (listed on page II-39 of the DEIS). However, the information has been changed to include all species harvested year-round.

The text has been changed from subsistence fishing to subsistence hunting to address the commenter's concerns. The concern about operating when ice is present has been noted.

The recent changes in subsistence law in Alaska have not changed much in Federal OCS waters offshore of Nome--except who manages the harvests. The Federal government manages marine mammals. Most crab harvests occur in State waters. Subsistence has had and continues to have "priority use," which means priority over other types of hunting and fishing. Since Nome has always been considered an area where residents may harvest subsistence resources for subsistence use, the new ruling most likely would have little effect on Nome residents.

#### **Response NOME-6**

See Response EPA-2.

#### **Response NOME-6a**

The U.S. Army Corps of Engineers does not have permitting responsibility for gold mining in Federal waters. Minimizing turbidity in the water column results in increased siltation near the dredging operation. We agree with your concern regarding mitigation for habitat alteration and recolonization of the benthos. Mitigation is practiced by limiting the height of tailing piles and by dumping tailings into the dredged pit when feasible. The monitoring program that is part of the proposal may be effective in limiting the extent or severity of effects to bottom-dwelling organisms. Siltation and effects on the bottom topography (e.g., creation of hills and gullies) are direct results of dredging but may be affected by the conditions imposed by permitting agencies. See also Response EPA-1.

#### **Response NOME-7**

The MMS and ADF&G in Nome (Nelson, 1990, oral comm.) are unaware of any Alaska Fish and Game report that says that Sledge Island is an important concentration area for polar bear. Although polar bears commonly occur during the winter-early spring on St. Lawrence Island, which is about 100 mi west-southwest of Sledge Island, polar bears are uncommon visitors to Sledge Island and do not occur in the sale area during the open-water season (Nelson, 1990, oral comm.) when the proposed activities would be conducted. Thus, effects as a result of the proposed mining activities on polar bears are not expected and are not an issue that needs to be covered in the FEIS. See also Response MMC-24.

#### **Response NOME-8**

As specified in ITL No. 1, paragraph 5, lessees are advised that Letters of Authorization must be obtained concerning the incidental take of marine mammals and endangered species from the appropriate agencies, FWS or NMFS. The enforcement of the incidental take would be a responsibility of the issuing agency; however, any violation would be reported to the appropriate agency by MMS.

Under the requirements of the Marine Mammal Protection Act, it is the industry's responsibility to obtain Take Permits. Because polar bears are not known to occur in or near the sale area during dredging activities (open-water season), such a permit is not likely to be required. Violations can be documented by anyone who witnesses an illegal take although violations normally are investigated and reported by ADF&G, NMFS, and FWS.

#### **Response NOME-9**

The text has been changed to address this concern.

#### **Response NOME-10**

It is agreed that effects on mollusks are critical in light of their importance as food for walrus, bearded seals, and other organisms. Effects on mollusks are most likely to be intense in the area affected by dredging. Since these effects are expected to be relatively site specific and local, the monitoring program that is part of the proposal would provide the most appropriate and effective avenue for examining mollusk distribution and abundance and identifying any areas of particular concern. Studies that have looked at mollusk distributions in Norton Sound are discussed in Section III.B.1.b. The scale of some of these studies is such that they do not provide very fine resolution on the distribution and abundance of mollusks in the proposed sale area. This could be better provided by the monitoring program and would be taken into consideration by the Postlease Review Team.

#### **Response NOME-11**

The MMS agrees with your position. It has become clear to MMS that local communities need to receive impact assistance. For this reason, MMS recently recommended to the President that impact assistance be provided for local communities. The President has agreed to this proposal and legislation is being drafted. It will then be up to Congress to make a decision. It is intended that impact assistance would include offshore mining.

#### **Response NOME-12**

The hair samples were collected in October 1990; the hair sampling report will not be completed until mid-1991, after completion of the FEIS. These data could not be included in the FEIS, but will be used in future planning of the monitoring program.

#### **Response NOME-13**

See Response NRDC-20.

#### **Response NOME-14**

See Response NOME-11.

#### **Response NOME-14a:**

The potential gold resources for the proposed lease sale are estimated by MMS to provide hypothetical scenarios of the types and levels of mining activities that might be used to exploit these resources. The types and levels of activities associated with these scenarios constitute a common basis for evaluating the potential effects mining might have on the various biological and physical resources in and adjacent to the sale area. The offshore dredge assumed for the scenario used in this EIS is similar to the Bima, operated by WestGold from 1986 to 1990 offshore of Nome in State waters. In September 1990 WestGold announced that the Bima was no longer an economical operation and also needed repair to its tumbler shaft. In November 1990, the Bima was put on the market for sale. While a Bima type of dredge was used for the scenario for the proposed sale, the type of dredge that will be used is not known at this time. It should be noted that no exploration, testing, development, or production plans will be approved before completion of comprehensive environmental evaluation to assure that the activities described will be carried out in a safe and environmentally responsible manner (30 CFR 282.21, 282.25, and 282.28; see also Note to Reader in the front of this document).

The gold resource estimates for both the base and high cases are based on the best information available to MMS at the time the EIS was being prepared. Section II.A.2.b of the EIS contains a description of the data and assumptions used by MMS to estimate these resources; this information is presented in the EIS to indicate to the public the basis for the estimates. Furthermore, in Section II.A.2.b of the EIS, MMS acknowledges that "there is a high degree of uncertainty associated with the gold resource estimates for the proposed lease sale." The MMS recognizes that the potential effects of offshore mining would be more accurately analyzed in an EIS based on a mining plan, submitted in accordance with 30 CFR 282.24 after a discovery has been assessed, which describes the types, levels, and locations of mining activities. The MMS also acknowledges that exploring and mining in the marine environment is a high-risk venture.

#### **Response NOME-15**

This is not an issue relevant to the second DEIS; therefore, it will not be responded to in the FEIS. This comment will be fully considered by the Director of MMS in making his final determination on the lease terms and conditions to be issued in the Final Leasing Notice.

#### **Response NOME-16**

See Response NOME-15.

**Response NOME-16a**

If the Director of MMS determines to conduct the proposed OCS Mining Program Norton Sound Lease Sale, the size of the area to be offered for leasing is one of the terms and conditions determined by him; other terms and conditions include minerals to be leased, bidding procedures, and mitigating measures.

The steps in the leasing process are discussed in Section I.A of the EIS; the process provides opportunities for the public to comment on the issues related to the proposed sale and on the terms and conditions of the sale.

As noted in Section I.A.8, the Director, prior to offering minerals in an area for lease, will assess the available information to determine lease-sale procedures to be prescribed and to develop a Proposed Leasing Notice (PLN) which sets out, among the proposed terms and conditions, the area to be offered for lease. The Notice of Availability for the PLN for the OCS Mining Program Norton Sound Lease Sale was published in the Federal Register ([55] 116) on June 15, 1990. In this PLN, MMS proposes to offer 34 whole and partial blocks, approximately 59,510 hectares, for leasing; this is the same area that was included the Alternative I, the Proposal, of the second DEIS for the lease sale. The PLN also noted that comments on the Notice should be submitted to the Program Director, Office of Strategic and International Minerals, MMS, not later than 60 days after the publication of Notice of Availability. Comments regarding availability of geological data and the size of the lease sale submitted to MMS at this time would assist the Director in determining the terms and conditions of the proposed lease sale.

**Response NOME-17**

This concern is addressed in detail in the description of existing water quality (Sec. III.A.8.b) and also in the analysis of effects on water quality (Sec. IV.B.2.b[3]). Table III-2 in the second DEIS which compares the valid trace-metal data to the water-quality criteria has been corrected in the FEIS as per the errata sheet provided as part of the second DEIS. The various WestGold NPDES data for mercury in the water column are analytically suspect and have not been used in the EIS analysis. The suspect data include that collected in 1989 with improved methods and tabulated in Jewett et al. (1990). In this latter data set, only mercury values below the criteria were reported, with higher values deleted on the basis of presumed contamination. In essence, the fact that there were different, conflicting data has been explained in Sections III.A.8 and IV.B.2.b; however, the EIS has limited its final analysis and presentation to data that the EIS analysts confidently believe to be correct.

**Response NOME-18**

See Response NOME-11. MMS has no authority to require lessees to hire local Natives and there are no provisions for hiring preferences in the OCS Lands Act to require that lessees hire local Natives. However, it would seem likely that lessees would follow the general pattern of other businesses throughout Alaska and make sincere attempts to hire locally.

**SECTION VI**

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**CONSULTATION  
AND  
COORDINATION**

## **VI. CONSULTATION AND COORDINATION**

### **A. Development of the Proposal**

Industry interest in mining for gold in the outer continental shelf (OCS) near Nome was expressed in the fall of 1987. Soon after that, the State of Alaska requested the MMS to establish a Federal-State task force. The State made this request with the intent to share technical information about protection of the environment and development of mineral resources. The State has gained this experience through leases it has in its offshore waters within the 3-mile limit near Nome. The State conducted an environmental review which led to mining activity in 1985. On February 5, 1988, the Department of the Interior and the State jointly established a Task Force. The term Task Force was changed to the term Coordination Team (CT) by the time of the first CT meeting held April 1, 1988, in Nome after the scoping meeting held March 31, 1988. The CT meetings were held April 1, 1988; July 29, 1988; November 1988; January 6, 1989; November 1989; February 27, 1990, and September 28, 1990.

The CT is co-chaired by a representative of the State of Alaska and an MMS regional official. The CT is composed of State and Federal agency representatives and representatives of other groups that have an interest in the proposed lease sale. Also, industry observers and other parties with an interest in the lease sale have received copies of the preliminary draft Environmental Impact Statement (EIS). The CT members, observers, and courtesy copy recipients are listed in Section VI.C.

The Request for Comments and Nominations for a Lease Sale in Norton Sound and the Notice of Intent to Prepare an Environmental Impact Statement were issued by MMS on March 8, 1988. Comments in response to the Request and the scoping meeting were received from the City of Yakutat, Alaska; Trustees for Alaska; National Marine Fisheries Service; Alaska Department of Natural Resources, Division of Parks and Outdoor Recreation; Bering Sea Fishermen's Association; University of Alaska, Institute of Marine Sciences; Alaska Office of the Governor, Division of Governmental Coordination; Kawerak, Inc.; U.S. Environmental Protection Agency; National Ocean Service, Office of Ocean and Coastal Resource Management; one mining industry company, and two individuals. Nominations were received from three mining industry companies. Comments and Nominations were due April 11, 1988.

Following evaluation of the area nominations and environmental information received in the process described above, the MMS formulated a recommendation for area identification. In May 1988, the MMS selected the area shown in Figure I-1 for further environmental study (see Sec. I). In December 1989, MMS deleted six blocks from the proposal for the protection of red king crab habitat.

### **B. Development of the EIS**

During preparation of this EIS, Federal, State, and local agencies; industry; and the public were consulted to obtain descriptive information, to identify significant effects and issues, and to identify effective mitigating measures and reasonable alternatives to the proposal. The information received was considered in preparing the EIS. In addition, a scoping meeting was held on March 31, 1988, in Nome Alaska, to more clearly and specifically identify issues and alternatives to be studied in the EIS. Scoping information can be found in Section I.D.

From November 29 through December 1, 1988, the MMS held a workshop entitled "Mercury in the Marine Environment." Experts in the area of mercury in water and sediments, mercury accumulation and effects in organisms, and mercury effects on human health provided their knowledge and expertise to MMS. In November 1988, the first DEIS was issued. Major effects from the proposal were anticipated for water quality, commercial fisheries, subsistence-harvest patterns, and sociocultural systems based on available data. As defined in the first DEIS, the proposal did not include stipulations and ITL clauses specifically designed to mitigate adverse effects from mining. The State, Federal, and local government agencies, as well as members of the public, expressed concern that the information used for the first DEIS was inadequate for proper analysis and reasoned decision. Lack of information was of concern for the actual level of mercury in the water column, the bioaccumulation of mercury in the food chain, levels of mercury in humans, and the effect of dredging on habitat, particularly for red king crab. In addition to the State, Federal and local government agencies reviewing the preliminary FEIS, MMS requested a review from public health agencies, including the U.S. Public Health Service, the IHS, the State Dept. of Health and Human Services, and the NSHC.

In response to comments that data on mercury levels in humans were inadequate, the MMS coordinated with the IHS and the NSHC to obtain hair samples to be analyzed for levels of mercury and arsenic (results of this study are presented in Secs. III.D and IV.B.15).

In response to concerns that the data for the water quality for the proposed lease sale were insufficient, MMS sponsored studies by the University of Alaska Fairbanks (UAF) in October 1988 (Naidu et al., 1989), and by Battelle Northwest in June and September 1989 (Hood, 1989), to obtain additional trace-metal data for the ambient sale area and inshore waters (results are discussed in Secs. III.A.8 and IV.B.2).

The MMS sponsored a monitoring workshop from November 28 through 30, 1989, to determine how studies for monitoring water quality, habitat alteration, and human health should be designed. Experts in the areas of water and sediment sampling, effects of trace metals in marine organisms, habitat alternation, and mercury effects on human health provided their knowledge and expertise to MMS, and in particular, the authors of the second DEIS.

As a result of comments from the CT, the MMS chose to include as part of the proposal in the second DEIS Stipulation Nos. 1, 2, 3, and 4 and ITL Nos. 1, 2, 3, 4, and 5.

### **C. List of Contacts for Review of the EIS**

Federal, State, and local government agencies; academic institutions; industry; special-interest groups; other organizations; and private citizens consulted prior to and during the preparation of this EIS and listed below.

#### **Federal Agencies**

U.S. Army Corps of Engineers, Alaska District, Regulatory Branch  
U.S. Bureau of Indian Affairs  
U.S. Coast Guard, MSO  
U.S. Dept. of Commerce, NOAA, National Marine Fisheries Service  
U.S. Dept. of Commerce, NOAA, National Marine Fisheries Service, Habitat Conservation  
U.S. Dept. of the Interior, Bureau of Mines  
U.S. Dept. of the Interior, Fish and Wildlife Service  
U.S. Dept. of the Interior, Geological Survey, Water Resources Division  
U.S. Dept. of the Interior, Minerals Management Service, Office of Strategic and International Minerals  
U.S. Environmental Protection Agency  
U.S. Public Health Service

#### **State of Alaska**

Office of the Governor, Division of Governmental Coordination  
Dept. of Community and Regional Affairs  
Dept. of Commerce and Economic Development, Division of Minerals and Forest Products  
Dept. of Environmental Conservation, Northern Regional Office  
Dept. of Health and Social Services  
Dept. of Fish and Game, Habitat Division  
Dept. of Fish and Game, Subsistence Division  
Dept. of Natural Resources, Geologic/Geophysical Survey  
Dept. of Natural Resources, Division of Mining  
University of Alaska, Institute of Marine Science

#### **Local and Regional Organizations and Government**

Bering Straits Coastal Management Programs  
City of Golovin  
City of Nome  
Eskimo Walrus Commission

Kawerak, Inc.  
Nome Eskimo Community  
Sitnasuak Native Corporation  
Norton Sound Native Health Corporation



### Special Interest Groups

Alaska Miners Association  
Bering Sea Fishermen's Association

Friends of the Earth

### Observers

Alaska Standard Mining Inc.  
Aspen Exploration  
BHP Utah  
Charter Resources  
Englehard West, Inc.  
ENSR (formerly NORTEC)  
Giant Bay Resources, Ltd.  
Greatland Exploration  
Inspiration Gold, Inc.

Joe Manga  
Ron Martin  
Meacham and Associates  
Offshore Exploration and Mining  
Placer Dredging and Technology, Inc.  
Queenstakes Resources, Ltd.  
Thurman Oil and Mining  
WestGold  
WGM, Inc.

### Courtesy Copy

KNOM Radio  
NANA Regional Corp., Inc.  
Natural Resources Defense Council

Nome Nugget Newspaper  
Northern Alaska Environmental Center

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## APPENDICES

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- A    ARCHAEOLOGICAL ANALYSIS PREPARED BY  
      MINERALS MANAGEMENT SERVICE
  
- B    ENDANGERED SPECIES ACT SECTION 7  
      CONSULTATION AND DOCUMENTATION
  
- C    SUPPORTING TABLES FOR SECTION III.C.1 "THE  
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**APPENDIX A**

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**ARCHAEOLOGICAL ANALYSIS  
PREPARED BY  
MINERALS MANAGEMENT SERVICE**



## **Prehistoric Resource Analysis Proposed OCS Mining Program Norton Sound Lease Sale**

### **Purpose**

In accordance with the Minerals Management Service (MMS) Handbook for Archaeological Resource Protection (#620.1-H, June 17, 1985), this archaeological analysis was prepared for the proposed OCS Mining Program Norton Sound Lease Sale. The analysis is intended to identify areas of possible prehistoric archaeological site potential and to aid the MMS in making recommendations to the Secretary on archaeological resource lease stipulations.

### **Project Area Description**

The area of the proposed lease offering is offshore the State of Alaska south of Nome in northern Norton Sound. It is approximately bounded on the north by the 3-mile Federal/State boundary; on the south by 64° 15' N. latitude; on the west by 166° 10' W. longitude; and on the east by 163° 30' W. longitude.

The proposed lease area is approximately 350,000 acres and contains 80 whole and partial blocks. All blocks are included in this archaeological analysis.

### **Method**

The method used to develop the archaeological analysis was established in the Handbook for Archaeological Resource Protection (MMS 620.1-H, June 17, 1985).

The procedures outlined in Chapter 2, Section D.1-4 of the handbook are:

Integration of the geophysical/geological and archaeological information is the focus of the prehistoric resource analysis. It includes a technical interpretation of existing geophysical/geological data in order to establish sea-level changes and to identify relict landforms. This technical interpretation will provide the basis for evaluating the potential for prehistoric resource occurrence (habitability) within the proposed lease sale area. The process of integration should begin at the broadest database level and proceed toward the specific. Preparation of the analysis may be conducted in the following manner:

(1) Review the baseline study. If the regional baseline study indicates that the entire proposed lease sale area lies within an area of low probability for the occurrence of prehistoric resources, and no new data exist which contradict the regional baseline study findings, then no further prelease prehistoric resource analysis or postlease resource reports will be required.

(2) Review the sea-level data in the proposed lease sale area to establish the best estimate of paleo-sea level when blocks of medium or high probability occur in the proposed lease sale area. Blocks which a regional baseline study indicates are medium or high probability, but were not above sea level during times of potential human habitation (habitability), will require no further prelease prehistoric resource analysis or postlease prehistoric resource report.

(3) Examine the geophysical/geological literature for information regarding forces or processes that might have destroyed potential prehistoric resources (survivability) or rendered them unrecoverable. Examples of such forces and processes are:

- (a) glacial scouring;
- (b) sea-ice gouging;
- (c) subaerial exposure;
- (d) inlet migration;
- (e) transgressive seas; and
- (f) sedimentation.

The block will require no further prelease prehistoric resource analysis or a postlease prehistoric resource report if the block exhibits any of these processes to an extent that it would be expected that prehistoric resources did not survive and/or are not recoverable.

(4) Examine the USGS geology report, existing shallow hazards survey data, etc., for indications of significant landforms. If sufficient data exist to make a determination, those blocks that do not contain significant relict Pleistocene or Holocene landforms will require no further prelease prehistoric resource analysis or postlease prehistoric resource report. Those blocks that are not excluded from further consideration shall require a prehistoric resource report under the archaeological lease stipulation or ROW permit requirements.

## Analysis

### Step 1 - Review of the Baseline Study

Using the above method, 80 blocks contained in this proposed action were reviewed. Baseline studies which cover portions of the study area include:

- Bering Land Bridge Cultural Resource Study (Dixon et al., 1976);
- Alaska Outer Continental Shelf Cultural Resource Compendium, Technical Report #119 (Dixon et al., 1986);
- Western Gulf of Alaska Cultural Resource Study (Dixon et al., 1977).

The baseline studies have developed a general model which delineates areas likely to contain archaeological sites on the OCS (Dixon et al., 1978). The criteria used for designating probability zones are:

#### Areas of High Probability

- (1) Non-glacial river mouths and constricted marine approaches to these river mouths. Such areas would have concentrated anadromous fish and their predators.
- (2) Natural terrestrial conditions, such as passes, which funnel large mammal movements.
- (3) Prominent spits, points, rocky capes, headlands, and islands that may have provided habitats for seals and 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 a natural constriction which would tend to concentrate these species.
- (4) Areas of possibly enhanced marine coastal habitat diversity and availability.

#### Areas of Medium Probability

- (1) Lake margins. Although the presence of fish and waterfowl resources enhances these areas as settlement locales, they are less likely to be as productive (and less likely to foster winter settlements) as those listed above.
- (2) North- and south-facing slopes. Guthrie (in Dixon et al., 1976) indicated that south-facing slopes tend to concentrate grazing mammals during early spring plant maturations 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.

#### Areas of Low Probability

- (1) Any habitat type not listed below.

In addition, the geological report prepared for this analysis utilized a recent study (Hess, 1985) which allowed

for a more detailed assessment of the archaeological potential of individual lease blocks.

#### Step 2 - Review of Sea Level Curves to Determine Habitability

In a previous archaeological analysis prepared by MMS for Norton Basin Sale 100, Friedman and Schneider noted that the entire sale area was shallower than -40 meters. This finding is still accurate. Therefore, this sea level figure is not a limiting factor for habitability. The entire study area was submerged under the early Holocene.

#### Step 3 - Review of the Geological/Geophysical Data to Determine Survivability

In the analysis done for Sale 100, Friedman and Schneider recognized three factors in the Norton Basin area which could affect the survivability of sites during and subsequent to submergence:

- (1) Extensive churning of the gently sloping, shallow bottom by waves and current action;
- (2) The potential for ice gouging as the seas advanced;
- (3) The erosion of topographic landform features by swift tidal currents.

Friedman and Schneider concluded that ". . . the probability of any prehistoric sites surviving the dynamic and destructive processes in the Norton Basin area are low . . . "

The geologic report done for this analysis also indicates that "The rapid migration of small streams plus the thermokarst erosion of their banks and associated ponds would destroy any prehistoric archaeological sites."

#### Step 4 - Review to Identify Significant Landforms

The previous archaeological analysis done by Friedman and Schneider for Sale 100 indicated that significant landforms, using existing data, were unrecognizable. They concluded that "The landforms, mainly river and stream channels, that are recognizable in the geophysical record existed and were subsequently filled prior to man's habitation of the area."

New data available subsequent to the analysis done for Sale 100 (Hess, 1985) indicated an area which is believed to have a high potential for archaeological site occurrence. This area contains a significant landform which consists of a paleochannel which is assumed to encompass a nonglacial river margin. The specific blocks which contain this significant landform are numbers 586 and 587, on protraction diagram NQ 3-8.

#### Step 5 - Prehistoric Site Potential Recommendation

The OCS Mining Program Norton Sound Lease Sale area contains blocks which have a high potential for prehistoric site occurrence. However, any potential prehistoric sites are likely to have been destroyed as a result of wave action, channel migration, and thermokarst erosion during subaerial exposure and subsequent marine transgression. Therefore, block numbers 586 and 587 on protraction diagram NQ 3-8 require no further prelease resource analysis or a postlease prehistoric resource report.

# **Summary of Geomorphological Processes Pertaining to Survivability of Potential Archeological Resource Sites in the Norton Basin Nonenergy Mineral Lease Sale Area**

**Prepared by N. Frank Miller**

## **Introduction**

This report is written in accordance with the Minerals Management Service Handbook for Archaeological Resource Protection. Previously, Friedman, Schneider, and Bowers had prepared an archaeological analysis of the Sale 100, Norton Basin area. The OCS Mining Program, Norton Sound Lease Sale area, covers a portion of the previous sale area. This summary updates and expands upon the work of Friedman, Schneider, and Bowers concerning the geomorphological processes pertaining to survivability of potential prehistoric resource sites in the OCS Mining Program, Norton Sound Lease Sale area. This report also addresses the survivability and detectability of shipwrecks within the sale area.

The previous work by Friedman, Schneider, and Bowers found no tracts in the Sale 100 area to possess a potential for survivability of prehistoric resource sites. This report reevaluated the area studied by Friedman, Schneider, and Bowers, taking into consideration new data on the potential for site survivability and new data concerning Quaternary depositional processes. This reevaluation confirmed those same authors conclusions for tracts in the nonenergy sale area.

This report reflects a modification of the original baseline study as well as a reinterpretation of the area's depositional history and the natural forces limiting site survivability. The geomorphological forces which have acted upon the floor of the Bering Sea sale area are summarized with regard to the distribution, survivability, and detectability of potential prehistoric resource sites.

## **Review of the Baseline Study**

The baseline study, Alaska Outer Continental Shelf Cultural Resource Compendium, was prepared by Dixon, Stoker, and Sharma and published in March 1986. This report utilized bathymetric features for the evaluation of specific lease blocks. No areas of medium or high probability of archaeological site occurrence were noted within the lease sale area.

A recent study (Hess, 1985) has identified a channel system which existed when the seafloor of the Northern Bering Sea was exposed by a drop in sea level during the last Ice Age. Utilizing this study, it is now possible to better define the archaeological potential of individual lease blocks.

The study of Quaternary stratigraphy and sedimentation by Hess allows for a reinterpretation of the archaeological potential of the sale area. The major channels which have been identified in this study were created during the low sea level periods of the Ice Age. The ages of these channels could possibly span the range of time encompassed by the Late Pleistocene from 10,000 to 250,000 years ago. The major channels could have, therefore, been in existence during that period of time when Beringia was occupied. Two lease blocks containing one of these channels were reevaluated as having a high probability of archaeological site occurrence. These blocks are Nos. 586 and 587, on protraction diagram NQ 3-8.

## **Review of Sea Level Curves to Determine Habitability**

The previous archaeological analysis for the Sale 100 area by Friedman, Schneider, and Bowers concluded: "As the Norton Basin is everywhere shallower than -40 meters, this sea level figure does not enter into the habitability analysis as a limiting factor. The entire area was emerged until the early Holocene." This report concurs with that conclusion.

## **Review of the Presence of Significant Landforms**

The criteria for significant landforms were reiterated by Friedman, Schneider, and Bowers as follows:

### Significant Landforms With a High Probability of Archaeological Site Occurrence

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 anadromous 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 Otariid 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 sinuous embayments.

### Significant Landforms With a Medium Probability of Archaeological Site Occurrence

1. Lake margins. Although the presence of fish and waterfowl resources enhances these areas as settlement locales, they are less likely to be as productive (and consequently less likely to foster winter settlements) as 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 a large aggregate of animals can be harvested. Although these areas are generally more productive, the mammals are scattered over a comparatively large area.

The paleochannel reported by Dr. Hess would constitute a significant landform with a high probability of archaeological site occurrence. Whether this channel was fed by glacial streams could not be determined, so the area should be assumed to encompass a nonglacial river margin. This paleochannel has a muted surface expression and is overlain by a shallow bathymetric depression.

### Review of Potential of Survivability of Prehistoric Sites

Friedman, Schneider, and Bowers described northern Norton Sound as an area of few sediments and little ice gouging. The sale area west of Cape Nome experiences severe current activity. East of Cape Nome biogenic gas cratering has disrupted the seafloor (Thor and Nelson, 1979).

Nonmarine Pleistocene sediments have been identified over a large portion of the sale area in water depths shallower than 35 m. Upper sediments have been described as limnic peaty muds. Where encountered during offshore coring, this mud generally overlies a silty fine sand or clayey silt. (Olson, Clakey, and Nelson, 1980).

The limnic peaty muds have been described as late Pleistocene tundra deposits. These deposits are cut by many small channels. The sediments were deposited by a braided system of rapidly shifting small, sediment-laden streams, which flowed through a tundra bog with many short-lived lakes and ponds (Hess, 1985). The rapid migration of small streams plus the thermokarst erosion of their banks and associated ponds would destroy any prehistoric archaeological sites.

### Review of Potential Prehistoric Resource Site Detectability

Detectability was not considered by Friedman and Schneider since no tracts were determined to possess potential prehistoric resource sites. A prehistoric resource site could not be detected by available geophysical methods including a sidescan sonar or subbottom profiler. Such a combination of tools could possibly detect significant landforms and whether a blanket sand deposit, which could contain a resource, is present,

depending on the spacing of survey lines. However, it is extremely unlikely that an actual prehistoric resource site, if it existed, would be detected since the site would be expected to be buried, and its features would be too small to be identified even if it were exposed on the seafloor.

### **Physical Factors Which Influence Survivability of a Shipwreck**

The survivability of shipwrecks depends on the characteristics of the water mass and how it interacts with the seafloor. Characteristics of the area's water mass includes its temperature, salinity, and oxygen content. This water mass affects the seafloor in the vicinity of the sale area by winnowing and bottom scouring of currents, storm wave resuspension of sediments, and disruption by ice gouging. These processes have resulted in the bathymetry and sediment patterns observed within the sale area.

The water mass within Norton Sound consists of Alaskan coastal water. This brackish water has a temperature between 10° C in summer when the river runoff is greatest and 0° C in winter when the area is covered by shorefast and pack ice. Circulation in Norton Sound results in a strong western current with maximum velocity greater than 80 cm/sec over much of the sale area. This strong current results in divergent flow of pack ice near the sale area. Storm induced wave activity in Norton Sound is most severe in summer and late fall storms. The storm waves cause turbulent bottom currents over the entire sale area.

The ice cover over the sale area consists of both shorefast and pack ice. Ice gouging is weak and typically aligned east/west parallel to the shore and in the direct of the prevailing coastal current (Thor and Nelson, 1980). The divergent ice flow prevents a stumacki zone from forming between the shorefast and pack ice. Therefore, the few ice gouges which are observed are believed to be caused by collisions of pack ice.

Bathymetry within the sale area ranges in depth from 14 to 36 m. The seafloor sediments consist of modern silts derived from the Yukon River, relic sands and gravels which were deposited during the last Ice Age, and mixtures of both modern silts and relic sands. Glacial gravels are present along the coast to the west of Solomon. While to the east, Yukon-derived silts extend from the coast. The western offshore gravels are succeeded further offshore by relict sands east of Cape Nome and by mixtures of modern silts and relic sands further west. In the area east of Solomon, the offshore silts are rippled or laminated by the weak offshore current, while to the west, the offshore sands and gravels show the effects of a stronger current, including sand waves and sand ribbons (Nelson et al., 1980). Besides modern current features, the area west of Cape Nome contains ancient shoreline shoals. The shoals were formed as the sea level rose with the end of the Ice Age. These shoals are not believed to be actively migrating. Neither the presently active sand bodies nor the ancient inactive shoreline shoals would be capable of burying a modern shipwreck if it exists. The modern sandbodies do not attain sufficient height to bury a wreck, while the ancient shoals are not mobile.

In summary, the sale area is overlain by cold, brackish Alaskan coastal waters. The seafloor is locally scoured by the coastal currents and winnowed by storm waves. Ice gouging is present but only to a limited extent due to the divergent flow of this current. Offshore sediments are modern silts to the east of Solomon and relict glacial gravels to the west. Further offshore, these gravels are replaced by modern silts, relict sands, and mixtures of both. To the west of Cape Nome, modern sandwaves and sand ribbons coexist with relict shoreline shoals. Shipwrecks could potentially survive the coastal currents, storm waves, and limited ice gouging. Such wrecks, if they exist, would be expected to now be exposed on the seafloor. If shipwrecks exist in the sale area, they could be located by use of the sidescan sonar. The sidescan sonar is probably capable of identifying a shipwreck exposed on the seafloor when run with the grid spacing commonly used for geohazard surveys.

### **Conclusions**

The OCS Mining Program Norton Sound Lease Sale area contains two blocks, Nos. 586 and 587, in NQ 3-8, which contain a major paleochannel reported by Hess. This paleochannel may have been active when ancient hunters occupied the area at the close of the last Ice Age. This channel could be a high potential area for prehistoric site occurrence. However, any archaeological resource sites within this channel would probably have been destroyed by channel migration and thermokarst erosion of the banks during subaerial exposure. Also, it should be noted that identification and detectability of sites, if they did exist, would be extremely difficult and such prehistoric sites would not be likely to be discovered or identified by an existing geophysical technique.

Shipwrecks within the sale area could survive the currents and storm waves. Ice gouging in northern Norton Sound, though present, is not abundant and reflects isolated encounters of pack ice. Modern depositional processes are not sufficient to bury a shipwreck. If a shipwreck exists on the seafloor, it probably could be identified by sidescan sonar required for site-specific geohazard surveys.

## **Shipwreck Update Analysis for Proposed OCS Mining Program Norton Sound Lease Sale**

This report is written in accordance with Chapters 1, 2, 7, and 8 of the OCS Oil and Gas Prelease Procedures MMSM 621.1-H: Handbook for Archaeological Resource Protection. The handbook states that if baseline studies exist to detect the potential for shipwrecks, then a shipwreck update analysis should be done to determine if there is the potential for any shipwreck resources occurring in the proposed lease area to survive marine transgression and other physical processes, and if the resources can be detected by state-of-the-art geophysical technology.

Baseline studies of shipwrecks exist. A computer file was made by the State of Alaska which includes most Alaskan shipwrecks (State of Alaska, DNR, 1990). One technical paper on cultural resources and shipwrecks relevant to sites in the Norton Sound Lease Sale area exists (Tornfelt, 1983). A computer file with details about 1,100 Alaskan shipwrecks exists at the MMS, Alaska OCS Region. An MMS report on shipwrecks covering the entire Alaskan OCS is in preparation (Tornfelt, In press). These studies show general locations for shipwrecks and, in some cases, archaeological sites. A list of the shipwrecks occurring in the Norton Sound Lease Sale area sea shelf and shore is provided in the Table of the technical report entitled "Shipwrecks of the Alaskan Shelf and Shore" (Tornfelt, In press).

The MMS Archaeological Analysis of the Norton Basin Proposed Oil and Gas Lease Sale 100 (Friedman, Schneider, and Bowers, 1985) is an analysis of the probabilities of any archaeological site surviving outside of the 3-mile geographical line. This MMS report concludes that "the strong bottom currents, exposed bedrock, ice gouging, and lack of sediments in the high and medium probability areas, as identified by the baseline study (Dixon et al., 1976) make it improbable that any prehistoric habitation sites would have survived." New information that may change this conclusion is included in the Prehistoric Resource Analysis in this appendix (areas shoreward of the 3-mile line are not analyzed in this report). This new information implies that the probability of shipwreck survival is higher for the area offshore than was previously thought. Shipwrecks may have survived in the sale area because the water is deeper in some locations and there are certain prehistoric river valleys where sediment protection exists. Moreover, in some shallower areas, shipwrecks may have survived because they have been there only a short time and have not been subjected to long intervals of eroding action as compared to the much older prehistoric landforms. Shipwrecks, therefore, have an increased chance of surviving.

Three known shipwrecks, the Letha R. Thomas (1900) wrecked "off" Nome, the El Sueno (1903) wrecked "off" Nome, the Jessie (1910) wrecked "near" Nome, and the P.C.S. Co. No. 1 (1911) barge wrecked "off" Cripple Creek are close enough to the sale area to make survey of certain blocks prudent. The Letha R. Thomas is reported to lie 2.25 miles offshore, just inshore of the proposed sale area. The reported location accuracy of this shipwreck indicates that it could occur somewhere in NQ 3-7 within Blocks 555, 599, and 600. Likewise the P.S.C Co. No.1 barge is reported to lie 2 miles offshore and southwest of Cripple River. The reported location accuracy of this wreck indicates that it could also occur somewhere in NQ 3-7 within Blocks 506, 507, 551 and 552. The archaeological report requirement of the lease stipulation (Stipulation No. 4) should be invoked on these seven blocks, if leased, to insure detection of a shipwreck prior to conducting lease operations.



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**ENDANGERED SPECIES ACT SECTION 7  
CONSULTATION AND DOCUMENTATION**

FEB 18 1988

We look forward to working with you and your staff in protecting and conserving endangered and threatened species. If you have any questions concerning this proposed action, please contact Dan Benfield, 261-4677.

## Memorandum

To: Regional Director, U.S. Fish and Wildlife Service  
 From: Regional Director, Alaska OCS Region  
 Subject: Endangered Species - Proposed Nonenergy Minerals Lease Sale  
 (Norton Basin)

The Minerals Management Service has initiated the planning process for the leasing and mining associated with the proposed Norton Sound Nonenergy Minerals Lease Sale. This lease sale is proposed for an area within the Norton Basin Planning Area located in the Bering Sea of Alaska (map attached--Norton Sound Nonenergy Minerals Lease Sale dated February, 1988). We expect to further define the study area during the area identification process, following receipt of comments from the Request for Information and Nominations and Notice of Intent to prepare an Environmental Impact Statement.

In accordance with the Endangered Species Act Section 7 regulations governing interagency cooperation, we are providing a notification of the listed and proposed species and critical habitat that will be included in our biological assessment, as specified in 50 CFR 402.12.

It is our understanding that there are no designated or proposed critical habitats for any listed species in Alaska. In our biological assessment we will review the following listed species that may be present in the vicinity of the proposed Norton Sound Nonenergy Minerals Lease Sale:

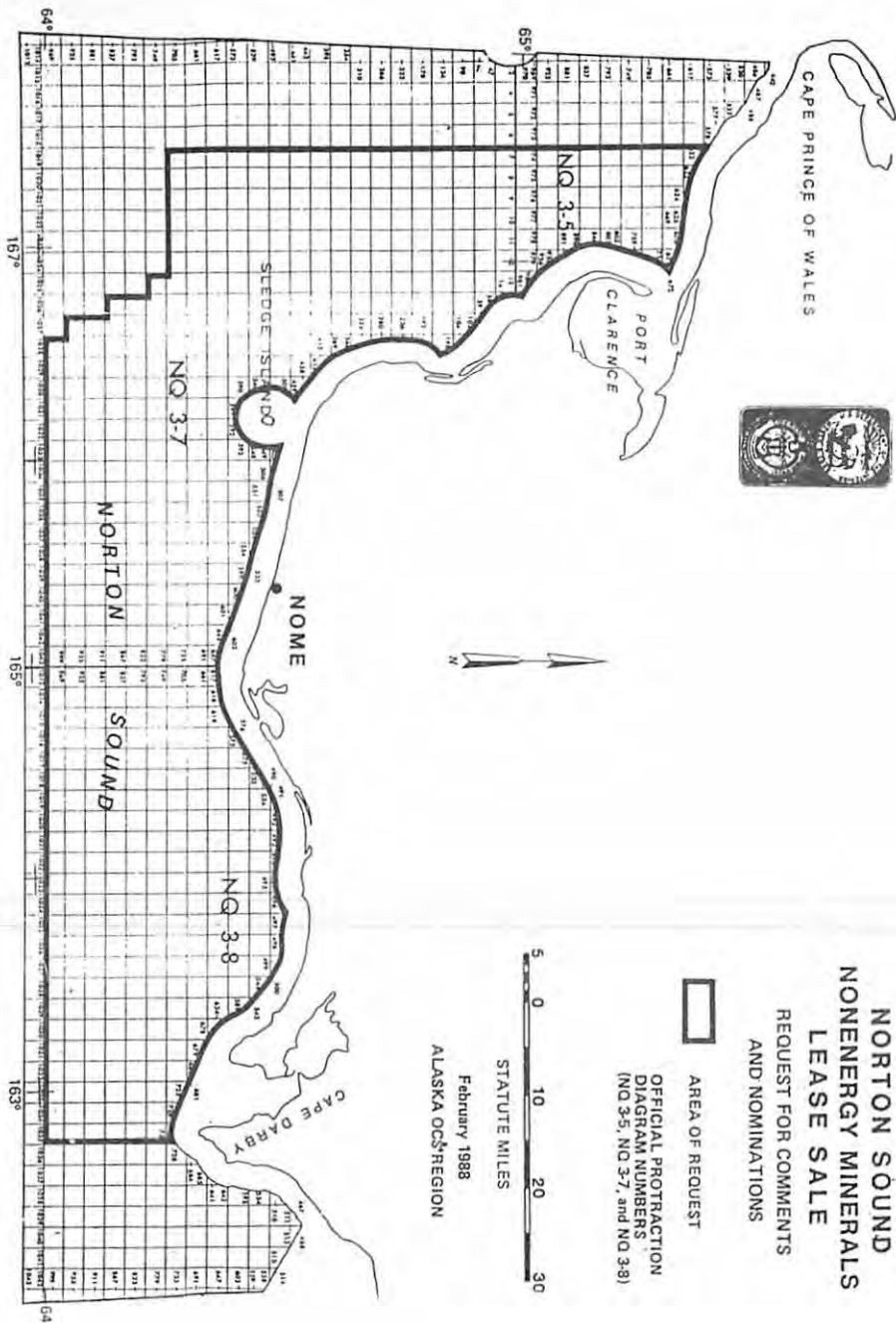
<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>
Arctic peregrine falcon	<u>Falco peregrinus tundrius</u>	Threatened
Eskimo curlew	<u>Numenius borealis</u>	Endangered

Please review our list and notify us of your concurrence or revisions and any new information concerning the occurrence of these species in relation to the proposed project area. Due to the compressed schedule for this sale, we have begun the preparation of our assessment to review the potential effects of the proposed action. We may be contacting your staff for informal consultation and discussions prior to the end of your 30-day review period.

Approved by  
 Original signed by  
 Alan D. Powers

Attachment (EAS) 1001-03a (Gold Sale)  
 bcc: File: (EAS) ~~102-01a Env 7 (Gold Sale)~~  
 LE Read  
 Author  
 RD Chron  
 MS 644 (Jack Lewis)  
 Laura Yoesting, Gold Coordinator

Doc:Endangered species:Disk:Dan:IK:BENFIELD:02/08/88  
 revised 2/12/88:mop revised 2/16/88:gr  
 revised 2/17/88:cp



IN REPLY REFER TO:  
FBX-FWE

United States Department of the Interior

FISH AND WILDLIFE SERVICE  
1011 E. TUDOR RD.  
ANCHORAGE, ALASKA 99503



MAR 29 1988

**RECEIVED**  
APR 1 1988  
REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

Memorandum

To: Regional Director  
Minerals Management Service  
Alaska

From: Regional Director  
Alaska

Subject: Endangered Species - Proposed Nonenergy Minerals Lease Sale  
(Norton Basin)

On February 18, 1988, you provided the Fish and Wildlife Service (Service) a list of the threatened and endangered species that your agency intends to consider in the biological assessment relative to the proposed Norton Sound Nonenergy Minerals Lease Sale. This lease sale is proposed for an area within the Norton Basin located in the Bering Sea. Your letter states that the following species will be reviewed:

Common Name:	Scientific Name:	Status:
Arctic peregrine falcon	<u>Falco peregrinus tundrius</u>	Threatened
Eskimo curlew	<u>Numenius borealis</u>	Endangered

We concur that these species may be present in the vicinity of the proposed lease sale. We have no recent information on the eskimo curlew in the sale area and our most current information indicates that the only remaining population of these birds nests in Northwest Territories in Canada. A precursory survey for Arctic peregrine falcons in the proposed lease area was conducted in 1987 and a copy of the report on that survey was mailed to your office. This survey was conducted by personnel from the Alaska Department of Fish and Game (Department) with funding provided by the Service through Section 6 of the Endangered Species Act. Service and Department personnel are currently reviewing survey plans for 1988 in the general area of the proposed lease. It may be worthwhile for the Minerals Management Service to become involved in planning this and future surveys to ensure that accurate information on peregrine falcons is available for Section 7 consultations.

In a November 9, 1981, Biological Opinion to the directors of the Bureau of Land Management and U.S. Geological Survey, the Service stressed the need for intensive surveys for peregrine falcons relative to proposed oil and gas leasing

and exploration in the Arctic Offshore Area. Again, in a January 26, 1984, Biological Opinion to the Director, Minerals Management Service, we elaborated the need "to intensively survey, for peregrine falcons, those coastal areas where proposed onshore activities or aircraft traffic may conflict with peregrine falcons." The Service and Department have initiated surveys along the west coast of Alaska in anticipation of oil, gas and nonenergy mineral sales. This would be an opportune time for the Minerals Management Service to become involved in these surveys.

Please contact Paul Gertler or Skip Ambrose of our Fish and Wildlife Enhancement Field Office 456-0203 or 456-0239 for additional information or assistance. We appreciate your cooperation in protecting and conserving endangered species.

*Walt Stiegitz*

APR 4 1988

Memorandum

To: Regional Director, U.S. Fish and Wildlife Service  
From: <sup>Acting</sup> Regional Director, Alaska OCS Region  
Subject: Endangered Species - Proposed OCS Mining Program, Norton Sound Lease Sale

In accordance with the Endangered Species Act Section 7 regulations governing interagency cooperation, we provided your office with a notification of the listed species that were to be included in our biological assessment, as specified in 50 CFR 402.12 (memorandum dated February 18, 1988). Subsequently, we have completed our biological assessment to determine if the proposed OCS Mining Program, Norton Sound Lease Sale is or is not "likely to adversely affect" any threatened or endangered species population. Attached is the biological assessment for your review. It is our understanding that the Section 7 regulations allow 30 days for your review and decision on whether you concur with our conclusion. Also, we acknowledge that if you do not concur with our conclusion, informal or possibly formal consultation may be required.

If you have specific questions or concerns about our assessment, we request that informal consultation be initiated to reconcile any concerns before formal consultation is required.

We look forward to your reply and please contact Dan Benfield at (907) 261-4672 if you have any questions on the proposed action.

Orig. Sgd by Irven F. Palmer, Jr.

Attachment

bcc: Official File: (EAS) 1001-03a (Gold Sale)  
LE Read  
✓ Author  
RD Chron  
MS 644 (Jack Lewis)  
Laura Yoesting, Gold Coordinator

doc-ocs mining program:disk-dan:benfield:3/22/88 kp  
revised 3/28/88:kp

Biological Assessment for Threatened and Endangered Species  
with Respect to the Proposed OCS Mining Program  
Norton Sound Lease Sale  
in the Norton Basin Planning Area,  
Outer Continental Shelf, Alaska

Prepared in Accordance with Section 7(c)  
Endangered Species Act of 1973,  
as Amended

Minerals Management Service  
Alaska OCS Region  
March 1988

doc-benfields comments atc:disk-dan

I. Purpose

Section 7(c) of the Endangered Species Act of 1973, as amended, requires that a Federal agency prepare a biological assessment for listed and proposed threatened and endangered species or critical habitat that may be present in an area of a proposed major Federal action. The assessment should evaluate the potential effects of the action and determine whether or not it will "adversely affect" any listed species or critical habitat and thus require formal consultation.

This assessment describes the proposed action to the extent feasible, the species most likely to be affected, the major effects of the proposed action to the species, and potential mitigating measures to eliminate any adverse effect to any species.

A detailed description of the endangered and threatened species within the Norton Basin Planning Area and effects analyses of similar proposed actions may be found in the following documents that are hereby incorporated by reference as allowed in the Interagency Cooperation Regulations, 50 CFR 402.12(g):

- Final EIS for Norton Basin Proposed Oil and Gas Lease Sale 100, 1985
- Final EIS for Norton Basin Proposed Oil and Gas Lease Sale 57, 1982
- Final EIS for Proposed Arctic Sand and Gravel Lease Sale, 1983
- Biological Assessment for Endangered Whales of the Arctic Region with Respect to Proposed Offshore Oil and Gas Exploration, 1981
- Biological Assessment for Endangered Whales of the Arctic Region with Respect to Hard Mineral Leasing, 1982

Various sections of these documents will be summarized throughout this assessment.

II. Summary

The Minerals Management Service (MMS) has initiated the planning process for a proposed OCS Mining Program lease sale within the Norton Basin Planning Area (Figure 1). The EIS development process has begun, and a draft EIS is planned for publication in May 1988. The proposed action (leasing and subsequent offshore mining) scenario calls for an estimated maximum of four dredging vessels with tending vessels, and daily helicopter support from existing mainland facilities in Nome, Alaska. A list of threatened and endangered species which may be affected by the proposed project was requested from both the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) on February 18, 1988. The following species are considered in this analysis:

<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>
Blue whale	<u>Balaenoptera musculus</u>	Endangered
Sei whale	<u>Balaenoptera borealis</u>	Endangered

Common Name	Scientific Name	Status
Right whale	<u>Balaena glacialis</u>	Endangered
Sperm whale	<u>Physeter macrocephalus</u>	Endangered
Fin whale	<u>Balaenoptera physalus</u>	Endangered
Humpback whale	<u>Megaptera novaeangliae</u>	Endangered
Bowhead whale	<u>Balaena mysticetus</u>	Endangered
Gray whale	<u>Eschrichtius robustus</u>	Endangered
Eskimo curlew	<u>Numenius borealis</u>	Endangered
Arctic peregrine falcon	<u>Falco peregrinus tundrius</u>	Threatened

It is unlikely that there will be any significant interaction between the threatened and endangered avian species and actual offshore mining. However, there could be adverse effects to some peregrine falcon nesting due to any low-level helicopter support flights from the mainland that may occur within close proximity of active nest sites. Endangered cetacean populations of the blue, sei, right, sperm, fin, humpback, and bowhead whale are not likely to be affected by the proposed action, since the major concentrations of these species are much further offshore from the proposed lease area. It is anticipated that only individual or small numbers of gray whales will experience adverse effects due to any activities from the proposed action, since their main summer-feeding area and migration corridors are further offshore.

There is no designated or proposed critical habitat for any listed species in Alaska. Also, there are no proposed species for listing within, or in the vicinity of, the proposed lease area.

### III. Description of the Proposed Action

The proposed offshore mining activities are planned for water depths ranging from 20 to 30 meters during the ice-free period--late May/early June to late October/early November. The lease period is for 18 years and it is expected that the first 4 years will be devoted to assessing mineral potential within the leased area through low-resolution shallow-seismic activity and core-drilling operations. An estimated 10,000 line kilometers of seismic lines will be completed. It is anticipated that two (most likely case) to four (high case) offshore mining operations will be operating annually beginning in the fifth year through the end of the lease period. An estimated total of 1,600 to 3,200 acres of marine bottom is projected to be mined and altered during the entire 18 years of the proposal. The dredges will be of the ladder-bucket type, but bucket-wheel or cutter-head suction dredges may also be used to mine the seafloor to an average depth of 7 meters. Seawater (13.05-15.66 million gal/day) will be used in extracting minerals from the mined substrate. The spoil material will be composed of outwashings from the dredge, coarse materials discharged by the conveyor belt, and process tailings discharged through an 8- to 10-inch elephant-trunk pipe near the seafloor. One tending vessel (usually a tug) and two helicopter flights per day will be expected to support each of the two to four estimated offshore mining operations.

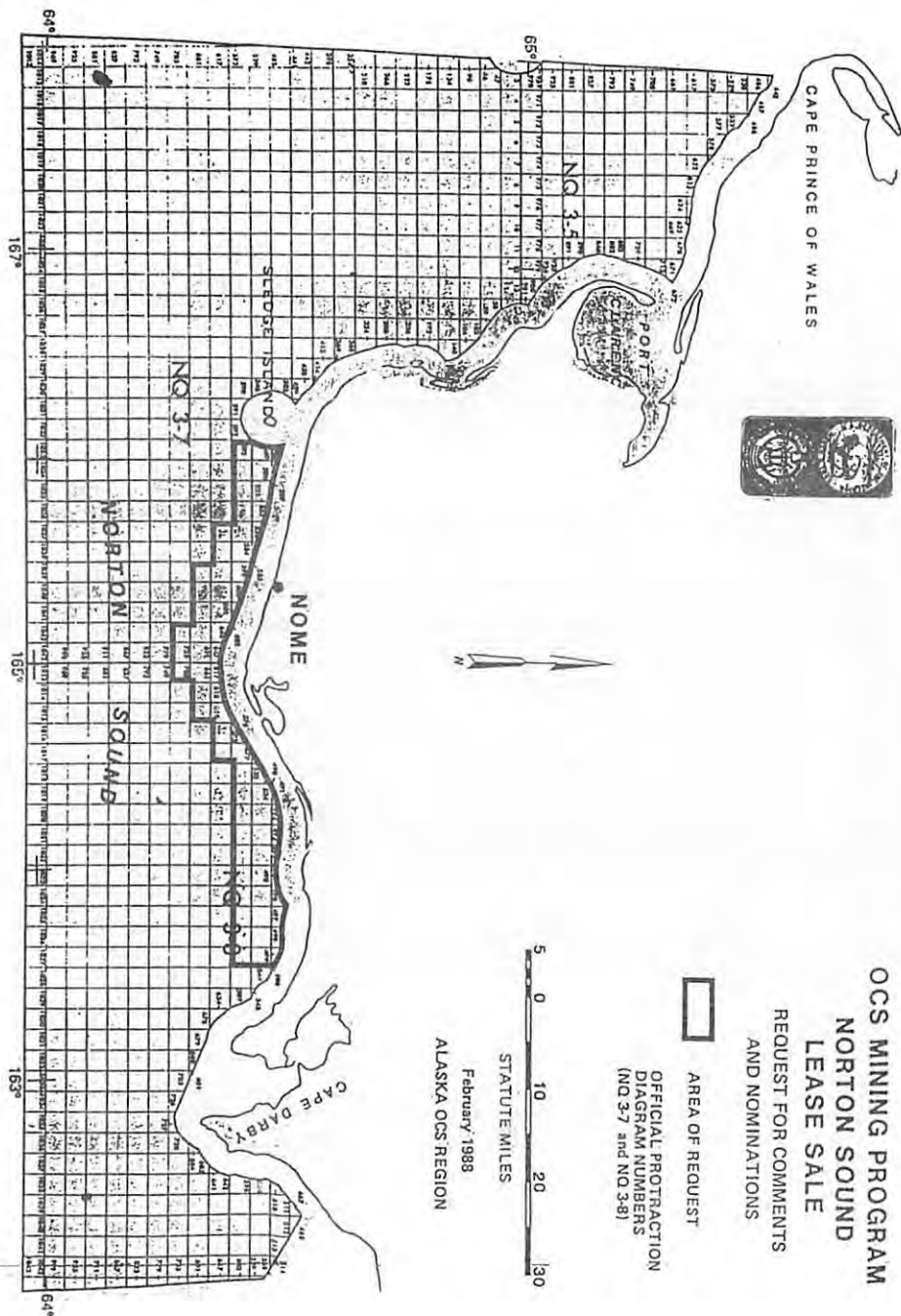


Figure 1. Location of proposed OCS Mining Program, Norton Sound Lease Sale.

**OCS MINING PROGRAM  
NORTON SOUND  
LEASE SALE**  
REQUEST FOR COMMENTS  
AND NOMINATIONS

AREA OF REQUEST  
OFFICIAL PROTRACTION  
DIAGRAM NUMBERS  
(NO 3-7 and NO 3-8)

February 1988  
ALASKA OCS REGION



IV. Summary of Species Biology and Occurrence in the Vicinity of the Proposed Lease-Sale Area

A detailed description of the threatened and endangered species associated with the Norton Basin Planning Area is provided in the final EIS's for Lease Sales 57 and 100, and the respective Biological Opinions (in appendices to these final EIS's) prepared by NMFS (1983, 1984) and FWS (1980, 1984). The following is a summation and update of this information in relation to the proposed lease area.

A. Cetaceans

1. Blue, Sei, Right, Sperm, Fin, and Humpback Whales: The blue, sei, right, and sperm whales are primarily found in deeper waters of the continental shelf break--further offshore from the proposed lease area. On rare occasions they may be found in the far western section of the Norton Basin Planning Area.

Small numbers of fin and humpback whales may be found either feeding or migrating from July to November in the general area around St. Lawrence Island. It would be a rare occurrence for these species to be found within or near the proposed lease-sale area. Two fin whales were observed in July 1981, approximately 24 miles southwest of Sledge Island. This is the nearest sighting to the proposed lease-sale area.

Since it is very unlikely that any of these species will occur within or adjacent to the proposed lease area, they will not be addressed in the remainder of the assessment.

2. Bowhead Whale: The endangered bowhead whale population is currently estimated at approximately 7,200 ( $\pm$  2,400) individuals, part of which may be found annually within the Norton Basin Planning Area (IWC, in press). The bowhead's winter range is in the central and western Bering Sea, from the southwest section of the planning area below St. Lawrence Island to the pack-ice front. Spring and fall migrations between the winter and summer ranges in the Beaufort Sea occur primarily within the far north and west sections of the planning area from March through May and October through December. The migration timing and routes are greatly influenced by seasonal ice conditions. Bowhead breeding, calving, and feeding is thought to occur during the spring-migration period. Since all of these bowhead activities occur at a considerable distance further offshore, it would be very improbable for bowheads to be found within or adjacent to the proposed lease area. Also, the proposed action will occur during the ice-free period when the bowhead population is in its summer-feeding waters in the Beaufort Sea. Consequently, the bowhead whale will not be included in the remainder of the assessment.

3. Gray Whale: The gray whale is the most commonly occurring endangered cetacean within the Norton Basin Planning Area during the ice-free period. The eastern North Pacific stock, which represents most of the world's population, migrates annually from the coast of Baja, California to Alaskan and Soviet waters. This stock is estimated to number approximately 17,000 individuals. The population has increased steadily and recovered well from a low level (resulting from severe over-exploitation) to population numbers comparable to historical levels.

Gray whales are present in the planning area from about mid-May through November. Their northward coastal migration begins in February from off the Baja California coast. Most of the gray whale population enters the Bering Sea through Unimak Pass from March through June; generally following the Alaskan coast until reaching the west coast of Nunivak Island. At this point, the whales appear to move offshore directly toward feeding areas, arriving near St. Lawrence Island in May and June, and subsequently at other summer feeding areas in the northern and northwestern Bering Sea and the Chukchi Sea. Feeding areas include the coast of the Chukotsk Peninsula from Cape Serdtse Kamen in the Chukchi Sea to the southwestern Gulf of Anadyr, the central Chirikov Basin from St. Lawrence Island to the Bering Strait, waters near the southern capes of St. Lawrence Island, the central Chukchi Sea south of 69°N. latitude, and the Alaskan coast from Cape Prince of Wales to Barrow. Migration from the planning area probably begins in October, with the peak southward migration through Unimak Pass occurring in November and December.

The St. Lawrence Island/Chirikov Basin region within the western section of the planning area is a very important gray whale feeding area. It is estimated that nearly a third of the summering gray whale population within the American waters of the Bering Sea feeds extensively within the Chirikov Basin. It could be a much higher percentage, since it is unknown whether a specific group spends the summer there or whether individuals move to other feeding areas. In either case, the Chirikov Basin is an extremely important habitat for the summering gray whale population.

Gray whales have been observed feeding at the surface, in mid-water regions, and on the bottom. The three methods of feeding used are skimming, engulfing prey, and benthic suction. On their northern summer grounds, suction feeding on bottom-dwelling organisms appears to be the primary feeding method.

Tube-dwelling amphipods of the genus Ampelisca are a major food source of gray whales, and in the planning area the distribution of whales during the summer months appears to be closely related to areas of high amphipod biomass. Although ampeliscid amphipods are present over a wide area, their optimum habitat appears to consist of waters 20 to 40 meters deep, having a bottom composed of moderately sorted, slightly silty, very fine sand, containing 80- to 90-percent sand-sized particles. In the American portion of the Chirikov Basin, gray whales appear to feed selectively in areas of high amphipod biomass. Ampeliscid amphipods have been found to occupy about 40,000 square kilometers of this area, whereas gray whale benthic-feeding features have thus far been recorded over only about 22,000 square kilometers. Ampeliscid amphipods are not common in Norton Sound due to its decreased salinity and sediment-grain size and, correspondingly, the area appears to be of low value for gray whale feeding.

Migrating or summer feeding gray whales may be found occasionally near or within the proposed lease area from about mid-May through November. The major gray whale feeding and migration area is the Chirikov Basin, which is primarily west of 168°W. longitude and approximately 60 miles further west and offshore from the western boundary of the proposed lease area (Figs. 1 and 2). A compilation of gray whale sightings (1975-1986) from various study sources--primarily Ljungblad's annual aerial surveys and NOAA vessel sightings--clearly delineates the Chirikov Basin as the major concentration area (Fig. 2). The three sightings (a total of eight whales) made in nearshore waters near Nome,



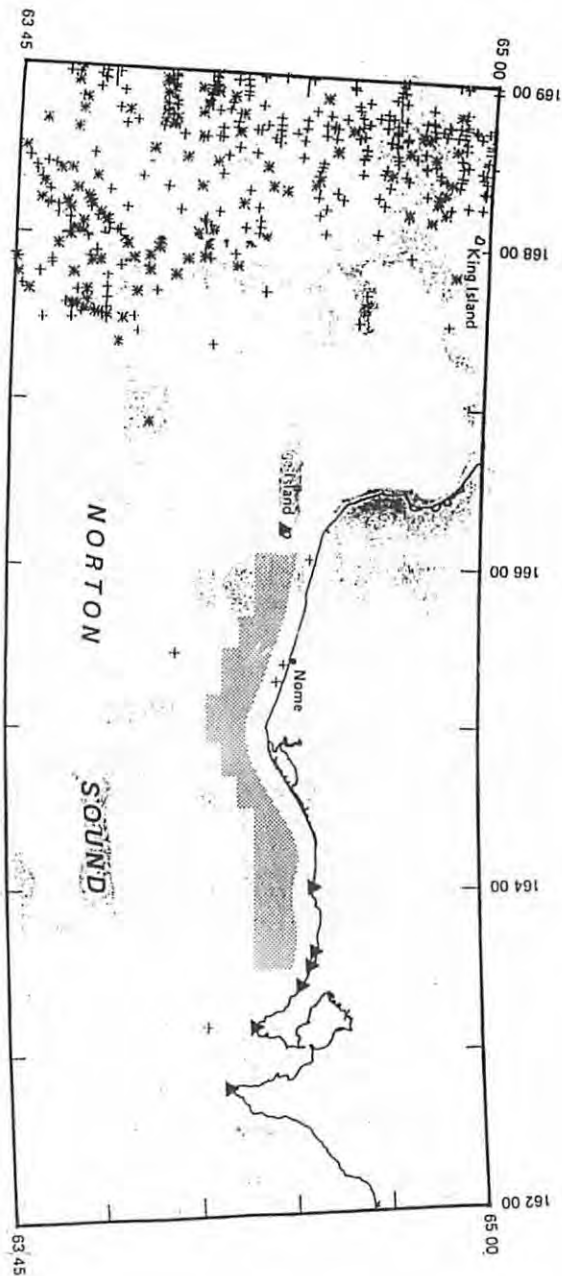


Figure 2. Gray whale sightings(+, non-feeding; \*, feeding) and location(Δ) of arctic peregrine falcon nest sites.

B-7

Alaska, were made in May 1980 and July 1982. None of the whales sighted near the proposed lease area exhibited feeding behavior characterized by trailing mud plumes. Consequently, a few individual or small numbers of migrating or feeding gray whales would likely come in contact with activities from the proposed action.

#### B. Avian

1. Eskimo Curlew: The Eskimo curlew nested in the tundra areas adjacent to Norton Sound in the mid- to late 1800's (Gollop et al., 1986). However, the population has been greatly reduced and is near extinction, and there have been no confirmed sightings in Alaska during this century. Recent nest sightings have been centered in the Canadian Arctic, and provide some hope that a small population still exists (FWS, 1987). Due to its greatly reduced range and a lack of sightings for the Norton Sound area, the Eskimo curlew is not presumed to occur within or near the proposed lease-sale area. Therefore, potential effects of the proposed action on the Eskimo curlew are not included in this assessment.

2. Arctic Peregrine Falcon: Nest sites for the threatened arctic peregrine falcon occur along the shoreline within 3 miles of the proposed lease-area boundary. Nest sites are usually located on bluffs or cliffs that contain seabird nesting colonies, and most sites have been discovered in conjunction with seabird surveys. Wright (1987) conducted a limited raptor survey of the area during July 1987, and found an increase in peregrine falcon nesting activity from previous records. Six of the eleven historical nest sites along the northern shore of Norton Sound had nesting peregrine falcons. Five of the historical sites exist along the shoreline within 3 miles of the proposed project area (Fig. 2). Consequently, arctic peregrine falcons nesting at these sites may encounter activities from the proposed action.

#### V. Potential Effects of the Proposed Action

The major potential sources of effects to endangered and threatened species from the proposed offshore mining activity are habitat alteration, turbidity/water quality, and noise and disturbance. Additional detailed information of the potential effects on endangered species of dredging operations and associated activities can be found in the final EIS's for Lease Sales 57 and 100, the final EIS for the Arctic Sand and Gravel Lease Sale, and the Biological Assessment for Endangered Whales of the Arctic Region with Respect to Hard Minerals Leasing (Dubsky, 1982).

#### A. Habitat Alteration

From 1,600 acres (most likely case) to 3,200 acres (high case) of marine bottom may be mined and altered by two to four dredges respectively during the entire 18 years of the proposed offshore mining project. This will be an annual rate of 80 to 120 acres for two dredges and 160 to 240 acres for four dredges. Amphipod communities are not common within the Norton Sound due to the lack of bottom sediments containing 80- to 90-percent sand-sized particles. Furthermore, the majority of the marine bottom within the proposed lease area is composed of lag gravel, medium sands, and glacial deposits of cobbles and boulders, which are the desirable areas for mining (Hess and Nelson, 1982). Therefore, the direct alteration of the marine bottom from the proposed off-

shore mining project would most likely involve low value feeding habitat for the gray whale.

There would be no alteration of arctic peregrine falcon habitat, since only underwater mining is involved and existing onshore facilities at Nome, Alaska would be used.

#### B. Turbidity

It is expected that mining at individual sites (from two to four dredges) would create local turbidity plumes within 500 meters of the dredge. The turbidity plumes are expected to be comparable in intensity to turbidity caused by natural phenomena associated with arctic conditions (storm waves, ice gouging, direct influx of muddy river water). Since these natural phenomena have no apparent adverse effects on gray whales, local turbidity plumes associated with mining are not expected to result in adverse effects to the few gray whales that may encounter them.

Possible, but remote, indirect effects on gray whales due to the proposed project action would be the reduction of biological productivity because of siltation and the degradation of water quality due to release of natural trace metals within the sediments. Gravels on the sea bottom provide substrate for epifauna, which may in turn be a food source for animals (including whales) higher in the food chain. However, the Norton Sound, including the proposed lease area, is not an important feeding area for gray whales since it lacks the necessary substrate (that occurs in the Chirikov Basin) for amphipod communities. An increase of trace-metal levels, especially mercury, may occur in the surrounding waters of the mining operations. Since few gray whales feed within the proposed lease area it is doubtful that any deleterious accumulation of trace metals would occur to the few whales that may encounter the mining operations.

The turbidity and siltation from the proposed offshore mining operations are not expected to significantly affect the habitats or population levels of arctic peregrine falcon prey species, such as marine birds, shorebirds, or waterfowl. However, an increase of trace metals (especially mercury) above standard levels may accumulate through the food chain into some of the prey species and eventually result in lower reproductive levels within the local peregrine falcon population. (Scheuhammer, 1987)

#### C. Noise and Disturbance

Increases in noise and disturbance from vessels, aircraft, seismic activity, core-sample drilling, and mining and dredging can be anticipated from the proposed action. The proposed action is planned for the ice-free period--late May/early June to late October/early November. Some interaction between gray whale movements and the noise and disturbance from the proposed action may be expected.

One vessel (usually a tug) and two helicopter flights per day are projected to support each of the two to four estimated offshore mining operations. An estimated 10,000 line kilometers of low-resolution shallow-seismic activity and core-drilling activity will be performed during the initial 5 years of the lease. Since the major portion of the gray whale population occurs outside the

proposed lease area, only a few individuals or small groups are expected to be affected by noise-generating and disturbance activities. Reactions generally would be short term and temporary in nature, consisting of movements away from the sound source; however, gray whales may avoid feeding within several hundred meters of the individual dredge units.

Noise effects from the individual dredge units to nesting arctic peregrine falcons within the proposed lease-sale area are expected to be minimal since all nest sites will be a minimum of 3 miles from any mining and dredging operation. Daily helicopter support flights present a greater noise and disturbance potential if low-level flights occur within close proximity of a nesting site.

#### VI. Cumulative Effects

The cumulative effects to gray whales and arctic peregrine falcons described and discussed in Sections IV. A. and B. of the Norton Basin Sale 100 final EIS are still appropriate. However, Sale 100 was not completed and a majority of Sale 57 leases have been relinquished. In addition to proposed oil and gas development throughout the Bering Sea, other development plans for the Norton Basin area, such as the current mining and dredging operation in State waters, the Port of Nome development, and various other mining projects, were addressed in the cumulative effects analysis of the final EIS. The proposed action would not add appreciably to the total cumulative effects to gray whales or arctic peregrine falcons from proposed oil and gas development and other industry development addressed in the final EIS, especially considering that many of the activities have not occurred.

#### VII. Mitigating Measures and Conclusions

##### A. Mitigating Measures

Stipulations and Information to Lessees (ITL's) are measures that can be included in the leasing process to reduce or eliminate the previously identified effects to endangered and threatened species. Stipulations are included in the lease and are legally binding. The ITL's advise the lessee of other legal responsibilities, such as the Endangered Species Act, and other protection measures they should implement. Stipulations and ITL's similar to those suggested for the proposed Norton Basin Sale 100 oil and gas lease sale will be developed and considered for the OCS Mining Program, Norton Sound Lease Sale. A detailed description of the stipulations and ITL's for Sale 100 can be found in Section II of the final EIS. In addition, stipulations and/or ITL's will be developed to address the following specific endangered and threatened species concerns:

1. **Gray Whale:** In the Biological Opinion of December 21, 1984, for the proposed oil and gas lease Sale 100, the NMFS limited their concern for gray whales to the western portion of the Norton Basin and recommended monitoring for gray whales around any activities "west of 166°W." longitude. This was recommended as a "reasonable and prudent alternative, to avoid the likelihood of jeopardizing the continued existence" of the gray whale. A similar extensive monitoring program should not be required for the proposed lease sale since all but three blocks of the proposed lease-sale area lie east of 166°W. longitude. However, a whale monitoring program similar to that required for

the current mining operation occurring in adjoining State waters will be considered. This measure, in conjunction with similar stipulations and ITL's (from proposed Sale 100), will aid in protecting the few gray whales that may encounter the proposed project activities.

2. Arctic Peregrine Falcon: There are five documented peregrine falcon nest sites within 3 miles of the proposed lease area. Since any nest site will be no nearer than 3 miles to any proposed offshore mining operation, there should not be any direct noise disturbance. Helicopter support flights could present a disturbance factor if proper distances are not maintained from the nest sites. Consequently, an ITL will be analyzed in the EIS advising the lessee to contact FWS for assistance in developing protection criteria for their exploration plans, and that FWS will review all exploration plans submitted to MMS.

The potential for trace-metal accumulation will be controlled by the Environmental Protection Agency's (EPA) permitting program. Water quality near the mining operation will be required to meet the standards of EPA's National Pollution Discharge Elimination System, which is mandated under the Clean Water Act.

#### B. Conclusions

Considering the operating season, location, and considerable distance from the major whale populations within the Norton Basin Planning Area, the proposal is not likely to adversely affect the populations of the blue, bowhead, fin, humpback, right, sei, and sperm whales.

The gray whale may occur infrequently within or adjacent to the proposed lease area during the ice-free period when the proposed action will occur. All available gray whale sighting information and studies of their feeding locations documents the Chirikov Basin, further west of the proposed lease area, as the major gray whale concentration area. With the consideration and incorporation of the above mitigating measures, we conclude that the proposed action is not likely to adversely affect the endangered gray whale population.

Nesting arctic peregrine falcons may encounter some project activities. However, considering the distance from the proposed offshore mining activities and the incorporation of the above mitigating measures to protect the nesting peregrine falcons, we conclude that the proposed project is not likely to adversely affect the threatened arctic peregrine falcon population.

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revised & additions-2/17/88:gr/revised & additions-2/18/88:gr  
revised & additions-2/25/88:mop/revised & additions-2/25/88:mop  
revised and additions 3/16/88:cp revised 3/28/88:revised 3/29/88 kp

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- doc-benfields comments bib:disk-dan:kp 3/88



IN REPLY REFER TO:  
FBX-FWE

# United States Department of the Interior

FISH AND WILDLIFE SERVICE  
1011 E. TUDOR RD.  
ANCHORAGE, ALASKA 99501

RECEIVED

MAY 26 1988

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

Memorandum

TO: Regional Director  
Minerals Management Service  
Alaska

MAY 24 1988

FROM: Regional Director  
Alaska

SUBJECT: Endangered Species - Proposed OCS Mining Program, Norton Sound Lease Sale

This responds to your memorandum of April 4, 1988, subject above. Your assessment concludes that the proposed action is not likely to adversely affect the threatened Arctic peregrine falcon (Falco peregrinus tundrius) due to the distance between the proposed activity and the nest sites of peregrine falcons (3 miles), and the proposed incorporation of measures to avoid disturbance from support activities. To ensure that the proposed activity will not adversely affect this species, "Information to the Lessees" will be issued instructing them to contact the Fish and Wildlife Service (Service) for assistance in developing protection criteria for their exploration plans. The lessees will also be advised that the Service will review all exploration plans submitted to Minerals Management Service.

We concur with your conclusion that the proposed action will not adversely affect peregrine falcons as long as the lessees comply with the protection criteria recommended by the Service. The lessees should be informed that the Service will recommend protection criteria currently found in the Peregrine Falcon Recovery Plan, Alaska Population (Fish and Wildlife Service, 1982). Additionally, since predators are at the top of the food chain and are especially sensitive to biocide accumulation, it is essential that water quality near the mining operations meet the Federal water criteria standards (Marine Chronic) for mercury and cadmium (Environmental Protection Agency, 1986).

This document does not constitute a Biological Opinion. The Minerals Management Service need not initiate formal consultation since, as a result of your biological assessment, you have determined, with Service concurrence, that the proposed action is not likely to adversely affect any listed species. However, if any of the Service's recommended protection measures are not incorporated in the lessees' exploration plans, or if biocide accumulation in the area of the proposed activity exceeds Federal water criteria standards, we request that you reinstate consultation.



Please contact Paul Gertler or Skip Ambrose of our Northern Alaska Ecological Services Office at 456-0203 or 456-0339, respectively, for additional information or assistance.

We appreciate your cooperation in protecting and conserving endangered species.

B-10

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U.S. Environmental Protection Agency. 1986. Quality criteria for water: 1986. U.S. Environmental Protection Agency, Office of Water Regulations and Standards. EPA 440/5-86-001.

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FEB 18 1988

Mr. Robert W. McVey  
Director, Alaska Region  
National Marine Fisheries Service  
P.O. Box 1668  
Juneau, Alaska 99802

Dear Mr. McVey:

The Minerals Management Service has initiated the planning process for the Leasing and mining associated with the proposed Norton Sound Nonenergy Minerals Lease Sale. This lease sale is proposed for an area within the Norton Basin Planning Area located in the Bering Sea of Alaska (map enclosed--Norton Sound Nonenergy Minerals Lease Sale dated February, 1988). We expect to further define the study area during the area identification process, following receipt of comments from the Request for Information and Nominations and Notice of Intent to prepare an Environmental Impact Statement.

In accordance with the Endangered Species Act Section 7 regulations governing interagency cooperation, we are providing a notification of the listed and proposed species and critical habitat that will be included in our biological assessment, as specified in 50 CFR 402.12.

It is our understanding that there are no designated or proposed critical habitats for any listed species in Alaska. In our biological assessment we will review the following listed species that may be present in the vicinity of the proposed Norton Sound Nonenergy Minerals Lease Sale:

<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>
Blue whale	<u>Balaenoptera musculus</u>	Endangered
Bowhead whale	<u>Balaena mysticetus</u>	Endangered
Fin whale	<u>Balaenoptera physalus</u>	Endangered
Gray whale	<u>Eschrichtius robustus</u>	Endangered
Humpback whale	<u>Megaptera novaeangliae</u>	Endangered
Right whale	<u>Balaena glacialis</u>	Endangered
Sei whale	<u>Balaenoptera borealis</u>	Endangered
Sperm whale	<u>Physeter macrocephalus</u>	Endangered

Please review our list and notify us of your concurrence or revisions and any new information concerning the occurrence of these species in relation to the proposed project area. Due to the compressed schedule for this sale, we have begun the preparation of the assessment to review the potential effects of the proposed action. We may be contacting your staff for informal consultation and discussions prior to the end of your 30-day review period.

We look forward to working with you and your staff in protecting and conserving endangered and threatened species. If you have any questions concerning this proposed action, please contact Dan Benfield, 261-4677.

Sincerely,

original signed by

Alan D. Powers  
Regional Director

Enclosure

bcc: Official File: ~~(EAS) 102-01a Env 7 (Gold Sale)~~ *(EAS) 1001-03a (Gold Sale)*  
LE Read  
✓ Author  
RD Chron  
MS 644 (Jack Lewis)  
Laura Voesting, Gold Coordinator

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revised 2/12/88:mop revised 2/16/88:gr

B-12



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
National Marine Fisheries Service  
P.O. Box 21668  
Juneau, Alaska 99802-1668

March 9, 1988

Mr. Alan D. Powers  
Regional Director  
Minerals Management Service  
Alaska Outer Continental Shelf Region  
949 E. 36th Avenue, Room 110  
Anchorage, AK 99508-4302

RECEIVED

MAR 14 1988

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

Dear Mr. Powers:

This letter is in reply to your request for confirmation of listed endangered species that may be present in the area of two proposed projects of your agency; i.e., St. George Basin Oil and Gas Lease Sale 101, and Norton Sound Nonenergy Minerals Lease Sale. We concur with your identification of eight species of endangered whales that may be present in each of the project areas.

However, some species are more likely to be present in the project areas than others. In order of likelihood of occurrence from most likely to least likely, we rank these species in the following order. Species that would not be likely to be present are marked with an asterisk.

St. George Lease Sale 101

Norton Sound Nonenergy Minerals

Fin whale  
Gray whale  
Humpback whale  
Bowhead whale  
Right whale  
Sperm whale  
Blue whale\*  
Sei whale\*

Gray whale  
Bowhead whale  
Right whale  
Fin whale  
Humpback whale\*  
Blue whale\*  
Sperm whale\*  
Sei whale\*

Thank for the opportunity to comment on these lists. We look forward to receiving your Biological Assessments for review.

Sincerely,

*for James H. Kinoshka*  
Robert W. McVey  
Regional Director



APR 4 1988

Robert W. McVey  
Director, Alaska Region  
National Marine Fisheries Service  
P.O. Box 1668  
Juneau, Alaska 99802

Dear Mr. McVey:

In accordance with the Endangered Species Act Section 7 regulations governing interagency cooperation, we provided your office with a notification of the listed species that were to be included in our biological assessment, as specified in 50 CFR 402.12 (memorandum dated February 18, 1988). Subsequently, we have completed our biological assessment to determine if the proposed OCS Mining Program, Norton Sound Lease Sale is or is not "likely to adversely affect" any threatened or endangered species population. Enclosed is the biological assessment for your review. It is our understanding that the Section 7 regulations allow 30 days for your review and decision on whether you concur with our conclusion. Also, we acknowledge that if you do not concur with our conclusion, informal or possibly formal consultation may be required.

If you have specific questions or concerns about our assessment, we request that informal consultation be initiated to reconcile any concerns before formal consultation is required.

We look forward to your reply and please contact Dan Benfield at (907) 261-4672 if you have any questions on the proposed action.

Orig. Sgd by Irven F. Palmer, Jr.

*Lucyng* Regional Director

Enclosure

bcc: Official File: (EAS) 1001-03a (Gold Sale)  
LE Read  
✓ Author  
RD Chron  
MS 644 (Jack Lewis)  
Laura Yoesting, Gold Coordinator

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revised 3/28/88:kp

Biological Assessment for Threatened and Endangered Species  
with Respect to the Proposed OCS Mining Program  
Norton Sound Lease Sale  
in the Norton Basin Planning Area,  
Outer Continental Shelf, Alaska

Prepared in Accordance with Section 7(c)  
Endangered Species Act of 1973,  
as Amended

Minerals Management Service  
Alaska OCS Region  
March 1988

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B-13



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
National Marine Fisheries Service  
P.O. Box 21668  
Juneau, Alaska 99802-1668

May 5, 1988

Mr. Irven F. Palmer  
U.S. Department of the Interior  
Minerals Management Service  
Alaska Outer Continental Shelf Region  
949 E. 36th Ave., Room 110  
Anchorage, Alaska 99508-4302

RECEIVED

MAY 9 1988

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

RE: Biological Assessment and Informal Consultation, Norton  
Sound Mining Lease Sale

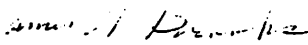
Dear Mr. Palmer:

This letter is in response to your April 4, 1988, Endangered Species Act (ESA, as amended, and 50 CFR 402.13) Section 7 Biological Assessment to determine effects of the proposed OCS Mining Program, Norton Sound Lease Sale on endangered whales in Norton Sound.

We concur with your biological assessment that there is currently no identified critical habitat in Norton Sound for any of the eight species of endangered whales and that mining in the proposed lease sale area is "not likely to adversely affect" any of these species. Specifically for the gray whale (Eschrichtius robustus), we endorse MMS's conclusion that "With the consideration and incorporation" of the plan for monitoring avoidance behavior in lease tracts west of 166 degrees West Longitude, "the proposed action is not likely to adversely affect the endangered gray whale population."

Unless the proposed action is significantly modified or if new information becomes available concerning these endangered whales, this concludes the Minerals Management Service's related Section 7 consultation responsibility under the Endangered Species Act of 1973, as amended.

Sincerely,

  
James W. Brooks  
Acting Director, Alaska Region

NMFS Contact: Roger Mercer (907-271-5006)







United States Department of the Interior

MINERALS MANAGEMENT SERVICE  
WASHINGTON, DC 20240



2

Memorandum

To: Director, U.S. Fish and Wildlife Service

From: Director, Minerals Management Service (2024) (100-100000-100)

Subject: Endangered Species Act Section 7 Formal Consultation for the Proposed Outer Continental Shelf (OCS) Mining Program, Norton Sound Lease Sale

On February 18, 1988, the Minerals Management Service's (MMS's) Alaska Regional Director notified the U.S. Fish and Wildlife Service's (FWS's) Alaska Regional Director about the start of the planning process for the proposed OCS Mining Program Lease Sale in Norton Sound, off the coast of Alaska. The Lease Sale is scheduled for July 1989. In that memorandum, we also listed the endangered and threatened species under FWS jurisdiction which we planned to discuss in an action-related biological assessment. On March 29, 1988, we received written concurrence with this species list from FWS. On April 4, 1988, we sent the completed biological assessment to the FWS Alaska regional office for review and, on May 24, 1988, received written concurrence with our assessment conclusion that leasing and mining are "not likely to adversely affect" the threatened arctic peregrine falcon (Falco peregrinus tundrius). This concurrence (and the concomitant lack of need to initiate Endangered Species Act (ESA) section 7 formal consultation) assumed the following: (1) that FWS-recommended falcon protection measures will be included in lessees' exploration plans and (2) that Federal (marine chronic) water quality criteria, especially for mercury and cadmium, will not be exceeded.

The MMS recently completed a preliminary draft Environmental Impact Statement (EIS) on the proposed action, which was sent to the FWS Fairbanks field office for informal review because personnel there are on the coordination team for this sale. Subsequently, FWS staff in Fairbanks and MMS staff in Anchorage discussed by phone additional information bearing on potential effects to the arctic peregrine falcon. This information was developed after completion of the biological assessment and is summarized as follows. The preliminary draft EIS for the Lease Sale reviewed the available data on Norton Sound trace metals and revealed that the Federal water quality criteria (especially for mercury) may be exceeded in the proposed mining area. Also, a recent raptor survey by the Alaska Department of Fish and Game has recorded a larger peregrine falcon nesting population in the Norton Sound area than had been previously documented.

Because of the potential for bioaccumulation of trace metals in the local peregrine falcon population and the recent survey data indicating a peregrine population larger than the biological assessment addressed, MMS has determined that the assessment conclusion of "not likely to adversely affect" for the arctic peregrine falcon may no longer apply. Therefore, in accordance with ESA section 7(a)(2), MMS hereby officially requests initiation of formal

consultation on all operations pertaining to offshore leasing and mining for the proposed OCS Mining Program, Norton Sound Lease Sale. To preclude an unnecessary delay in starting the consultation, copies of this memorandum are being sent to the FWS Regional Director in Anchorage and the FWS Field Supervisor in Fairbanks.

From the previously noted phone discussions between MMS regional and FWS field staff, we understand that the information currently available to FWS in Alaska (biological assessment, preliminary draft EIS, and raptor survey data) is adequate for the formal consultation and completion of a biological opinion. We understand, further, that if a meeting or further information is needed, FWS regional or field office personnel will contact MMS regional staff directly.

Should problems arise or your staff consider a potential finding of "jeopardy," we strongly request that our respective staffs discuss the problems or finding, as well as "reasonable and prudent alternatives" and any incidental take terms and conditions, as early as possible during the consultation to minimize or prevent later confusion or misunderstandings. In this case, as for oil and gas lease sales, it is the position of MMS that by providing us with a biological opinion for the proposed OCS Mining Program, Norton Sound Lease Sale, FWS will not be foreclosing on opportunities to reconsider that opinion if the proposal or likely effects change significantly or if future lease sales are proposed for this area.

If you have any questions regarding this request, please address them to Jackson E. Lewis, Minerals Management Service, Mail Stop 644, 12203 Sunrise Valley Drive, Reston, Virginia 22091 (commercial telephone: 703-648-7771; FTS: 959-7771), or Dan Benfield, Minerals Management Service, Alaska Region, 949 East 36th Avenue, Anchorage, Alaska 99510 (commercial and FTS telephone: 907-261-4672).

cc: Field Supervisor, U.S. Fish and Wildlife Service, Fairbanks, Alaska  
Regional Director, U.S. Fish and Wildlife Service, Anchorage, Alaska  
Mr. Larry Thomas, U.S. Fish and Wildlife Service, Washington, D.C.

B-15



United States Department of the Interior

MINERALS MANAGEMENT SERVICE  
WASHINGTON, D.C. 20240

OFFICIAL  
FILE COPY

SEP 28 1988

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OCT 3 1988

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

Mr. James W. Brennan  
Assistant Administrator for Fisheries  
National Marine Fisheries Service  
Department of Commerce  
Washington, D.C. 20235

Dear Mr. Brennan:

As you know, the Minerals Management Service (MMS) began preparations earlier this year for a proposed Outer Continental Shelf Mining Program Lease Sale in Federal waters of Norton Sound, offshore the vicinity of Nome, Alaska. In April 1988, MMS completed an Endangered Species Act (ESA) section 7(g) biological assessment on the proposed leasing and mining, which concluded that mining operations are not likely to adversely affect endangered whales because few whales, if any, occur in the proposed mining area. On May 5, 1988, the Regional Director of the National Marine Fisheries Service (NMFS) Alaska Region concurred with this conclusion, thereby obviating ESA section 7 formal consultation on the action.

The MMS recently completed a preliminary draft Environmental Impact Statement on the proposed action, which was sent to the NMFS field office in Anchorage for informal review because personnel there are on the coordination team for this sale. Information in the preliminary draft, developed after completion of the ESA biological assessment, revealed that some trace metals in the proposed mining area (particularly mercury) may exceed Federal water quality criteria even before mining begins.

Despite its relevance to an endangered species under U.S. Fish and Wildlife Service jurisdiction, this new information does not change MMS's biological assessment conclusion that the proposed sale is not likely to adversely affect endangered whales. This is true because few, if any, of these animals occur in or near the proposed mining area, and because there is little or no potential for bioaccumulation of the trace metals in the prey of the vast majority of animals, which summer and feed predominantly far to the west of where mining would occur.

Because NMFS staff in Anchorage are aware of this conclusion and our rationale for it, and because we believe it is neither necessary nor appropriate to do so, MMS will not request ESA section 7 formal consultation at this time. We do believe, however, that it is in our mutual best interest to officially inform NMFS about this decision.

If you have any questions concerning this matter, please contact Jackson E. Lewis, Minerals Management Service, Mail Stop 644, 12203 Sunrise Valley Drive, Reston, Virginia 22091 (commercial telephone: 703-648-7771; FTS: 959-7771),

Mr. James W. Brennan

or Dan Benfield, Minerals Management Service, Alaska Region, 949 East 36th Avenue, Anchorage, Alaska 99508-4302 (commercial and FTS telephone: 907-261-4672).

Sincerely,

Director

bcc: AS/LM(2)  
MMS General  
Director's Chron  
Official File (Sale 107; ENV 7-1.a)(BEO) MS 644  
AD/OMM  
DAD/Leasing  
DAD/Operations  
RD, Alaska Region  
RS/LE, RS/FO, Alaska Region  
Piet deWitt  
Chief, OROD  
OEAD RF  
Chief, BEO  
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IN REPLY REFER TO:  
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JUN 7 1988



United States Department of the Interior

REGIONAL DIRECTOR, ALASKA OCS  
FISH AND WILDLIFE SERVICE Minerals Management Service  
1011 E. TUDOR RD. ANCHORAGE, ALASKA  
ANCHORAGE, ALASKA 99503

Memorandum

JUN 6 7 1988

To: Regional Director, Minerals Management Service  
Alaska OCS Region

From: Regional Director  
Region 7

Subject: Biological Opinion for the Outer Continental Shelf Mining Program,  
Norton Sound Lease Sale

This responds to your September 21, 1988, memorandum requesting consultation pursuant to Section 7 of the Endangered Species Act of 1973 (the Act), and constitutes the Biological Opinion of the Fish and Wildlife Service relative to the proposed Outer Continental Shelf Mining Program in Norton Sound. The only species to be considered in this consultation is the threatened arctic peregrine falcon (Falco peregrinus tundrius).

Background

On February 18, 1988, the Alaska Regional Director, Minerals Management Service, notified the Alaska Regional Director, Fish and Wildlife Service, of the proposed Outer Continental Shelf Mining Program Lease Sale in Norton Sound. In that memorandum, the Minerals Management Service listed the endangered and threatened species under the Fish and Wildlife Service's jurisdiction, and on March 29, 1988, the Fish and Wildlife Service concurred with that list. The Minerals Management Service sent the Biological Assessment for the proposed sale to the Fish and Wildlife Service on April 4, 1988, and on May 24, 1988, the Fish and Wildlife Service concurred with the assessment's conclusion that leasing and mining were not likely to adversely affect the threatened arctic peregrine falcon. This conclusion, and subsequent concurrence, assumed that the Fish and Wildlife Service's recommended protection measures for arctic peregrine falcons would be included in the lessees' plans, and Federal water quality criteria (marine chronic), especially for mercury and cadmium, would not be exceeded. The Draft Environmental Impact Statement (November, 1988), released after the above correspondence, reviewed available data on Norton Sound trace metals and disclosed that Federal water quality criteria may already be exceeded in the proposed mining area. Additionally, a 1988 raptor survey in the Norton Sound area recorded a much larger arctic peregrine falcon nesting population than previously documented. Because of a local arctic peregrine falcon population larger than the Biological Assessment addressed and the potential for bioaccumulation of trace metals in this local population, the Minerals Management Service determined that the assessment's conclusion that the proposed project would not likely adversely affect the arctic peregrine falcon may no longer be valid. Therefore, they requested initiation of formal consultation.

Project Description

The area of the proposed project consists of approximately 72,148 hectares (178,285 acres), ranging from 5 to 22 kilometers (3.1 to 13.6 miles) offshore, in Norton Sound near Nome, Alaska. The proposed offshore mining activities are planned for water depths ranging from 20 to 30 meters during the ice-free period--late May/early June to late October/early November. The lease period with its associated activities is estimated for 18 years, and it is expected that the first three to four years will be devoted to assessing mineral potential within the leased area through low-resolution shallow-seismic and core drilling operations. An estimated 12,400 kilometers of seismic lines will be completed. It is anticipated that one (most likely case) to two (high case) offshore mining operations will be operating annually beginning in the fourth or fifth year through the end of the lease period. An estimated 1,300 to 2,600 acres of marine bottom is projected to be mined and altered during the estimated 18 years of the proposal. The dredges will be bucket-ladder type; although, bucket-wheel or cutter-head suction dredges may also be used to mine the sea floor to an average depth of 3.6 meters. Seawater (47.8 million gal/day) will be used in extracting minerals from the mined substrate. The spoil material will be composed of outwashings from the dredge, coarse materials discharged by the conveyor belt, and process tailings discharged through an 8- to 10-inch elephant-trunk pipe near the sea floor. One tending vessel (usually a tug) and three helicopter flights per day are expected to support each offshore mining operation. The proposed activity is described in detail in the Norton Sound Lease Sale Draft Environmental Impact Statement (November 1988).

Effect on Peregrine Falcons

The arctic peregrine falcon is geographically distributed throughout the tundra regions of North America. In Alaska, this includes the area north of the Brooks Range and along the west coast south to and including Norton Sound. The Fish and Wildlife Service estimates that 200 pairs historically occupied Alaska. Beginning in the late 1940s, the use of the pesticide Dichloro diphenyl trichloroethane and its metabolites (hereafter referred to as organochlorine pesticides) greatly affected arctic peregrine falcons, causing birds to lay thin-shelled eggs which often failed to hatch and consequently lowered reproduction. In Alaska, the population declined to approximately 30 percent of historical levels by 1972, at which time the United States restricted the use of organochlorine pesticides. The population remained stable for the next six years, and in 1978 the population began to increase. In 1984 the Fish and Wildlife Service, prompted by markedly improved numerical levels, changed the status of the arctic peregrine falcon from endangered to threatened. In 1988, surveys by the Fish and Wildlife Service, Bureau of Land Management, and the Alaska Department of Fish and Game located 79 pairs, five lone adults and 120 young in northern and western Alaska. Twenty of the nest sites were in Norton Sound, and six were within 15 miles of the proposed action.

The Draft Environmental Impact Statement identified four consequences of mining activities which could affect arctic peregrine falcons: habitat alteration and turbidity; trace metals; noise and disturbance; and fuel spills. Effects of habitat alteration, turbidity and fuel spills were determined to be

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negligible. The trace metal mercury is one of the factors responsible for population declines of peregrine falcons and other raptors in numerous locations (Newton 1979). The Peregrine Falcon Recovery Plan, Alaska Population (Fish and Wildlife Service 1982) identified man-caused disturbances as one of several factors that contributed to reductions in breeding success. The potential effects of trace metals and noise and disturbance are summarized in the Draft Environmental Impact Statement (Minerals Management Service 1988) as follows: "The trace-metal effect on the local population could result in the loss of some or all of the six nesting pairs near the proposed sale area from the regional population (20-30 pairs), resulting in a MODERATE effect to the regional arctic peregrine falcon population," and "...the effect from noise and disturbance to the regional population is expected to be MINOR." A moderate effect is defined as when "a portion of a regional population declines in abundance and/or distribution, and recovery requires more than one breeding cycle but less than one generation." A minor effect is defined as when "a specific group of individuals of a population in a localized area is affected over a short time period (less than one breeding cycle)."

The Draft Environmental Impact Statement (Minerals Management Service 1988) for this action presents an excellent overview of the mercury situation in Norton Sound and states the following: "Mercury is the most toxic trace metal regulated by the EPA [Environmental Protection Agency]. Its toxicity is of the same order of magnitude as that of several pesticides, and a hundredfold more toxic than the other trace metals of concern. Mercury is unique among toxic metals in that it is the only metal consistently biomagnified within the aquatic food chain (Lindberg et al. 1987). The concentration of mercury increases in organisms at increasingly higher-trophic levels of the food chain."

For a local and worldwide perspective of the mercury situation, we again refer to the Draft Environmental Impact Statement (Minerals Management Service 1988): "For the purpose of analysis, the ambient concentration of mercury in waters of the sale area is assumed to be 0.26 ppb. Concentrations of mercury above 0.02 ppb in coastal oceans are indicative of pollution or presence of natural mercury sources (Fitzgerald, 1979), and the sale area is known to be affected by both (Nelson et al., 1972, 1975)." The concentrations reported for the sale area are very high, exceeding the Federal chronic criterion for marine waters (0.025 ppb) by a factor of 10. The Draft Environmental Impact Statement (Minerals Management Service 1988) continues: "During the process of offshore mining, trace-metal concentrations in the water column may be increased (1) through the release of metals dissolved in interstitial waters, (2) by washing metals off of dredged tailings, (3) through the resuspension of particulate trace metals, and (4) by exposing previously buried placer deposits with high-metal content to the water column." Mercury can readily bioaccumulate and biomagnify within the food chain of the ecosystem, increasing from less than 0.002 ppm to several ppm while transferring from sediments to plants to filter-feeding invertebrates to fish to fish-eating birds and finally to bird-eating birds such as peregrine falcons (Gardner et al. 1978, Scheuhammer 1987).

In assessing the impacts of mercury and other trace metals on seabirds (prey species of peregrine falcons breeding in Norton Sound), the Draft Environmental Impact Statement (Minerals Management Service 1988) states: "The specific

effect of toxic metal release from sediments on marine and coastal birds from mining/dredging operations in the proposed lease area is unknown. Assuming that dredging operations excavate sea-bottom sediments with high or elevated levels of mercury (0.034 ppm in sediments), some contamination and bioaccumulation of mercury compounds in marine organisms and birds is considered likely to occur. ...[A] chronic increase in mercury bioaccumulation from this level of dredging activity is likely to result in a significant decline in reproduction and nesting survival for the seabird populations at Bluff, Safety Lagoon, or other local bird populations that forage within the proposed sale area. Part of the 0.034 ppm mercury in sediments recorded in the Nome area could rapidly bioaccumulate through the food chain; from the sediments and water column to plankton and benthic invertebrates, to fish and to seabirds. It could subsequently increase to several ppm in seabird tissues. Mercury doses as low as 2 to 3 ppm can significantly reduce reproduction in some bird species (Scheuhammer, 1987)."

The Norton Sound arctic peregrine falcon population could decline due to reduced prey availability. In a study of peregrine falcons and seabirds nesting at Langara Island, British Columbia, Nelson and Myres (1975) theorized that mercury was responsible for the decline of the ancient murrelet population, the principal prey species of the peregrine falcons in that area. Reduced prey availability is believed to be the primary factor in the decline of the peregrine falcon population at Langara Island.

In addition to potentially reducing prey numbers, increased mercury levels could influence reproduction of arctic peregrine falcons breeding in Norton Sound. The effects of mercury on breeding populations of wild raptors has been difficult to assess because reproduction of most of these populations has been influenced by persistent organochlorine pesticides as well (Newton 1979). Mercury was likely a factor in some of these population declines as indicated by levels of mercury above those now known to reduce reproduction in some raptor species. Mercury levels of about 2 ppm are known to impair breeding success of white-tailed eagles and other raptors (Newton 1979). Mercury levels in the prey of arctic peregrine falcons would be magnified in arctic peregrine falcons themselves. Studies by Enderson and Berger (1968) and Cade et al. (1968) documented 20-fold differentials between body organochlorine residues of prey and egg organochlorine residues of raptors. Mercury, like the persistent organochlorine pesticides, passes readily from one animal to another and is found at highest levels in bird-eating species. The magnification of mercury is greatest in aquatic food chains with concentration factors of hundreds or even thousands compared to concentration factors of two to three in terrestrial food chains (Newton 1979).

The Minerals Management Service (November 1988) concluded that the take of arctic peregrine falcons would likely occur as a result of the proposed lease sale and related mining activity. Given the extreme toxicity of mercury and the effects of this metal on prey species and peregrine falcons in other locations, the Fish and Wildlife Service agrees that take of arctic peregrine falcons would likely occur, either through direct mortality of adults birds or fledged young or through reduced productivity of breeding pairs, or both. Although the Fish and Wildlife Service believes the proposed action would likely result in the take of arctic peregrine falcons, the action would not jeopardize the continued existence of the species.

#### Incidental Take

Section 9 of the Act makes it unlawful for any person to "take" a listed species. As defined by the Act, the term "take" means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct" [16 U.S.C. 1532 (19)]. Further, "harm" is defined to include "an act...[that] may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering" (50 CFR 17.3). However, Section 7(b)(4) of the Act recognizes that a proposed action may result in some taking of individuals of a listed species incidental to the action, although such incidental taking cannot be to such a degree that the continued existence of the species is likely to be jeopardized [see also 50 CFR 402.14 (1)].

Where incidental take may occur, the Fish and Wildlife Service is required by 50 CFR 402.14 (1) to provide the applicant with a written statement that specifies: 1. The impact (i.e., amount or extent) of anticipated take; 2. The reasonable and prudent measures necessary to minimize the amount or extent of incidental take; 3. The terms and conditions, including reporting requirements, that must be complied with by the applicant in order to implement the reasonable and prudent measures; and 4. The procedure to be used to handle or dispose of any individual protected species taken.

1. Amount or Extent of Incidental Take: Increased mercury levels in Norton Sound could result in direct mortality of arctic peregrine falcons, reduced productivity of breeding pairs, and reduced prey availability. The Minerals Management Service (November 1988) concluded that the proposed mining activities would result in a "moderate" effect on the regional population. With 1988 population estimates, this would equate to a take of approximately 3 individuals per year. The Fish and Wildlife Service agrees, but believes the figure would vary annually. It is unlikely that all 12 adults and all of their young would be affected in the same manner in all years due to different nest locations, different feeding habitats of individuals, and different reactions among individual birds to various stimuli. Because of the variability of individual arctic peregrine falcons and the inability to predict the levels of trace metals (especially mercury) that will occur due to the mining operations, neither the Minerals Management Service nor the Fish and Wildlife Service can predict the exact level of take that will occur as a result of the mining activity. However, as mentioned earlier, if the Fish and Wildlife Service anticipates that take will occur, 50 CFR 402.14 directs the Fish and Wildlife Service to specify the amount or extent of anticipated take. If the Fish and Wildlife Service did not specify the amount or extent of anticipated take, the taking of one arctic peregrine falcon would result in the Minerals Management Service being in violation of Section 9(g) of the Act, which prohibits the take of any threatened species. The Fish and Wildlife Service estimates that up to five individuals per year could be taken due to the mining activities. In estimating a take of five individuals per year, the Fish and Wildlife Service acknowledges that there may be years with no take as well as years with a take of as many as five individuals. Should actual take exceed five individuals, the Minerals Management Service will be required to reinstate consultation.

2. Reasonable and Prudent Measures: The Draft Environmental Impact Statement (Minerals Management Service 1988) states: "Bioaccumulation of some trace metals in the marine ecosystem is considered unavoidable under the proposal." Also, "An increase of trace metals (especially mercury) in the local arctic peregrine falcon population and their prey species could lead to a long-term reduction of the population." During our review of the proposed action, the Fish and Wildlife Service has been unable to develop measures to reduce release of trace metals that do not alter the basic design, location, scope, duration, or timing of the action. Potential Stipulation Number 2, "Prohibition of Use of Mercury or Other Toxic Substances in Processing," would limit bioaccumulation of mercury to that released from the sediments by the dredging/mining process. The Fish and Wildlife Service recommends that this stipulation be included as a condition of the Lease Sale in order to minimize the potential for bioaccumulation of mercury in arctic peregrine falcons.

In order to minimize disturbance to nesting arctic peregrine falcons, the Minerals Management Service should incorporate the "Recommended protection measures for peregrine falcons during the nesting period" (attached) as a condition of the Lease Sale. These conditions should apply to all activities associated with outer continental shelf mining activities, including related on-shore activity, and should be incorporated in any proposed mining plans developed by the lessee.

3. Terms and Conditions: In order to be exempt from the prohibitions of Section 9 of the Act, the following terms and conditions must be implemented. Since release and bioaccumulation of trace metals, especially mercury, is considered unavoidable in the proposed action, and since such bioaccumulation could result in the loss of some individuals (Paragraph 1, above), the Minerals Management Service and/or the lessee is required to monitor arctic peregrine falcon nest sites within 15 miles of leased blocks and provide a report by December 1 of each year which describes the extent of the project operations and the status and productivity of arctic peregrine falcon nest sites. Status and productivity of those sites will be compared with those in a control area such as the upper Yukon River index population to determine if significant differences occur.

Comparisons with a control population are essential in order to determine if take is due to the mining activity. The Fish and Wildlife Service monitors the upper Yukon River population annually and will be responsible for that effort. The Fish and Wildlife Service has developed guidelines for monitoring peregrine falcons in Alaska. Basically, study areas must be visited twice during the breeding season, once during incubation to determine the number of territories occupied and the number of pairs attempting to breed, and again when the young are approximately 75 percent of their fledging age to determine productivity and to collect prey remains and addled eggs. The Fish and Wildlife Service will assist Minerals Management Service and/or the lessee in developing a monitoring program, and additional information and guidance will be provided as needed.

In order to document changes, if any, of trace metals (especially mercury) in arctic peregrine falcons in Norton Sound due to mining activities, feather samples from young (hatch year) arctic peregrine falcons in those nest sites within 15 miles of the lease sale area must be collected on an annual basis for the life of the project (or until the species is delisted). Feather samples must be analyzed for trace metal content every second year and compared with those of a control area (e.g., upper Yukon River) and compared over time. The Fish and Wildlife Service will collect feather samples from the upper Yukon River, but the Minerals Management Service and/or the lessee will be responsible for analysis of samples. Off-year feather samples must be archived and analyzed if considered necessary. Feather analysis is the most efficient method of documenting and comparing trace metal levels in birds (Kochert 1972). Since feathers of young arctic peregrine falcons are grown at the nest site, mercury levels in those feathers will reflect mercury levels in the prey species taken in the Norton Sound area. Since arctic peregrine falcons and most of their prey are highly migratory and therefore may accumulate mercury outside the Norton Sound area, analysis of feathers from a sample of young peregrine falcons from a control area (also migratory) will determine if mercury accumulation in birds in the Norton Sound area, if any, is a result of the local environment.

As part of the recovery efforts for arctic peregrine falcons in Alaska, the Fish and Wildlife Service annually monitors selected index populations in Alaska. Procedures for surveys and collection of biological samples have been developed by the Fish and Wildlife Service to assure comparison of data from different investigators and different areas. Proposals for monitoring nest sites and collection and analysis of biological samples must be coordinated with the Endangered Species Branch, Northern Alaska Ecological Services, Fish and Wildlife Service, Fairbanks, Alaska.

4. Procedures for Handling and Disposal: All eggs, chicks, adults or biological samples (eggs, blood, feathers or prey) will be turned over to the Endangered Species Branch, Northern Alaska Ecological Services, Fish and Wildlife Service, Fairbanks, Alaska.

If the allowable take of five individuals annually is exceeded as a result of the proposed actions, the Minerals Management Service will be required to reinstate consultation. Since this allowable take is the expected level and not the level which would dictate a jeopardy opinion, mining operations need not cease should reinstatement of consultation be required.

Three federal agencies are currently permitting or proposing to permit mining operations in Norton Sound. The U.S. Army Corps of Engineers (Corps) and the Environmental Protection Agency are permitting mining operations in near-shore areas, and the Minerals Management Service is proposing a lease sale in off-shore areas. The actions currently permitted or being considered by these three agencies are similar, and the effects of the actions are the same and cannot be differentiated. The major concern of the Fish and Wildlife Service relative to endangered or threatened species is mercury contamination of food eaten by arctic peregrine falcons and reduced prey availability due to mercury contamination. Previous informal consultations with the Corps and the Environmental Protection Agency concluded that mining operations would not

effect arctic peregrine falcons. However, new information relative to mercury levels in Norton Sound was provided in the Draft Environmental Impact Statement (November 1988) prepared by the Minerals Management Service for the outer continental shelf lease sale, and in ascertaining the potential impacts to endangered or threatened species as required by Section 7 of the Act, both the Minerals Management Service and the Fish and Wildlife Service concluded that ongoing and proposed mining activity in Norton Sound would likely result in the take of arctic peregrine falcons. Both agencies also identified the difficulty in differentiating the take of arctic peregrine falcons resulting from outer continental shelf activities from mining activities on near-shore areas. This new information led the Fish and Wildlife Service to request that the Corps and the Environmental Protection Agency reinstate Section 7 consultation, and to suggest that, due to the difficulty in differentiating take resulting from different mining activities the three permitting agencies jointly consult. Because the Mineral Management Service was concerned that joint consultation would delay a final Biological Opinion, the Fish and Wildlife Service agreed to issue separate opinions, even though each opinion would have the same conclusion. It is important that all federal agencies realize the although each opinion will allow the take of five arctic peregrine falcons, that number represents the total allowable take before reinstatement is required. In other words, the allowable take is five, not 15, arctic peregrine falcons, and if take exceeds five, all three agencies will be required to reinstate consultation. The monitoring requirements in each opinion will be the same, thus we encourage the three agencies to meet and discuss their respective roles in conducting the monitoring effort.

This concludes formal consultation on this action. Reinstatement of formal consultation is required if the amount of incidental take is exceeded, if new information reveals that effects of the action may impact listed species in manner or to an extent not considered in this opinion, if the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in this opinion, or if a new species is listed or critical habitat designated that may be affected by this action.

Thank you for your concern for endangered species.

Attachments

*Walter D. Stoughton*

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#### Recommended Protection Measures for Peregrine Falcons During the Nesting Period

The following protection measures are intended as general guidelines and may not be appropriate in all situations. The level of protection needed may vary with topography, vegetation and the sensitivity of individual birds to human activity. When feasible, proposed activities should be examined on a case-by-case basis by a biologist knowledgeable of the habits and behavior of Peregrine Falcons.

##### A. Within 1 mile of nest sites:

1. Require aircraft to maintain minimum altitudes of 1,500 feet above nest level from April 15 through August 31.
2. Prohibit all ground level activity from April 15 through August 31 except on existing thoroughfares.
3. Prohibit habitat alterations or the construction of permanent facilities.

##### B. Within 2 miles of nest sites:

1. Prohibit activities having high noise levels from April 15 through August 31.
2. Prohibit permanent facilities having high noise levels, sustained human activity, or altering limited, high quality habitat (e.g. ponds, lakes, wetlands and riparian habitats).

##### C. Within 15 miles of nest sites:

1. Prohibit alteration of limited high quality habitat which could detrimentally and significantly reduce prey availability. Of particular concern area ponds, lakes, wetlands and riparian habitats.
2. Prohibit use of pesticides. The only exception may be limited non-aerial application of approved non-persistent insecticides.





# United States Department of the Interior

MINERALS MANAGEMENT SERVICE  
WASHINGTON, D.C. 20240

JAN 23 1990

RECEIVED

JAN 29 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

Memorandum

To: Director, U.S. Fish and Wildlife Service  
From: Director, Minerals Management Service  
Subject: Reinitiation of Endangered Species Act (ESA) Section 7 Formal Consultation for a Proposed Outer Continental Shelf (OCS) Mining Program Lease Sale in Norton Sound, Alaska

On June 7, 1989, the U.S. Fish and Wildlife Service (FWS) issued to the Minerals Management Service (MMS) an ESA section 7 biological opinion for a proposed OCS Mining Program lease sale in Norton Sound, Alaska. This opinion concluded that mining in Federal waters is not likely to jeopardize the continued existence of threatened peregrine falcons but that their incidental take (IT) may occur owing to high concentrations of ambient toxic trace metals, particularly mercury. Preliminary studies indicated that mercury levels in the water column exceeded Federal water quality criteria, which could result in bioaccumulation of mercury in falcons feeding on contaminated prey. This conclusion also reflected findings of a recent Alaska Department of Fish and Game raptor survey in the Norton Sound area, which showed a larger falcon population there than had been previously thought to exist. The "reasonable and prudent measures" identified by FWS to minimize the amount or extent of IT focused on monitoring the Norton Sound peregrine population for mercury accumulations.

As discussed at the November 1989 monitoring workshop attended by FWS personnel (and documented in the attached results of a more recent MMS-funded analysis), the best currently available data indicate that Federal criteria for cadmium and mercury would not be exceeded. (Battelle's complete report on the analyses is expected shortly; copies will be sent immediately on receipt to FWS offices in Anchorage and Fairbanks.) Besides data on trace metal concentrations, MMS also has more information on the structure and conditions of the sale. This information is described in a second attachment to this memorandum. Because some of this "new information" differs significantly from what FWS considered relative to its June 1989 biological opinion, we hereby request reinitiation of formal consultation on all operations attendant offshore leasing and mining in the Norton Sound area. In view of the new information, we believe the FWS concerns about toxic trace metals are no longer warranted, and the recommended monitoring program is no longer needed.

If a meeting or further information is needed, FWS regional or field office personnel should contact MMS regional staff directly. To avoid an unnecessary delay in reinitiating this consultation, copies of this memorandum and attachments are being sent directly to the FWS Regional Director in Anchorage and the FWS Ecological Services Field Supervisor in Fairbanks.

Should problems arise or your staff consider a potential finding of "jeopardy," we strongly request that our respective staffs discuss the problem or finding, as well as potential "reasonable and prudent alternatives" and any IT terms and conditions, as early as possible during the consultation to minimize or prevent later confusion or misunderstandings.

It is MMS's position that by FWS providing us with an updated biological opinion for the proposed OCS Mining Program lease sale in Norton Sound, FWS will not be foreclosing on opportunities to reconsider that opinion if the proposal or likely effects change significantly or if future lease sales are proposed for this area.

If you have any questions about this request, please contact Mr. Jackson E. Lewis, Minerals Management Service (Mail Stop 644), Parkway Atrium Building, 381 Elden Street, Herndon, Virginia 22070-4817 (commercial telephone: 703-787-1729; FTS: 393-1729), or Mr. Dan Benfield, Minerals Management Service, Alaska OCS Region, 949 East 36th Avenue, Anchorage, Alaska 99508 (commercial and FTS telephone: 907-261-4672).

/s/ Barry A. Williamson

Barry A. Williamson

2 Attachments

cc: Regional Director  
U.S. Fish and Wildlife Service  
1011 East Tudor Road  
Anchorage, Alaska 99503

Supervisor  
Ecological Services Field Office  
U.S. Fish and Wildlife Service  
101--12th Avenue, Box 20  
Fairbanks, Alaska 99701

bcc: MMS General  
Director's Chron  
AS/LM, AD/CMM  
Frank DeLuise, FWS  
Regional Director, RS/LE, RS/FO, Alaska Region  
Dan Benfield, Alaska Region  
Chief, OSIM  
OEAD RF  
Official File BEO (goldsa1e) & ESA Alaska/Bering  
Chief, BEO  
Turner, Lewis, Sun, Valiulis  
BEE/BEM/BES  
Offshore Chron (1)/(2)  
BEO RF

LMS:OEAD:MS644:Lewis:1m:1/9/90:9-787-1729:Lewis:fswgold.mem

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IN REPLY REFER TO:

**Copy For  
Your Information**  
United States Department of the Interior



FISH AND WILDLIFE SERVICE  
1011 E. TUDOR RD.  
ANCHORAGE, ALASKA 99503

NAES/DOS

JUN 26 1990

Memorandum

To: Regional Director  
Minerals Management Service, Alaska

From: Regional Director      Original Signed By  
Region 7                      Walter O. Steglitz

Subject: Reinitiation of Section 7 Consultation for the Outer  
Continental Shelf Mining Program, Norton Sound Lease  
Sale

This responds to your January 23, 1990, subject memorandum requesting reinitiation of Section 7 consultation of the proposed Norton Sound Mining Program Lease Sale. Minerals Management Service's stated purposes for reinitiating Section 7 consultation are based on the need to (1) evaluate analysis of new data about mercury levels in water and organisms in the Norton Sound area as well as (2) assess the ramifications of new information on the structure and conditions of the sale. The only species considered in this consultation is the threatened Arctic Peregrine Falcon (Falco peregrinus tundrius).

Background

On February 18, 1988, the Regional Director, Minerals Management Service, Alaska, notified the Regional Director, Region 7, U.S. Fish and Wildlife Service (Service), of the proposed Outer Continental Shelf Mining Program Lease Sale in Norton Sound. In that memorandum, Minerals Management Service listed the endangered and threatened species under the Service's jurisdiction. On March 29, 1988, the Service concurred with that list. Subsequently, Minerals Management Service sent the Service on April 4, 1988, the Biological Assessment for the proposed sale. On May 24, 1988, the Service concurred with Mineral Management Service's conclusion that the threatened Arctic Peregrine Falcon would not likely be affected adversely by the proposed leasing and mining program. This conclusion, and subsequent concurrence, assumed that the Service's recommended protection measures for Arctic Peregrine Falcons would be included in the lessees' plans and that Federal water quality criteria (marine chronic) would not be exceeded, especially for mercury and cadmium.

The Draft Environmental Impact Statement (Minerals Management Service, 1988), released after the above correspondence, reviewed available data on Norton Sound trace metals. This review showed that water quality in the proposed mining area may fail already to meet Federal criteria. Additionally, a raptor survey (1988) showed that the Norton Sound area sustained a much larger Arctic Peregrine Falcon nesting population than previously documented. Because the local Arctic Peregrine Falcon population is larger than the Biological Assessment addressed and the potential for bioaccumulation of trace metals in this local population is a valid concern, Minerals Management Service determined that the assessment's conclusion that the proposed project would not likely adversely affect the Arctic Peregrine Falcon may no longer be valid.

Therefore, Minerals Management Service requested reinitiation of formal consultation. On June 7, 1989, the Service issued a biological opinion for the lease sale which concluded that the proposed action would not likely jeopardize the continued existence of the Arctic Peregrine Falcon but that the incidental take of some individuals was likely to occur. Minerals Management Service conducted additional mercury sampling and analysis in 1989 and concluded that previous analyses were in error and that mercury levels were, in fact, below Federal water quality criteria. Based on those new findings, Minerals Management Service prepared a Second Draft Environmental Impact Statement (Minerals Management Service, 1990), and reinitiated Section 7 consultation on January 23, 1990. On April 27, 1990, the Service requested a 60-day extension of the consultation period in order to review all additional available mercury data. This memorandum represents the second Biological Opinion of the Service on the Norton Sound Lease Sale.

Project Description

The proposed project has changed somewhat since the June 7, 1989, Biological Opinion. The updated project description follows. The area of the proposed project consists of approximately 59,530 hectares (147,050 acres) in the Norton Sound area near Nome, Alaska, ranging from 5 to 22 kilometers (3.1 to 13.6 miles) offshore. The proposed offshore mining activities are planned for water depths ranging from 20 to 30 meters during the ice-free period (late May/early June to late October/early November). The lease period with its associated activities is estimated to be 20 years, and it is expected that the first three to four years will be devoted to assessing mineral potential within the leased area through low-resolution, shallow seismic exploration and core drilling operations. An estimated 12,400 kilometers (7440 miles) of seismic lines will be completed.

It is anticipated that one (most likely case) to two (high case) offshore mining operations will be operating annually beginning in the fourth or fifth year through the end of the lease period. An estimated 525 to 1050 hectares (1300 to 2600 acres) of marine

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bottom is projected to be mined and altered during the estimated 20 years of the proposal. Bucket-ladder type dredges will be used to mine the sea floor to an average depth of 3.6 meters. Bucket-wheel or cutter-head suction dredges may also be used. Seawater (47.8 million gal/day) will be used in extracting minerals from the mined substrate. The spoil material will be composed of out-washings from the dredge. Coarse materials will be discharged by conveyor belt, and process tailings will be discharged through an 8- to 10-inch elephant-trunk pipe near the sea floor. One tending vessel (usually a tug) and three helicopter flights per day are expected to support each offshore mining operation. The proposed activity is described in detail in the Norton Sound Lease Sale Second Draft Environmental Impact Statement (Minerals Management Service, 1990).

#### Effect on Peregrine Falcons

The Arctic Peregrine Falcon is geographically distributed throughout the tundra regions of North America. In Alaska, this includes the area north of the Brooks Range and along the west coast south to and including Norton Sound. The Service estimates that 200 pairs historically occupied Alaska. Beginning in the late 1940s, the use of the pesticide Dichloro-diphenyl-trichloroethane and its metabolites (hereafter referred to as organochlorine pesticides) greatly affected Arctic Peregrine Falcons, causing birds to lay thin-shelled eggs which often failed to hatch and consequently lowered reproduction.

In Alaska, the population declined to approximately 30 percent of historical levels by 1972, at which time the United States restricted the use of organochlorine pesticides. The population remained stable for the next six years, and in 1978 the population began to increase. In 1984 the Service, prompted by markedly improved numerical levels, changed the status of the Arctic Peregrine Falcon from endangered to threatened. In 1989, surveys by the Service, Bureau of Land Management, and the Alaska Department of Fish and Game located 117 pairs, 14 lone adults and 190 young in northern and western Alaska. Twenty-three of the nest sites were in the Norton Sound area, and six were within 15 miles of the proposed action.

The Second Draft Environmental Impact Statement (Minerals Management Service, 1990) summarized the expected effect of the proposed Norton Sound Lease Sale on Arctic Peregrine Falcons as follows (page IV-B-112):

"A local population of six arctic peregrine falcon nest sites could be exposed to the following potential effect-producing agents from the proposed OCS Mining Program Norton Sound Lease Sale: habitat alteration, turbidity, trace metals, noise and disturbance, and fuel spills. There would be a potential for a MODERATE effect to the arctic peregrine falcon population from trace-metal contamination. However, the effect level would be reduced to negligible assuming

projected low toxic trace-metal levels released by the proposed mining operation (indicated by recent data) and the incorporation of Stipulation Nos. 1, 2, and 3 as part of the proposal. The proposed OCS mining activities are expected to have an overall MINOR effect on the regional arctic peregrine falcon population."

"CONCLUSION (Effect on Arctic Peregrine Falcons): The effect of the proposed OCS Mining Program Norton Sound Lease Sale on the threatened arctic peregrine falcon regional population is expected to be MINOR for the base case."

A MINOR effect was defined as when "a specific group of individuals of a population in a localized area is affected over a short time period (less than one breeding cycle)." A MODERATE effect is defined as when "a portion of a regional population declines in abundance and/or distribution, and recovery requires more than one breeding cycle but less than one generation."

The Second Draft Environmental Impact Statement (Minerals Management Service 1990) for this action presents an overview of the mercury situation in Norton Sound relative to marine and coastal birds and states the following (page IV-B-71):

"Concentrations of mercury (the metallic form) of both human (gold mining) and natural origin (cinnabar ore), are present in the Nome/southern Seward Peninsula area. The marine environment of Norton Sound, particularly the Nome area, has been exposed to mercury and arsenic contamination from gold processing through runoff from contaminated soil and from streams where gold dredging has occurred for decades. Sea bottom sediments constitutes the principle (sic) sink or deposition area for mercury (Birge et al. 1979). Much of this mercury probably is in metallic or inorganic form. However, inorganic or metallic mercury in the sea-bottom sediments (up to 0.6-1.3 ppm) that could be dredged can be readily acted upon by microorganisms and/or chemically converted to methylmercury compounds that are highly absorbable and toxic to marine organisms and that readily bioaccumulate in the ecosystem (Window and Kendall 1979; Silver 1984). Therefore, dredging operations associated with gold mining in the Norton Sound proposed lease-sale area have the potential of significantly increasing the exposure of marine organisms and seabirds to mercury. However, mercury levels in the water column associated with current dredging are low (1-2 ng/L, Sec. IV.B.2.) indicating that very little mercury is being released from the sediments."

In assessing the impacts of mercury and other trace metals on seabirds (prey species of peregrine falcons breeding in Norton Sound), the Second Draft Environmental Impact (Minerals Management Service, 1990) states (page IV-B-71):

"The effect of mercury contamination on seabirds depends on: (1) the form in which the mercury is in when exposure occurs (sic) (methylmercury is the most toxic form at low levels, 2-3 ppm); (2) the species of bird contaminated; and (3) the presence or deficiency of other trace elements or metals in the birds such as selenium which, in the case of methylmercury contamination, helps to alleviate the toxicity (Fimreite 1979, Scheuhammer 1987). If dredging operations excavate sea-bottom sediments with high or elevated levels of mercury (up to 0.6-1.3 ppm in sediments), some contamination and bioaccumulation of mercury compounds in marine organisms and birds is considered likely to occur. A chronic increase in mercury bioaccumulation from the above level of dredging activity could potentially contribute to a significant decline in reproduction and nesting survival for the seabird populations at Bluff, Safety Lagoon, or other local bird populations that forage within the proposed sale area. Part of the mercury in sediments recorded in the Nome area is expected to bioaccumulate through the food chain from the sediments and water column to plankton and benthic invertebrates, to fish and to seabirds; and increase in seabird tissues. Mercury doses as low as 2 to 3 ppm can significantly reduce reproduction in some bird species (Scheuhammer, 1987)."

Mercury levels in the prey of Arctic Peregrine Falcons would be magnified in Arctic Peregrine Falcons themselves. Studies by Enderson and Berger (1968) and Cade et al. (1968) documented 20-fold differentials between body organochlorine residues in prey species and organochlorine residues in raptor eggs. Mercury, like the persistent organochlorine pesticides, passes readily from one animal to another, and it is found at highest levels in bird-eating species. The magnification of mercury is greatest in aquatic food chains which exhibits concentration factors of hundreds or even thousands compared to concentration factors of two to three in terrestrial food chains (Newton 1979).

Increased mercury levels could influence reproduction of Arctic Peregrine Falcons breeding in Norton Sound. The effects of mercury, however, on breeding populations of wild raptors has been difficult to assess because reproduction of most of these populations has been influenced by persistent organochlorine pesticides as well (Newton 1979). Mercury was likely a factor in some of these population declines as indicated by levels of mercury above those now known to reduce reproduction in some raptor species. Mercury levels of about 2 ppm in eggs are known to impair breeding success of white-tailed eagles and other raptors (Newton 1979).

Egg and feather samples were collected from Arctic Peregrine Falcons nesting in Norton Sound in 1989. Samples were also collected from Arctic Peregrine Falcons on the Colville River in northern Alaska. Three eggs were collected at three different nest sites in Norton Sound, and 12 eggs were collected in

northern Alaska. Feather samples were collected from 12 nestling peregrine falcons in Norton Sound and from eight nestlings in northern Alaska.

Although the sample size from Norton Sound is small, mercury levels in eggs from northern Alaska appear to be significantly higher than those from Norton Sound (unpaired t test, unequal variances,  $t=1.806$ ,  $df=11.6$ ,  $P=.049$ ). The mean wet weight mercury level in Norton Sound eggs was 1.64 ppm ( $n=3$ , range 1.48-1.77, S.D. 0.147). The mean wet weight mercury level in eggs from northern Alaska was 2.55 ppm ( $n=12$ , range 1.48-7.69, S.D. 1.721).

Feathers from peregrine falcon in Norton Sound contained higher mercury levels than those from northern Alaska, but the difference was significant only to the .104 level (unpaired t tests, unequal variances,  $t=1.324$ ,  $df=13.7$ ,  $P=.104$ ). The mean wet weight mercury level in feathers from peregrine falcons in Norton Sound was 6.383 ppm ( $n=12$ , range 3.0-14.0, S.D. 3.469), and the mean wet weight mercury level in feathers from peregrine falcons in northern Alaska was 4.975 ppm ( $n=8$ , range 3.9-6.8, S.D. 1.015).

The small sample sizes make strict comparisons difficult. It appears that peregrine falcons in Norton Sound are laying eggs with less mercury than those from northern Alaska, but young peregrine falcons in Norton Sounds are taking in mercury quicker than those in northern Alaska. Mercury in eggs and feathers of both populations appear to be near levels which are believed to affect reproduction (Ron Eisler, presentation at 1988 Minerals Management Service Mercury Workshop). Although reproduction of peregrine falcons in Norton Sound and northern Alaska in 1989 did not differ significantly (unpaired t test, equal variances,  $t=.295$ ,  $df=74$ ,  $P=.768$ ), the Service is concerned that any increase in mercury levels in any area could adversely affect peregrine falcons. Mining activity in Norton Sound has the potential to increase mercury levels in the Norton Sound environment.

#### Incidental Take

In both the Draft Environmental Impact Statement (Minerals Management Service, 1988) and the Second Draft Environmental Impact Statement (Minerals Management Service, 1990), Minerals Management Service suggests that take of Arctic Peregrine Falcons could occur as a result of the proposed lease sale and related mining activity. The Service agrees the proposed action could result in the take of Arctic Peregrine Falcons, however, existing data are inadequate and/or fraught with methodological problems. These data, therefore, are not useable to predict what the take will be, if any. Consequently, the Service is unable to conclude that dredging will or will not result in elevated mercury levels in Arctic Peregrine Falcons. Therefore, the Service assumes no take will occur and no incidental take is authorized. Should any

take occur, Minerals Management Service must reinitiate formal consultation with the Service and provide the circumstances surrounding the take. Although the Service does not at this time anticipate any incidental take, the potential for adverse effects on Arctic Peregrine Falcons warrants including the Arctic Peregrine Falcon in the monitoring program described in Stipulation No. 1 (see Conservation Recommendations).

#### Cumulative Effects

Cumulative effects are those effects of future State or private activities on endangered or threatened species or critical habitats that are reasonably certain to occur within the action area subject to this consultation. Future Federal actions will be subject to the consultation requirements established in Section 7 and, therefore, are not considered cumulative in the proposed action. State and private activities reasonably certain to occur near the area of the proposed action include additional mining and dredging near-shore and onshore, and support activities associated with this additional mining. The State has no categorical exclusion on the use of mercury in near-shore or offshore mining which could increase the risk to Arctic Peregrine Falcons.

Oil and gas lease sales have occurred in the Norton Sound area (Lease Sale 57) and exploration activities could be forthcoming. Although offshore lease activities will be subject to Section 7 consultation, near-shore and onshore oil and gas activities may not be subject to Section 7 consultation. These activities could include near-shore and onshore leasing, exploration, development and production; gravel mining, support facilities and road construction to support these activities; and pipelines and related oil and gas transport facilities. Although the impacts of these activities are impossible to predict, the improving status of the Arctic Peregrine Falcon leads the Service to conclude that the cumulative effects of these reasonably certain activities are not likely to affect adversely Arctic Peregrine Falcons.

#### Biological Opinion

It is my biological opinion that the proposed lease sale will not likely jeopardize the continued existence of the Arctic Peregrine Falcon. This opinion is based, in part, on the inclusion of Stipulation No. 2 (prohibition of the use or storage of mercury on-board the dredge) in the lease conditions and the assumption that the Federal water quality criteria (marine chronic) for mercury will not be exceeded.

#### Conservation Recommendations

Section 7(a)(1) of the Endangered Species Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of

endangered and threatened species. The term conservation recommendations has been defined as suggestions of the Service regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information.

The Service believes that an effective monitoring program could detect increases in mercury levels (and possible subsequent declines) in species selected for monitoring. However, given the nature of biological magnification of mercury in the food chain, the Service does not believe that the monitoring program as described in stipulation No. 1 will effectively monitor mercury levels or declines of Arctic Peregrine Falcons. Dr. Anton Scheuhammer (1989) and Dr. Ronald Eisler (1989), both experts in the field of mercury contamination and consultants to Minerals Management Service on the proposed action, recommend that Arctic Peregrine Falcons be included in a monitoring program. As a species at the top of the food chain in Norton Sound, peregrines would be an excellent indicator species, regardless of their listed status. For this reason, the Service recommends that Arctic Peregrine Falcons be included in Stipulation No. 1 as a species that will be monitored. The Service has developed standard survey techniques for peregrine falcons in Alaska and is ready to assist Minerals Management Service in the monitoring program.

In addition to occupancy and productivity surveys, feather samples from nestling peregrine falcons in Norton Sound should be collected for mercury analysis. Feather analysis is the most efficient method of documenting and comparing trace metal levels in birds (Kochert 1972). Since feathers of young Arctic Peregrine Falcons are grown at the nest site, mercury levels in those feathers will reflect mercury levels in the prey species taken in the Norton Sound area. Arctic Peregrine Falcons and most of their prey are highly migratory, and therefore, they may accumulate mercury outside the Norton Sound area. Analysis of feathers from a sample of young peregrine falcons from a control area (also migratory) will show if mercury accumulation, in birds of the Norton Sound area, is a result of the local levels in the environment. In order to document mercury levels in Arctic Peregrine Falcons in Norton Sound, feather samples from young (hatch year) Arctic Peregrine Falcons in those nest sites within 15 miles of the lease sale area should be collected at least every two years. Feather samples should be analyzed for trace metal content and compared with those from a control area (e.g., Colville River) and compared over time. The Service will collect feather samples from the Colville River as part of our Arctic Peregrine Falcon recovery efforts and can provide those data for comparison with Norton Sound data.

This concludes formal consultation on this action. Reinitiation of formal consultation is required if: any listed species are taken; if new information reveals that effects of the action may impact listed species or critical habitat in a manner or to an

extent not considered in this opinion, if the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in this opinion, or if a new species is listed or critical habitat designated that may be affected by this action.

Thank you for your concern for endangered species.

*Walter D. Stutz*

Attachment

#### References

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- Minerals Management Service. 1989. Supplemental Environmental Impact Statement. Draft 5 year Outer Continental Shelf Oil and Gas Leasing Program. Minerals Management Service, Anchorage, AK.
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Dr. William W. Fox, Jr.

2

distribution of sea lions and on the types and levels of effect that might result from Sale 107. (We enclose a copy for your information and understand that NMFS Anchorage Office staff are reviewing a separate copy.) You will note that the draft EIS lacks the detailed population data used by NMFS in its rule listing Steller sea lions as threatened. Presumably, all this information will be considered and summarized in the amended or revised opinion for Sale 107. The MMS plans to describe the status and specifics about Steller sea lions in the endangered species section of the final EIS, and to insert the amended or revised opinion into the appropriate final EIS appendix. To be appropriately factored into the final EIS, we request receipt of the amended or revised opinion at MMS headquarters before October 1, 1990.

If during this formal consultation NMFS considers for Steller sea lions a potential finding of "jeopardy," new conservation recommendations, or incidental take measures, terms, and conditions, we request that our respective staffs discuss these aspects as early as possible during the consultation. Such discussions would be essential to ensure that the alternatives, recommendations, and/or measures are within our authority to control or implement and that they would be feasible, appropriate, and effective. Through these discussions, if they should be needed, MMS believes it would be possible to minimize or prevent later problems or misunderstandings and greatly expedite timely and effective conclusion of the formal consultation.

It is understood that by amending or revising the biological opinion for Sale 107, NMFS will not be foreclosing on opportunities to reconsider that opinion as future lease sales are proposed for this area or as significant new information is developed on impacts or changes in the proposed action.

If you have any questions regarding this matter, please contact Mr. Jackson E. Lewis, Minerals Management Service, Mail Stop 4330, Parkway Atrium Building, 381 Elden Street, Herndon, Virginia 22070-4817 (commercial telephone: 703-787-1742; FTS: 393-1742), or Mr. Dan Benfield, Minerals Management Service, Alaska Region, 949 East 36th Avenue, Anchorage, Alaska 99508-4302 (commercial telephone: 907-261-4672; FTS: 907-869-4672).

Sincerely,

/s/ Ed Cassidy

Ed Cassidy  
Deputy Director

Enclosure



United States Department of the Interior

MINERALS MANAGEMENT SERVICE  
WASHINGTON, DC 20240



Dr. William W. Fox, Jr.  
Assistant Administrator for Fisheries  
National Marine Fisheries Service  
1335 East-West Highway  
Silver Spring, Maryland 20910

JUL 26 1990

Dear Dr. Fox:

On April 5, 1990, the National Marine Fisheries Service (NMFS) issued an emergency interim rule listing the Steller (northern) sea lion as threatened under the Endangered Species Act (ESA). As required when a species is newly listed, the Minerals Management Service (MMS) has reviewed its proposed oil and gas and other lease sales in Alaska to determine whether any sale and/or associated exploration might affect sea lions.

Specifically, MMS has reviewed its proposed oil and gas lease Sales 107 (Navarin Basin), 124 (Beaufort Sea), and 126 (Chukchi Sea), as well as the proposed Norton Sound Mining Program Lease Sale. The areas proposed for oil and gas leasing in the Beaufort and Chukchi Seas are far from Steller sea lion habitat. We have therefore determined that no "may affect" situation exists for any exploration or subsequent activities that might result from Sales 124 and 126. Neither is it likely that activities associated with proposed mining in northern Norton Sound would affect the one or two individuals that reportedly may use the area from time to time (Frost, Lowry, and Burns (1982)). Accordingly, MMS has determined that reinitiation of ESA section 7 formal consultation for the sales proposed for the Beaufort and Chukchi Seas and Norton Sound is not justified or necessary.

Our review of proposed oil and gas lease Sale 107 has, however, caused us to recognize that exploration and subsequent activities (particularly aircraft and vessel support traffic to, from, or near St. Matthew, Hall, St. Lawrence, and the Pribilof Islands) might affect locally present sea lions. In light of this "may affect" situation, and because NMFS's existing ESA section 7 biological opinion for Sale 107 did not address Steller sea lions, MMS hereby requests, under ESA section 7(a)(2), reinitiation of formal consultation for Sale 107 and amendment or revision (as appropriate) of the existing opinion for the sale. (The existing opinion was issued on June 1, 1989.) To facilitate start of consultation, we are sending a copy of this request directly to the NMFS Anchorage Field Office.

The draft Environmental Impact Statement (EIS) for proposed Navarin Sale 107, issued in May 1990, contains information on the



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
NATIONAL MARINE FISHERIES SERVICE  
1225 East-West Highway  
Silver Spring, MD 20910  
OFFICE OF THE DIRECTOR

OCT 25 1990

Mr. Ed Cassidy  
Deputy Director  
Minerals Management Service  
U.S. Department of the Interior  
Washington, D.C. 20240

Dear Mr. Cassidy:

Thank you for your letter regarding the reinitiation of Endangered Species Act (ESA) section 7 consultations as a result of the emergency listing of the Steller sea lion.

We concur with your determination that proposed oil and gas lease sales 124 (Beaufort Sea) and 126 (Chukchi Sea) and the proposed Norton Sound mining program are not likely to affect the continued existence of the Steller sea lion.

We also concur with your determination that lease sale 107 (Navarin Basin) may affect the Steller sea lion and reinitiated formal consultation for the lease sale. The enclosed Biological Opinion concludes that the proposed activities are not likely to jeopardize the continued existence of the Steller sea lion. However, we believe these activities will impact Steller sea lions in the lease sale area. We, therefore, are providing Conservation Recommendations to minimize the impacts on sea lions. We also recommend that the appropriate parties apply for incidental take authorization under Section 101(a)(5) of the Marine Mammal Protection Act so the incidental take of Steller sea lions can be considered.

This concludes consultation responsibilities for these actions. However, consultation must, once again, be reinitiated if new information reveals effects of these activities that may affect listed species or their habitat in a manner or to an extent not previously considered, the identified activities are modified in a manner that causes an effect to listed species or critical habitat that was not considered in the biological opinions, or if another species is listed or critical habitat designated that may be affected by the proposed activities.

If there are any questions please contact Steve Zimmerman in Alaska on 907-586-7939 or Robert Ziobro on 427-2323.

Sincerely,

*Michael F. Zellman*

(for) William W. Fox, Jr.

Enclosure

THE ASSISTANT ADMINISTRATOR  
FOR FISHERIES



P.2/16

OCT 25 10:57 AM '90 NPS-F/OM,F/PR

**SUPPORTING TABLES FOR SECTION III.C.1,  
"THE ECONOMY OF NOME"  
AND SECTION IV.B.8,  
"EFFECT ON THE ECONOMY OF NOME"**



Table C-1  
 Nome Employment and Population Projections  
 With the Sale  
 (Base Case)

Year	Employment					Population		
	Offshore Mining	Basic	Support	Gov't	Total	Native	Non- Native	Total
1980	0	161	566	438	1165	1769	1231	3000
1981	0	171	596	480	1247	1859	1421	3280
1982	0	192	630	469	1291	1917	1478	3395
1983	0	162	697	460	1319	1978	1535	3513
1984	0	152	782	453	1387	2051	1641	3693
1985	0	102	846	464	1412	2118	1714	3832
1986	40	103	835	462	1440	2171	1721	3892
1987	85	131	794	416	1426	2223	1649	3872
1988	85	131	815	375	1406	2276	1581	3858
1989	85	131	833	384	1433	2331	1571	3902
1990	85	131	843	383	1441	2387	1561	3948
1991	85	131	862	396	1474	2450	1584	4034
1992	87	131	876	400	1493	2511	1594	4106
1993	87	131	881	391	1490	2572	1575	4146
1994	87	131	906	413	1537	2643	1614	4257
1995	162	131	947	415	1655	2737	1736	4473
1996	162	131	954	407	1654	2802	1725	4528
1997	162	131	985	438	1717	2887	1794	4681
1998	162	131	1006	452	1751	2965	1830	4795
1999	162	131	1013	442	1748	3036	1810	4846
2000	162	131	1020	433	1746	3109	1779	4888
2001	162	131	1026	422	1741	3184	1741	4925
2002	162	131	1048	436	1777	3260	1741	5001
2003	162	131	1058	430	1781	3338	1726	5064
2004	162	131	1071	428	1792	3418	1709	5127
2005	162	131	1082	423	1799	3500	1688	5188
2006	162	131	1095	421	1810	3584	1668	5253
2007	162	131	1108	418	1820	3670	1648	5318
2008	162	131	1135	438	1866	3764	1671	5435

Sources: State of Alaska, ISER Rural Alaska Model and USDOJ, MMS, Alaska OCS Region.

Table C-2  
 Nome Employment and Population Projections  
 Without the Sale  
 (Base Case)

Year	Employment					Population		
	Offshore Mining	Basic	Support	Gov't	Total	Native	Non- Native	Total
1980	0	161	566	438	1165	1769	1231	3000
1981	0	171	596	480	1247	1859	1421	3280
1982	0	192	630	469	1291	1917	1478	3395
1983	0	162	697	460	1319	1978	1535	3513
1984	0	152	782	453	1387	2051	1641	3693
1985	0	102	846	464	1412	2118	1714	3832
1986	40	103	835	462	1440	2171	1721	3892
1987	85	131	794	416	1426	2223	1649	3872
1988	85	131	815	375	1406	2276	1581	3858
1989	85	131	833	384	1433	2331	1571	3902
1990	85	131	843	383	1441	2387	1561	3948
1991	85	131	862	396	1474	2450	1584	4034
1992	85	131	875	400	1491	2511	1591	4102
1993	85	131	881	391	1487	2571	1571	4142
1994	85	131	906	412	1534	2642	1610	4252
1995	85	131	919	415	1550	2707	1614	4321
1996	85	131	921	400	1537	2772	1584	4355
1997	85	131	952	430	1598	2851	1635	4486
1998	85	131	972	442	1630	2927	1666	4593
1999	85	131	979	433	1628	2997	1647	4644
2000	85	131	986	424	1626	3069	1618	4687
2001	85	131	993	413	1622	3143	1582	4725
2002	85	131	1014	426	1657	3218	1581	4799
2003	85	131	1025	421	1662	3295	1567	4862
2004	85	131	1037	419	1672	3375	1551	4926
2005	85	131	1049	415	1680	3456	1532	4987
2006	85	131	1062	413	1691	3539	1513	5052
2007	85	131	1075	410	1702	3623	1494	5117
2008	85	131	1102	429	1747	3716	1516	5231

Sources: State of Alaska, ISER Rural Alaska Model and USDOJ, MMS, Alaska OCS Region.

**Table C-3**  
**Comparison of Nome Employment and Population With**  
**and Without the Sale**  
**(Base Case)**

Year	Employment			Population		
	With Sale	Without Sale	Difference	With Sale	Without Sale	Difference
1980	1165	1165	0	3000	3000	0
1981	1247	1247	0	3280	3280	0
1982	1291	1291	0	3395	3395	0
1983	1319	1319	0	3513	3513	0
1984	1387	1387	0	3693	3693	0
1985	1412	1412	0	3832	3832	0
1986	1440	1440	0	3892	3892	0
1987	1426	1426	0	3872	3872	0
1988	1406	1406	0	3858	3858	0
1989	1433	1433	0	3902	3902	0
1990	1441	1441	0	3948	3948	0
1991	1474	1474	0	4034	4034	0
1992	1493	1491	3	4106	4102	4
1993	1490	1487	3	4146	4142	4
1994	1537	1534	3	4257	4252	5
1995	1655	1550	105	4473	4321	152
1996	1654	1537	116	4528	4355	172
1997	1717	1598	119	4681	4486	195
1998	1751	1630	121	4795	4593	202
1999	1748	1628	121	4846	4644	202
2000	1746	1626	120	4888	4687	201
2001	1741	1622	119	4925	4725	200
2002	1777	1657	120	5001	4799	201
2003	1781	1662	119	5064	4862	202
2004	1792	1672	119	5127	4926	201
2005	1799	1680	119	5188	4987	201
2006	1810	1691	118	5253	5052	201
2007	1820	1702	118	5318	5117	201
2008	1866	1747	119	5435	5231	203

Sources: State of Alaska, ISER Rural Alaska Model and USDOJ, MMS, Alaska OCS Region.

Table C-4  
Employment and Population Projections  
With the Sale  
(High Case)

Year	Employment					Population		
	Offshore Mining	Basic	Support	Gov't	Total	Native	Non- Native	Total
1980	0	161	566	438	1165	1769	1231	3000
1981	0	171	596	480	1247	1859	1421	3280
1982	0	192	630	469	1291	1917	1478	3395
1983	0	162	697	460	1319	1978	1535	3513
1984	0	152	782	453	1387	2051	1641	3693
1985	0	102	846	464	1412	2118	1714	3832
1986	40	103	835	462	1440	2171	1721	3892
1987	85	131	794	416	1426	2223	1649	3872
1988	85	131	815	375	1406	2276	1581	3858
1989	85	131	833	384	1433	2331	1571	3902
1990	85	131	843	383	1441	2387	1561	3948
1991	85	131	862	396	1474	2450	1584	4034
1992	87	131	876	400	1493	2511	1594	4106
1993	87	131	881	391	1490	2572	1575	4146
1994	87	131	906	413	1537	2643	1614	4257
1995	247	131	978	415	1771	2770	1869	4639
1996	247	131	989	414	1782	2840	1887	4727
1997	247	131	1023	448	1849	2929	1971	4900
1998	247	131	1044	463	1885	3010	2011	5021
1999	247	131	1051	453	1882	3082	1990	5072
2000	247	131	1057	444	1879	3156	1957	5113
2001	247	131	1063	432	1873	3232	1916	5147
2002	247	131	1085	446	1909	3309	1916	5226
2003	247	131	1095	440	1913	3389	1900	5289
2004	247	131	1108	438	1923	3470	1882	5352
2005	247	131	1119	433	1930	3553	1859	5413
2006	247	131	1132	431	1941	3639	1838	5477
2007	247	131	1145	427	1950	3726	1816	5542
2008	247	131	1172	447	1998	3821	1840	5662

Sources: State of Alaska, ISER Rural Alaska Model and USDOl, MMS, Alaska OCS Region.

**Table C-5**  
**Comparison of Nome Employment and Population With**  
**and Without the Sale**  
**(High Case)**

Year	Employment			Population		
	With Sale	Without Sale	Difference	With Sale	Without Sale	Difference
1980	1165	1165	0	3000	3000	0
1981	1247	1247	0	3280	3280	0
1982	1291	1291	0	3395	3395	0
1983	1319	1319	0	3513	3513	0
1984	1387	1387	0	3693	3693	0
1985	1412	1412	0	3832	3832	0
1986	1440	1440	0	3892	3892	0
1987	1426	1426	0	3872	3872	0
1988	1406	1406	0	3858	3858	0
1989	1433	1433	0	3902	3902	0
1990	1441	1441	0	3948	3948	0
1991	1474	1474	0	4034	4034	0
1992	1493	1491	3	4106	4102	4
1993	1490	1487	3	4146	4142	4
1994	1537	1534	3	4257	4252	5
1995	1771	1550	221	4639	4321	318
1996	1782	1537	244	4727	4355	372
1997	1849	1598	251	4900	4486	414
1998	1885	1630	255	5021	4593	428
1999	1882	1628	254	5072	4644	427
2000	1879	1626	253	5113	4687	426
2001	1873	1622	251	5147	4725	423
2002	1909	1657	252	5226	4799	426
2003	1913	1662	251	5289	4862	426
2004	1923	1672	251	5352	4926	426
2005	1930	1680	250	5413	4987	426
2006	1941	1691	249	5477	5052	425
2007	1950	1702	249	5542	5117	425
2008	1998	1747	250	5662	5231	430

Sources: State of Alaska, ISER Rural Alaska Model and USDOl, MMS, Alaska OCS Region.

Table C-6  
Nome Population Projections by Age and Race  
(No Sale Case)

	1980	1985	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
<b>Native: Total</b>	1769	2118	2276	2331	2387	2450	2511	2571	2642	2707	2772	2851	2927	2997	3069	3143	3218	3295	3375	3456	3539	3623
Pre-school (0-4)	180	215	231	237	242	249	255	261	268	275	281	289	297	304	312	319	327	335	343	351	359	368
School-age (5-18)	574	687	738	756	774	795	814	834	857	878	899	925	949	972	996	1019	1044	1069	1095	1121	1148	1175
Adult (19-64)	879	1054	1133	1160	1188	1219	1249	1279	1315	1347	1379	1418	1456	1491	1527	1564	1601	1640	1679	1719	1760	1803
Senior (65+)	136	162	174	179	183	188	192	197	202	207	212	218	224	230	235	241	246	252	258	265	271	278
<b>Non-Native: Total</b>	1231	1714	1581	1571	1561	1584	1591	1571	1610	1614	1584	1635	1666	1647	1618	1582	1581	1567	1551	1532	1513	1494
Pre-school (0-4)	89	123	113	113	112	114	114	113	116	116	114	117	120	118	116	113	113	112	111	110	109	107
School-age (5-18)	239	24	22	22	22	22	22	22	22	23	22	23	23	23	23	22	22	22	22	21	21	21
Adult (19-64)	864	1204	1111	1104	1096	1113	1118	1104	1131	1134	1113	1149	1171	1157	1137	1111	1111	1101	1090	1076	1063	1049
Senior (65+)	39	38	35	35	34	35	35	35	36	36	35	36	37	36	36	35	35	35	34	34	33	33
<b>Total population</b>	3000	3832	3858	3902	3948	4034	4102	4142	4252	4321	4355	4486	4593	4644	4687	4725	4799	4862	4926	4987	5052	5117
Pre-school (0-4)	269	338	345	349	354	362	369	374	384	391	395	407	417	422	428	433	440	447	454	461	468	475
School-age (5-18)	813	711	760	778	796	817	837	856	880	900	921	948	973	995	1018	1042	1066	1091	1116	1142	1169	1196
Adult (19-64)	1743	2258	2243	2263	2284	2332	2367	2383	2446	2481	2491	2567	2627	2648	2664	2675	2712	2740	2769	2795	2823	2852
Senior (65+)	175	200	209	213	217	223	227	232	238	243	247	254	261	266	271	276	281	287	293	299	304	311

Sources: State of Alaska, ISER, Rural Alaska Model and USDOJ, MMS, Alaska OCS Region.

**Table C-7**  
**Nome Population Projections by Age and Race**  
**(Base Case)**

	1980	1985	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
<b>Native: Total</b>	1769	2118	2276	2331	2387	2450	2511	2572	2643	2737	2802	2887	2965	3036	3109	3184	3260	3338	3418	3500	3584	3670
Pre-school (0-4)	180	215	231	237	242	249	255	261	268	278	285	293	301	308	316	323	331	339	347	355	364	373
School-age (5-18)	574	687	738	756	774	795	815	834	857	888	909	936	962	985	1008	1033	1057	1083	1109	1135	1163	1191
Adult (19-64)	879	1054	1133	1160	1188	1219	1249	1279	1315	1362	1394	1436	1475	1510	1547	1584	1622	1661	1701	1741	1783	1826
Senior (65+)	136	162	174	179	183	188	192	197	202	210	215	221	227	233	238	244	250	256	262	268	275	281
<b>Non-Native: Total</b>	1231	1714	1581	1571	1561	1584	1594	1575	1614	1736	1725	1794	1830	1810	1779	1741	1741	1726	1709	1688	1668	1648
Pre-school (0-4)	89	123	113	113	112	114	114	113	116	125	124	129	131	130	128	125	125	124	123	121	120	118
School-age (5-18)	239	24	22	22	22	22	22	22	23	24	24	25	26	25	25	24	24	24	24	24	23	23
Adult (19-64)	864	1204	1111	1104	1096	1113	1120	1106	1134	1220	1212	1260	1286	1272	1250	1223	1223	1212	1201	1186	1172	1157
Senior (65+)	39	38	35	35	34	35	35	35	36	38	38	40	40	40	39	38	38	38	38	37	37	36
<b>Total population</b>	3000	3832	3858	3902	3948	4034	4106	4146	4257	4473	4528	4681	4795	4846	4888	4925	5001	5064	5127	5188	5253	5318
Pre-school (0-4)	269	338	345	349	354	362	369	374	384	402	408	422	432	438	443	448	456	463	470	477	484	491
School-age (5-18)	813	711	760	778	796	817	837	856	880	912	933	961	987	1010	1033	1057	1082	1107	1133	1159	1186	1214
Adult (19-64)	1743	2258	2243	2263	2284	2332	2369	2386	2449	2581	2606	2697	2761	2782	2797	2807	2845	2873	2901	2927	2955	2983
Senior (65+)	175	200	209	213	217	223	228	232	238	248	253	261	268	273	277	282	288	294	300	305	311	318

Sources: State of Alaska, ISER, Rural Alaska Model and USDOJ, MMS, Alaska OCS Region.

**Table C-8**  
**Nome Population Projections by Age and Race**  
**(High Case)**

	1980	1985	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
<b>Native: Total</b>	1769	2118	2276	2331	2387	2450	2511	2572	2643	2770	2840	2929	3010	3082	3156	3232	3309	3389	3470	3553	3639	3726
Pre-school (0-4)	180	215	231	237	242	249	255	261	268	281	288	297	306	313	320	328	336	344	352	361	369	378
School-age (5-18)	574	687	738	756	774	795	815	834	857	898	921	950	976	1000	1024	1048	1073	1099	1126	1153	1180	1209
Adult (19-64)	879	1054	1133	1160	1188	1219	1249	1279	1315	1378	1413	1457	1497	1533	1570	1608	1646	1686	1726	1768	1810	1854
Senior (65+)	136	162	174	179	183	188	192	197	202	212	218	224	230	236	242	247	253	260	266	272	279	285
<b>Non-Native: Total</b>	1231	1714	1581	1571	1561	1584	1594	1575	1614	1869	1887	1971	2011	1990	1957	1916	1916	1900	1882	1859	1838	1816
Pre-school (0-4)	89	123	113	113	112	114	114	113	116	134	135	141	144	143	140	137	137	136	135	133	132	130
School-age (5-18)	239	24	22	22	22	22	22	22	23	26	26	27	28	28	27	27	27	26	26	26	26	25
Adult (19-64)	864	1204	1111	1104	1096	1113	1120	1106	1134	1313	1325	1384	1413	1398	1375	1346	1346	1335	1322	1306	1291	1276
Senior (65+)	39	38	35	35	34	35	35	35	36	41	42	44	44	44	43	42	42	42	42	41	41	40
<b>Total population</b>	3000	3832	3858	3902	3948	4034	4106	4146	4257	4639	4727	4900	5021	5072	5113	5147	5226	5289	5352	5413	5477	5542
Pre-school (0-4)	269	338	345	349	354	362	369	374	384	415	424	439	450	456	461	466	473	480	487	494	501	509
School-age (5-18)	813	711	760	778	796	817	837	856	880	924	948	978	1004	1027	1051	1075	1100	1126	1152	1179	1206	1234
Adult (19-64)	1743	2258	2243	2263	2284	2332	2369	2386	2449	2691	2739	2842	2910	2931	2945	2954	2993	3021	3048	3074	3102	3130
Senior (65+)	175	200	209	213	217	223	228	232	238	253	259	268	275	280	285	290	296	302	307	313	319	326

Sources: State of Alaska, ISER, Rural Alaska Model and USDOJ, MMS, Alaska OCS Region.



**APPENDIX D**

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**MINERALS MANAGEMENT SERVICE,  
ALASKA OCS REGION  
STUDIES PROGRAM**

## Norton Basin-Completed Environmental Studies

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**AUTHORIZATION TO DISCHARGE  
UNDER THE  
NATIONAL POLLUTANT DISCHARGE  
ELIMINATION SYSTEM**



OCT 23 1990

Reply To  
Attn Of: WD-137

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Paul Rusanowski  
Western Gold Exploration and Mining Company, Limited Partnership  
1536 Cole Boulevard, Building #4, Suite 350  
Golden, Colorado 80401

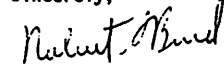
Re: NPDES Permit No. AK-004319-2, WestGold, Mining Vessel BIMA

Dear Mr. Rusanowski:

We are issuing the above referenced National Pollutant Discharge Elimination System (NPDES) permit. The enclosed document authorizes the referenced facility to discharge to the receiving waters indicated in the permit. Also included is the Agency's response to the comments received during the public notice period on the draft permit.

This permit will become effective 30 days after the issuance date unless a request for an evidentiary hearing which meets the requirements of 40 CFR 124.74 is received. A copy of these requirements is enclosed for your information.

Sincerely,

  
Robert S. Burd  
Director, Water Division

Enclosures

cc: Department of Environmental Conservation, Fairbanks  
Office of Management and Budget, Fairbanks



OCT 23 1990

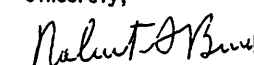
Reply To  
Attn of: WD-137

Re: NPDES Permit No. AK-004319-2, WestGold, Mining Vessel BIMA

To All Interested Parties:

A National Pollutant Discharge Elimination System (NPDES) permit has been issued to the referenced facility. Enclosed is a copy of the transmittal letter, the Agency's Response to Comments, and a copy of the permit. The permit will become effective on the date indicated unless a request for an evidentiary hearing meeting the requirements of 40 CFR 124.74 is received within 30 days.

Sincerely,

  
Robert S. Burd  
Director, Water Division

Enclosures

cc: Alaska Department of Environmental Conservation, Fairbanks  
Office of Management and Budget, Fairbanks

**§ 124.74 Requests for evidentiary hearing.**

(a) Within 30 days following the service of notice of the Regional Administrator's final permit decision under § 124.15, any interested person may submit a request to the Regional Administrator under paragraph (b) of this section for an evidentiary hearing to reconsider or contest that decision. If such a request is submitted by a person other than the permittee, the person shall simultaneously serve a copy of the request on the permittee.

(b)(1) In accordance with § 124.76, such requests shall state each legal or factual question alleged to be at issue, and their relevance to the permit decision, together with a designation of the specific factual areas to be adjudicated and the hearing time estimated to be necessary for adjudication. Information supporting the request or other written documents relied upon to support the request shall be submitted as required by § 124.73 unless they are already part of the administrative record required by § 124.18.

**Note:** This paragraph allows the submission of requests for evidentiary hearings even though both legal and factual issues may be raised, or only legal issues may be raised. In the latter case, because no factual issues were raised, the Regional Administrator would be required to deny the request. However, on review of the denial the Administrator is authorized by § 124.93(a)(1) to review policy or legal conclusions of the Regional Administrator. EPA is requiring an appeal to the Administrator even of purely legal issues involved in a permit decision to ensure that the Administrator will have an opportunity to review any permit before it will be final and subject to judicial review.

(2) Persons requesting an evidentiary hearing on an NPDES permit under this section may also request an evidentiary hearing on a RCRA or UIC permit. PSD permits may never be made part of an evidentiary hearing under Subpart E. This request is subject to all the requirements of paragraph (b)(1) of this section and in addition will be granted only if:

(i) Processing of the RCRA or UIC permit at issue was consolidated with the processing of the NPDES permit as provided in § 124.4;

(ii) The standards for granting a hearing on the NPDES permit are met;

(iii) The resolution of the NPDES permit issues is likely to make necessary or appropriate modification of the RCRA or UIC permit; and

(iv) If a PSD permit is involved, a permittee who is eligible for an evidentiary hearing under Subpart E on his or her NPDES permit requests that the formal hearing be conducted under the procedures of Subpart F and the Regional Administrator finds that consolidation is unlikely to delay final permit issuance beyond the PSD one-year statutory deadline.

(c) These requests shall also contain:

(1) The name, mailing address, and telephone number of the person making such request;

(2) A clear and concise factual statement of the nature and scope of the interest of the requester;

(3) The names and addresses of all persons whom the requester represents; and

(4) A statement by the requester that, upon motion of any party granted by the Presiding Officer, or upon order of the Presiding Officer *sua sponte* without cost or expense to any other party, the requester shall make available to appear and testify, the following:

(i) The requester;

(ii) All persons represented by the requester; and

(iii) All officers, directors, employees, consultants, and agents of the requester and the persons represented by the requester.

(5) Specific references to the contested permit conditions, as well as suggested revised or alternative permit conditions (including permit denials) which, in the judgment of the requester, would be required to implement the purposes and policies of the CWA.

(6) In the case of challenges to the application of control or treatment technologies identified in the statement of basis or fact sheet, identification of the basis for the objection, and the alternative technologies or combination of technologies which the requester believes are necessary to meet the requirements of the CWA.

(7) Identification of the permit obligations that are contested or are inseparable from contested conditions and should be stayed if the request is granted by reference to the particular contested conditions warranting the stay.

(8) Hearing requests also may ask that a formal hearing be held under the procedures set forth in Subpart F. An applicant may make such a request even if the proceeding does not constitute "initial licensing" as defined in § 124.111.

(d) If the Regional Administrator grants an evidentiary hearing request, in whole or in part, the Regional Administrator shall identify the permit conditions which have been contested by the requester and for which the evidentiary hearing has been granted. Permit conditions which are not contested or for which the Regional Administrator has denied the hearing request shall not be affected by, or considered at, the evidentiary hearing. The Regional Administrator shall specify these conditions in writing in accordance with § 124.60(e).

(e) The Regional Administrator must grant or deny all requests for an evidentiary hearing on a particular permit. All requests that are granted for a particular permit shall be combined in a single evidentiary hearing.

(f) The Regional Administrator (upon notice to all persons who have already submitted hearing requests) may extend the time allowed for submitting hearing requests under this section for good cause.

United States Environmental Protection Agency  
Region 10  
1200 Sixth Avenue  
Seattle, Washington 98101

**AUTHORIZATION TO DISCHARGE UNDER THE  
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM**

In compliance with the provisions of the Clean Water Act, 33 U.S.C. §1251 et seq., as amended by the Water Quality Act of 1987, P.L. 100-4, the "Act",

Western Gold Exploration and Mining Company, Limited Partnership  
1536 Cole Blvd, Bldg. #4, Suite 350  
Golden, Colorado 80401

is authorized to discharge from the BIMA, a bucket-ladder dredge mining vessel operating in offshore lease blocks ADL-17867, ADL-17911, ADL-17921, ADL-17929, ADL-17968, ADL-18684 and ADL-57959 located near Nome, Alaska, to receiving waters named Norton Sound, in accordance with the discharge point(s), effluent limitations, monitoring requirements and other conditions set forth herein.

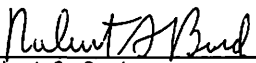
This permit shall be modified or revoked at any time if, on the basis of any new data, the Director determines that this information would have justified the application of different permit conditions at the time of issuance. Permit modification or revocation will be conducted in accordance with 40 CFR 122.62, 122.63, and 122.64 and State of Alaska procedures found at 18 AAC 15.130 and AS 46.03. In addition to any other grounds specified herein, this permit shall be modified or revoked at any time if, on the basis of any new data, the Director determines that continued discharges may cause unreasonable degradation of the marine environment.

Under 40 CFR 122.44(c)(3), if an applicable standard or limitation is promulgated under Sections 301(b)(2)(C-D), 304(b)(2), and 307(a)(2), and the effluent standard or limitation is more stringent than any effluent limitation in the permit or controls a pollutant not limited in the permit, the permit shall be promptly modified or revoked and reissued to conform to the effluent standard or limitation.

This permit shall become effective November 23, 1990 .

This permit and the authorization to discharge shall expire at midnight, November 24, 1995.

Signed this 23rd day of October, 1990.

  
Robert S. Burd  
Director, Water Division, Region 10  
U.S. Environmental Protection Agency

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I. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

A. Dredge Bucket-ladder (Discharge 001).

1. The discharge shall be limited and monitored by the Permittee as specified below:

Effluent Characteristic (units)	Discharge Limitation		Monitoring Requirements	
	Average	Maximum	Sampling Method and Frequency	Monthly Reporting Values
Settleable Solids (m <sup>3</sup> /hr)	21	42	Estimate: 4/month	Average monthly; maximum

B. Trommel Screen Rock Chute (Discharge 002)

1. The discharge shall be limited and monitored by the Permittee as specified below:

Effluent Characteristic (units)	Discharge Limitation		Monitoring Requirements	
	Average	Maximum	Sampling Method and Frequency	Monthly Reporting Values
Settleable Solids, large fraction (m <sup>3</sup> /hr)	--	--	Estimate: 4/month	Average monthly; maximum
Settleable Solids, small fraction (m <sup>3</sup> /hr)	--	--	Estimate: 4/month	Average monthly; maximum

1/ The large fraction of the settleable solids is defined herein as those solids having a maximum width of greater than 1.9 cm (3/4"), generally including pebble, gravel, cobble and boulder.

2/ The small fraction of the settleable solids is defined herein as those solids having a maximum width of equal to or less than 1.9 cm, generally including clay, silt, sand and small pebble.

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C. Process Tailings Launderers (Discharge 003)

1. The combined discharge of the process tailings launderers shall be limited and monitored by the Permittee as specified below:

Effluent Characteristic (units)	Discharge Limitation		Monitoring Requirements	
	Average	Maximum	Sampling Method and Frequency	Monthly Reporting Values
Flow (MGD)	45	56	Estimate; daily	Average monthly; maximum daily
Settleable Solids, small fraction (m <sup>3</sup> /hr)	--	--	Estimate: 4/month	Average monthly; maximum
Suspended Solids (mg/l) <sup>1/</sup>	15,000	30,000	Grab; daily	Average monthly; maximum
Arsenic (ug/l) <sup>2,3/</sup>	234	1,242	Grab; 4/month	Average monthly; maximum
Copper (ug/l) <sup>2,3/</sup>	52.2	52.2	Grab; 4/month	Average monthly; maximum
Lead (ug/l) <sup>2,3/</sup>	100.8	2,520	Grab; 4/month	Average monthly; maximum
Mercury (ug/l) <sup>2,3/</sup>	0.45	37.8	Grab; 4/month	Average monthly; maximum
Nickel (ug/l) <sup>2,3/</sup>	149.4	1,350	Grab; 4/month	Average monthly; maximum

1/ Suspended solids is defined herein as the combination of clay and silt particles.

2/ Metal concentrations shall be measured and reported as total recoverable and total dissolved metals. EPA may reduce the monitoring requirements after the development of a substantial, reliable record of metals concentrations in the discharge plume.

3/ Total recoverable and total dissolved metals shall be measured in accordance with EPA-approved methods which meet the requirements of 40 CFR Part 136 to achieve detection limits for (or at least) As (23 ug/l), Cu (5 ug/l), Pb (10 ug/l), Hg (0.05 ug/l) and Ni (15 ug/l).

2. The average daily discharge of process tailings shall not exceed 10% solids, of which the daily average fines content shall not exceed 25% and the maximum fines content shall not exceed 60%. If any of these values are exceeded, the Permittee shall notify EPA and ADEC within 24 hours and immediately take steps to reduce the percent solids and/or percent fines to within allowable limits.



D. Gold Table Sluice Tailings Launder (Discharge 004)

- The discharge shall be limited and monitored by the Permittee as specified below:

Effluent Characteristic (units)	Discharge Limitation		Monitoring Requirements	
	Average	Maximum	Sampling Method and Frequency	Monthly Reporting Values
Flow (MGD)	--	0.34	Estimate; 4/month	Average monthly; maximum daily
Suspended Solids (mg/l)	15,000	30,000	Grab; 4/month	Average monthly; maximum
Copper (ug/l) <sup>1,2/</sup>	52.2	52.2	Grab; 4/month	Average monthly; maximum
Mercury (ug/l) <sup>1,2/</sup>	0.45	37.8	Grab; 4/month	Average monthly; maximum

<sup>1/</sup> Metal concentrations shall be measured and reported as total recoverable and total dissolved metals. EPA may reduce the monitoring requirements after the development of a substantial, reliable record of metals concentrations in the discharge plume.

<sup>2/</sup> Total recoverable and total dissolved metals shall be measured in accordance with EPA-approved methods which meet the requirements of 40 CFR Part 136 to achieve detection limits for (of at least) Cu (5 ug/l) and Hg (0.05 ug/l).

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E. Non-contact Cooling Water (Discharge 005)

- The discharge shall be limited and monitored by the Permittee as specified below:

Effluent Characteristic (units)	Discharge Limitation		Monitoring Requirements	
	Average	Maximum	Sampling Method and Frequency	Monthly Reporting Values
Flow (MGD)	--	1.8	Estimate; 4/month	Average monthly; maximum daily
Temperature (°C)	10° above ambient	--	Instantaneous; 4/month	Average monthly; maximum

- Surface waters and shorelines within 1,000 meters of the mining vessel shall be virtually free from floating oil, film, sheen or discoloration. Monitoring shall be by visual observation on a daily basis.

F. Sewage Plant Water (Discharge 006)

- The discharge shall be limited and monitored by the Permittee as specified below:

Effluent Characteristic (units)	Discharge Limitation		Monitoring Requirements	
	Average	Maximum	Sampling Method and Frequency	Monthly Reporting Values
Flow (MGD)	--	0.001	Estimate; monthly	Average monthly
Total Suspended Solids (mg/l)	--	50	Grab; monthly	Maximum
Biochemical Oxygen Demand (mg/l)	--	50	Grab; monthly	Maximum

- pH shall be limited to 6.0 - 9.0. Effluent monitoring shall be conducted and reported monthly.

3. Surface waters and shorelines within 1,000 m of the mining vessel shall be virtually free from floating oil, film, sheen or discoloration. Monitoring shall be by visual observation on a daily basis during discharge.
4. There shall be no discharge of floating solids, garbage, grease or foam. Monitoring shall be by visual observation on a daily basis.

G. Other General Requirements

1. All black sands material removed from the dredge material shall be taken to a separate onshore facility for further processing.
2. The discharges shall comply with applicable water quality standards and criteria at the edge of the applicable mixing zones.
  - a. The mixing zone for compliance with standards and criteria for temperature, pH, dissolved oxygen and dissolved metals is circular in shape, has a 100 m radius, and is centered between the process tailing launders. The entire water column within this circular area constitutes the mixing zone.
  - b. The mixing zone for compliance with standards for turbidity and suspended sediments is circular in shape, has a 1,000 m radius, and is centered between the process tailings launders. The entire water column within this circular area constitutes the mixing zone.
3. There shall be no discharge within 30 m (100 ft) of the shoreline at mean lower low water (MLLW).
4. There shall be no discharge within one mile of the mouth of any anadromous fish streams listed in the "Catalog of Waters Important for the Spawning, Rearing and Migration of Anadromous Fish," Alaska Department of Fish and Game, 1985 et seq. During the period June 1 through July 15 there shall be no discharge within one mile plus 1,000 m of the mouth of any such stream, nor within 1,500 m of the seaward tip of the Nome causeway; the Permittee shall coordinate with ADFG regarding discharges during this period.
5. Settleable solids shall be discharged to the area from which they were dredged.
6. All dredge water-intake structures shall be screened and the water-intake velocities across the screened surfaces shall not exceed 0.5 feet per second.
7. The Permittee shall maintain a record of the number and species of pelagic fish entrained in the dredge water-intake structures and the location of the dredge at the time of entrainment. A record of entrained marine life shall be submitted to EPA, ADEC, ADFG and COE in the annual report.

H. Quality Assurance/Quality Control Plan

1. Objective. The quality assurance/quality control (QA/QC) plan shall ensure that all data gathered and information generated in the monitoring of effluent discharges and environmental conditions shall be of sufficient quality to permit well-informed and meaningful interpretation.
2. Implementation. The Permittee shall, during the term of this permit, follow the procedures presented in the document "Quality Assurance Plan for NPDES Effluent and Environmental Monitoring Programs - Nome Offshore Placer Mining Project" (ENSR 1989) and subsequent amendments or revisions to the plan. In particular, the Permittee shall collect and analyze samples in accordance with the QA/QC plan. In addition, all monitoring and analytical equipment shall be maintained in good working order and routinely calibrated. Calibration records shall be kept on all laboratory equipment and effluent monitoring equipment, including, but not limited to, flow meters, pH meters, temperature meters and weighing balances.
3. Records maintenance. The Permittee shall maintain a copy of the QA/QC plan at the facility and provide it to EPA or ADEC upon request.
4. Annual adequacy review and QA/QC amendment. The Permittee shall evaluate the adequacy of the QA/QC program by January 31 of each year and revise it if necessary. A brief evaluation and any proposed changes shall be submitted for review to EPA and ADEC. The proposed changes will take effect upon approval by EPA.
5. Agency review and QA/QC amendment. If the QA/QC plan proves to be ineffective in ensuring the quality of the data gathered and information generated in the monitoring programs, EPA and ADEC shall cooperate in developing appropriate modifications to the plan. The Permittee shall amend the QA/QC plan in accordance with a written request from EPA and submit the plan for review to EPA and ADEC. The proposed changes will take effect upon approval by EPA.

I. Best Management Practices Plan

1. Objective. The best management practices (BMP) plan shall prevent the release or minimize the potential for the release of pollutants from the facility to the waters of the United States through normal operations, runoff, spillage or leaks from any part of the facility or its ancillary activities. The BMP plan shall ensure proper operation and maintenance of the facility.
2. Implementation. The Permittee shall, during the term of this permit, operate the facility in accordance with the "Best Management Practices Plan for the WestGold BIMA - Nome Offshore Placer Project," (WestGold 1990, available upon request) and subsequent amendments or revisions to the plan.

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3. Records maintenance. The Permittee shall maintain a copy of the BMP plan at the facility and provide it to EPA or ADEC upon request.
4. Annual adequacy review and BMP amendment. The Permittee shall evaluate the adequacy of the BMP program by January 31 of each year, and revise it if necessary. A brief evaluation and any proposed changes shall be submitted for review to EPA and ADEC with the Discharge Monitoring Report (DMR) for that month. The proposed changes in the plan will take effect upon approval by EPA.
5. Facility modification and BMP amendment. The Permittee shall amend the BMP plan whenever there is a change in the facility or change in the operation of the facility which materially increases the potential for an increased discharge of pollutants. The Permittee shall also amend the BMP plan, as appropriate, when vessel operations covered by it change. Any such amendments to the BMP plan shall be consistent with the objectives and specific requirements listed above. All changes in the BMP plan shall be reviewed by manager and engineering staff of the facility and shall be submitted for review to EPA and ADEC. The proposed changes in the plan will take effect upon approval by EPA.
6. Agency review and BMP amendment. If the BMP plan proves to be ineffective in ensuring the quality of the data gathered and information generated in the monitoring programs, EPA and ADEC shall cooperate in developing appropriate modifications to the plan. The Permittee shall amend the BMP plan in accordance with a written request from EPA and submit the plan for review to EPA and ADEC. The proposed changes will take effect upon approval by EPA.
- J. Definitions.
1. "Average monthly" means the total units discharged during a monitoring month divided by the number of days in that period that the production facility was operating. Where less than daily sampling is required by this permit, the average shall be determined by the summation of the measured daily discharges divided by the number of days during the monitoring month when the measurements were made.
  2. "Average daily" means the total units measured during a monitoring day divided by the number of samples collected in that day.
  3. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility, as specifically defined at 40 CFR §122.41(m) and described in Part IV.G, below.
  4. "Daily discharge" means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the "daily discharge" is calculated as the average measurement of the pollutant over the day.
  5. A "grab" sample is a single sample or measurement taken at a specific time or over as short a period of time as is feasible.
  6. "Maximum discharge limitation" means the highest allowable discharge; such a maximum may be a daily volume (e.g., flow) or an instantaneous rate (e.g., settleable solids, small fraction).
  7. "mg/l" means milligrams per liter; equal to parts per million (ppm).
  8. "MGD" means million gallons per day.
  9. "Monitoring month" means the period consisting of the calendar weeks which end in a given calendar month.
  10. "NTU" means nephelometric turbidity units.
  11. "Settleable solids/large fraction" is defined herein as those solids having a maximum width of greater than 1.9 cm (3/4"), generally including pebble, gravel, cobble and boulder.
  12. "Settleable solids/small fraction" is defined herein as those solids having a maximum width of equal to or less than 1.9 cm, generally including clay, silt, sand and small pebble.
  13. "ug/l" means micrograms per liter; equal to parts per billion (ppb).
  14. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.
  15. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with permit effluent limitations because of factors beyond the reasonable control of the Permittee as described in Part IV.H, below.

K. List of Acronyms

1. ADEC: Alaska Department of Environmental Conservation, Fairbanks
2. ADFG: Alaska Department of Fish and Game, Fairbanks
3. ASTM: American Society for Testing and Materials
4. BAT: Best Available Technology Economically Achievable
5. BCT: Best Conventional Pollutant Control Technology
6. BMP: Best Management Practices
7. BPJ: Best Professional Judgment
8. BPT: Best Practicable Control Technology Currently Available
9. CFR: Code of Federal Regulations
10. COE: U.S. Army Corps of Engineers, Anchorage
11. DMR: Discharge Monitoring Report
12. EPA: U.S. Environmental Protection Agency Region 10
13. NPDES: National Pollutant Discharge Elimination System
14. ODCE: Ocean Discharge Criteria Evaluation
15. ODES: Ocean Data Evaluation System, U.S. EPA Office of Marine and Estuarine Protection, Washington, D.C., ph. (202) 475-7119.
16. TSS: Total suspended solids

II. Environmental Monitoring ProgramA. Summary Tables1. Monitoring Program Design: Components, Stations, Frequency and Replicate Samples

<u>Monitoring Component and Permit Reference</u>	<u>Station ID</u>	<u>Months and Year*</u>	<u>Replicate Samples</u>
BATHYMETRIC SURVEY Part II.C	R6 and R7: D8:	June-Oct; annually; 1 and 4	Not applicable
WATER QUALITY Receiving water; Part II.D	D100, D500, D1000, U2000	June-Oct; annually; if mining	1 @ each of 1 m, mid-depth and 2 m above the bottom
SEDIMENT Side-scan; Part II.E	C2,C3,S2,S3, R6,R7,D8	June-Oct; 1 and 4 if mining	Not applicable
BIOLOGICAL Benthic macroinvertebrates; Part II.F	C2,C3,S2,S3,R6,R7: D8: others as required	June-Oct; annually; 1 and 4	6

\*Year shall be defined according to the year of operation under the permit.

2. Station Locations

<u>Station</u>	<u>Station Location</u> (within a circle of 10 m radius centered on)
D100	100 m directly down-current of the center of the mixing zone.
D500	500 m directly down-current of the center of the mixing zone.
D1000	1,000 m directly down-current of the center of the mixing zone.
U2000	2,000 m generally up-current of the center of the mixing zone.
C2	Light-subsistence control station in depths of 6-8 m.
C3	Light-subsistence control station in depths of 10-12 m.
S2	Heavy-subsistence control station in depths of 6-8 m.
S3	Heavy-subsistence control station in depths of 10-12 m.
R6	Mined station in depths of 6-8 m; historically R6a.
R7	Mined station in depths of 10-12 m.
D8	Mined station in depths of 14-22 m.

B. Overview and General Requirements.

The Permittee shall develop and implement the bathymetric, water quality, sediment and biological monitoring projects as outlined in Parts II.C-F, below. The goal of the environmental monitoring program is to assess the effect of the discharges from the BIMA bucket-ladder dredge mining vessel on the chemical, physical and biological integrity of the marine environment. The general objectives of these projects are (1) to provide data to assess the efficacy of permit limitations and supporting technical analyses in providing for compliance with applicable water quality standards and criteria, (2) to monitor discharge-related impacts to the environment in areas of greatest expected impact, (3) to assess whether these impacts warrant implementation of further permit conditions, and (4) to provide data to assess any long-term degradation of the marine ecosystem within the Nome offshore placer mining project area.

The Permittee shall submit a plan of study for the environmental monitoring program outlined below on or before January 31 of the year of study to EPA for review. Copies of the study plan shall be sent concurrently to ADEC, ADFG and COE. The plan shall address: (1) the monitoring objectives, (2) appropriate hypotheses, (3) a statistically valid sampling design, (4) all monitoring procedures and methods, (5) a quality assurance/quality control program, (6) a detailed discussion of how data will be used to meet, test and evaluate the monitoring objectives, and (7) a summary of the results of previous environmental monitoring as they apply to the proposed program plan. EPA may require changes in the monitoring program's design before approving the study plan.

The Permittee shall provide the environmental monitoring data on or before December 15 of the year of study to EPA and ADEC. The water quality, sediment and biological data collected shall be coded in the format specified in the Ocean Data Evaluation System (ODES) Data Submissions Guidelines Manual and provided on a computer disk (IBM-PC DOS compatible, ASCII files) at this time. Other computer specifications may be required by EPA in the future. The use of ODES is recommended for subsequent data analysis prior to report preparation.

The Permittee shall analyze the data and submit a draft annual report on or before January 31 of the year following sample collection to EPA. Copies of the draft report shall be sent concurrently to ADEC, ADFG and COE. The annual report shall consider data collected in the summer sampling and shall compare results between stations and years. It shall address the general environmental monitoring objectives, above, and the specific objectives of each monitoring project, below, by using appropriate descriptive and analytical methods to test for and to describe any impacts of the discharge on water quality, seafloor and sediment character, and the biological community. The detection limits and precision requirements of the applied analyses shall be provided.

EPA will review the draft final report in accordance with the environmental monitoring objectives and evaluate it for compliance with the requirements of the permit. If revisions to the annual report are required, the Permittee shall complete them and submit the final annual report to EPA within two months of EPA's request. Copies of the final report shall be sent concurrently to ADEC, ADFG and COE. The Permittee will be required to correct, repeat and/or expand environmental monitoring projects which have not fulfilled the requirements of the permit.

C. Bathymetric Survey

The Permittee shall conduct a bathymetric survey to assess changes in the seafloor's relief in a shallow (6-8 m) and a deep (14-22 m) dredge/discharge study area during June through October. The surveys of stations R6 and R7 shall be conducted annually and the survey of D8 shall be conducted in years 1 and 4 of operation under the permit.

D. Water Quality Monitoring.

1. Objective. The objectives of the water quality monitoring program are to provide a basis for determining compliance with water quality criteria and assessing potential impacts of the discharges on marine biota.
2. Station Locations. Water quality shall be monitored at D100, D500, D1000 and U2000 (Part II.A.2, above). Immediately before sampling, the predominant direction of the current at the outfall shall be determined. Stations shall be chosen at the prescribed distance down-current and up-current from the center of the mixing zone.
3. Frequency and Timing. Water quality samples and measurements shall be collected four times per month of operation, within thirty minutes of the sampling of the process tailings discharge, and during periods of flood tidal currents. The monitoring shall be conducted annually during the mining vessel's operating periods in June through October.
4. Parameters. Total suspended solids (TSS) and turbidity (in NTU) shall be measured at all stations. In addition, total recoverable and total dissolved concentrations of arsenic (As), copper (Cu), lead (Pb), mercury (Hg), and nickel (Ni) shall be measured at (only) stations D100 and U2000.

5. Sampling Procedures. Water samples shall be collected at each station at a depth of approximately one meter beneath the surface, at mid-depth and at a depth approximately two meters above the bottom. The procedure shall be designed to ensure the collection of unbiased samples representative of the chemistry (esp. metals content), turbidity and suspended solids within the water column. Total recoverable and total dissolved metals shall be measured in accordance with EPA-approved methods which meet the requirements of 40 CFR Part 136 to achieve detection limits for (of at least) As (1 ug/l), Cu (1 ug/l), Hg (0.025 ug/l), Ni (1 ug/l) and Pb (1 ug/l).
6. Additional Reporting Requirements. The direction and speed of the local ocean current shall also be recorded and reported for at least five minutes of each sampling period.

E. Sediment Monitoring

1. Side-scan Sonar Survey

The Permittee shall conduct a side-scan sonar survey to assess changes in the seafloor's surficial sediments in shallow (6-8 m) and deep (14-22 m) dredge/discharge study areas during years 1 and 4 of operation under the permit between June through October.

2. Modeling Study: Analysis of the Accumulated Volume of Solids Produced by Dredge Mining Under a Range of Depth, Silt/Clay Content and Current Conditions

The Permittee shall conduct a computer modeling study of deposition patterns associated with mining an average-sized dredge course for depths of 7 m, 10 m, 15 m and 20 m (at MLLW) under simulated conditions of average and high silt-laden substrates. The draft report shall be provided on or before January 31 of the first year of operations under the permit to EPA for review and approval. Copies of the report shall be sent concurrently to ADEC, ADFG and COE. If revisions to the report are required, the Permittee shall complete them and submit the final report to EPA within two months of the EPA's request. Copies of the report shall be sent concurrently to ADEC, ADFG and COE.

F. Biological Monitoring

1. Benthic Grab Study (1): Recolonization of Historical Dredge Sites by Infaunal Macroinvertebrates

- a. Objective. The objective of the biological monitoring of infaunal macroinvertebrates at historical dredge sites is to evaluate the long-term impacts of the discharge (and dredging) on and the recovery times of marine infaunal communities in dredge areas and adjacent areas heavily blanketed by deposition of dredged materials. More specifically, the purpose of this study is to compare the spatial and temporal variability of infaunal communities at historical dredge sites with similar communities at control sites to determine the extent to which the former communities are affected by the mining activity and the time required for their full recovery.
- b. Station Locations. Replicate samples of benthic macroinvertebrates shall be collected at each of stations C2, C3, S2, S3, R6, R7 and D8 (Part II.A.2, above).
- c. Sampling Procedure. Six replicate samples of at least the top 10 cm of the substrate shall be collected at random within a circle of 10 m radius centered on each station using a 0.1 m<sup>2</sup> benthic sampler.
- d. Frequency and Timing. Benthic macroinvertebrate samples shall be collected at stations C2, C3, S2, S3, R6 and R7 annually for both cobble and sand substrates until recovered. Benthic macroinvertebrate samples shall be collected at D8 in years 1 and 4 of operation under the permit.
- e. Sample Processing and Analysis. Samples collected will be passed through a standard 1.0 mm mesh screen and the contents of the screen preserved with 10% formalin solution, buffered with borax. After three days and within one week, the formalin shall be replaced with 70% alcohol containing glycerine at a concentration of 50 ml of glycerine to each liter of alcohol. All organisms except oligochaetes and nematodes which are retained shall be identified to the lowest practical taxonomic level.

The following information and statistical analyses shall be recorded and provided as appropriate in the data and written reports:

- 1) the number of species,
- 2) the total biomass (damp-dry wet weight) and biomass by major taxonomic groups (phylum),
- 3) the total number of individuals and number of individuals by the lowest taxonomic groups identified,

- 4) the mean, standard deviation and range of the number of individuals of the numerically dominant species (i.e., present in at least 50% of the samples) for each station and for all samples collectively,
- 5) cluster analysis,
- 6) species diversity, and
- 7) other analyses as appropriate.

The analysis of subsequent-year monitoring data will include appropriate statistical comparisons of important environmental and ecological parameters and indices from previous sampling years.

The Permittee's quality assurance/quality control program shall address items such as resorting and taxonomic verification of benthic samples.

The Permittee shall store all collected benthic organisms for 4 years and shall not discard any samples without the approval of EPA. Stored samples shall be inspected every three months and alcohol that has evaporated shall be replaced.

The Permittee shall maintain a reference collection of all species collected and provide EPA with a list of the names and experience of those persons responsible for identifying the benthic organisms.

2. Benthic Grab Study (2): Potential Impacts on the Infaunal Macroinvertebrate Community within Mixing Zone

- a. Objective. The objective of the biological monitoring of infaunal macroinvertebrates within the State mixing zone during a dredge mining operation is to determine the impacts of the discharge (and associated sediment deposition) on the marine infaunal communities within the zone. More specifically, the purpose of this study is to compare the temporal variability of infaunal communities of suspension feeders and deposit feeders within the zone of turbidity and sediment impacts with similar communities at control sites to determine the extent to which the former communities are affected by the discharge.
- b. Station Locations. Replicate samples of benthic macroinvertebrates shall be collected at three stations located 100 m, 500 m and 1,000 m distant from the edge of the most proximal boundary of the dredge course in the predominant downcurrent direction.

- c. Sampling Procedure. Six replicate samples of at least the top 10 cm of the substrate shall be collected at random within a circle of 10 m radius centered on each station using a 0.1 m<sup>2</sup> benthic sampler.
- d. Frequency and Timing. Benthic macroinvertebrate samples shall be collected during the first and last week of occupying and mining a dredge tract for a period of at least three weeks during the first year of operations under the permit.
- e. Sample Processing and Analysis. Samples collected will be passed through a standard 1.0 mm mesh screen and the contents of the screen preserved with 10% formalin solution, buffered with borax. After three days and within one week, the formalin shall be replaced with 70% alcohol containing glycerine at a concentration of 50 ml of glycerine to each liter of alcohol. All organisms except oligochaetes and nematodes which are retained shall be identified to the lowest practical taxonomic level.

The following information and statistical analyses shall be recorded and provided as appropriate in the data and written reports:

- 1) the number of species,
- 2) the total biomass (damp-dry wet weight) and biomass by major taxonomic groups (phylum),
- 3) the total number of individuals and number of individuals by the lowest taxonomic groups identified,
- 4) the mean, standard deviation and range of the number of individuals of the numerically dominant species (i.e., present in at least 50% of the samples) for each station and for all samples collectively,
- 5) cluster analysis,
- 6) species diversity, and
- 7) other analyses as appropriate.

The Permittee's quality assurance/quality control program shall address items such as resorting and taxonomic verification of benthic samples.

3. Trace Metals Bioaccumulation Study:

The Permittee shall conduct a study to assess the bioaccumulation of trace metals (As, Cu, Pb, Hg and Ni) in appropriate representative species of the Norton Sound ecosystem. The study shall be conducted in the first year of operations under the permit. The plan of study shall be developed in consultation with EPA, ADEC, ADFG and COE, and provided on or before January 31 of the year of the study to EPA for review and approval. Copies of the report shall be sent concurrently to ADEC, ADFG and COE. The draft report shall be provided on or before October 31 of the year of the study to EPA for review and approval. Copies of the report shall be sent concurrently to ADEC, ADFG and COE. If revisions to the report are required, the Permittee shall complete them and submit the final report to EPA within two months of EPA's request. Copies of the report shall be sent concurrently to ADEC, ADFG and COE.

G. Changes in the Environmental Monitoring Program

1. Expanded Monitoring.

An expanded monitoring program may be required if EPA, in consultation with ADEC, determines that there are significant long-term impacts of the discharge on the biological community, that there is a bioaccumulation of trace metals within the selected representative species of the Norton Sound ecosystem, or that adjustments in the sampling design are necessary. This expanded program may include (1) additional sampling stations to determine the extent of biological impacts, (2) additional sampling times during years 2-5 of operations under the permit and/or (3) additional studies to address concerns for aquatic toxicity and/or human health.

2. Reduced Monitoring.

The environmental monitoring program may be reduced if EPA, in consultation with ADEC, determines that sufficient evidence exists that concerns for and uncertainties pertaining to the risks of the offshore placer mining project to marine life and human health have been addressed. The program may be reduced as to (1) the number of sampling stations or replicates, (2) the frequency of sampling and/or (3) the types of analyses conducted.

III. MONITORING, RECORDING AND REPORTING REQUIREMENTS

- A. Representative Sampling. Samples taken in compliance with the monitoring requirements established under Part I shall be collected from the effluent stream prior to discharge into the receiving waters. Samples and measurements shall be representative of the volume and nature of the monitored discharge.
- B. Monitoring Procedures. Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.
- C. Reporting of Monitoring Results. Monitoring results shall be summarized each month on the Discharge Monitoring Report (DMR) form (EPA No. 3320-1). The reports shall be submitted monthly and are to be postmarked by the 10th day of the following month. Legible copies of these, and all other reports, shall be signed and certified in accordance with the requirements of Part V.H, Signatory Requirements, and submitted to the Director, EPA Water Division and the State agency at the following addresses:  
  
original to: United States Environmental Protection Agency (EPA)  
Region 10  
1200 Sixth Avenue, WD-135  
Seattle, Washington 98101  
  
copy to: Alaska Department of Environmental Conservation (ADEC)  
Northern Region  
1001 Noble Street, Suite 350  
Fairbanks, Alaska 99701  
  
Alaska Department of Environmental Conservation (ADEC)  
Nome District Office  
Nome, Alaska 99762
- D. Additional Monitoring by the Permittee. If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Such increased frequency shall also be indicated.



E. Records Contents. Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements;
2. The individual(s) who performed the sampling or measurements;
3. The date(s) analyses were performed;
4. The individual(s) who performed the analyses;
5. The analytical techniques or methods used; and
6. The results of such analyses.

F. Retention of Records. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by request of the Director or ADEC at any time. Data collected on-site, copies of Discharge Monitoring Reports, and a copy of this NPDES permit must be maintained on-site during the duration of activity at the permitted location.

G. Twenty-four Hour Notice of Noncompliance Reporting.

1. The following occurrences of noncompliance shall be reported by telephone within 24 hours from the time the permittee becomes aware of the circumstances:
  - a. Any noncompliance which may endanger health or the environment;
  - b. Any unanticipated bypass which exceeds any effluent limitation in the permit (see Part IV.G, Bypass of Treatment Facilities);
  - c. Any upset which exceeds any effluent limitation in the permit (see Part IV.H, Upset Conditions); or
  - d. Violation of a maximum daily discharge limitation for any of the pollutants listed in the permit to be reported within 24 hours.
2. A written submission shall also be provided within five days of the time that the permittee becomes aware of the circumstances. The written submission shall contain:
  - a. A description of the noncompliance and its cause;
  - b. The period of noncompliance, including exact dates and times;

- c. The estimated time noncompliance is expected to continue if it has not been corrected; and
  - d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.
3. The Director may waive the written report on a case-by-case basis if the oral report has been received within 24 hours by the Water Compliance Section in Seattle, Washington, by phone, (206) 442-1213.
  4. Reports shall be submitted to the addresses in Part III.C, Reporting of Monitoring Results.

H. Other Noncompliance Reporting. Instances of noncompliance not required to be reported within 24 hours shall be reported at the time that monitoring reports for Part III.C are submitted. The reports shall contain the information listed in Part III.G.2.

I. Inspection and Entry. The permittee shall allow the Director, ADEC, or an authorized representative (including an authorized contractor acting as a representative of the Administrator), upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and
4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the Act, any substances or parameters at any location.

J. Compliance Schedules. Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any Compliance Schedule of this permit (Parts I and II) shall be submitted no later than 10 days following each schedule date.

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## IV. COMPLIANCE RESPONSIBILITIES

A. Duty to Comply. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. The permittee shall give advance notice to the Director and ADEC of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

B. Penalties for Violations of Permit Conditions.

1. Civil Penalty. The Act provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act shall be subject to a civil penalty, not to exceed \$25,000 per day for each violation.

2. Criminal Penalties:

- a. Negligent Violations. The Act provides that any person who negligently violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act shall be punished by a fine of not less than \$2,500 nor more than \$25,000 per day of violation, or by imprisonment for not more than 1 year, or by both.
- b. Knowing Violations. The Act provides that any person who knowingly violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act shall be punished by a fine of not less than \$5,000 nor more than \$50,000 per day of violation, or by imprisonment for not more than 3 years, or by both.
- c. Knowing Endangerment. The Act provides that any person who knowingly violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act, and who knows at that time that he thereby places another person in imminent danger of death or serious bodily injury, shall, upon conviction, be subject to a fine of not more than \$250,000 or imprisonment of not more than 15 years, or both. A person which is an organization shall, upon conviction of violating this subparagraph, be subject to a fine of not more than \$1,000,000.
- d. False Statements. The Act provides that any person who knowingly makes any false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under this Act or who knowingly falsifies, tampers with, or renders inaccurate any monitoring device or method required to be maintained under this Act, shall upon conviction, be punished by a fine of not more than \$10,000, or by imprisonment for not more than 2 years, or by both.

Except as provided in permit conditions in Part III.G., Bypass of Treatment Facilities and Part III.H., Upset Conditions, nothing in this permit shall be construed to relieve the permittee of the civil or criminal penalties for noncompliance.

- C. Need to Halt or Reduce Activity not a Defense. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.
- D. Duty to Mitigate. The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.
- E. Proper Operation and Maintenance. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.
- F. Removed Substances. Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.

G. Bypass of Treatment Facilities:

1. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs 2 and 3 of this section.
2. Notice:
  - a. Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least 10 days before the date of the bypass.
  - b. Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required under Part III.G, Twenty-four Hour Notice of Noncompliance Reporting.
3. Prohibition of bypass.
  - a. Bypass is prohibited and the Director or ADEC may take enforcement action against a permittee for a bypass, unless:
    - (1) The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
    - (2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and
    - (3) The permittee submitted notices as required under paragraph 2 of this section.
  - b. The Director and ADEC may approve an anticipated bypass, after considering its adverse effects, if the Director and ADEC determine that it will meet the three conditions listed above in paragraph 3.a of this section.

H. Upset Conditions.

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of paragraph 2 of this section are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.
2. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:
  - a. An upset occurred and that the permittee can identify the cause(s) of the upset;
  - b. The permitted facility was at the time being properly operated;
  - c. The permittee submitted notice of the upset as required under Part III.G, Twenty-four Hour Notice of Noncompliance Reporting; and
  - d. The permittee complied with any remedial measures required under Part IV.D, Duty to Mitigate.
3. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.
- I. Toxic Pollutants. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

## V. GENERAL REQUIREMENTS

A. Changes in Discharge of Toxic Substances. Notification shall be provided to the Director and ADEC as soon as the permittee knows of, or has reason to believe:

1. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":
  - a. One hundred micrograms per liter (100 ug/l);
  - b. Two hundred micrograms per liter (200 ug/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/l) for 2,4-dinitrophenol and for 2-methyl-4, 6-dinitrophenol; and one milligram per liter (1 mg/l) for antimony;
  - c. Five (5) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7); or
  - d. The level established by the Director in accordance with 40 CFR 122.44(f).
2. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":
  - a. Five hundred micrograms per liter (500 ug/l);
  - b. One milligram per liter (1 mg/l) for antimony;
  - c. Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7); or
  - d. The level established by the Director in accordance with 40 CFR 122.44(f).

B. Planned Changes. The permittee shall give notice to the Director and ADEC as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

1. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source as determined in 40 CFR 122.29(b); or
2. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under Part V.A.1.

C. Anticipated Noncompliance. The permittee shall also give advance notice to the Director and ADEC of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.D. Permit Actions. This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.E. Duty to Reapply. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The application should be submitted at least 180 days before the expiration date of this permit.F. Duty to Provide Information. The permittee shall furnish to the Director and ADEC, within a reasonable time, any information which the Director or ADEC may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director or ADEC, upon request, copies of records required to be kept by this permit.G. Other Information. When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Director or ADEC, it shall promptly submit such facts or information.H. Signatory Requirements. All applications, reports or information submitted to the Director and ADEC shall be signed and certified.

## 1. All permit applications shall be signed as follows:

- a. For a corporation: by a responsible corporate officer.
- b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively.
- c. For a municipality, state, federal, or other public agency: by either a principal executive officer or ranking elected official.

## 2. All reports required by the permit and other information requested by the Director or ADEC shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

- a. The authorization is made in writing by a person described above and submitted to the Director and ADEC, and

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- b. The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)
3. Changes to authorization. If an authorization under paragraph V.H.2 is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph V.H.2 must be submitted to the Director and ADEC prior to or together with any reports, information, or applications to be signed by an authorized representative.
4. Certification. Any person signing a document under this section shall make the following certification:
- "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."
- I. Availability of Reports. Except for data determined to be confidential under 40 CFR Part 2, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Director and ADEC. As required by the Act, permit applications, permits and effluent data shall not be considered confidential.
- J. Oil and Hazardous Substance Liability. Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.
- K. Property Rights. The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

- L. Severability. The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.
- M. Transfers. This permit may be automatically transferred to a new permittee if:
1. The current permittee notifies the Director at least 30 days in advance of the proposed transfer date;
  2. The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them; and
  3. The Director does not notify the existing permittee and the proposed new permittee of his or her intent to modify, or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph 2 above.
- N. State Laws. Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by Section 510 of the Act.

**Response to Comments**  
 Received on the Re-issuance of the NPDES Permit for  
 the WestGold Nome Offshore Placer Mining Vessel, BIMA (AK-004319-2)

The public comment period for the proposed re-issuance of the opened June 4, 1990, and closed August 20, 1990. The following parties submitted written comments:

Al Adams, District L, Alaska State Legislature, Kotzebue, Alaska,  
 Irene Anderson, Land Planner, Sitnasuak Native Corporation, Nome, Alaska,  
 Jeff Burton, Vice President of Lands, Bering Straits Native Corporation, Nome, Alaska,  
 Linda E. Conley, Nome, Alaska,  
 Robert Fagerstrom, President, Sitnasuak Native Corporation, Nome, Alaska,  
 Richard Garnett, Vice President, WestGold, Anchorage, Alaska,  
 John Handeland, Mayor, Nome, Alaska,  
 Tom Johnson, Nome, Alaska,  
 Gary L. Longley, President, Kawerak, Inc., Nome, Alaska,  
 Eloise Montoya-Nelson, Nome, Alaska,  
 Loretta Muktoyuk, Secretary, King Island Native Corporation, Nome, Alaska,  
 Charlotte L. MacCay, Environmental Field Officer, WestGold, Nome, Alaska,  
 Lonnie O'Connor, President, Nome Chamber of Commerce, Nome, Alaska,  
 Paul Rusanowski, Manager of Environmental Affairs, WestGold, Anchorage, Alaska,  
 Alfred Sahlin, Executive Board, Nome Eskimo Community, Nome, Alaska,  
 Don Smith, Bering Strait Economic Council, Nome, Alaska,  
 Alan Steinbeck, Special Assistant for Natural Resources to Senator Murkowski, Anchorage, Alaska,  
 Tim Towarak, President, Bering Strait Economic Council, Nome, Alaska, and  
 Mike Wenig, Staff Attorney, Trustees for Alaska, Anchorage, Alaska.

1. **Comment:** WestGold requested that the discharge limit on settleable solids for the dredge bucket ladder (# 001) be increased from 0.5 m<sup>3</sup>/hr (average) and 1.0 m<sup>3</sup>/hr (maximum) to 21 m<sup>3</sup>/hr (average) and 42 m<sup>3</sup>/hr (maximum). These proposed limits are based upon an average recovery rate of 99% and a maximum loss rate of 2%. WestGold further noted the difficulty and danger in estimating the magnitude of the discharge. Finally, WestGold indicated its willingness to address the efficiency of recovering dredge material from the buckets in its best management practices plan; the company provided specific language to be incorporated in the BMP plan during its 1990-91 revision.

**Response:** EPA accepts the argument that loss rates of 1-2% represent reasonable efficiency limits for the dredge bucket ladder. The permit has therefore been revised at Part I.A.1 to provide limits of 21 m<sup>3</sup>/hr (average) and 42 m<sup>3</sup>/hr (maximum). During a field examination of the BIMA, we found that weekly estimates of the retention rates of the buckets could be obtained upon stopping the operation of the ladder (during shutdowns) through either photography or direct observation of samples of five to ten buckets. Region 10 looks forward to appropriate revisions in the WestGold BMP Plan.

2. **Comment:** WestGold requested that the discharge limit on settleable solids for the trommel screen rock chute (# 002) and process tailings launders (# 003) be eliminated from the NPDES permit. The company observed that the reason for developing the discharge limit on settleable solids was the apparent need to control production rates and attendant discharge volumes in order to limit the plume of suspended solids. The company further observed that the basis for the limits on the discharge of settleable solids at both the rock chute and tailings launders was DIFCD Monte Carlo analyses conducted with relatively small data sets under worst-case scenarios. In order to provide a more complete and accurate technical foundation for understanding and controlling the discharge plume, WestGold undertook and completed the DIFCD modeling study proposed as Part II.E.2 in the draft NPDES permit. The analytical approach was reviewed and approved by EPA, ADEC and ADFG; the public comment period was extended in order to provide adequate time for completion of the analyses. The "DIFCD Modeling Analysis of the BIMA Discharge System for Purposes of NPDES Permit Mixing Zone Evaluation" (EHI, 8/90) concludes that "for the normal range of dredge production rates (400 to 1200 m<sup>3</sup>/hr), the effects of changes in production rate on the turbidity were small ... (and) ... the dredge can operate at its maximum capacity of 1200 m<sup>3</sup>/hr without exceeding water quality standards (under average silt and currents)." WestGold further noted the difficulty and danger in estimating the magnitude of the discharge.

**Response:** EPA has reviewed the expanded DIFCD analyses and finds that the extent of the discharge plume depends primarily upon the fines content of the dredged material rather than the processing rate and discharge volumes of the BIMA. We have therefore determined that

establishing operational limits on the discharge of settleable solids is not required in order to assure compliance with State water quality standards for turbidity. The permit has therefore been revised at Parts I.B.1 and I.C.1 to eliminate limits on the discharge of large and small settleable solids. During a field examination of the BIMA, we found that estimates of the discharge of large and small settleable solids could be made using operating information and photographic techniques. Region 10 concludes that, in light of the many variables determining the nature of the turbid plume, appropriate operational guidelines pertaining to discharges of solids volumes shall be provided in the BMP plan and we look forward to appropriate revisions in the WestGold BMP Plan.

3. Comment: WestGold requested that restrictions on digging depths be eliminated at Parts I.B.2 and I.C.2. The company observed that the reason for developing the discharge limit on minimum depth was to control the plume of suspended solids, thereby protecting State water quality standards. As described in comment no. 2 above, WestGold undertook and completed the DIFCD modeling study proposed as Part II.E.2 in the draft NPDES permit. The "DIFCD Modeling Analysis of the BIMA Discharge System for Purposes of NPDES Permit Mixing Zone Evaluation" (EHI, 8/90) determined that the primary determinants of the turbid plume are percent fines and current velocity. Depth of discharge (and volume of solids discharged) is a secondary determinant which does not present significant risk to violation of State water quality standards for turbidity over the range of depths tested (i.e., 7, 10, 15 and 20 m).

Response: EPA has reviewed the DIFCD modeling study and found that discharges of solids to depths of 5 meters or greater should comply with State water quality standards for turbidity under combinations of average silt-average currents, high silts-average currents, and average silts-high currents. In addition, discharges of solids to depths of 7 m or greater should comply with State standards under all conditions (the previous three plus high silts-high currents). The permit has therefore been revised at Part I.B.2 and I.C.2 to eliminate restrictions on the depth of discharge of settleable solids. Region 10 concludes that, in light of the many variables determining the nature of the turbid plume in waters of 5-7 m, appropriate operational guidelines pertaining to discharges in such shallow seas shall be provided in the BMP plan and we look forward to specific operational procedures addressing the monitoring and control of turbidity within the 1990-91 revision of the BMP plan.

4. Comment: WestGold stated that the flow rate limitations are too restrictive and do not permit replacement of the BIMA's old, inefficient water pumps with newer, more efficient pumps. The company requested that the limitations on average flow be eliminated and on maximum flow be increased to a maximum of at least 56 MGD at Part I.C.1.

Response: EPA concurs that the limitations on flow should provide for the replacement of equipment at the facility. The permit has therefore been revised at Part I.C.1 to provide for average flows of 45 MGD and maximum flows of 56 MGD. Region 10 concludes that, in light of the many variables determining the nature of the turbid plume, appropriate operational guidelines pertaining to flow shall be provided in the BMP plan and we look forward to specific operational procedures addressing the monitoring and control of turbidity within the 1990-91 revision of the BMP plan.

5. Comment: WestGold requested that the restrictions on the solids and silt content of the discharge plume be eliminated at Part I.C.2 of the permit.

Response: EPA finds that the extensive DIFCD modeling analysis provides a technical basis for increasing the limits on percent solids and silt in the process tailings discharge (# 003). The permit has therefore been revised at Part I.C.2 to establish a daily average fines content of 25% and to increase the maximum fines content from 15% to 60%. We do not agree that the plume analyses, which determined that the silt content of the discharge is the primary determinant of turbidity (and suspended solids), provide a basis for eliminating limitations on the solids composition of discharge # 003 and confining the issue of the silt content to the BMP plan. In addition and as above, Region 10 concludes that, in light of the many variables determining the nature of the turbid plume, appropriate operational guidelines pertaining to solids and silt content shall be provided in the BMP plan and we look forward to specific operational procedures addressing the monitoring and control of turbidity within the 1990-91 revision of the BMP plan.

6. Comment: WestGold requested that the limitations on suspended solids in discharges # 003 and 004 be eliminated.

Response: As in response no. 5 above, EPA concludes that limitations on suspended solids are appropriate for a turbid discharge whose plume characteristics are determined primarily by the volumes of fine silts and clays discharged (as well as current velocity).

7. Comment: WestGold requested that the limitations on arsenic, cadmium, lead, nickel and zinc be eliminated from the permit at Part I.C.1 and that detections limits be increased to 10% of the appropriate permit limitations for each metal so limited. The company provided a summary of the record indicating that none of these metals had exceeded its respective water quality criteria more than once 121 samples.

Response: EPA has reviewed the data collected during the past summer in light of previous analyses of metals concentrations in the effluent, in the water column, and in specimens collected for bioaccumulation. We agree that cadmium does not appear to be an issue of concern in any of these three sets of data. We find that the record for the concentrations of arsenic, lead and nickel (as well as copper and mercury) within the water column and marine biota does not clearly demonstrate that the discharge poses no risk of unreasonable degradation. We concur that detection limits of 10% of the respective

effluent limits are adequate to assure compliance with State water quality standards. The permit has therefore been revised at Part I.C.1 to eliminate the limitation on cadmium and zinc and to increase the detection limits to 10% of the respective effluent limitations.

8. **Comment:** WestGold requested that the measurement of metals concentrations in the effluent and water column be conducted using total dissolved methodologies only, and that the requirement for the measurement of total recoverable metals be eliminated at Parts I.C.1 and I.D.1 of the permit. The company cited the comparative results of the 1990 monitoring of both total recoverable and total dissolved metals as evidence that the former, more conservative parameter reflects the metals content of the suspended solids rather than water quality.

**Response:** EPA believes that the limited amount of data generated during the 1990 operating season is a significant start on establishing the relationship between total recoverable and total dissolved metals concentrations associated with the offshore dredge mining operation. Region 10 will utilize Part II.G.2 to reduce the level of monitoring in future years if the monitoring data generated firmly establishes that total dissolved concentrations are sufficient to assessing water quality.

9. **Comment:** WestGold requested that the limitations on and monitoring of copper and mercury in the gold room (# 004) be eliminated at Part I.D.1 of the permit. As in comment no. 7 above, the company requested that detection limits be increased to 10% of the effluent limits in order to the reduce costs of monitoring.

**Response:** EPA believes that the issue of water quality degradation from the effect of the mining operation on concentrations of copper and mercury is, as yet, unresolved. The data generated during past monitoring has been characterized by numerous gaps and inaccuracies. We look forward to utilizing a more complete and accurate set of metals analyses from the 1990 and 1991 seasons in considering the issue and the company's request. Region 10 agrees that the detection limits can reasonably be set at 10% of the effluent limits and has therefore revised the permit at Part I.D.1 to increase the detection limits accordingly.

10. **Comment:** WestGold requested that the monitoring of the flow of non-contact cooling water be estimated rather than measured instantaneously, noting that their engine room's equipment does not include the necessary gauges.

**Response:** EPA acknowledges the sufficiency of estimating flows of discharge # 005 and the permit has therefore been revised at Part I.E.1 accordingly. We believe that the proper maintenance and testing of the engine room pumps and temperature gauges is appropriate for inclusion in the BMP plan and look forward to specific operational procedures addressing these items in the 1990-91 revision of the plan. Additionally, appropriate gauges can be installed during the planned drydock and overhaul of 1991.

11. **Comment:** WestGold requested that the frequency of monitoring the sewage plant discharge (# 006) be reduced in light of the onboard septic facilities' regulation by and compliance with Coast Guard specification for such equipment.

**Response:** EPA agrees that State water quality standards can be protected with monthly monitoring of the flow, total suspended solids and biochemical oxygen demand of the sewage plant discharge. The permit has therefore been revised at Part I.F.1 to provide for less frequent monitoring of the effluent. In addition, we believe that the proper maintenance and testing of the onboard sewage treatment plant is appropriate for inclusion in the BMP plan and look forward to specific operational procedures addressing these items in the 1990-91 revision of the plan.

12. **Comment:** WestGold requested that the permit specify the State water quality standards and federal water quality criteria which are to be met at the boundary of appropriate mixing zones of initial dilution.

**Response:** EPA has revised the permit at Part I.G.2 by listing the parameters referred to within this section.

13. **Comment:** WestGold and numerous public commentors requested that the size of the State mixing zone for turbidity be extended to 1,400 meters in each of the longshore, downcurrent directions within Part I.G.2.b of the permit. The company cited its 1990 DIFCD analyses as demonstrating that 100% compliance with State water quality standards for turbidity requires a mixing zone of this size.

Trustees of Alaska have countered any such increase by requesting that the mixing zone be maintained at 500 m, observing that:

"The enlargement ... of the mixing zone to ensure 100% compliance with (the State water quality standards for) turbidity ... greatly distorts the purpose and limited role of mixing zones and is totally inconsistent with Congress' intent in adopting the water quality standards provisions of the Clean Water Act. Simply put, if mixing zones were calculated as the distance necessary to ensure that water quality standards are being met through a given pollution control technology, there would never be any need for water quality standards. Rather than being established in a manner that will render the water quality standards meaningless, mixing zones should be determined by environmental factors, not solely by the technological capability of the discharger."

**Response:** EPA reminds WestGold and interested members of the public that the purpose of a mixing zone is to provide a limited area of environmental impact within which the discharger is permitted to utilize the dilution within the receiving water in order to comply with the State water quality standards. Under the existing permit a mixing zone of 500 m radius and 0.3 sq. mi. was established. In lieu of any restrictions on its offshore dredge mining operation, WestGold has requested a 1,400 m mixing zone covering 2.38 sq. mi. in order to comply



with State water quality standards. This constitutes an eightfold increase in the zones of environmental impacts which would occur with each of the 4-8 dredge tracts occupied annually.

EPA finds that the precise effects of the turbid discharge, in terms of sediment deposition and sealife mortality, is uncertain. In light of the record of BIMA operations and impacts to date, the results of 1990 DIFCD modeling and the size of mixing zones for turbidity provided in other Alaskan permits, we find that the mixing zone can be extended to a radius of 1,000 m pending the results of further study. These studies will include (1) the modeling of the deposition of sediment around dredge tracts, (2) the biological monitoring of changes in benthic communities within the impacted mixing zones, and (3) a literature review of the environmental impacts associated with turbidity and suspended solids. The permit has therefore been revised at Part I.G.2/b to provide for a 1,000 m mixing zone for turbidity and suspended sediments.

14. Comment: Trustees for Alaska have contended that the State water quality standards do not allow any mixing zone for heavy metals and have requested that none be provided within the permit. The Trustees state that "18 AAC 70.032(a)(1) provides that mixing zones are not allowed, for purposes of applying State water quality standards, if there is a significant potential for adverse environmental or health effects due to discharge of a substance that bioaccumulates in food chains, concentrates in sediments, or is a persistent carcinogenic, mutagenic, or teratogenic ... (substance)."

Response: EPA has required a substantial number of significant monitoring requirements on effluents, water quality, sediment chemistry, and biological indicators. This monitoring has been conducted under the existing permit and will be continued under the reissued permit. Study results obtained to date have not demonstrated that there is a significant potential for adverse environmental or human health effects due to the discharge of heavy metals in association with the large volumes of dredged sediments discharged. It is noteworthy that the BIMA does not add any chemicals to the waste stream; rather, the effluents consist of sorted natural sediments. The definition of a mixing zone of 100 m for arsenic, copper, lead, mercury and nickel serves as a precautionary basis for the establishment of effluent limitations to reinforce the focus on metal concentrations of interest within the monitoring programs. We conclude that no change is necessary to protect the environmental quality of the receiving water or to ensure State water quality standards.

15. Comment: WestGold requested that required monitoring of temperature, salinity and dissolved oxygen be eliminated from the permit at Part II.D.4. The company cited data sets of 141, 69 and 33 samples for T, S and DO respectively which established that the BIMA's discharges have not affected these water quality parameters significantly.

Response: EPA concurs that the BIMA's discharges do not significantly affect T, S or DO within the water column at distances of 100 m or more; measurements of these parameters at the edge of the mixing zones appear to be within the range of natural variability within the receiving water. In light of the additional expense of collecting this information, the permit is revised at Part II.D.4 and 5 to eliminate the monitoring of temperature, salinity and dissolved oxygen.

16. Comment: WestGold requested that measurements of current direction and speed be required for durations of no more than six minutes at the surface and six minutes at the bottom due to the operating constraints of their current meter. The company requested that the permit be revised at Part II.D.6 from ten to six minutes.

Response: EPA staff participated in field monitoring of the discharge during the 1990 operating season and concur that it is not necessary to collect ten minutes of data at each monitoring depth in order to accurately estimate current direction and speed. The permit is therefore revised at Part II.D.6 to provide for monitoring of at least five minutes at each depth, thereby allowing for an operational margin of error within the design of the equipment.

17. Comment: WestGold requested the option to utilize an appropriate model of its choosing (rather than the DIFCD model) to assess sediment accumulation as per Part II.E.3, noting the high costs of analyses using DIFCD.

Response: EPA concurs that other models may provide reliable assessments of sediment deposition at lower costs to the company and therefore revises the permit at Part II.E.2 to allow the Permittee to select an appropriate model for these analyses. The Permittee is directed to confer with EPA, ADEC and ADFG in selecting the sediment deposition model and defining parameters appropriate to its analyses. EPA notes further that WestGold undertook and completed the turbidity modeling required within the draft permit as Part II.E.2 and that this requirement has consequently been withdrawn from the final permit.

18. Comment: WestGold requested that the requirement for a literature review of the environmental impacts of turbidity and suspended solids on marine life be eliminated from the permit at Part II.F.1. The company contended that a literature review pertaining to a general parameter like turbidity is the responsibility of the regulatory agencies.

Response: EPA agrees that a literature review of the environmental impacts of turbidity and suspended solids is indeed applicable to a number of permitted discharges within the Pacific Northwest and will seek the resources to complete the review at government expense. The permit has therefore been revised at Part II.F.1 to eliminate the requirement for a literature review.

19. Comment: WestGold requested that Part II.F.4 provide for the possibility that the prey species specified for collection and analysis within the permit may not be available, and that the permit language require "at least three prey species, preferably Arenicola, Echinarachinus and Travisia if available."

Response: EPA acknowledges that the bioaccumulation study should provide for the possibility that the certain species may not be available. In consultation between ADEC, ADFG and WestGold, a decision to defer the design of the bioaccumulation study was made and specific stipulations were developed within the State's 401 certification.

20. Comment: WestGold has requested the addition of language within the permit to provide for the reduction of effluent monitoring upon the acquisition of data which demonstrates the absence of unreasonable degradation and compliance with State water quality standards.

Response: EPA finds that it is useful and appropriate to provide for the need to either reduce or expand the level of effluent monitoring contingent upon the results of such monitoring and has therefore revised the permit at Part I.G.6 and 7 to provide for such changes.

21. Changes attendant to 401 certification by the State of Alaska:

- (1) The permit has been revised at Parts I.A-D such that the sampling frequency for effluent monitoring of settleable solids, suspended solids and heavy metals is at least 4 times per month;
- (2) The permit has been revised at Part I.G such that there shall be no discharge within one mile plus 1,000 m of the mouth of any anadromous stream or within 1,500 m of the seaward tip of the Nome causeway during the period June 1 through July 15;
- (3) The permit has been revised at Part I.G such that "all dredge water intake structure(s) shall be screened and the water intake velocities across the screened surface(s) shall not exceed 0.5 feet per second;
- (4) The permit has been revised at Part I.G such that "the Permittee shall maintain a record of the number and species of pelagic fish entrained in the dredge water intake structure(s) and the location of the dredge at the time of entrainment. A record of entrained marine life shall be submitted to the EPA, ADEC and ADFG in the annual report;"
- (5) The permit has been revised at Parts II.A and C such that a bathymetric survey of the shallow water mined stations, R6 and R7, shall be conducted annually and a bathymetric and side-scan survey of the deep water mined station, D8, be conducted during the first and fourth years of operation under the reissued permit;

- (6) The permit has been revised at Parts II.A and D such that the water quality monitoring is conducted 4 times per month in the first and second years of operation under the reissued permit;
- (7) The permit has been revised at Parts II.A and D such that the water quality monitoring shall be conducted at 1 m below the surface, at mid-depth and at 2 m above the seafloor;
- (8) The permit has been revised at Part II. such that the detection limit for mercury shall be 0.025 ug./l; and
- (9) The permit has been revised at Parts II.A and F such that the recolonization study of the shallow water control and mined stations, C2, C3, S2, S3, R6 and R7, shall be conducted annually and comparable biological monitoring of the deep water mined station, D8, be conducted during the first and fourth years of operation of the reissued permit.
- (10) The permit has been revised at Parts II.A and F such that the Permittee shall conduct a study to assess the bioaccumulation of trace metals (As, Cu, Pb, Hg and Ni) in appropriate representative species of the Norton Sound ecosystem.

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.

