Alaskan OCS Program Development Plan

PROGRAM DEVELOPMENT PLAN

Environmental Assessment of the Alaskan Continental Shelf

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

U.S. DEPARTMENT OF INTERIOR
Bureau of Land Management

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PROGRAM DEVELOPMENT PLAN

ENVIRONMENTAL ASSESSMENT

OF THE

ALASKAN CONTINENTAL SHELF

DECEMBER 1976

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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PART I

1.0 SUMMARY

The Bureau of Land Management (BLM) has initiated the Outer Continental Shelf Environmental Assessment Program (OCSEAP) in response to national needs for marine environmental studies to assess the effects of OCS oil and gas development and to protect the environment. A study program for the nine lease areas of Alaska plus non-area specific studies is planned and conducted for BLM by the National Oceanic and Atmospheric Administration's OCSEAP offices.

The Program Development Plan presents an applied study program responding to the specific needs, goals and objectives of BLM. A program management system contains the mechanisms for developing and implementing an interdisciplinary scientific program, including providing guidance to investigators, contracting for specific deliverables, and reporting the results and interpretations and recommendations to BLM. This is accomplished through the use of an interdisciplinary staff in the planning activities and in the synthesis and integration of the results.

Both needs stated by BLM and analysis of the program results were used in the planning. A special Users Panel provides other agency input to planning. Meetings are held with the scientists to coordinate efforts and to improve program direction. The planning activity produces annually a Technical Development Plan (TDP) for each of nine lease areas and a Plan for non-area specific studies. After approval by BLM, these plans are implemented by NOAA and the results reported on an annual basis as well as in quarterly status reports.

NOAA-OCSEAP also provides and arranges for the ships (these in large part with NOAA funds) and arranges for the aircraft support needed to operate in the inhospitable Alaskan environment. OCSEAP monitors each contract and evaluates and reports on performance, adjusting resources as needed within the scope of the approved TDPs.

NOAA also manages the data flow from the Alaskan program, from providing formats to reporting the data, to archiving it and performing analyses on it. NOAA monitors and works to improve data quality, both in the encoding and in the instrument quality and calibration aspects.

The products and deliverables of the program are directly and immediately applicable to BLM needs for prediction, assessment, setting stipulations and regulation. They include models for calculating oil transport and for estimating biological damage, charts of geological hazards and of the distribution of biological parameters and biota, probability distributions for hazards, and data sources and banks for future reference and analyses.

The authorized funds for FY 1977 Alaskan program are 21.1 million from BLM, plus NOAA ship-time contributions of $5.0 million. These funds are distributed by lease area in accordance with the lease schedule and deficiencies in environmental information. The planning recognizes that there will be successive sales in the same lease area, and that even after development proceeds, a study and monitoring effort will be essential.

Part II

2.0 INTRODUCTION

2.1 BACKGROUND

Expeditious development of the Outer Continental Shelf (OCS) is essential to meeting the energy needs of our Nation during the remainder of this decade and throughout the next. The OCS oil and gas deposits can provide the largest single source of petroleum during this time when our Nation most needs it. In each OCS area for which development is proposed, extensive environmental studies are to be conducted before such development is allowed. If these studies show that development of specific areas will result in unacceptable environmental risks, leases for those areas will not be issued. As manager of the Outer Continental Shelf Leasing Program, the Bureau of Land Management (BLM) of the Department of Interior (DoI) (BLM) has initiated the Outer Continental Shelf Environmental Assessment Program (OCSEAP) as an essential part of its management responsibilities in order to ensure that the marine environment is not seriously disturbed.

This document is the Program Development Plan for the Alaskan Outer Continental Shelf environmental studies being managed by the National Oceanic and Atmospheric Administration (NOAA) for the Bureau of Land Management. It was developed by the interdisciplinary staff of the NOAA-OCSEAP Office, with input from the Bureau of Land Management, State of Alaska, and Users Panel composed of representatives from several Federal and State agencies and private environmental groups. The planned effort herein described begins with environmental studies already underway.

In May 1974, the Bureau of Land Management requested that the National Oceanic and Atmospheric Administration initiate a program of environmental assessment in the Northeastern Gulf of Alaska in anticipation of a possible oil and gas lease sale in the region early in 1976. These studies, outlined in the document "Environmental Assessment of Northeastern Gulf of Alaska - First Year Program," were initiated in July 1974.

In October 1974, a major expansion of the environmental assessment program was requested by BLM to encompass eight additional areas of the Continental Shelf of Alaska during the FY 1975-1976 period. After an intensive planning effort including workshops, consultations with over 300 scientists and other concerned persons, and public comment, a program proposal equivalent to a plan was published. This document was entitled "Environmental Assessment of the Alaskan Continental Shelf, First 18-month Program - Gulf of Alaska, Southeastern Bering and Beaufort Seas, April 1975."

Since the time that document was approved, the scientific efforts have been extended into the northern Bering Sea, Chukchi Sea, and Lower Cook Inlet. Many of these efforts are simply geographic extensions of the work already underway in earlier areas, which has been subjected to wide review and comment.

This Program Development Plan now brings into one document the planned program for all nine proposed lease areas of the Alaskan OCS, including work underway and planned. The nine areas, extending from the Northeastern Gulf of Alaska (NEGOA) in the south to the Beaufort Sea in the north, are shown in Figure 2-1 and their characteristics are briefly

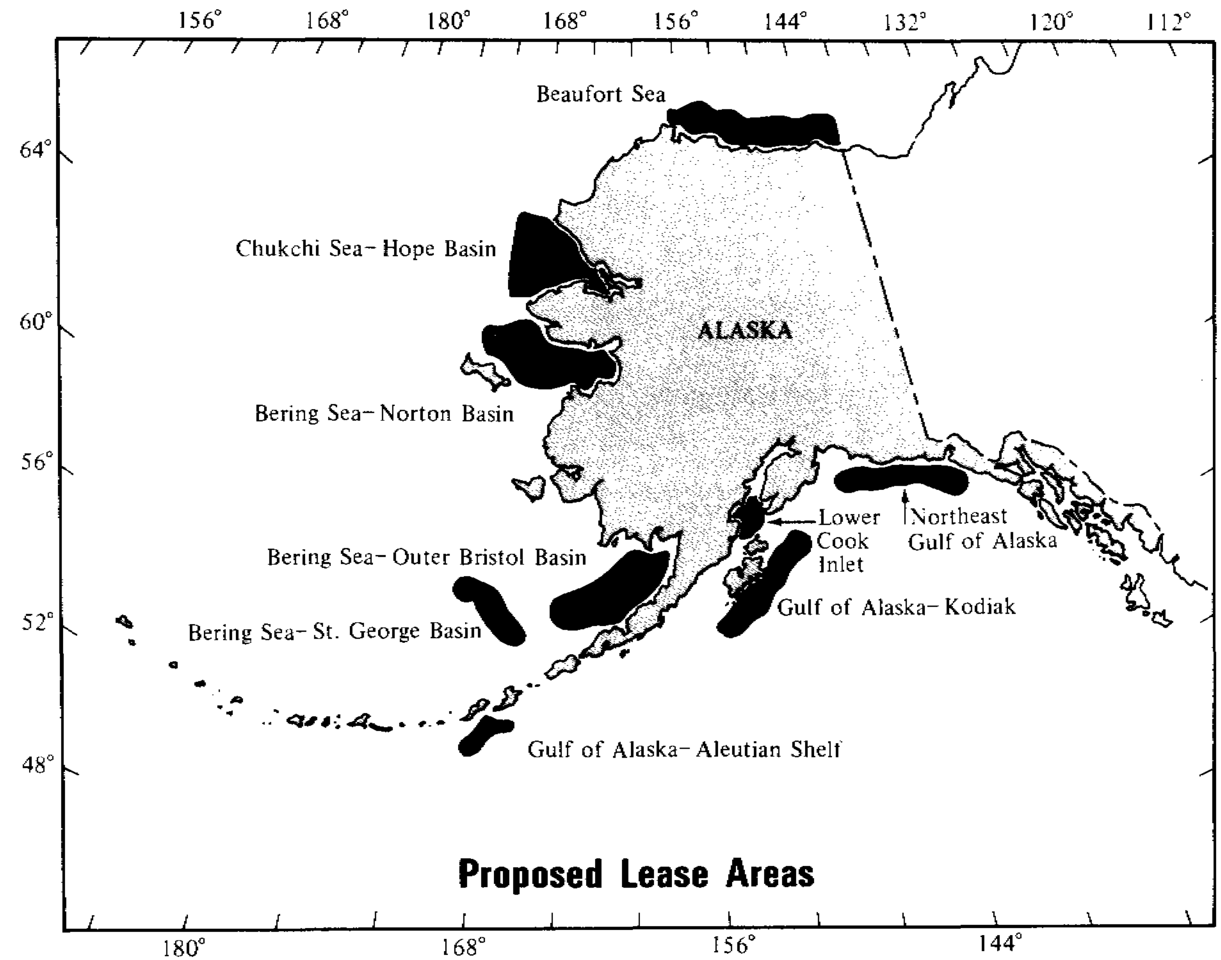
156° 168° 180° 168° 156° 144° 132° 120° 112°
64°
60°
56°
52°
48°
Beaufort Sea
Chukchi Sea- Hope Basin
ALASKA
Bering Sea- Norton Basin
Bering Sea- Outer Bristol Basin
Bering Sea- St. George Basin
Lower Cook Inlet
Northeast Gulf of Alaska
Gulf of Alaska- Kodiak
Gulf of Alaska- Aleutian Shelf
Proposed Lease Areas
180° 168° 156° 144°

Fig.2-1

described in Appendix A. There are only limited amounts of available data and limited numbers of experienced investigators or specialized facilities and platforms for conducting studies under the formidable environmental conditions of the Alaska OCS.

It is recognized that the program will require annual adjustment to fit budget constraints and lease schedules. These adjustments, however, will be made within the overall context of this Plan and will be reflected in an annual Technical Development Plan (TDP) for each lease area describing the studies to be conducted during that year.

The program for each of the nine lease areas evolves from general reconnaissance of biota and physical parameters through site specific studies that provide functional understanding. This understanding can be used in assessment of effects on entire ecosystems from chronic exposures and in initiation of long-term monitoring efforts. The program evolution and rationale for it are elaborated upon in Part IV, Technical Approach. Part IV is organized in a logical engineering program sequence including general approach, user needs, sites of work, related work past and present, the types of studies included in the program, considerations in setting priorities, definition of specific tasks, methods for handling, integrating, and synthesizing the data, and finally definitions of the end products or "deliverables".

Part III describes the goals and objectives for the OCSEA program. Parts V and VI detail the study schedules tied to user needs, and the management structure, established to provide the study products in a usable and timely manner. Appendixes provide essential background material on each geographic lease area, and interagency agreements.

2.2 AUTHORITY

2.2.1 OUTER CONTINENTAL SHELF LANDS ACT OF 1953

The Outer Continental Shelf Lands Act of 1953 established Federal jurisdiction over the submerged lands of the continental shelf seaward of the line delineating the outer limits of the lands conveyed to the coastal states by the Act. The OCS Lands Act charged the Secretary of the Interior with the responsibility for administration of mineral exploration and development of the Nation's Outer Continental Shelf (OCS). The Secretary of the Interior designated the Bureau of Land Management as the administrative agency for OCS leasing and the U.S. Geological Survey for supervising exploration and production. The OCS Lands Act also gives the Secretary of the Interior authority to promulgate such rules and regulations as may be necessary to carry out the leasing provisions, including those required for "the prevention of waste and conservation of the natural resources of the Outer Continental Shelf . . . ."

2.2.2 OTHER OCS RELATED AUTHORITIES

2.2.2.1 NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

The National Environmental Policy Act of 1969 (NEPA) set forth a clear statement of national policy on environmental quality, and created the Council on Environmental Quality (CEQ) within the Executive Office of the President. It also required a statement of environmental impact for every proposed Federal project and all proposed legislation significantly affecting the quality of the human environment, and formal coordination between Federal agencies for major actions undertaken. During the leasing and development procedure, the DOI is required by NEPA to solicit review and comment on proposed actions that will affect the environment.

2.2.2.2. MARINE PROTECTION, RESEARCH, AND SANCTUARIES ACT OF 1972

This legislation addresses problems of ocean dumping, comprehensive marine environmental research programs, and special protection to unique coastal areas. Title II, Section 202, of the Act assigns to the Secretary of Commerce (NOAA) responsibility for initiating comprehensive and continuing programs of research with respect to the possible long-range effects of pollution, overfishing, and offshore development activities. The Act further states that the Secretary, in carrying out the mandated research, shall take into account economic considerations involved in both the protection and the use of the oceans, possible alternatives to existing programs, and ways in which the health of the oceans may be best preserved.

Title III of the Act states that the Secretary of Commerce, after consultation with the heads of other appropriate departments and agencies, may designate as marine sanctuaries those coastal areas that he determines necessary for the purpose of preserving or restoring such areas for their conservation, recreational, ecological, or aesthetic values. The Secretary, prior to designating a marine sanctuary, is also required to consult with, and give due consideration to the views of, the responsible officials of the State involved. After designation of a marine sanctuary, the Secretary shall issue appropriate regulations to control any activities proposed to take place within the designated marine sanctuary. Title III of the Act is also administered by NOAA.

2.2.2.3 COASTAL ZONE MANAGEMENT ACT OF 1972

This legislation addresses management of the Nation's coastal zone in a coordinated and uniform basis. The Act declares that it is national policy to preserve, protect, develop and, wherever possible, to restore or enhance the resources of the Nation's coastal zone for this and succeeding generations. The objectives of the Act are: (1) to encourage and assist the States to develop and implement coastal zone management programs; (2) to foster Federal-State cooperation and joint participation in effectuating the purposes of the Act; and (3) to promote broad participation in the development of State coastal zone management programs. The law authorizes funds for both the development and implementation phases of the State coastal management programs. It also authorizes the Secretary of Commerce to make available to a coastal state grants of up to 50 percent of the costs of acquisition, development, and operation of estuarine sanctuaries for the purpose of studying the phenomena occurring within the estuaries of the coastal zone. The Act is administered by NOAA.

The legislation was amended in 1976 to provide assistance to the coastal states to study, plan for, manage, and control the impact of energy resource development and production affecting the coastal zone. A major feature of the 1976 amendment is the Coastal Energy Activity Impact Program established under Section 308. This new provision authorizes loans and annual automatic grants to coastal states for use in plans and programs designed to provide OCS-related public facilities and services, to retire state and local bonds, and to prevent, reduce or ameliorate unavoidable loss of unique or valuable ecological or recreational resources resulting from OCS development activity.

2.2.2.4 MARINE MAMMAL PROTECTION ACT OF 1972

This legislation limits the taking of marine mammals. The Secretary of Commerce or the Secretary of the Interior, depending on the species, may waive this phohibition only if he receives scientific evidence that the waiver would not endanger the species to be taken. The legislation has for its primary purpose the protection and preservation of mammals in order to maintain the health and stability of the marine ecosystem as a whole. The Act also created the Marine Mammal Commission whose responsibility is to undertake a continuing review of the condition of the stocks of marine mammals and other related matters and to make recommendations to appropriate departments to further the purposes of the legislation.

2.2.2.5 ENERGY RESEARCH AND DEVELOPMENT ACT OF 1975

The special Energy Research and Development Act of 1975, provided for the reactivation of three NOAA vessels ".... for the purpose of conducting surveys, investigations and research connected with the environmental effects of offshore energy-related activities." Specifically, all government agencies are to give preference to the use of these vessels in conducting environmental assessment studies in connection with OCS energy development. These vessels are the primary ship support for the Alaskan OCS environmental studies.

2.2.3 BASIC AGREEMENT BETWEEN NOAA/BLM

The specific authority under which the OCS Environmental Assessment Program is implemented is the Basic Agreement between the National Oceanic and Atmospheric Administration and the Bureau of Land Management. This agreement sets forth the objectives of the BLM environmental studies program and designates NOAA as the manager for Alaskan OCS marine environmental data acquisition and analysis studies. The Basic Agreement also delineates the respective agency responsibilities with respect to funding, reporting requirements, information exchange, project modification, data handling, the news media, and other matters.

PART III

3.0 GOALS AND OBJECTIVES

3.1 GOALS OF THE OCS MANAGEMENT PROGRAM

The passage of the OCS Lands Act in 1953 established Federal jurisdiction over the submerged lands of the Continental Shelf seaward of State boundaries. Subsequent to the passage of this Act, the Secretary of the Interior designated the BLM as the administrative agency for leasing submerged Federal lands and the U.S. Geological Survey (USGS) as the agency for supervising exploration and production. The DOI formulated the following three major goals of a comprehensive management program for marine minerals:

a. Orderly development of the marine mineral resources to meet the energy demands of the Nation.

b. Protection of the marine and coastal environment.

c. Receipt of a fair market value for the leased minerals.

3.2 OBJECTIVES OF THE ALASKA OCS ENVIRONMENTAL ASSESSMENT PROGRAM

The primary objective of the Alaska OCS environmental studies program is to provide background information for management decisions that may be necessary to protect the OCS marine environment from damage during oil and gas exploration and development. The protection of the marine and coastal environment is a direct outgrowth of the National Environmental Policy Act of 1969. The program must develop meaningful data, in a usable form, in a timely manner, so that any required corrective actions can be taken before serious or irreversible impacts occur.

The objectives of the BLM environmental studies program for all OCS areas, including the nine Alaska areas addressed in this Program Development Plan, are:

1. To provide information about the OCS environment that will enable the Department of the Interior and the Bureau of Land Management to make sound management decisions regarding the development of mineral resources on the Federal OCS.
2. To acquire information that will enable BLM to identify those aspects of the environment that might be impacted by oil and gas exploration and development.
3. To establish a basis for prediction of impact on the environment of OCS oil and gas activities.
4. To acquire impact data that may result in modification of leasing regulations, operating regulations, and OCS operating orders, to permit more efficient resource recovery with maximum environmental protection.

In response to these program objectives, the environmental investigations of the Alaska OCS Environmental Assessment Program must address scientific objectives (henceforth referred to as Tasks) which are to determine:

A. Contaminant Baselines - Determination of the pre-development distribution and concentration of potential contaminants commonly associated with oil and gas development.

B. Souces - Determination of the nature and magnitude of contaminant inputs and environmental disturbances that may be assumed to accompany exploration and development on the Alaskan continental shelf.

C. Hazards - Identification and estimation of the potential hazards posed by the environment to petroleum exploration and development.

D. Transport - Determination of the ways in which contaminant discharges move through the environment and how they are altered by physical, chemical and biological processes.

E. Reconnaissance - Determination and characterization of the biological populations and ecological systems that are subject to impact from petroleum exploration and development.

F. Effects - Determination of the effects of hydrocarbon and trace element contaminants on individuals, populations, and ecological systems.

PART IV

4.0 TECHNICAL APPROACH

4.1 GENERAL

The technical approach followed in the development of this program is based on the Outer Continental Shelf Environmental Studies Advisory Committee's report Guidelines for the Design and Conduct of OCS Oil and Gas Development Environmental Baseline Studies" dated February 1976. The introduction to the Guidelines states in part that:

> "An Environmental Studies Program for an Outer Continental Shelf (OCS) oil and gas area consists of a complex, several-faceted process of information acquisition, compilation, and analysis. Such programs consist of three basic elements: baseline studies, which are conducted during the predevelopment period; long-term monitoring studies; and special studies, which may occur during the baseline and monitoring studies phases."

The programs and the three basic elements are defined in Section 4.6.1.

4.2 USER REQUIREMENTS

4.2.1 GENERAL

The U.S Department of the Interior has primary responsibility under the Outer Continental Shelf Lands Act of 1953 for administering mineral leasing and development of the offshore areas under Federal jurisdiction. This responsibility has been delegated to two bureaus of the Department - the Bureau of Land Management (BLM) and the U.S. Geological Survey (USGS). These two bureaus are the principal recipients of the results from the OCS environmental studies program.

While this program is intended primarily to provide information and data required for Federal management decisions necessary for the leasing and development of OCS frontier oil and gas areas, it also provides information for other Federal and State programs that may be influenced or impacted by such development. Such programs range from the management of living resources, such as birds, mammals, and marine fish to coastal zone management plans. Many of these programs have specific statutory bases and must be addressed as development of the frontier areas proceeds. Consequently, the needs and requirements of a wide range of Federal and State users have been addressed. The major Federal and State agencies and the nature of their needs and requirements are outlined in the following sections.

4.2.2 FEDERAL AGENCIES

4.2.2.1 DEPARTMENT OF THE INTERIOR

4.2.2.1.1 BUREAU OF LAND MANAGEMENT

The Bureau of Land Management requires specific data for decision making related to its Outer Continental Shelf leasing program. The following tables outline the significant decision points, the types of data required, and the generic timetable for a lease area. Table 4-1 summarizes the significant decision points in the Bureau of Land Management (BLM) Outer Continental Shelf (OCS) minerals management program that utilize data derived from the environmental studies program. The summary is structured to provide some general information about the decision itself, the emphasis placed on various types of information, the level of detail desired, the nature of the outcome, and the influence that environmental information has on the outcome.

Table 4-1

DEPARTMENT OF INTERIOR ENVIRONMENTAL INFORMATION UTILIZATION FOR OCS MINERALS LEASING PROGRAM

1. Leasing Schedule Preparation

A. General

(1) All types of sale area specific environmental information are evaluated to determine reliability, quantity, quality, etc., of date.
(2) Other factors considered are political and socioeconomic.
(3) Primarily a Washington Office function with input from the field.

B. Emphasis

(1) Identification of unique environments.
(2) Location and severity of hazards.
(3) Resource use conflict.
(4) Identification of data gaps that if filled would enhance later decisions.

C. Level of Detail

(1) Cursory
(2) Summary-type information.
(3) Judgments are qualitative
(4) Area-wide.

D. Outcome

(1) Change in timing and sequence of studies or leasing action to accommodate availability of information at some later date.
(2) Change in nature of studies to provide certain information at later points in time.
(3) Final decision by BLM Director.

2. Call for Nominations

A. General

(1) In preparation for a call for nominations, BLM requests resource reports on a sale area from other Federal agencies. These reports are evaluated to determine areas that should not be included in the call based on:

(a) Environmental sensitivity such as:

((1)) Wildlife refuges.

((2)) Unique environments.
((3)) Extremely hazardous areas.

(b) Resource assessments.
(c) Multiple use conflicts.

(2) Frequently will call for marginal areas to determine level of interest. Tract selection will eliminate hazardous or sensitive tracts.
(3) Basically a Washington Office function.

B. Emphasis

(1) Broad coverage within anaarea.
(2) Gross environmental features.
(3) More emphasis on economic (potential resource recovery) information.

C. Level of Detail

(1) Tens of square miles.
(2) General Coverage of an area.
(3) Qualitative judgments.

D. Outcome

(1) Elimination of large areas from offer.
(2) Not a critical decision to be influenced by environmental studies data.
(3) Final Decision by OCS Office Manager in consultation with USGS and FWS. Announcement comes out under signature of the Director of BLM.

3. Tract Selection

A. General

(1) All types of environmental data are evaluated. Environmental and resource potential data are most important.
(2) First run of Harris, SEAS, and Davis-Smith Models.
(3) Basically a Field Office responsibility.

B. Emphasis

(1) Identification of unique environments.
(2) Location of hazardous areas.
(3) Resource use conflict.
(4) Pollutant trajectory analysis.

C. Level of Detail

(1) Small groups of tracts (3 to 10)
(2) Site specific information.
(3) Seasonal data.
(4) Semi-quantitative bases for decisions on a tract-by-tract basis.

D. Outcome

(1) Elimination of tracts from offer.
(2) Recognize additional information to drive risk analysis models
(3) Decision by OCS Office Manager in consultation with USGS and FWS.
(4) Significant decision point that can be influenced by environmental studies data.
(5) Still two more critical pre-leasing decision points that can be influenced if a tract slips by.

4. Environmental Impact Statements

A. General

(1) Most intensive analysis of data.
(2) Broadest range of environmental and socioeconomic data.
(3) Critical section includes:

(a) Description of the Environment.
(b) Anticipated Impact of the Action.
(c) Mitigating Measures

((1)) Operating Orders
((2)) Notices to Lessees and Operators
((3)) Uncommitted Mitigating Measures

(d) Long Term vs. Short Term Impacts
(e) Cumulative Effects

(4) Second run of the risk analysis models.
(5) Preparation of impact-risk matrix.
(6) Document prepared by BLM OCS Office for signature of the Director.

B. Emphasis

(1) Environmental and Socioeconomic Data.
(2) Identification of data gaps.
(3) Discussion of alternatives to the Action.
(4) Objective analysis.

C. Level of Detail

(1) Tract specific.
(2) Quantitative assessment of impact.
(3) Resolution on a scale of 2 to 5 miles.

D. Outcome

(1) Recognition of sensitive tracts.
(2) Identification of data gaps.
(3) Relative impact of alternatives.
(4) Recommendations for stipulations, operating orders, tract elimination.
(5) No decisions made or implied.
(6) Critical document to be influenced by environmental studies information.

5. Program Decision Option Document

A. General

(1) Weighs resource value of various alternatives.
(2) Considers biologic, mineral, social, economic, legal, and political aspects.
(3) Final formal decision point before sale notice.
(4) Uses all the most recent information.
(5) Davis-Smith Model, final run.

B. Emphasis

(1) Tracts recognized for conflict of resource use.
(2) Tracts recognized for conflict with sensitive or unique environments.
(3) Greater detail on crucial items recognized in EIS.
(4) Quantitative evaluation.
(5) Economic, Social, Political, and Environmental data given nearly equal weight.

C. Level of Detail

(1) Tract specific.
(2) Value of resources in dollars saved or unrecovered.

6. Approval of Exploratory Drilling Permits for Each Tract

A. General

(1) Permit requests concentrate on geologic information and potential resource recovery.
(2) Engineering data included in permit request.
(3) High resolution seismic, side scan sonar and TV transect data is required and is available to BLM on a proprietary basis.
(4) Any stipulation requirements are fulfilled, or plans for fulfillment are included in these permit requests.

B. Emphasis

(1) Geologic data, potential resource recovery information.
(2) Engineering data.
(3) Rig siting.
(4) Target horizon(s) or depth(s); anticipated hazards.

C. Level of Detail

(1) Tract specific (3x3 miles).
(2) Site specific within tracts.
(3) Based on "in-hand" data.

D. Outcome

(1) Possible relocation of site.
(2) Site approval.
(3) Disapproval of permit.
(4) USGS-Conservation Division is lead agency in approval; BLM is consulted.

7. Approval of Development Plan for Each Tract

A. General

(1) Development plan concentrate on geologic information, amounts and timing of resource recovery, and onshore plans for servicing field development and handling production.
(2) Engineering data, proposed transportation mode, onshore facilities included.
(3) Well log data is available on proprietary basis.
(4) All stipulation requirements must be satisfied, or plans for satisfaction included.
(5) Coastal State involvement and coordination is large.

B. Emphasis

(1) Geologic data, resource recovery information, onshore planning.
(2) Siting of development platforms; producing rate.
(3) Target horizon(s) or depth(s); anticipated hazards.

C. Level of Detail

(1) Tract specific (3x3 miles).
(2) Site specific within tracts.
(3) Onshore specific; facility siting.
(4) Based on "in-hand" data.

D. Outcome

(1) Relocation of site.
(2) Approval of site.
(3) Modification of development plan to accommodate environmental concerns and State coastal development requirements.
(4) Disapproval of development plan.
(5) USGS is lead agency in approval; BLM and Coastal States are consulted. States have approval over pipelines coming ashore.

8. Monitoring

A. General

(1) Not a mandated function of BLM; USGS monitors produced formation waters; EPA has issued effluent guidelines for OCS rigs.
(2) To deal with basic unknowns about what comes off of rigs, where it goes, what its residence time is and so on. Will help answer long term, chronic exposure problems.
(3) Based on results of banchmark program.

B. Emphasis

(1) Site-specific.
(2) Chemical/Biological Data
(3) Time series sampling
(4) Changes with time.

C. Level of Detail

(1) Site specific, using broader benchmark data for comparison with range of conditions.
(2) Changes on at least a quarterly basis, monthly in particular areas.

D. Outcome

(1) Modification of Operating Orders, Operating Regulation, or Leasing Regulations.
(2) Issuance of Notices of Lessees.
(3) Modification of overall leasing strategy or schedule.
(4) Answers to long standing questions regarding cumulative effects, long- vs. short-term effects.

9. Pipeline Permitting

A. General

(1) "Common Carriers" permitted by BLM.
(2) "Gathering Lines" permitted by USGS.
(3) Conditioned upon availability of "commercial quantities of oil and/or gas.
(4) Three to seven years after initial lease sale.
(5) Examination and selection of pipeline corridors.
    (a) Determination of possible land fall based on socioeconomic, political and gross environmental considerations.
    (b) Connecting offshore producing areas with possible onshore receiving areas.
    (c) Detailed environmental investigation of possible corridors.
(6) Joint Federal-State effort.

B. Emphasis

(1) Biological-Geological-Chemical data.
(2) High resolution reconnaissance data.
(3) Area specific resource data.

C. Level of Detail

(1) Site specific corridor area 3 to 5 miles wide.
(2) Enough to determine rate and scale of recovery of area after pipeline has been emplaced.

D. Outcome

(1) Selection of appropriate corridors.
(2) Approval or disapproval of permit and right-of-way.
(3) Preparation of stipulations for emplacement.
(4) Decision by Director of BLM or recommendation of OCS Manager; Environmental Assessment Report is required presently, perhaps will require an EIS in the future.

This information is gathered by numerous diverse groups involving the public, Federal, State, and private organizations. The National Oceanic and Atmospheric Administration (NOAA) Outer Continental Shelf Environmental Assessment Program (OCSEAP) is limited to the gathering of environmental data, as the socio-economic, technological, and resource estimates are presently being addressed by other portions of the BLM program.

Table 4-2 lists the types of data required for the various decision points. It should be emphasized that the environmental studies program produces data for basically tyo types of needs: short-term and long-term. Short-term information needs are cyclical in nature for a given area, include baoad reconnaissance studies, and mostly influence pre-leasing decisions. It must be borne in mind that there will likely be more than one lease sale in an area, even if mineral resources are not discovered as a result of the initial lease sale. This means that the initial lease sale, although a point of focus is not the only critical decision point in the minerals management program. Long-term data needs are required for long-range problems. Long-term data needs are required for long range planning of minerals development. More accurate descriptions of the environment, identification of possible indicators of impact from oil and gas operations, establishment of better basis for prediction of long term cumulative impact, and assessment of impact of chronic pollution are all long range problems.

Table 4-3 is a timetable for information needs for individual areas. The timing and sequencing of data needs is important in determining the scheduling and mix of long- versus short-range studies.

TABLE 4-2

TYPES OF DATA USED IN OCS DECISION-MAKING

I. Literature Surveys

   A. Compile and Update All Existing Environmental Information
   B. Identify Major Data Gaps
   C. Environmental Information on All Subsequent Topics in Outline

II. Chemical Studies

   A. Heavy Hydrocarbon and Trace Metal Content, Over Time

      1. Sediments (surficial and suspended)
      2. Biota
         a. Epifauna
         b. Infauna
         c. Zooplankton
         d. Nekton
         e. Demersals
         f. Neuston

      3. Water and Suspended Particulates
      4. Surface Film Hydrocarbons

   B. Nutrients, Dissolved Oxygen, and Salinity
   C. Light Hydrocarbons in Water
   D. Light Hydrocarbons in Sediments
   E. Particulate and Dissolved Organic Carbon in Water
   F. Total Organic Carbon and Grain Size Analysis in Sediments

III. Biological Studies

   A. Marine Microbiology

      1. Sediments
      2. Surface Film and Water Column

   B. Toxicology Studies

      1. Chronic
         a. Epifauna
         b. Infauna
         c. Zooplankton
         d. Demersals
         e. Nekton
         f. Mammals
         g. Birds

      2. Acute

         a. Epifauna
         b. Infauna
         c. Zooplankton
         d. Demersals
         e. Nekton
         f. Mammals
         g. Birds

C. Histology

1. Epifauna
2. Infauna
3. Zooplankton
4. Demersals
5. Nekton

D. Benthic and Littoral Community Characterization, Over Time
E. Mammals - Reconnaissance Data, Over Time
F. Birds - Reconnaissance Data, Over Time
G. Fishes
1. Marine - Reconnaissance Data, Over Time
2. Anadromous - Reconnaissance Data, Over Time

H. Plankton - Reconnaissance Data, Over Time

IV. Geological Studies

A. Sediment Mobility - *In Situ* Measurements and Remote Sensing
B. Seston flux - *In Situ* Measurements
C. Sediment Types and Distributions
D. Geological Hazards

1. Seismicity
2. Mobility of Sediment Strata
3. Volcanism

V. Physical Oceanography

A. Surface Currents, Over Time
B. Mass Transport
C. Sea Ice Conditions
D. Hydrography
E. Material Flux
F. Propagating Disturbances
G. Modelling

TABLE 4-3

Generic Timetable of Information Needs for an Individual Lease Area

Time Prior to Sale	Decision	Information for Decision	Environmental Studies or Studies Elements Needed To Obtain Information
3 years	Area Selection	°Mineral Resources Estimates (USGS) °Resource Conflicts (fisheries, shipping, unique environments, recreation, other resource development) °Environmental Hazards °Technology Assessment °Cumulative Efforts of All Sales (over a given period of time) °Alternatives to Leasing	°Literature Survey °Historical Data Summaries and Evaluation °Leasing and Development Scenarios (Longer Term Environmental Program Required)
2 years	Area Offered for Call for Nomination (i.e. Size of area, e.g., 10 million acres vs. 1 million acres)	°Geological and Geophysical Data °Historical Bidding Information °General Resource Conflict	°The items considered in Area Selection will also input here °Fine Tuning Resource Reports (no studies focus here)
17 months (precedes (DEIS)	Tract Selection	°Identification of Unique or Sensitive Environments °Trajectory Information (First Becomes Important) °Hazards Assessment °Mineral Resource Evaluation (USGS Required to do Tract by Tract) °Resource Use Conflict °Historical Bidding Information (BLM)	°Reconnaissance Studies -Side Scan Sonar -High Resolution Seismic -Remote Sensing -Bathymetry °Physical Oceanography -Wave, Climate Data -Surface Meteorology -Currents °Studies of Fates and Effects of Petroleum Pollutants °Studies of Migration Routes (FWS) °Studies of the Distribution of Organisms

Time Prior to Sale	Decision	Information for Decision	Environmental Studies or Studies Elements Needed To Obtain Information
8 months, Draft EIS 4 months, Final EIS	EIS (no decision) A point used extensively for decisions. Serves as basis for Program Decision Option Document (PDOD)	°Long Term vs. Short Term Effects °Cumulative Impacts -This Action -Similar Actions Over Time °Mitigating Measures (Proposed Stipulations operating orders) °Alternatives to Proposed Action	°Benchmark °Effects Studies (Effects with Time) °All of the aforementioned Studies.

4.2.2.1.2 U.S. GEOLOGICAL SURVEY

The U.S. Geological Survey shares responsibility for many parts of the OCS leasing process with the BLM. Environmental information from the OCS program is used in many areas of the leasing process, including the tract selection process and risk assessments formulated by Interior. OCSEAP data are also used in the establishment of requirements for post-sale activities such as performance standards for OCS Orders or design factors for offshore facilities, to the extent that these can be determined on a regional basis. Examples of post-sale activities to be conducted under constraints imposed by environmental factors include: (1) drilling platforms, (2) installation of platforms, and (3) construction of pipelines. The USGS needs are sea floor data, atmospheric data, and oceanic data in order to accomplish the above responsibilities.

4.2.2.1.3 U.S. FISH AND WILDLIFE SERVICE

The U.S. Fish and Wildlife Service has responsibilities for the management and wise use of the Nation's fish and wildlife resources and the habitats upon which these depend. These responsibilities extend to include the Outer Continental Shelf. Particular responsibilities include migratory birds, certain marine mammals, endangered and threatened animal and plant species, and protection and management of the National Wildlife Refuge System. The Wildlife Refuge System in Alaska, existing and proposed, includes hundreds of miles of coastline distributed around the entire state.

The Service participates in the OCS minerals leasing and development process by providing advice, input, and reviews at various stages including baseline studies, resource assessments, tract selection, Program Decision Option Documents (PDOD) and stipulations.

In order to accomplish these mandated responsibilities in the most effective manner, the Service requires additional information, particularly concerning fish and wildlife resources for which it has lead responsibility. Such information needs include further understanding of distribution and abundance of various species using coastal habitats and OCS waters in Alaska as well as improved understanding of the status of these populations and critical habitats and food species necessary for their well-being. Finally, it requires an understanding of the effects that oil and gas development and related perturbations may have on these biotic resources.

4.2.2.2 ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency is responsible for the issuance of permits for municipal and industrial waste discharges (NPDES - National Pollutant Discharge Elimination System). In addition, for each discharge permit, EPA has the responsibility of either publishing a negative declaration or an Environmental Impact Statement, depending on the envisioned extent of deleterious impacts.

In order to either issue the NPDES permit or write the negative declaration/ EIS, EPA needs environmental information dealing with the existing water quality, the natural resources dependent on that water quality, and the probable impact of the proposed discharge on that water quality. If such information is not available or is inadequate, EPA risks issuing NPDES permits deleterious to the flora and fauna of the area and possibly the socio-econimic welfare of the resident human population as well. The criteria and requirements of EPA's NPDES permits are written for specific industries and are in part dependent on their location and remoteness to man and to the natural resources important to man's welfare. Without biological inventory and ecological process information for the Alaska Outer Continental Shelf region, discharge criteria and requirements formulated for the Alaskan offshore petroleum industry could unwittingly result in major damage to the ecosystem or certain of its component parts. Therefore, biological and ecological data are needed by EPA.

4.2.2.3 NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

The responsibilities of the National Oceanic and Atmospheric Administration (NOAA) concern management of marine fisheries and mammals, research with respect to long-range effects of pollution and effects of offshore development activities on the marine environment, and provision of environmental services to offshore operations. In collaboration with the State of Alaska, NOAA is responsible for the management of the marine fisheries and mammal resources of the continental shelf, and under international agreement is responsible for the management of the Pribilof fur seals. With this responsibility, NOAA furnishes information on the living marine resources in proposed sale areas and evaluates potential impacts. It identifies sensitive or vulnerable areas, reviews the developed environmental impact statements, and comments on potential conflicting uses of OCS with respect to fisheries and mammals. In reviewing these proposed actions, NOAA has a responsibility for evaluating them for consistency with the Fish and Wildlife Coordination Act (FWCA) as well as the need to develop the offshore oil and gas resources. To provide the necessary evaluations and assessments, NOAA requires information about the distributions of fish and mammal populations, their habitats and the impact of petroleum upon specific species.

NOAA also conducts environmental research and draws upon similar research sponsored by other agencies so as to assess the impact of offshore development activities on the marine environment. This research encompasses the description and understanding of physical and biological processes involved in offshore development and the resulting potential impacts.

Finally, the safety and efficiency of OCS oil and gas exploration, development and production operations requires national services provided by NOAA which include those of mapping and charting as well as environmental forecast and warnings. To provide such services requires detailed information about the marine environment extending from the sea floor to the overlying atmosphere.

To meet these broad responsibilities NOAA requires additional information for those areas specifically selected for OCS oil and gas development. While NOAA's own studies will contribute to the environmental assessment of these areas, more information is required to meet NOAA needs.

4.2.2.4 U.S. COAST GUARD

The U.S. Coast Guard has lead agency responsibility for organizing cleanup operations for oil spills off the coast of Alaska. In cooperation with local oil companies, they have developed contingency cleanup plans to be followed in the event of a spill. They require prior information concerning the likely trajectories of spills from various source locations in order to decide where cleanup equipment should be predeployed. Once a spill occurs the Coast Guard needs ocean circulation, meteorological, and oil behavior information to determine potential dispersion patterns in order to conduct any cleanup activities.

4.2.3 STATE OF ALASKA

The State of Alaska requires OCS research information that addresses the avoidance or mitigation of adverse impacts on the natural and human environment of the Alaskan coast. A variety of environmental information is required to accomplish this purpose, and in order to be useful this information must be analyzed, synthesized, and adequately distributed. One of the major classes of data needed deals with fish and wildlife populations. Major fish and wildlife populations and their trophic relationships must be clearly identified. In addition, the principal seasonal, geographical, and behavioral factors controlling numbers, distribution, and vulnerability to all OCS-related effects must be defined. In particular, juvenile and larval forms of commercially important species must be emphasized.

Another major area in which information is desired by the State concerns principal factors controlling the behavior and fate of development-related pollutants. Information must include not only the effects of catastrophic and chronic pollution from oil, but also pollutants from ancillary activities such as facility construction and the inevitable population increase in coastal communities. These factors must be considered on two scales, as generalized offshore processes and on an individual onshore site port basis where OCS activity is inevitable.

Geologic hazards represent another area in which data are needed. Earthquake and tsunami sites and probabilities, sea floor faulting and areas of instability, and coastal morphology and processes relating to facility siting must be carefully defined for each lease area.

Technology scenarios, describing in detail the probable equipment, materials and requirements of OCS developments are needed, by area, to identify specific populations likely to be impacted. Based upon these technology scenarios, specific development scenarios can be prepared, pinpointing the location and magnitude of probable impacts.

The State of Alaska requires timely, synthesized information that can be applied directly to the responsibilities it has for planning and regulating OCS-related activities off the coast of Alaska. These activities impact primarily the nearshore and coastal zones. Therefore, it is imperative that concentrated research take place in these areas. State responsibilities extend throughout the active history of each OCS area, from exploration to final disengagement.

4.3 BENEFITS

The primary benefits of the OCSEA Program are in supplying assessments capability to aid the Department of the Interior in its decision-making process as concerned with possible conflicts between development of oil and gas resources on the Alaskan OCS and other uses of resources of the marine environment. Specifically, the program provides the necessary environmental information for management decisions in the tract selection process, draft and final environmental impact statements, lease administration, promulgation of environmental guidelines, and development of operating orders and stipulations. There are, in addition, a number of spin-off benefits from the program. One of these is a better scientific understanding of the intricate processes in the marine ecosystem, which has far-reaching returns with regard to other uses of the marine environment. Another is the development of awareness by the general public of the facts that there are potential hazards to the quality of the marine environment and that the Federal government is concerned and is taking the necessary precautions. Finally, the data will be of significant value to all industries working on the design of systems and operational procedures to meet the extreme environmental conditions expected to be imposed on those designs for the OCS.

4.4 GEOGRAPHIC AREAS

The nine areas in which studies are being conducted under the Alaskan program are shown in Figure A-1 "Proposed Lease Areas." These areas, described in Appendix A, are the Beaufort Sea, the Chukchi Sea, the Norton Sound, the St. George Basin, the Bristol Bay, the Aleutians, the Kodiak, the Cook Inlet, and the Northeast Gulf of Alaska.

4.5 RELATED RESEARCH

The Alaskan Outer Continental Shelf, because of its vast size and difficult working conditions, has had the benefit of much less research than the remainder of our coast. Even so, useful information has been collected over the years by a number of investigators. In many cases, these investigations provide observations that can be compared with current data to yield estimates of temporal variability which would otherwise require the expense of a research program covering several years. This accumulation of information is obtained from the literature, organized for use, and considered in the development of OCSEAP study plans.

Data, results, and other information on these projects are available from papers published in research journals, technical reports (for example, AIDJEX bulletins, Beaufort Sea Project Technical Reports, FRB Canada manuscript report series), proceedings of scientific meetings and symposia (e.g., the Proceedings of the Arctic Institute of North America Symposium on the Beaufort Sea Environment), and through personal contact. A few comprehensive reviews on general oceanography, the environment, and the biotic resources for Alaskan waters are as follows:

- i) Biological Oceanography of the Northern North Pacific Ocean - Proceedings of a Symposium, Tokyo 1972.
- ii) The Environment of the Cape Thompson Region, Alaska - Environmental Studies Related to the Project Chariot, Washington, D.C. 1966.
- iii) Oceanography of the Bering Sea - Proceedings of an International Symposium, Hakodate, Japan 1972.
- iv) The Coast and Shelf of the Beaufort Sea - Proceedings of an AINA Symposium 1974.
- v) Final Environmental Impact Statement for the Northern Gulf of Alaska, BLM 1976. (See also reports by AEIDC for other areas.)
- vi) Oceanography of the Sub-arctic Pacific Ocean, INPFC Bull. 33, (ms. dated November 1974).
- vii) A Review of the Oceanography and Renewable Resources of the Northern Gulf of Alaska. Fairbanks, 1973.

A summary of pertinent studies that have been conducted in the past or are presently underway, follows.

4.5.1 ICE STUDIES

Sea ice distribution is being studied by several U.S. and Canadian agencies. Probably the longest on-going programs studying Alaskan sea ice are those associated with the U.S. Naval Weather Service (NWS) and Naval Oceanographic Office (NOO). The former is responsible for short range ice forcasting and the latter for long range forecasting. Operational ice reconnaissance studies to support ship movements have been performed over Alaskan coastal areas and northward into the Arctic Basin by the NWS Ice Reconnaissance Unit. Recently, the Fleet Weather Service has undertaken the development of ice forecasting models.

Airborne ice distribution information from the Canadian Arctic Sector has been collected since about 1958 by the Ice Reconnaissance Patrol of the Canadian Department of Environment and by the Defense Research Establishment ARGUS flights. Some distribution information has also been obtained by the Polar Continental Shelf Project. Compilations of mean ice distribution have been published by NOO for the Alaskan seas and by the Canadian Beaufort Sea Project for the Beaufort Sea east of Demarcation Point.

Studies of sea ice dynamics attempt to explain the internal flow characteristics of the ice cover and correlate movement to the various forces driving sea ice circulation. The Arctic Ice Dynamics Joint Experiment (AIDJEX) has been the focal point of this research. A summary of pertinent studies that have been conducted in the past or are presently underway, follows.

Remote sensing information, either from aircraft or satellite, continues to be the primary data source for ice distribution, movement, and to a limited degree, morphology studies of Arctic sea ice. Recent programs have concentrated on improvement in interpretation of surface features as viewed by low resolution satellite systems and investigation of new types of sensing systems. New systems are needed to determine ice thickness and age, and to expand the operational period into the polar night and during high cloudiness. Remote sensing programs have included the Bering Sea Experiment (BESEX) and AIDJEX, and have drawn primarily on the resources of NASA, CRREL, NOAA-National Environmental Satellite Service (NOAA-NESS), and NOAA-Environmental Data Service (NOAA-EDS).

Work on engineering problems related to structures and ships in moving sea ice may be found in most countries with sea ice occurrence. Historically, the bulk of work has come from Northern Europe, Scandinavia, and Iceland. U.S. efforts are mostly centered in CRREL, which is probably the largest source of on-going research publishing non-proprietory information. Recent developments have been reported at a biannual series of conferences entitled "Port and Ocean Engineering under Arctic Conditions (POC)", the last of which was in August 1975.

Research on floral and/or faunal ecological associations with sea ice has been conducted by diverse groups. Significant results of such research are presented in the "Oceanography of the Bering Sea" symposium volume and in the final reports of the Canadian Beaufort Sea Project. Related on-going research is funded by the Alaska Department of Fish and Game and the Canadian Fish and Wildlife Service.

Sea ice has direct influence on the global climate. Research in the area of climate-sea ice associations has been conducted by universities through funding from the National Science Foundation (NSF), Office of Naval Research (ONR) and other government sources. Direct government research is being done by NOAA, NASA, and the National Center for Atmospheric Research (NCAR). The

Polar Experiment (POLEX) of the Global Atmospheric Research Program (GARP) is a proposed multi-national program to study in greater detail atmosphere-ocean-ice and to determine more accurately actual atmospheric states through improved observation in polar regions. Recent advances have been reported at the Alaska Science Conference in the volume "Climate of the Arctic."

Other important ice related research involves the Naval Arctic Research Laboratory (NARL), the Alaskan Sea Grant program, the University of Alaska and the Cold Regions Research and Engineering Laboratories (CRREL) of the Corps of Engineers. McGill University (Canada) has also undertaken an Ice Research Project. The University of Washington, the Naval Undersea Center, Naval Post Graduate Schools and the Delco Electronics Division of General Motors have been working in the southeastern Chukchi Sea since 1971 on a study of the Marginal Ice Zone of the Pacific (MIZPAC).

4.5.2 PHYSICAL OCEANOGRAPHY STUDIES

A large quantity of oceanographic data has been collected in the seas and embayments around Alaska for a number of years by various national and international agencies. Most of the scientific studies were conducted in relation to the finfish and shellfish resources of commercial importance. The International North Pacific Fisheries Commission (INPFC), especially its Standing Committee on Biology and Research and the sub-committee on Oceanography, has studied the physical and biological environments in the North Pacific Ocean with reference to the living marine resources, especially salmon. The International Pacific Halibut Commission (IPHC) has maintained a comprehensive research program for a number of years, collecting statistics on the fishery, developing and administering regulations, and publishing scientific reports. Scientists at the

Fisheries Research Board of Canada, especially the Pacific Oceanographic Group, have been conducting research on oceanographic properties and processes in the eastern Sub-arctic Pacific Ocean for many years. As a result of these studies, a very valuable time-series of data is available for station P', 50°N, 145°W. The Japan Maritime Safety Agency has published a series of temperature and current atlases for the northern Pacific and western Pacific based on data from 1955-1969. The Japan Oceanographic Data Center publishes a series of atlases in relation to the Cooperative Studies of the Kuroshio (CSK).

The Canadian Beaufort Sea Project (BSP), which was recently concluded, was composed of a number of environmental and ecological studies conducted in anticipation of exploratory offshore drilling for oil in Summer 1976. The project was funded by both the Canadian Government and the petroleum industry. It was administered by the Department of the Environment, Government of Canada.

The Arctic Ice Dynamics Joint Experiment (AIDJEX) is aimed at the understanding of the interaction between the atmosphere/pack-ice/ocean. Its objectives also include parameterization for general circulation for the Arctic Ocean and ice-prediction capabilities. The program is funded by NSF, ONR, NASA and NOAA. Its 14-month field program began in Spring 1975.

The Japanese Study of Coastal Ice Dynamics in the Sea of Okhotsk has been underway for over 10 years and is conducted by the Sea Ice Laboratory of the Institute of Low Temperature Sciences, University of Hokkaido. The practical aim of this study is to protect and facilitate commercial fishery activities.

Processes and Resources of the Bering Sea Shelf (PROBES) is a long-term research program for the Bering Sea Shelf which has been initiated to conduct multidisciplinary field and laboratory studies to examine the physical environment and biological resources of the region. Objectives of this program include the description of water masses, circulation and time-variability of velocity fields. These determine nutrient distribution in the water column and may also affect the distribution and abundance of benthic fauna and sediments.

Other research projects related to this study of sea-ice include the Ice Research Project (McGill University, Canada) and the Polar Continental Shelf Project (Dept. of Energy, Mines and Resources, Government of Canada).

4.5.3 COASTAL STUDIES

The Arctic Institute of North America has participated in polar research for nearly 30 years. In recent years, a substantial part of its effort was through the Man in the Arctic Program and the Arctic Development and the Environment Program. These programs focused largely on the Beaufort Sea and its coastal areas and were terminated by lack of additional funding. One of the main contributions relevant to the OCSEA program is the organization and systematization of current ideas related to the importance of the Arctic region as described in The Coast and Shelf of the Beaufort Sea, a proceedings of a symposium on the Beaufort Sea Coast and Shelf Research.

The Office of Naval Research, Geography Programs, and the Advanced Research Projects Agency have jointly sponsored a number of basic research programs designed to analyze the processes operating on coastal landforms along the Arctic coast of Alaska. Scientists in the fields of meteorology, nearshore hydrodynamics, wave mechanics, morphodynamics, and beach dynamics have combined efforts in a field and laboratory study for the Arctic coastal area between Point Hope and Demarcation Point.

4.5.4 FISHERIES STUDIES

Fisheries research in the Alaskan marine environment has been of utmost interest to diverse agencies and international governments; including Army Corps of Engineers, International Pacific Halibut Commission, International North Pacific Fisheries Commission, governments of Japan and the U.S.S.R., Alaska Department of Fish and Game, Alyeska Pipeline Service Co., U.S. Atomic Energy Commission, and the Canadian Beaufort Sea Project. The Army Corps of Engineers has provided funds to compile existing data for impact assessment related to proposed offshore petroleum development. International governments and commissions are interested in the maintenance and development of existing commercial fishery stocks and potential commercial fisheries. These data include abundance, distribution, life histories, migratory pathways, and productivity of salmon, halibut, pollock, various flatfish, ocean perch, crabs, shrimp, and other sea life. The Alaska Department of Fish and Game annually assesses fish stocks to maintain adequate fish for both commercial and recreational industries. Most of their efforts are centered nearshore, monitoring creel and commercial catches and evaluating escapement and hatching success. Other studies involve the assessment of the marine environment, including fisheries, in terms of specific projects, e.g., marine transport of oil from the North Slope to ports in Washington and California, and utilization of nuclear devices to excavate deep water ports as in "Operation Chariot." However, the most extensive ecosystem-oriented research to date has taken place as part of the Canadian Beaufort Sea Project, designed to establish baseline data prior to the development of offshore oil resources in the Mackenzie River Delta regions.

4.5.5 MARINE BIRDS AND MAMMALS STUDIES

The Canadian Beaufort Sea Project (BSP) has also included studies of polar bears, seals, and water birds. Studies have been completed that describe the ecology, demography, and reproductive habits of polar bears and seals and that address the effects of crude oil on the behavior, physiology, and survival of ringed and harp seals. Water bird migrations have also been studied by BSP.

The North Pacific Fur Seal Commission (NPFSC) is a coalition of fisheries agencies in the U.S., Canada, Japan, and the U.S.S.R. Its primary objective is to maintain the maximum sustainable yield of northern fur seal populations through research-based management practices. Its research emphasizes population dynamics, demography, migration, food habits, conflicts with fishing industries, and quality of pelts relative to sex, age, season, and sealing method. The National Marine Fisheries Service of NOAA (NMFS) has official jurisdiction over seals, sea lions, fur seals and cetaceans. The Marine Mammal Division of NMFS, located in Seattle is investigating fur seal biology.

The Alaska Department of Fish and Game (ADFG) is concerned with the protection and management of seals, sea lions, sea otters, waterfowl, and other game, furbearers, and potential pest species. Research in areas necessary for sound management practices relating to these species has been conducted by ADFG. The U.S. Fish and Wildlife Service (USFWS) nationally has official jurisdiction over sea otters, polar bears, walruses and birds. Alaskan studies have been made by USFWS of mammals such as sea otters, and of waterfowl migration at the Bering Strait and Point Barrow.

Additional Alaskan bird and mammal studies have been conducted by the U.S. Atomic Energy Commission (AEC) and by the Canadian Wildlife Service (CWS). From 1959-1961 the AEC supported comprehensive studies of marine birds and mammals in the Cape Thompson - Pt. Hope region as part of their "Project Chariot." The CWS has published numerous documents on Canadian marine birds. In addition, the Bering Sea Mammal Experiment (BESMEX) is developing techniques for marine mammal research using remote sensing techniques which may prove useful in the future. Since the advent of NOAA's Sea Grant Program, universities such as the University of Washington, Oregon State, and the University of Alaska have been able to substantially increase their research efforts on birds and mammals.

4.5.6 SOCIO-ECONOMIC STUDIES

Recently BLM has funded a program of Socio-Economic studies in Alaska. This program is intended to determine and assess the social, economic and physical impacts resulting from OCS oil and gas development. This is a multi-year, multi-discipline program involving sociological and anthropological studies of ethnically diverse groups, economic analyses of underdeveloped as well as developed communities and of the state and regions within the state, and assessments of both natural and man-made infrastructures. The program will also require the establishment of a management information system for the archiving, retrieval and dissemination of interdisciplinary data and analyses.

The design of the program in general and the first year's effort in particular is based upon the "Study Plan for a Social and Economic Impact Assessment of Alaska Outer Continental Shelf Petroleum Development" prepared by the Alaska Sea Grant Program under contract with BLM.

4.6 PROGRAM IMPLEMENTATION

4.6.1 SCOPE OF THE PROGRAM

The OCSEAP is a comprehensive studies program for proposed OCS gas and oil areas, including baseline, monitoring, and special studies phases, conducted to provide an environmental information base for area identification, selection, development and management decisions.

4.6.1.1. BASELINE STUDIES PROGRAM*

Baseline studies are environmental studies conducted in an OCS area prior to oil and gas exploration and development. They are designed to provide timely, comprehensive, environmental information for use in both prediction and *post facto* evaluation of the environmental effects and hazards of oil and gas development on an OCS area. Data from these studies provide an information base for (1) consideration in the progressive management decisions prior to exploration and production, (2) use as a predevelopment reference for future detection of environmental changes, and (3) aid in planning monitoring and special studies.

A *baseline*, as used in this program, is a measure of those parameters that will 1) provide information for predictions of the effects of OCS oil and gas development activities upon the components of the ecosystem; 2) provide a description of the physical, chemical, geological, and biological components and their interactions for further studies design and as a base upon which assessments can be made and 3) provide a base against which changes or impacts subsequent to oil and gas exploration and development can be compared. An essential part of such a measure is an estimate of spatial and temporal variability. This permits the use of a baseline with a known level of confidence in the data at hand. Such baseline studies include:

Environmental characterization. The environment is characterized by studies, occurring early in the study period that compile, synthesize and analyze existing environmental data (e.g., from literature on an OCS area, file data, or reports).

* The concept of reconnaissance, as used in the Alaskan OCSEAP, should not be equated to baseline. This is amplified in Section 4.6.4.5.

Complementary studies. A broad range of qualitative and quantitative field and laboratory studies designed and conducted to fill knowledge gaps and improve upon historical background data.

4.6.1.1.1 ENVIRONMENTAL CHARACTERIZATION

The first major phase of the baseline studies effort is environmental characterization. It consists of a comprehensive, interdisciplinary review and description of the regional environmental characteristics, accomplished through the use of all sources of existing data, including published literature, file reports, file data, and interviews. Such reviews might be described as environmental "mapping" of such things as the biogeographical distribution and abundance of important organisms, unique and environmentally sensitive areas, circulation patterns, and other physical transport mechanisms. These studies serve to gather and organize the area's existing base of environmental data for application in impact analysis and prediction, for future detection of environmental change, and to identify information gaps. As such, these studies provide a basis for developing and refining the total baseline program and for the design of the monitoring and special studies elements. Workshops, contracts, and interagency agreements and cooperation in data searches and analyses are utilized to maximize the efficiency and the thoroughness of this existing data search.

4.6.1.1.2 COMPLEMENTARY STUDIES

Complementary baseline studies complete the baseline information acquisition process initiated with the background studies. Complementary studies are the balance of field, laboratory, and other research required to expand upon and fill data gaps identified by environmental characterization.

There are two generic types of complementary studies. One is conducted to expand the qualitative and semi-quantitative data base. These studies are directed toward such fundamental data needs as the distribution and general abundance of the major biological components of the marine ecosystem, ocean circulation, and other information of importance in evaluating the effects of oil and gas development. A major limitation of data from such qualitative studies is their generally descriptive nature, which does not always yield knowledge of the causal mechanisms needed for improved prediction. This limitation reinforces the important role of special studies designed to develop better understandings of causal mechanisms and predictive relationships.

The second type of complementary study involves quantitative assessments of information such as indicator organisms, biotic communities, baseline levels of major contaminants, and other elements that can be used to assess future alterations resulting from the various phases of lease site development. These studies should be based on sound statistical sampling and analytical designs and result in conclusions that can be stated in terms of probability. These data are called benchmark data.

4.6.1.2 MONITORING STUDIES

Monitoring is a program of measurements after the onset of exploration. Although monitoring has been defined as sampling to detect changes from the baseline, continued monitoring can result in improved statistical validity or refinement of the baseline. In some instances, monitoring programs can proceed to develop time-series data that can reveal trends without an initial baseline description of the area in question. However, a baseline normally is considered to precede a monitoring program and to provide specific guidance for the continuing monitoring activity.

A monitoring program is properly designed using a baseline, a knowledge of processes and critical species of the ecosystem, the probable sources, and the transport mechanisms between the sources and the biological components.

It is important to realize that identification of a change from a biological baseline does not allow one to associate the change with a cause, unless the necessary understanding exists of the processes and vectors connecting the two.

4.6.1.3 SPECIAL STUDIES

Both baseline and monitoring studies have limitations in determining the effects of exploration and development activities in ocean areas. Basic processes and mechanisms operating in areas require experimental studies. These studies complement the remainder of the work, and may further add to generic applications.

Studies will be conducted to provide answers to specific problems related to program objectives. Selected experiments will be conducted on the fate and pathways of contaminants, transfer mechanisms within the ecosystem, and specific effects of contaminants. For example, research on transport processes for pollutants in waters with differing gross characteristics may be transferrable to similar problems elsewhere.

Both laboratory and field investigations will be conducted to develop or confirm the reliability of criteria to differentiate between harmful and non-harmful materials and validate results obtained thru only one type of experimental mode.

4.6.2 SETTING OF PRIORITIES

Determination of priorities for research between lease areas, disciplines, and timing sequence are made using numerous inputs. This determination is revised and updated annually in joint planning meetings between OCSEAP and BLM (Section 6.10.1). Changes to established studies will be made only after full evaluation of consequences. The following factors are considered:

- Overall objectives of the program.
- Potential environmental damage.
- BLM lease schedule priorities.
- State of Alaska recommendations and needs.
- Magnitude of individual tasks.
- Available resources.
- Users Panel recommendations
- Concerns of other agencies and groups.
- Rate of development following sales.
- Potential future sales in the same lease areas.
- Inter-relationship other studies and programs.

4.6.2.1. PRIORITIES BY LEASE AREA

Priorities and timing between lease areas are primarily determined by BLM upon consideration of its lease schedule and other Department of Interior needs. The distribution of funds between lease areas is then recommended by OCSEAP in order to meet those needs with due consideration to the current level of effort in each area and differences in logistics and support costs.

4.6.2.2. PRIORITIES BY PROJECTS

Distribution of funds is made by project, according to needs for assessment, regulation, and other considerations. The nature of the projects funded in each lease area depends upon the information already available, non-OCSEAP research underway, and needs defined by BLM, Users Panel, State of Alaska, RPC through analysis, etc. Section 4.6.7 on the Synthesis and Integration Effort expands upon how these needs are determined.

4.6.2.3. PRIORITIES BY TASK

Distribution of effort between Tasks and as a function of timing is described in 5.2.

4.6.3 BASIC ASSUMPTIONS

The following basic assumptions were used in developing the design and implementation strategy for the OCSEAP:

- The nature of the surveys and program priorities in general will be determined by the concerns and requirements of and constraints on BLM.

- Consideration was made, to the extent possible, for the program to meet requirements by agencies other than BLM, since actions are required by them in response to OCS development. Respective agency requirements will be spelled out in formal interagency agreements.

- Establishment of environmental baselines in each region will require, as a minimum, seasonal surveys to establish temporal variability. Monitoring surveys will be conducted at least annually after completion of the initial baseline survey phase.

- The area of study will extend beyond the defined limits of the lease area as a result of such factors as current, wind transport of oil, proximity to beaches and spawning areas, and migration of animals.

- A continuing study program as well as monitoring is required in each lease area following a sale because of the continuing need for regulation, environmental protection, and assessment following a specific sale, as well as in advance of successive sales in the same lease area.

4.6.4 TASKS A-F

A schematic overview of the implementation and integration process utilized in the technical approach of the program is illustrated in Figure 4-1. Information in the forms described later in Section 4.6.8 (End Products and Deliverables) is necessary for BLM to make their predictive assessment. These end products and information are the output of the six major Tasks introduced in Section 3.2. To obtain these end products requires

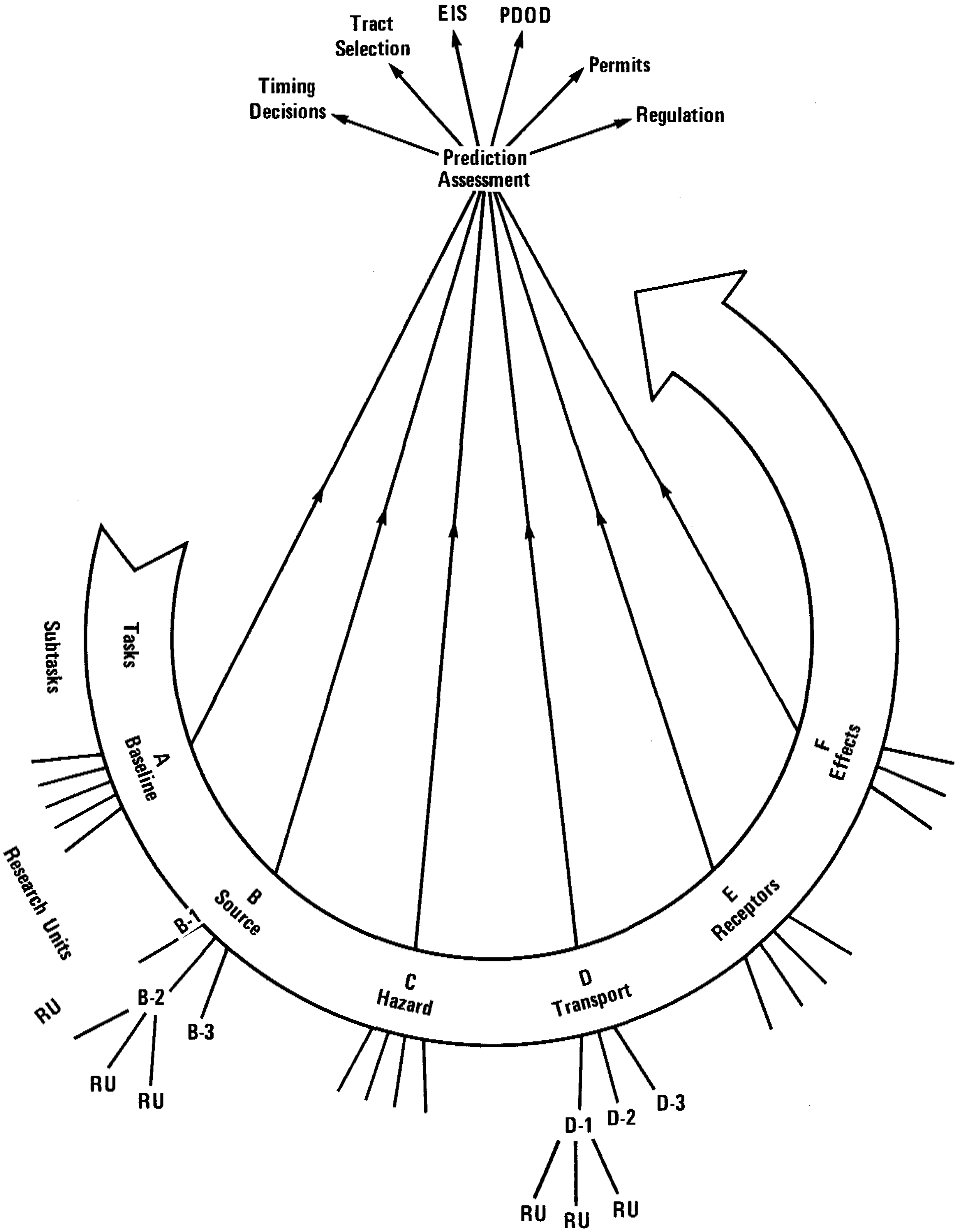

Figure 4-1. RELATIONSHIP BETWEEN INDIVIDUAL WORK UNITS (RU) AND THE ASSESSMENT PREDICTION FUNCTION OF BLM. ALSO, THE SEQUENTIAL RELATIONSHIP BETWEEN THE SIX TASKS, IN WHICH ALL THE OTHER TASKS FEED INTO THE EFFECTS TASK AND ONTO ASSESSMENT

the synthesis and integration of a hierarchy of Tasks, their Subtasks, and the research units addressing those Subtasks. Figure 4-1 shows the pyramidal relationship of research units leading to assessment.

The six major Tasks were originally derived from consideration of the information required. The Subtasks, which elaborate and expand upon the six Tasks, appear in this section. Finally, research units are determined annually for each lease area according to the special problems of the lease area and existing information. These research units are listed, described, and justified in the appropriate TDP.

The six Tasks and their Subtasks have a natural relationship to one another in the way in which they lead to assessment capability, as suggested by the curving arrow. An assessment requires A) a reference or baseline, B) estimation of the nature and magnitude of the contaminant or insult, C) information to set design standards in order to reduce releases and insults, D) ways to calculate the path and modification of released contaminants, E) identification of the biota that will be affected by exposure downstream, and F) the effects on the biota from these exposures.

The prediction and assessment capability created by the six Tasks is an integral part of timing decisions, tract selection process, EIS's, permits, regulations and other management decisions, of the DOI. The following sections amplify the six Tasks.

4.6.4.1 TASK A.

WHAT IS THE EXISTING DISTRIBUTION AND CONCENTRATION OF POTENTIAL CONTAMINANTS ASSOCIATED WITH PETROLEUM DEVELOPMENT?

The distribution of potential petroleum-related contaminants will be described before development of petroleum resources on the OCS; thus later changes, if any, in a contaminant's concentration or occurrence can be detected and examined for possible correlation with concurrent ecological changes. Four types of chemical compounds have been selected for measurement: light hydrocarbons (C_1-C_4), high-molecular-weight petroleum hydrocarbons, selected metals, and inorganic nutrients. Inorganic nutrients are included for correlation with associated biological measurements, particularly microbiological studies.

The Alaskan research program emphasizes the high-molecular-weight petroleum hydrocarbons and metals in each lease area. In addition, we are also determining the ambient concentrations and distribution of light hydrocarbons in arctic and subarctic marine waters, and exploring the feasibility of using C_1-C_4 concentrations as a monitoring indicator of hydrocarbon contamination in these regions. Inorganic nutrients are being measured only to the extent necessary to evaluate our reconnaissance of microbial populations and planktonic primary production.

Chemical baseline studies in the Alaskan program are divided into three classes of sampling effort; broad geographic reconnaissance, site-specific studies, and periodic resampling. The relative emphasis placed on each class for each contaminant type varies among lease areas and depends on the sequence of study initiation, the natural variability indicated within a particular lease area, and the differences observed among lease areas. Those lease areas studied last will receive proportionately less sampling effort if the analyses show ranges of variation and mean values that are similar to those found in areas previously studied with a more comprehensive sampling effort. The categories of sampling effort are:

1. *Broad geographic reconnaissance* of contaminant distributions in several types of sample matrices, e.g., neuston, water, sediments and selected biota. This effort will document the general levels of contaminants in each lease area and provide preliminary estimates of the ranges of variability encountered in the analyses. Although sources of variation will remain uncertain, general similarities or differences among broad areas will be documented. Since the Alaskan marine environment is generally unpolluted by petroleum or industrial wastes, all areas are anticipated to exhibit similarly low concentrations of contaminants. Therefore, we have allocated less sampling and analytical effort to those lease areas where studies will be initiated last. Should the analyses indicate otherwise, the sampling effort will be reallocated until characterization of general contaminant levels is adequate for each area. This sampling approach will continue from less than 1 year (Norton and Chukchi) to about 2 1/2 years (NEGOA). Lower Cook Inlet will receive early emphasis because of current oil and gas development activities in the Upper Cook Inlet.

2. *Site-specific studies* in areas expected to undergo OCS development (potential sources of contaminants) and in areas identified as vulnerable or critical ecological habitats (potential targets). From evaluating the first 1 to 2 years of circulation and trajectory analyses, the chemical and biological reconnaissance data in each lease area, and the best available OCS development scenarios, we will select specific study sites where changes in contaminant concentrations are considered most probable or of greatest concern to the ecological resource. To provide a better understanding of specific transport mechanisms, as well as the sources and ranges of natural variabilities for the contaminants in the system, these sites will be sampled intensively in both time and space.

3. *Periodic resampling* of areas and matrices sampled during broad geographic reconnaissance to determine whether changes have occurred over the broad geographic scale. The frequency of sampling and revision of sample grid spacing will depend upon the rate of development in each area and the results of site-specific studies. Presently we visualize that the first resampling effort will occur about 1 1/2 to 2 1/2 years after completion of the original reconnaissance in each lease area.

<u>Hydrocarbons</u>

Task A-1 Determine the total petroleum and selected potentially toxic hydrocarbon components of:

- *neuston and floating tar*
- *the water column (soluble and suspended material)*
- *selected marine organisms*
- *sea ice and the sea ice-water interface*
- *sediments*

Before OCS development begins, this task will be addressed in all lease areas to document the natural occurrence and concentrations of selected hydrocarbons in marine environmental samples. These analyses will form the basis for subsequent identification of changes in hydrocarbon concentrations. For each sample matrix, total hydrocarbons, total aliphatics (normal, branched, and cyclic), total mono- and dicyclic aromatics (benzenes and nephthalenes), and total polynuclear aromatics will be determined. In addition, the percent weight composition for identifiable individual component compounds will be determined. If possible, benzothiophenes will also be identified and quantified during the analysis of the hydrocarbon fractions above.

In general, analytical techniques will employ solvent extraction of samples, saponification separation of hydrocarbon fractions by conventional liquid-solid column chromatograph and gravimetric quantification of compound classes, followed by gas-liquid chromatographic separation, identification and quantification of individual compounds within each class. Mass spectrometric verification of compound identity is also required. All investigators involved in hydrocarbon analyses will participate in an intercalibration program involving replicate analyses of sample splits by various investigators and analysis of other reference materials as required.

Task A-2 Determine the seasonal horizontal and vertical distribution of methane, ethane, propane, butane, and relevant olefinic homologies in the water column. Determine the practicality of detecting and monitoring petroleum sources in Alaskan coastal waters through the use of these light hydrocarbons.

Normal concentrations and distributions of light hydrocarbons in the water column will be measured over a broad geographic scale in selected lease areas from the Northeast Gulf of Alaska to the Chukchi Sea. Light hydrocarbon measurements will probably be delayed in the Beaufort Sea until lease tracts are determined, but may be incorporated in the ecological process studies prior to leasing. This approach will document the baseline ratios of C_2-C_4 hydrocarbons to methane as a function of lease area, season, and depth. Whereas C_2-C_4 hydrocarbons are associated primarily with petroleum sources, methane is largely of recent biogenic origin, and the ratio between them is therefore an indicator of petroleum contamination. After initial surveys to document general pre-development levels, the program will refocus on areas of known petroleum sources, documenting the dynamics of light hydrocarbon distributions and evaluating the utility of C_2-C_4/C_1 ratios for identifying and tracing petroleum inputs over large portions of the Alaskan OCS.

Metals

Task A-3 Determine the total content and chemical species of selected toxic metals, and describe the distribution and concentrations of these contaminants in:

- *the water column (soluble and suspended forms)*
- *selected marine organisms*
- *bottom sediments, interstitial water, and subsea permafrost*
- *sea ice and sea ice-water interface*

Heavy metals are important potential pollutants in the marine environment. Various physiochemical processes promote removal of heavy metals to the co-existing solid phases. Although uptake and concentration by marine biota is of primary practical importance to man, the major concentration of heavy metals is in the sediments. Any perturbation of the natural environment that changes the prevailing steady-state distribution of heavy metals, such as the establishment of chemical conditions favoring remobilization of metals from the sediment reservoirs, requires an assessment of the consequences. The effects of suspended sediments on transport of oil, incorporation of oil into bottom sediments, and availability of oil to the biota will receive attention.

Oil-related activity may affect natural heavy metal distributions through complex chemical interactions occurring in connection with the release of oil or the direct release of metals associated with formation-waters. We are therefore determining the general distribution and concentration levels for selected trace metals over a broad geographic extent in each lease area. We will follow a rationale for metals similar to that presented for petroleum hydrocarbons, i.e., to perform site-specific intensive studies and periodic follow-up analyses of metals over broad areas. We will also conduct experiments to determine the extent that petroleum development may affect the normal distributions of trace metals in sea water and marine sediments. The extent of and strategy for periodic resampling of broad geographic areas will depend upon the results of these experiments, to be conducted early in the program, as well as the results of the intensive, site-specific studies.

The elements to be studied have been selected based on various criteria:

a. metals recognized as major pollutants affecting man:
   Ag, As, Cd, Cu, Hg, Pb, Sb, Se, Zn

b. natural petroleum index metals: Cr, Ni, V

c. indicators of chemical environment of sediments: Co, Fe, Mn

d. major component of drilling mud: Ba

The total number of elements exceeds the number usually considered to be indicators of OCS activities. However, analytical methods such as neutron activation provide a suite of incidental data on a variety of metals with no extra effort. All data will be reported even if only of peripheral interest to the Department of the Interior mineral mission at this time. Analytical methods will be selected based on sensitivity and reliability for each of the metals in each sample matrix to be analyzed. Atomic absorption spectrophotometry, polarography, and neutron activation analysis are most extensively relied upon. The neutron activation analysis produces information on other constituents as well.

4.6.4.2 Task B.

WHAT ARE THE NATURE AND MAGNITUDE OF CONTAMINANTS AND ENVIRONMENTAL DISTURBANCES THAT MAY BE ASSUMED TO ACCOMPANY PETROLEUM EXPLORATION AND DEVELOPMENT OF THE ALASKAN CONTINENTAL SHELF?

To guide the studies undertaken in succeeding phases of the Alaskan OCS program, a general understanding of the nature and magnitude of potential contaminants and environmental disturbances is required. This information, viewed together with preliminary transport and effects data, will be used to derive the structure of the research program and to establish study priorities and timing. The nature of effects research to be undertaken as well as the selection of sites for intensive ecological investigation (discussed later in this plan, Questions E and F) are two parts of the Alaskan program that are particularly dependent on information of this type. In the early stages of the program, general information on potential disturbances and contaminants is sufficient; as research proceeds more precise data are necessary.

Information on the probable nature and magnitude of OCS development and associated impacts has been assembled by the Department of the Interior, Environmental Protection Agency, Council on Environmental Quality, U. S. Coast Guard, State of Alaska, and the petroleum industry. Projections change, however, as methods and technology of extraction and transportation become established and more operating experience is gained in locations having environmental conditions comparable to the Southern Alaskan coast (e.g., the North Sea).

Task B-1 Obtain and continually update estimates of the location, nature, and timing of platform, pipeline, and facility development in each lease area.

The data obtained in this task will be furnished to NOAA in a timely manner, or contracted for with BLM approval. Timing dictates when the field studies are initiated. Data on locations determine which local populations and habitats may be at risk and, when combined with a knowledge of the particular facility, will determine what specific effects studies are relevant.

Task B-2 Estimate the quantity and physical and chemical nature of contaminants from each potential source based on projected design characteristics and operating methods, as well as on experience with petroleum development operations in other locations.

Data on contaminant input types and rates, when coupled with trajectory and dispersion analyses and effects data, will be used to determine if populations potentially at risk may receive contaminants in concentrations or at rates that are likely to be deleterious. Emphasis on such populations will then be increased appropriately and further consideration will be given to the need for statistical definition of natural population variability.

Task B-3 Estimate the nature and amount of possible environmental disturbance likely to accompany development.

In addition to contaminant inputs, development may affect circulation patterns, alter or remove habitats, or modify behavior of populations. Artificial gravel islands, causeways, man-made ice islands or any other platforms or structures may have these effects. Information on the predicted location and timing and nature of these will be provided to NOAA by BLM in a timely manner, or obtained by contract and staff investigations.

Estimates of environmental disturbance can be made from experience in other non-Alaskan lease areas already developed and from other Alaskan marine development. Both workshops and study contracts will be used to make these estimates. These estimates of environmental disturbances are also of prime concern in the ordering of research priorities.

4.6.4.3 Task C.

WHAT HAZARDS DOES THE ENVIRONMENT POSE TO PETROLEUM EXPLORATION AND DEVELOPMENT?

To adequately assess the risks associated with petroleum development, we must study and understand the environmental hazards that could damage facilities and potentially result in pollution incidents. Without this understanding, informed decisions about the tradeoffs involved in energy development are questionable. One of the primary objectives of the Alaskan Environmental Assessment Program is to identify hazards so that environmental risks can be avoided or minimized by appropriate plans, design, siting, stipulations, and regulations.

Many of the hazards present in Alaskan lease areas, such as faulting, unstable sediments, bottom scouring by ice and currents, and severe storms, also occur in other shelf areas of the United States. However, in Alaska these problems are unique both in terms of severity and complexity. In many areas, severe earthquakes, symptoms of adjustments between the boundaries of massive crustal plates, can create severe damage to structures. Rapid deltaic sedimentation with high volumes of fine rock flour, much of it from glaciers, leads to the accumulation of great thicknesses of unconsolidated, unstable sediment. For much of the year, ice covers a large part of the Alaskan shelf forming pressure ridges that can scour the seafloor at depths up to 45 meters. Subsea and coastal permafrost exist in approximate equilibrium with the surrounding thermal regime; if heat flow conditions change, the permafrost may melt creating unstable foundation conditions under or around facilities already in place.

These are only a few representative examples; the litany of potential dangers is long. In Alaska, "maximum credible event" scenarios cannot be taken lightly. A knowledge of the nature, frequency, and intensity of severe environmental events is essential since the greatest hazards to production-related structures and activities as well as the greatest effect on the environment will more than likely occur in conjunction with environmental extremes.

It is important to identify regional environmental hazards early in the decision-making process. Such information can be used by the Department of the Interior: (1) to determine which OCS areas are less environmentally hazardous than others and thus contribute to a risk/benefit analysis of areas to be leased; (2) to exclude particular tracts from leasing, and (3) to develop appropriate OCS orders, regulations, and stipulations that control the safety of energy development on the shelf. Consequently, hazard studies will receive priority emphasis early in the program.

The level of detail required will be determined by the proposed use of the information. For example, in the leasing process it is first necessary to rank areas according to their resource potential and relative environmental risk. As more information becomes available, the order of the leasing schedule may be altered. A broad regional knowledge of hazards would be sufficient for the initial ranking procedure. On the other end of the scale is the tract deselection procedure, at which time detailed hazards information must be available on a tract-by-tract basis to exclude hazardous locations.

Therefore, our initial approach is to achieve a broad regional understanding of the geologic, ice, and oceanographic hazards that might affect development. In subsequent studies, the level of detail will be increased with the objective of quantifying the particular risks of specific proposed actions. Geographically, the progression will be (1) regional reconnaissance of the entire lease area, (2) more detailed studies of the lease area to enable tract hazard evaluations, and (3) studies related to hazards in oil transport corridors.

GEOLOGICAL HAZARDS

Geologic hazards to petroleum related operations in the arctic and sub-arctic Alaska waters center around seismicity, surface and nearsurface faulting, sediment instability, erosion and deposition, coastal morphology, subsea permafrost, ice gouging, and stratigraphic hazards.

The specific tasks and data products that are necessary to address each of these problems are defined below and a rationale given for studying each problem. The data necessary to compile the data results are given. In this way, it should be possible to check off the existing data suite, identify data that should be obtained, and schedule data collection and interpretation time so that each task will be addressed in an expeditious way.

Task C-1 Determine seismic and tectonic hazards in, and peripheral to, regions proposed for petroleum development.

- *Maps indicating epicenters, foci, hypocenters, intensities, and seismicity*
- *Interpretive reports discussing the implications of seismic and tectonic hazards for exploration, development, production, and transportation activities*
- *Correlations between low magnitude earthquakes and surface/near-surface faulting*
- *Assessments of the relationship between earthquake intensity and ground motion*
- *Maps contouring recurrence rates by magnitude and/or intensity*

The tectonic framework of the continental shelf will be a fundamental environmental consideration in several of the frontier development areas. Earthquakes resulting from regional or local uplift, subsidence, or tilting may damage facilities directly and may create secondary impacts, such as tsunamis, which can have catastrophic consequences. In the Alaskan areas, volcano activity such as that of Mt. Augustine in Cook Inlet, may be of particular local importance. Our understanding of tectonism varies both geographically and topically.

The severity of earthquakes resulting from crustal movement is difficult to predict. The knowledge of deformational character is highly variable; seafloor fault breaks, broad crustal warping, and seismic sea waves have characteristics that commonly are unique to specific areas.

SURFACE AND NEARSURFACE FAULTING

Task C-2 *Determine hazards to petroleum exploration and development resulting from surface and near surface faulting.*

- *Maps indicating the distribution of surface and near-surface faults*
- *Maps indicating the recency of last movement of selected faults*
- *Interpretive reports on the hazards presented by faulting*

The identification of recent or active surface faults is fundamental to understanding the hazardous impact that the environment can have on offshore petroleum activities. Regional surveys identify those areas needing study on a closer grid. Displacements can affect drill casings, and even low magnitude earthquakes resulting from fault movement can trigger unstable sediments and cause slumping.

SEDIMENT INSTABILITY

Task C-3 Determine the types and extent of natural seafloor instability.

- *Isopach maps of unconsolidated sediment*
- *Maps indicating existing slumps*
- *Maps indicating the geotechnical properties of the sediments*
- *Maps and profiles of seafloor topography in areas of potential instability*

In some shelf areas, the properties of the sediment are such that the bottom becomes highly mobile under certain stresses. Man-made structures, such as oil platforms and pipelines placed in this environment, may be subject to extensive damage or loss, and allow hydrocarbons to escape and create pollution problems. It is important to have a regional understanding of such features so that environmental risks can be minimized, either by outright avoidance or by appropriate regulation of facilities.

EROSION AND DEPOSITION

Task C-4 Evaluate areas of seafloor erosion and deposition.

- *Maps indicating areas of rapid accumulation or erosion of sediments*
- *Interpretive reports discussing rates of sediment transport, bed form movement, etc.*

Erosion, through bottom cover or sand wave movement, may remove support from structures placed on the bottom. Foundation instability, particularly associated with major storms, is a potential cause of leakage or spills. Rapid rates of accumulation, i.e., delta fronts, can bury and break pipelines or create unstable slopes.

COASTAL MORPHOLOGY

Task C-5 Evaluate rates of change in coastal morphology, with particular emphasis on rates and patterns of man-induced changes. Locate areas where coastal morphology is likely to be changed by man's activities and evaluate the effect of these changes.

Several activities related to petroleum development may alter coastal morphology. Dredging, filling, creation of gravel islands and roads, etc., may change the shape of the coastline or may alter sedimentary processes thus altering the coastline as an indirect result of development. In either case coastal habitats would be changed and certain types of facilities (i.e., pipelines and quays) might become unstable. A knowledge of natural rates of change and initial status are necessary to document man-induced change.

SUBSEA PERMAFROST

Task C-6 Determine the extent and character of ice-bonded subsea permafrost along the Alaskan coast.

- *Maps indicating distribution, characteristics, depth, and presence or absence of ice-bonded subsea permafrost*
- *A thermal model*
- *Interpretive reports on the hazards presented by subsea permafrost to structures and pipelines.*

A knowledge of the distribution and character of permafrost is essential to developing an assessment of potential hazards associated with an alteration of the thermal regimes. Changes in heat flow, e.g., from installing structures, from drilling, and from pumping hot oil through pipelines, can cause subsidence and operation failure. The severity of these problems and the distribution and characteristics of subsea permafrost are not well understood. An understanding of the thermal regime will also add to the understanding of the natural processes that control coastal morphology, erosion, and deposition in these areas. These are natural hazards identified elsewhere in this section.

ICE GOUGING

Task C-7 Characterize the frequency of occurrence, geographical distribution, and nature of ice gouging phenomena.

- *Maps and interpretive reports indicating ice gouge density, trends, frequency, distribution and extremes of gouge depth,*
- *Comparisons of ice gouge distribution and evaluation of ice hazards*
- *Relation of ice gouge data to ice pack structure and behavior.*

In some areas sediments are highly distorted by the action of grounding ice, and the recurrence rate of gouging is very high. When the relation of gouging to the ice regime is better understood, it may be possible to evaluate the severity of ice hazards to man-made structures in various areas by mapping bottom characteristics. Ice gouging is also thought to contribute to sediment transport processes.

STRATIGRAPHIC HAZARDS

Task C-8 Determine, map, and interpret the distribution and pore pressures of shallow overpressured sediments.

In some shelf areas, gases accumulate in the uncompacted sediments creating high pore pressures. This makes it much easier for this material to creep, slump, or slide. Shallow gas pockets can create operational hazards during exploration and can cause blow-outs if the wells are not adequately cased. These two hazards can be minimized by early identification and appropriate regulation.

ICE RELATED HAZARDS

In ice covered regions, sea ice presents a very severe environmental hazard to offshore structures and ship operations. Even the relatively thin ice of Cook Inlet, which is generally less than 1 meter thick, can apply forces to structures that are comparable to those generated by moderate earthquakes.

In the Arctic Ocean, where the average thickness of multi-year ice is between 3 and 4 meters and where pressure ridges may have large sail heights and keel depth, giving total ice thicknesses in excess of 50 meters, the dynamic behavior of this ice (Task D-9) poses substantial threats to man-made structures. Relatively little is known about the mechanisms and forces created by multi-year ice floes and prepressure ridges, first year pressure ridges, shear ridges, and rubble fields.

Task C-9 Determine the stress-strain relationships in various types of sea ice encountered along the Alaskan coast to permit calculation of ice forces and loads on structures. Determine the range of forces and extremes of stresses and forces that may be placed on platforms and facilities by ice.

Sea ice properties vary widely with salinity, temperature, and growth history; as a result, the physics of sea ice deformation and failure are not well understood despite past experiments. Particularly little is known about the mechanisms and methods by which forces are exerted on structures by multi-year ice floes and pressure ridges, first year pressure ridges, shear ridges, and rubble fields. Of especial importance, little is known about extreme ice conditions and their forces, so that it is not possible to judge whether industry has designed adequately for the unusual event.

Since it may not be possible to obtain a statistically valid sampling of possible ice forces before exploration and development, emphasis is placed on an understanding of physical processes from which worst-case forces can be deduced or modeled. Ice force measurements have not been made as a part of any other major Arctic program.

The majority of studies on the physical properties of ice, such as stress-strain relationships, creep properties, etc., have been conducted in the laboratory. With sea ice, in which brine drainage occurs, the characteristics of the ice specimen being tested in the laboratory may be quite different from its natural state. It is therefore important to develop equipment that can test the properties of ice in situ.

WAVE RELATED HAZARDS

Severe oceanic events, such as high sea states, storm surges, and seismic sea waves, pose a hazard to offshore structures, shipping, and coastal facilities. Much of the predictive work done to define oceanographic transport mechanisms will be applicable to the prediction of severe events. Analysis of geologic hazards will suggest the potential for local tsunamis being generated.

Task C-10 Synthesize existing literature to provide analysis of the frequency, intensity, and effects of extreme oceanic events.

4.6.4.4 Task D

HOW ARE CONTAMINANT DISCHARGES MOVED THROUGH THE ENVIRONMENT AND ALTERED BY PHYSICAL, CHEMICAL, AND BIOLOGICAL PROCESSES?

In an assessment of the potential impact of petroleum and associated toxic metals on the marine environment, the transport and transformation of contaminants is of key significance. The program outlined in this section is specifically designed to provide data that will enable the Department of the Interior and other agencies to:

Plan stages of offshore petroleum development to minimize the potential risk to environmentally sensitive areas.

Provide, in the event of an oil spill or the introduction of other contaminants, trajectories, coastal landfall, and impact predictions required for cleanup operations.

Assist in planning the location of long-term environmental monitoring stations in the study area.

Petroleum or other contaminants introduced into the environment are transported in the atmosphere, water column and sea ice acting as an intercoupled system. Winds will disperse and transport pollutants reaching the atmosphere. Currents can transport contaminants over great distances, while simultaneously diffusion, dispersion and turbulence processes result in changes in concentration and exposure. Various constituents in the water mass, including suspended sediments, floating ice and free-floating biological elements, such as phytoplankton and zooplankton, tend to collect contaminants. Suspended sediment may remove contaminants as it settles out of the water. During the transport process, oil and other contaminants undergo continual physical and chemical changes brought about by such processes as evaporation, flocculation, emulsification, weathering, biodegradation, and chemical decomposition.

Spills occurring on or adjacent to sea ice can be entrained, transported, and forced by the ice edge to concentrate in narrow open leads of water.

PHYSICAL OCEANOGRAPHIC INVESTIGATIONS

ADVECTION

The rate and direction of oil movement on the sea surface can be caused by (1) water currents and (2) leeway, or sail effect, which is due to wind or waves creating differential stress on the oil and the sea water surface. Surface current advection is one of the major factors determining the path of spilled oil, and it has three components: the tidal current, the wind-induced shear current, and the wave-induced Stokes transport. The tidal current component is relatively well-understood, theoretically, although no area of the Alaskan Continental Shelf is well mapped in terms of the magnitude and direction of flow. The wind-induced shear current is the major contributor to advection.

Wave-induced Stokes transport is related to wave statistics and becomes especially important during storm conditions. Leeway is defined as "the movement of an oil slick through or over the water due to the action of the wind." In temperate waters, leeway speed is about 2 or 3 percent of the wind speed; however, this relationship needs to be examined in cold waters.

DISPERSION-DIFFUSION

Many elements of the dispersion-diffusion problem are understood; however,in cold water and ice dominated environments additional research is required. Dispersion-diffusion increases the total area of the spill horizontally and vertically and is a function of the volume of the oil spilled. The mechanisms affecting spreading on a calm sea--excluding effects of winds, waves, and tidal currents--are gravity, inertia, viscosity, and surface tension. The primary force is gravity. Spreading rates appear to be determined by the balance between gravitational pressure and oil inertia. As the oil layer becomes thinner, the water's viscous retarding effects become predominant until the dominant mechanism on spreading oil becomes surface tension. In cold waters, surface tension spreading of oil on water is thought to be absent. Thus, cold water oil spills are anticipated to spread more slowly into a thin film than their warm water counterparts.

Winds, waves, and currents also elongate the surface oil; increased wave action can break a slick into smaller patches, while high winds may pick up and transport oil droplets through the atmosphere.

Another factor influencing the diffusion of oil is the depth of the pycnocline, (that is, the vertical gradient of density). The pycnocline influences diffusion by limiting the depth of the mixed layer through which the wind drift current can act and by affecting the rate and depth of the oil mixing. In a turbulent sea, oil may be transported through a wind-mixed layer downward where it travels with subsurface currents.

The general goal of the physical oceanography program is to quantify the paths that OCS contaminants will follow, and the extent and character of the exposure of contaminants to biota along and at the ends of the transport. Our approach is to model the water mass, surface wind and oil trajectory circulation using models that will be driven with observations from past studies and our on-going observation program. The circulation models will be verified by comparing model-generated currents with those observed in the field. Oil trajectory models will be tested and refined by comparing the observed behavior of an oil spill with the model's trajectory forecasts. Then models such as those of spreading, downward mixing, removal by suspended sediments, evaporation, weathering, emulsification, diffusion, chemical change, and biodegradation, will be superimposed on the trajectories in order to arrive at predictions of the extent and nature of insult or exposure to the biota along the trajectories.

Initial emphasis focuses on offshore circulation, for which a large body of knowledge is currently available and existing instrumentation can obtain the required measurement. This information provides boundary information for smaller scale inshore projects to be conducted in subsequent phases. Once instrumentation is developed to measure the the nearshore surface circulation, program emphasis will shift to the nearshore regime and concentrate on those areas where oil impacts are most likely to occur.

Task D-1 Determine circulation patterns and develop the capability to predict the transport of petroleum-related pollutants in offshore regimes.

This task comprises the following elements:

a. Analysis of available data on general circulation. In many Alaskan OCS regions, large quantities of oceanographic data have already been collected. Analysis of these data will be useful in determining general circulation patterns. This analysis will cover data specifically collected not only within the OCS area, but also in larger areas that may govern local boundary conditions.

b. Measurement of baroclinic properties through STD (salinity-temperature-depth) surveys. STD data are fundamental inputs needed for diagnostic modeling techniques used to describe general circulation patterns. Regional studies of temperature and salinity fields will be carried on at least seasonally with several years of data being applied whenever possible. These data will give fundamental information on water mass movement, regional process, and dynamics. In specialized studies more detailed data will also be required (i.e., 25 hr time series to estimate the effects of internal tides, or high density coverage of small-scale topographic features).

c. Eulerian circulation measurements. Direct measurements of the currents by use of moored current meters are essential in every region. These data are indispensable for checking dynamic as well as diagnostic models, and they provide the basis upon which empirical models can be built. Direct measurements from long-term moorings supply information on such diverse phenomena as seasonal flow, shelf waves, tides, small-scale mixing, and severe events.

d. Lagrangian current measurements. Lagrangian current measurements supply direct information on particle trajectories and intermediate scale mixing. These data also offer a way of evaluating diagnostic modeling and pollutant distribution modeling results.

e. Measurements of sea surface slope. Pressure gauge measurements will be used to obtain information on changes in sea surface slopes. These data help define flow sptterns related to tidal and storm events and supply a major component of the data needed for empirical modeling studies.

f. Supporting meteorological measurements

1. Analysis of synoptic fields. The analysis of synoptic meteorological data provides information on large-scale forcing of the currents and thermohaline distribution.

2. Additional wind measurements. In some cases it may be necessary to supplement existing measurement networks to obtain appropriate regional description of the weather patterns.

g. Numerical modeling studies

1. Dynamic modeling. In cases where underlying dynamic processes can be clearly formulated and related to local circulation, well-established numerical models offer useful tools for describing flow characteristics. Examples are ocean basin general circulation models and tidal models.

2. Diagnostic modeling. In many cases simplified models can be used to aid in the dynamically consistent analysis of observational data. By their use the implications of sparse data sets can be effectively and economically extended.

3. Empirical modeling. Auto-regression and auto-correlation techniques can be used as a data analysis tool. Once the appropriate coefficients are established for modeling components, they can be used to describe many transient circulation features in an appropriate format for pollutant trajectory modeling.

Task D-2 Determine circulation patterns and develop the capability to predict the transport of petroleum-related pollutants into inshore regimes.

This task will cover the following elements:

a. Measurement of baroclinic properties. In many OCS areas specialized nearshore STD surveys are required. These will aid in the understanding of nearshore mixing and advective processes. Studies may require detailed station grids for local resolution around river mouths and irregular headlands.

b. Eulerian circulation measurement. Long-term near surface direct current measurements will be made in all OCS regions. These will provide direct advective information to compare with other techniques. In particular, these will supply the raw data for empirical models of advective and mixing processes.

c. Lagrangian current measurements. Lagrangian current measurements will supply detailed trajectory and dispersion data and provide an essential input for verification of modeling studies and supply data on special variability to supplement the direct measurements of currents.

d. Sea surface slope measurements. Nearshore pressure and tide gauge data will supply information on major forcing terms for circulation. These data will be used in empirical modeling studies to describe coastal flow.

e. Radar current mapping. This technique will be used in all OCS areas. The resulting current maps will supply detailed current pattern information that would be unavailable by any other means. The current maps, used in conjunction with longer term moored current meter data, will provide the advective data base for the nearshore trajectory and distribution modeling.

f. Remote sensing program. Many remote sensing techniques offer cost effective ways of obtaining large quantities of semi-quantitative data on nearshore mixing and advection. NASA and NOAA satellite imagery will be used to detect circulation patterns.

g. Surf zone dynamics. The actual grounding of oil related pollutants will take place through the surf zone and descriptions of dynamic process within this region are essential. Information will be collected on wave refraction characteristics, rip-current distributions, and storm surge probabilities and intensities.

h. Local meteorological studies

   1. In some OCS regions significant local modification to large-scale weather patterns are caused by coastal mountains or air-sea exchange processes. These modifications need to be studied as seashore winds are very influential in determining whether and where oil will reach the littoral zone. These will require nearshore studies and additional meteorological observations from ships, buoys, and nearshore stations to describe and parameterize local wind forcing of currents and oil.

   2. Correlation of synoptic and local weather. Studies will be carried out to relate the statistics of local observations to larger scale patterns.

   3. Climatology of the surface boundary layer stability and wind, and ice nuclei baseline measurements, for future use in assessing the air pollution problems associated with compression plants, oil transfer points, onshore development, offshore facilities, etc.

i. Special location studies. When special regions are identified for detailed study or interdisciplinary investigations on pollutant effects, relatively intense, small-scale circulation studies will be required.

j. Estuarine dynamics. Estuaries are commonly of greater biological importance than "smooth" sea coasts. Such subsystems may require individual studies that characterize local dynamics and describe the regional flow.

   Typical components of these studies might include STD mapping, moored current meter studies and monitoring of river run-off for sediment and fresh water input.

k. Modeling. Within the nearshore region, modeling is a useful tool for the interpretation and analysis of data. In addition, the modeling efforts supply the consistent velocity fields. Within this region the dynamics are complex with many small-scale phenomena making significant contributions to the flow. It is thus most likely that empirical modeling methods will offer the best cost effective approach, but dynamic formulations may be appropriate in some cases.

POLLUTANT PHYSICS AND WEATHERING STUDIES

Research also needs to be focused on understanding the physical, chemical, and biological factors influencing oil transport. Oil spill trajectory model forecasts need to be compared with actual spill behavior. Weathering processes in various Alaskan environments need to be investigated as they affect both the movement and the potential toxicity of the oil. There are several physical and chemical processes that, given sufficient time, tend to lessen the toxicity of the spilled oil. During the processes of dispersion and advection, the oil is simultaneously being transformed or degraded into other forms or removed from the water column. A few of the processes that can lead to the removal and degradation of spilled oil are (1) evaporation of volatile components, (2) dissolution of the soluble fractions into the water, (3) emulsification, (4) auto-oxidation, (5) sinking, (6) microbial degradation, (7) biotransformation, and (8) biological mobilization.

The rate of evaporation is governed by the composition of the oil, wind, temperatures, and sea state. The rate of dissolution is determined by the composition of the oil, which in turn may be changing due to other mechanisms of degradation. Auto-oxidation requires light in order to react with oxygen and form other compounds that may be more soluble or emulsifiable. Biodegradation of the oil may cause the density to increase to the point where the oil sinks. Additionally, the oil may adhere to settling sediments or particles and eventually sink to the bottom. Over much of the Alaskan coastline, nearshore waters contain large concentrations of suspended matter that could serve as a sink for spilled oil in the area.

Task D-3 Conduct theoretical and observational field and laboratory studies required to improve our understanding of plume behavior and weathering processes to improve oil spill trajectory and toxicity forecasts.

This task is composed of the following elements:

a. Oil slick dynamics

These oil slick dynamics studies will take two approaches -- observational and theoretical studies. Detailed observational data on oil slicks at sea are needed to evaluate existing models and upgrade the formulations and parameterizations used in trajectory modeling. In addition, observations will provide new data for upgrading model design to include more accurate descriptions of physical processes. Initially, spills of opportunity will be observed, to be followed up with controlled planned oil spill field tests. (Controlled spills will be conducted only after adequate planning and coordination with cognizant groups.) Theoretical studies will help answer many remaining questions as to the way an oil slick interacts with various flows in the marine environment. These studies, to be carried out early in the program, will provide valuable insights on how wave fields, mixed layer depth, and upper layer circulation affect oil spreading. This knowledge will enable us to improve the models for prediction.

b. Weathering studies

Field studies with either spills of opportunity or planned oil spills should document the changes due to volatilization, solubility, emulsification, adsorption onto suspended particulates, microbial biodegradation, and photoxidation of petroleum components. The chemical composition of contaminants remaining in the slick and those present in the water column below the slick should be determined. Laboratory studies will also be useful to identify these changes, and the results will be used as input to design experiments on effects of relative toxicities of petroleum in different stages of weathering.

c. Modeling

The modeling program will develop two models to support other studies and improve our basic predictive ability. The fundamental distribution model, for use in trajectory analysis as well as suspended sediment studies, is a set of algorithms that incorporate advective and diffusive formulations with source/sink and use terms. This general model will be developed as an operational tool early in the program so that it can be used as interactive feedback with all physical oceanography observational and modeling components studies.

A pollutant dynamics model, simulating the physical behavior of pollutants, including weathering will be developed in coordination with the theoretical and observational studies.

As these model components are developed and verified, they will be incorporated into improved versions of the distribution model.

SEDIMENT TRANSPORT INVESTIGATIONS

Understanding sediment source, transport, and fate is particularly important because contaminants (e.g., hydrocarbons, toxic elements) attached to suspended sediment particles are transported by the sediment, and because new contaminant-bearing particles (e. g., drilling mud) that are added can affect the properties of existing sediment particles. It is also important to understand the difference in dispersal response between "clean" and oil-bearing particles.

Knowledge of the texture and composition of bottom sediments is fundamental to understanding chemical reactions of the sediment with sea water and biota and the reservoir/sink capacity of the sediment transport system.

Knowledge of the mechanisms of resuspension of bottom sediment is particularly important. Concentrations of pollutants may be large in natural sediment deposition areas. If such areas coincide with areas of infrequent, but severe, resuspension by waves, large-scale pollutant releases might then occur months or years later, far from the initial point of input.

Task D-4 Determine the types and characteristics of bottom sediments including benthos-sedimentary substrate interactions.

Knowledge of the texture and composition of bottom sediments is fundamental to understanding chemical reactions of the sediment with seawater and biota and the reservoir/sink capacity of the sediment transport system. Areal calculations plus knowledge of relative abundances for each substrate can aid calculations of biologic abundance and distribution. Additionally, biologic abundance affects sediment resuspension rates by holding the sediments in place.

Task D-5 Characterize bottom sediment dynamics.

Contaminants frequently move in the marine environment as part of the sediment bedload. An understanding of the sources, pathways, and reservoirs of sediment, the processes and mechanisms that govern the velocities of movement, and knowledge of resuspension mechanisms and volumes are essential to an assessment of how pollutants will behave. Key processes to study include resuspension of bottom sediments by wave action.

Task D-6 Characterize physically and chemically suspended particulates, and their influx, transport and deposition. Determine the mechanisms, pathways, and rates of suspended sediment transport including coastal morphological processes. Develop an understanding of oil/sediment interaction processes.

Pollutants may be absorbed onto or react with suspended particulates. These then become part of the mechanism by which contaminants are dispersed through the marine environment. Suspended sediments may settle to the bottom when absorbed oil changes the specific gravity. In this way they may act as a natural mechanism for removing oil from the water column.

The pollutants would then be available to benthic and demersal biota. Understanding sediment processes in the coastal zones is of particular importance in order to predict the pathways and fate of pollutants in coastal areas. Theoretical and observational studies of oil-sediment interaction are required.

Task D-7 Map sea floor topography to support circulation studies and biologic work in spatial variations of populations.

Circulation is often forced to flow along seafloor topographic contours. Several types of development require dredging of bottom materials and rather extensive alteration of bottom morphology and hence, habitats. Knowledge of seafloor topography is also necessary since the water depth and general bottom roughness (e.g., sand waves) are variables in identifying hydrobiologic zones.

SEA ICE DISTRIBUTION AND TRANSPORT INVESTIGATIONS

Sea ice dominates the surface of the Beaufort, Chukchi and Bering Seas for long periods of each year. Its presence substantially affects the transport and distribution of spilled oil. Generally, in ice-covered waters, the oil is transported by the ice which is driven primarily by the wind, often in the opposite direction to ocean currents. A knowledge of both large-scale ice motion and small-scale ice structural characteristics is essential in order to predict the fate of spilled oil. For example, a long-lasting, severe under-ice well blow-out can distribute oil over very large areas. In fact, if such a blow-out occurs on the Beaufort Sea coast, the unique possibility exists that this oil may be transported by the ice into either the North Pacific or the North Atlantic. While the large-scale ice motion determines the pathways and final destination points of the oil, the small-scale structural characteristics determine whether the oil remains trapped under or within the ice, or whether it can rise to the surface through brine channels. Under the ice, pressure ridge keels may trap the oil in ponds and lenses; within the ice it may be contained in voids and interstices formed when the ice is crushed into pressure ridges. Once the oil reaches the surface it fills leads, overflows the surrounding pack ice and could possibly move rapidly over large distances when leads open and close.

It is important to develop an understanding of the behavior of oil-ice interactions, the forces affecting the ice deformation process, and the movements of the ice mass in order to predict the consequences of a pollution event and to facilitate its cleanup.

Studies of ice distribution and movement support OCSEAP biological studies. During the winter, seasonal ice may extend as far south as the Cape Sarichef-Pribilof line, effectively covering the Bering Sea shelf. At this time, much of the ice-associated subfauna is distributed throughout the ice covered area, its species being associated with ecological habitats within the ice area, e.g., leads, ice front, pack ice, or areas of semi-permanent open water. During the summer, the ice-associated subfauna moves northward mostly to the Arctic Ocean. Mammals of the Beaufort and Chukchi Seas live on and about the ice as a vital part of their ecology and are dependent on the yearly cycle of ice coverage and retreat.

The tasks outlined below address the key problems of the marginal and nearshore ice zone, with particular emphasis on dynamics and transport processes, movement, and also support. The general objective of the individual tasks will be to understand the seasonal distribution of various ice features and the dynamics of ice movement in order to predict ice motion stresses, and contaminant transport mechanisms. However as indicated above, these studies will also benefit the biological studies (e.g., Task E-17).

Task D-8 Characterize the distribution and nature of the most important sea ice features (leads, ridges, polynyas, etc.) on a seasonal basis and the undersea morphology of sea ice on the Alaskan Continental Shelf.

This task comprises the following elements:

a. Historical data base development. Large volumes of written historical records exist on ice conditions in the Arctic. So far these historical data have not been systematically gathered or interpreted, but by doing so now we can substantially expand our statistical data base on ice.

b. Remote sensing by aircraft. Remote sensing of the diverse ice features along more than 2000 km of ice-infested coastline is the only practical way to achieve a statistical data base on arctic sea ice on a seasonal and areal basis.

c. Remote sensing by satellites. The large-scale ice features that control transport processes of oil are relatively cheaply and conveniently assessed from satellites when cloud conditions permit. These include the seasonal extent of fast ice and the annual development of shore-leads and polynyas, as well as the position of the ice front.

d. Under-ice morphology. The underside morphology of sea ice determines where and to what extent oil is trapped in ponds and lenses under the ice. Pressure ridge keels, which may be tens of meters deep, may produce substantial reservoirs for oil and control the magnitude and direction of any flow under the ice.

The foregoing research elements will suffice to describe static sea ice and the distribution of ice-related features. They are not adequate for inclusion in a large scale, dynamic ice advection model, since no movement studies are included.

Task D-9 Describe and analyze the dynamic behavior of sea ice (stresses motions, deformations, etc.) and the effects on transport processes of pollutants and on the safety of man-made structures.

This task is composed of the following elements:

a. Large-scale motion and deformation studies of sea ice using ice buoys. Satellite-tracked buoys, which are relatively cheap, reliable and easy to deploy (by dropping them down to the ice from aircraft) are the best means to determine the large-scale motion of the ice. Products will include ice trajectories and rates of ice movement, which will allow an assessment of transport processes along the coast.

b. Meso- and small-scale ice motion and deformation studies of sea ice, using shorebased radars. Radar projects will address the problems of: (1) small scale ice motion and deformation from the shore fast ice out through the shear zone (at Prudhoe Bay); (2) pressure ridge formation in fast ice (at Barrow); and (3) extrusion of ice through Bering Strait at Cape Prince of Wales, all crucial meso-scale processes intimately connected with ice transport and hazards. Products are models of the behavior of sea ice under external stresses and ice displacement and movement of individual ice flows under a variety of different conditions. Aircraft and satellite remote sensing data will supplement these data.

c. Oil trajectories in ice. Whereas oil will be transported by surface currents and the wind-driven surface film in the NEGOA and the southern Bering Sea, oil will be transported by entrapment in and under ice during much of the year in the Beaufort Sea and for half the year in the northern Bering Sea. Pack ice does not move with prevailing currents but is driven by wind fields. Ice movement is also influenced by horizontally transmitted pressures over long distances. Predictions of specific trajectories of oil in ice, particularly in the nearshore environment, require special attention.

Task D-10 Determine the possible interaction between ice and oil and other contaminant discharges.

This task comprises two components:

a. Laboratory (test tank) studies. These studies are the most convenient and cheapest way to study the behavior of oil in a random ice matrix, grown in a wind and wave-agitated test tank.

The physical processes of oil movement, incorporation of the oil in the ice, and gradual release of the oil, depending on the ice change as they occur in nature, will be studied. Products will be models of the behavior of oil in an ice matrix representing natural conditions. While the behavior of oil under a uniformly grown sheet, in protected bays, has been studied in the field, similar experiments in the deformed ice pressure ridges and rubble fields are difficult and have not yet been done; the laboratory studies presently have to substitute for this work.

b. Accidental/deliberate spills. The opportunities to conduct field research on the behavior of oil in ice will be exploited by putting together a task force that can be rapidly flown to the scene of an accidental spill. Measurements of the actual transport of the oil spill will be compared with oil spill trajectories, forecasts and the predictive models refined to reflect observed behavior.

Task D-11 Evaluate and quantify the extent and likelihood of transport of oil inland beyond the normal beach line by storm surges.

Delta areas, marshlands, and lowlying lands near the beach can be inundated by high water levels produced by a combination of high tides and strong winds. The frequency and extent of such inundations will be calculated from existing models and some verification will be achieved by comparing the model results with known storm surge events and by observation of drift materials from past events. This may reveal the need for additional wind, wave, and tide observations. The Beaufort Sea section of the Climatological Atlas will document all known storm surges.

4.6.4.5 Task E

WHAT ARE THE BIOLOGICAL POPULATIONS AND ECOLOGICAL SYSTEMS MOST SUBJECT TO IMPACT FROM PETROLEUM EXPLORATION AND DEVELOPMENT?

A major incentive for conducting studies of biological populations is to determine which populations, communities, and ecosystems are at risk from either acute or chronic impacts. Estimates of the distribution and abundance, migration, feeding sites, and behavior of populations are among the first studies undertaken to establish potential vulnerability. The locations of the populations at each life-stage and activity are compared to predicted paths of petroleum and incidence of disturbance to determine whether risk may exist. The further criteria of uniqueness, importance to the ecosystem, sensitivity, or aesthetic considerations must be examined to define fully and assess the value of a species or community and the consequences. When vulnerability is indicated, detailed site-specific studies will be undertaken to focus on processes, positions in food webs, population dynamics, sensitivity to disturbance, ability to recover from disturbances, mobility, habitat dependence, feeding dependence, and physiological characteristics. The last involves studies of the direct effects of hydrocarbons, trace elements, and sediment characteristics on the physiology and behavior of target organisms. These detailed studies are described under Ecological Processes Studies in Task F.

BIOTA: POPULATIONS AND PROCESSES

Reconnaissance Studies

The earliest studies commonly initiated in response to suspected impact are those involving population parameters at a low level of precision with little supposition of accuracy. The "nominal" level of information is the lowest. The level of information records the presence or absence of species. Indicator species may be noted and indexes of association calculated. A higher level of information is found in "reconnaissance" studies, which usually occur during the first year or two in the OCSEAP. A reconnaissance provides data with precision to an order of magnitude ("ordinal" level) on the distribution and abundance of principal species, provides some trophic relationship information, describes the environment of the populations, and allows some non-parametric statistical treatment.*

In some situations a higher order of resolution is required on populations and communities; this is true when uncommon or thinly distributed populations are identified or the population meets some other criterion for special attention. The "index" level of resolution calls for a quantity of data allowing parametric statistical treatment (means, test of distribution, and confidence). The index level is more costly to obtain than the ordinal level, and the subject populations must be carefully chosen.

Baseline Studies

Finally, we may wish to estimate changes in population parameters with time to relate these changes to cause-effect relationships. This is the "ratio" level of resolution; it allows an estimate of numerical

* A reconnaissance may provide information adequate for program goals in some cases but is more often the first step in the development of a strategy to define the timing and grid spacing necessary for an adequate baseline measurement with a minimum expenditure of time and resources.

differences with time. This level of resolution requires a time-series against which numerical changes can be assessed and constitutes a "baseline." A genuine baseline must be established over a period of years with a sampling frequency at least double the frequency of any variable that we wish to examine. When the variable includes a considerable amount of stochastic fluctuation superimposed on secular trends, the sampling frequency must be increased. In most cases areal coverage and redundancy of sampling must be increased as well. Thus a baseline requires considerable expenditure of effort and energy, a well-designed sampling strategy. The effort is usually not justified unless correlations of statistical baselines of species with environmental variables do not prove to be cause-effect relationships, which must be established independently.

OCSEAP studies of populations and communities have been separated by taxonomy (birds, mammals), habitat (littoral, benthos), or ecological process studies (barrier island-lagoons, major river deltas).

The classification of research projects or research units into these divisions may obscure the fact that tish, benthos, and plankton investigations may go on simultaneously aboard a single platform or that littoral investigations are correlated with beach geomophological studies. These interdepencies will be characterized wherever possible. (See Section 4.6.7 on Synthesis and Integration).

Task E-1

Determine the seasonal density distribution, critical habitats, migratory routes, and breeding locales for marine mammals. Identify critical species and sites, particularly in regard to possible effects of oil and gas development.

Marine mammals are important and highly visible components of the marine ecosystem. Their aesthetic and economic value are unquestionable. Some populations are densely concentrated, particularly during the breeding season or are seasonally concentrated by ice distributions.

One critical aspect of the ice-dominated environment that may magnify the potential impact of oil on its mammals is the limited amount of open water present near the edge of the pack ice. The small open areas are vital to the ice-associated mammals for moving, breathing, and feeding; such areas may hold oil in varying degrees of concentration for long periods of time. Contamination of fur, respiratory passages, and digestive tracts would probably be an inevitable result of such an exposure.

Some mammals occupying the Gulf of Alaska and, in summer, the warmer waters of the Bering Sea, may be expected to be highly vulnerable to oil. The northern fur seal breeds on the Pribilof Islands and forages throughout the pelagic realm of the eastern Bering Sea and the entire North Pacific Ocean. The sea otter occurs along the Aleutian Arc and is abundant along the northern and western coast of the Gulf of Alaska. Both species depend upon air trapped in their fur for insulation from the low temperatures of their environment, and neither could survive the loss of this thermal barrier.

For a few select species population size is, or may soon be, fairly well known, but for the most part we have few useful data. Sizes of both walrus and polar bear populations are only crudely known, although remote-sensing used by the BESMEX (Bering Sea Marine Mammal Experiment) program may soon give fairly accurate counts of walrus. Data on bowhead and belukha whales are sparse, and populations of all of the northern seals can only be guessed. Fairly accurate data are available on the population size of fur seals, and some data are available on population sizes of sea otter and sea lions of the Aleutian Arc and the Gulf of Alaska. Few data are available on the foraging and migratory distributions of seals, sea lions, and whales, including their use of waters in and about the potential OCS lease sites in the Bering Sea and Gulf of Alaska.

Task E-2

Describe population dynamics and trophic relationships for selected species of marine mammals.

Information on population dynamics provides insight into the potential for recovery of a population from acute or chronic causes of attrition. Moreover, basic life history information helps to identify periods when marine mammal species are potentially more highly vulnerable to stresses, such as during gestation, pupping or weaning. Inasmuch as many marine mammal populations are already affected by commercial harvest and native subsistence hunting, the additional stresses of OCS development may prove severe. Where a mammal population depends upon prey species that may be affected by OCS development, the mammalian trophic dependencies must receive increased emphasis.

MARINE BIRDS

Task E-3

Determine the seasonal density distribution, critical habitats migratory routes, and breeding locales for principal marine bird species. Identify critical species particularly in regard to possible effects of oil and gas development.

Marine birds play an important role in the Alaskan marine ecosystem by recycling nutrients to the base of the productivity pyramid. It is also likely that marine birds serve a related function of smoothing out the curve of primary production and extending its period by making nutrients available for primary production in areas where, and during seasons when, oceanic circulation is not supplying nutrients in quantity. Marine birds may also exert a stabilizing influence on the ecosystem by foraging on those prey species that are temporarily in unusual abundance, thus contributing not only to stability in the prey species, but also to diversity. Marine birds are thus an important factor contributing to the productivity, efficiency, and long-term stability of northern marine ecosystems.

While fewer species and small total populations of marine birds are supported by the Chukchi and Beaufort ecosystems than by Gulf of Alaska and Bering Sea systems, large numbers of birds are concentrated in the restricted areas of open water during the arctic summer and autumn, where these birds work the lead systems, shores, and the icewater interfaces near and in pack ice.

Seabirds are highly vulnerable to oil pollution, both directly and indirectly. Direct effects include loss of insulating characteristics of feathers, loss of ability to swim or fly, ingestion of oil as a result of feeding or preening, and failure of oil-coated eggs to hatch. Indirect effects include contamination of foods and disappearance of forage organisms. Some species are highly vulnerable to structures erected in migration flyways; and human intrusion, such as with aircraft, can materially reduce the populations of seabird colonies. These effects are well documented throughout the world and are currently true at Pt. Barrow.

Although considerable information is available on the population distribution and seasonal production of that segment of the Alaskan bird fauna included under "migratory waterfowl," very little information exists for the seabird species. Census techniques for seabirds have been developed only recently; limited assessments have been attempted in Bristol Bay, and only started in the Gulf of Alaska. Major breeding colonies have been identified over the entire Gulf of Alaska-Bering-Beaufort arc.

Task E-4

Describe dynamics and trophic relationships of selected marine bird species at offshore and coastal study sites.

Many species are critically dependent on specific habitats in northern waters for breeding, feeding, moulting, or resting during migration. For example, estimates indicate that during the fall an oil spill in the rich eelgrass beds of Izembek Lagoon, on Bristol Bay, could affect 95 percent of the Pacific population of black brant and emperor geese, and that destruction in Izembek Lagoon of the eelgrass forage could be as damaging to these species as oiling of feathers.

Spilled oil entering any of the many lagoons, estuaries, river mouths, or tide flats between the Yukon-Kuskokwim Delta and Bristol Bay could result in enormous losses of emperor geese, cackling Canada geese, eider ducks, scoters, oldsquaw, and other waterfowl, shorebirds, and seabirds. Spills on the high seas in turn would impact murres, auklets, fulmars, shearwaters, gulls, and other pelagic species.

PELAGIC AND DEMERSAL FISH

The fish stocks of the Gulf of Alaska and Bering Sea constitute the single most valuable commercial resources of the North Pacific region. Commercial catch statistics and fisheries surveys provide an amount of information that the OCSEAP effort could not itself provide. Our program, then will add to an extensive data base, information that is outside the mission of fisheries agencies, and that can be used by the Department of Interior to better assess OCS development impact.

Task E-5

Determine the distribution and abundance of certain pelagic and demersal fish. Supplement current fisheries data when necessary. Determine the relative seasonal density distribution, critical habitats, growth and food habits of juvenile pelagic fish.

Extensive data are available on demersal fish species of commercial importance (such as pollock, cod, yellowfin sole, Pacific halibut, flathead sole, Greenland halibut, Pacific ocean perch, and sablefish) in the southeastern Bering Sea and the Gulf of Alaska. The demersal species complex is important throughout these areas. In the Bering Sea it forms the basis for one of the world's most intensive bottom fisheries, concentrating along the edge of the Bering Sea shelf from Unimak Island to approximately 175° W longitude (northwest of the Pribilof Islands).

The commercial importance of certain demersal fish species necessitates, at the minimum, an analysis of records of distribution, abundance, and spawning areas close to OCS lease areas.

Pelagic fish resources in the Bering Sea dominate the diets of marine mammal and bird populations. While some information is available on certain species of pelagic fish in the Gulf of Alaska and southeastern Bering Sea (e.g., Pacific salmon, herring), less is known about the density distribution and productivity of key species in the ecosystem, such as capeline, other smelt, pomfret, and sandlance. In the central and northern sections of the Bering Sea, as well as in the Beaufort and Chukchi Seas, there is an information gap on the distribution of pelagic fish.

Herring, capelin, other smelts, and sandlance are important forage species for marine birds, mammals, and such predatory fish species as salmon and halibut. Herring spawn intertidally and in the shallow subtidal region throughout most of the eastern Bering Sea; these areas include several hundred miles of coastline from Bristol Bay to Kotzebue Sound, and their eggs and larvae may be particularly vulnerable to impact by petroleum. These species are dependent upon planktonic food and play a key role in converting the primary productivity of the Bering Sea into fish, bird, and mammal resources. The same species occur in deeper waters bordering the Gulf of Alaska; however, in the shallow water they are replaced by a rich variety of other forms that serve the same ecosystem function. The density distribution and productivity of nearshore pelagic species are poorly documented in all regions.

Pelagic fish are relatively mobile and have high recruitment. Thus losses may be made up relatively quickly and the probable effect from OCS development is likely to be slight except where fresh water and spawning area dependencies exist. Because juvenile and mature salmon imprint on their birth streams and return to them by olfactory cues, hydrocarbon inputs could have drastic effects if this mechanism was impaired.

Task E-6

Determine the food dependencies of commonly occurring species of pelagic and demersal fish to establish principal ecological relationships.

In many instances prey species may be affected more severely by OCS development than predator species. A description of principal prey species can be used to determine the species of choice for physiological effects studies.

Soft parts of prey species are digested very rapidly and frequently are not well preserved. Hard parts (skeletons, otoliths) resist digestion and frequently appear in sediments, nesting sites, and foraging areas. Skeletal remains are often diagnostically identifiable to the species level and can provide additional information on species age and pathological condition. Illustrated keys are absent for many of the common prey species of fish.

Herring are a primary prey species for fish, birds, and mammals. In the past, and perhaps in the future, they were of considerable commercial importance. Herring spawning grounds occur in shallow coastal embayments and would be vulnerable to acute or chronic hydrocarbons as well as site disturbance.

BENTHOS

Benthic fauna support populations of birds, mammals, and fish. Some 108 species of benthic organisms have been reported from the Continental Shelf and upper slope of the Gulf of Alaska. The highest standing stocks occurred in rocky areas and those with gravels and pebbles. Although the Bering Sea biomass of benthos exceeds that of the Gulf of Alaska, the biomass of the Gulf of Alaska is about three times more useful as fish food than that of the Bering Sea.

In spite of a much more rigorous environment, the benthos of the Beaufort Sea is comparable in biomass and density with that of temperate regions. Benthic organisms are affected by OCS exploration during exploration and drilling. During development, further impact is possible if oil is incorporated into suspended sediments and subsequently deposited on the seafloor, thereby decreasing food quality or substrate suitability. Finally, most larvae of benthic organisms are pelagic meroplankters. Dissolved hydrocarbons could affect their development and thus the production of organisms and the animals dependent on them. For this reason, particular emphasis is being placed on surveys of meroplankton under Task E-10.

Task E-7

Determine the distribution, abundance, diversity, and productivity of the benthic community.

Benthic communities change slowly in response to seasonal and longer term climatological forces. Thus a relatively intensive one-time look suffices for a reconnaissance level examination. The larger commercial fauna (crabs and shrimp) are severely affected by fishing activities; it will be difficult, if not impossible, to discriminate between fishing and petroleum development impacts without tissue residue levels. However, several aspects of benthic ecology require examination: the distribution and abundance of principal infaunal species to an ordinal level, the present body burdens of hydrocarbons in populations close to natural seeps and near future lease tracts, and the relation of benthic crustacea to seasonal ice cover, particularly at the ice fronts. This latter aspect should be dealt with as an intensive ecological process study (Task F-9).

LITTORAL COMMUNITIES

The intertidal and shallow subtidal zone that makes up the littoral region of the ocean is generally an area of unusually high productivity and of high ecosystem "action" for its relatively small area. Part of the reason for this activity is that the littoral zone is an ecological edge between the marine and land habitats, and thus shares biotic elements of each. We can compile a long list of Alaskan biota that require access to both habitats - ranging from seabirds, sea lions, and bald eagles, to salmon - and the productive inshore ocean waters as nursery areas. A further reason for the productivity of the littoral zone lies in the simultaneous occurrence of three environmental attributes--substrate in the upper (photic) zone of the ocean, a rich source of nutrients, and a generally rapid water exchange. Examples of biota that are dependent on this set of environmental characteristics include the extensive pastures of algae and kelp that line the shores of the rocky littoral zone of the Gulf of Alaska and southern Bering Sea, the eelgrass beds in lagoons and estuaries, extensive resources of sea otter, abalone, and clams, and a rich fauna of shallow water fish and shellfish.

The special characteristics of the littoral zone also make it highly vulnerable to oil impact, either from large spills or from chronic low-level releases. Potential effects on the biota include oiling of birds and mammals that heavily use this zone; smothering of attached animal life such as sponges, mussels, and barnacles, or the infauna such as razor clams and cockles; and poisoning of all soft-bodied forms. Especially susceptable are the eggs and larvae of almost all animals that live in this zone.

Task E-8

Provide a general description of the intertidal and shallow subtidal habitat.

Studies of the littoral zone will first estimate Alaska's littoral resources - principal biota and their density distribution. The list of principal species should include not only those of actual or potential commercial importance, e.g., dungeness crab, hardshelled clams, and razor clams, but also dominant or characteristic animals and plants of the littoral zone, e.g., barnacles, mussels, snails, sea urchins, sea quirts, sponges, macrophyte algae, and seagrasses. Studies will require both intertidal and subtidal investigations, as well as intensive on a few sites selected as representing the major habitats and biota of the littoral zone.

Because of the enormous extent of the coastline, a stratified sampling strategy has been adopted. Aerial flights will map the general distribution and decide the predominant characteristics of various habitats: rocky intertidal, sandy beach, cliff, gravel island, salt marsh, etc. Subsequently, ground studies at selected sites will be used to authenticate the aerial surveys. A few of these sites will be chosen for intensive, long-term studies that could provide the basis for a baseline. Special note will be made of the position and composition of strand lines which can assist in the analysis of storm surge hazards.

Task E-9

Describe the ecosystem dynamics for littoral biota of the principal shore types with particular emphasis on potential, immediate and long-term impacts of contaminants and disturbances in species population dynamics, community composition, and productivity of the ecosystem.

Additional studies are required to describe the dynamics of littoral ecosystems. The studies will include the ecology of principal plant and animal species by shore type (e.g., sand, mud, gravel, and rocky beaches, salt marshes, estuaries, bays, fiords, and lagoons) and depth strata (e.g., splash, intertidal, subtidal). Particular emphasis will be on immediate and long-term impacts of contaminants and disturbances on species population dynamics, community composition, and productivity of the ecosystem. Impacts on immature stages of species not normally inhabiting the littoral zone as adults will also be assessed.

PLANKTON COMMUNITIES

All life in marine ecosystems is supported by the photosynthetic activity of plants: phytoplankton in the pelagic zone and sea-ice biomes, attached macro-algae in the littoral zone, attached micro-algae in coastal habitats and salt marshes, and vascular plants including seagrasses in coastal embayments. This organic production may be used directly by animals (zooplankton, benthic fauna, etc.) or after being converted to detritus.

The classical ecological approach to production systems is not particularly appropriate for studying the impacts of OCS development. The direct effects of increased dissolved hydrocarbons or heavy metals on phytoplankton are likely to be local, transitory, and of low magnitude. Biomagnification via phytoplankton does appear to be a factor. Zooplankton and meroplankton (principally eggs and larvae of fish and crustaceans) may be more seriously affected because either their developmental or sensory physiology may be impaired by hydrocarbons. Thus under the general heading of plankton, particular emphsis will be placed on zooplankton and meroplankton in nearshore areas and in known spawning areas. Lower trophic levels will be dealt with more specifically in the context of "Ice-related Communities" and "Ecosystems", where they constitute components of complicated systems that could be severely affected by OCS activities.

Task E-10

Determine seasonal density distributions of principal species of phytoplankton, zooplankton, and meroplankton.

Zooplankton and meroplankton studies will be emphasized. Field investigations will be keyed to critical periods of blooms and spawning while simultaneously obtaining data on circulation patterns. Although interest in fisheries usually has placed attention on icthyoplankton, consideration must be given to other meroplankton since all of these larval stages provide food for higher trophic levels as well as the potential for repopulating benthic and littoral habitats.

Task E-11

Determine seasonal indices of phytoplankton production, particularly the sea ice flora. Identify pathways of matter (energy) transport between synthesizers and consumers.

This task will be implemented mainly through the Ice-Front Ecosystem Task (F-10).

Task E-12

Determine non-population dependent physiological and population parameters of plankton communities.

This task will be accompanied primarily through Task E-9. Plankton populations vary spatially and temporally so much that extensive and frequent sampling are required to develop trends in population-dependent parameters. One alternative approach is to measure parameters that are independent of population size and reflect the health of the population. For zooplankton it is possible to measure lipid content in pre-overwintering population or percentage of ovorigenous females. For phytoplankton it is possible to measure assimilation ratio, pigment ratios, or carbon/nitrogen ratios. Non-population dependent parameters, particularly in zooplankton, indicate the health of populations at critical periods of the year.

Task E-13

Identify and characterize critical regions and habitats required by egg and larval stages of fish and shellfish species, especially those of commercial or ecosystem importance.

This task will be accomplished as part of Tasks D-7 and E-10. The study of nearshore circulation patterns will reveal the presence of gyres and eddies that retain eggs larvae and pollutants, which would increase their contact time. Identification of overlapping meroplankton source areas, gyres, and pollutant source areas thus becomes extremely crucial.

Task E-14

Development on ichthyoplankton key to aid identification of the ichthyoplankton occurring in Alaskan waters.

This task will bee accomplished as part of Task E-9 and will in turn permit accomplishment of that task.

MICROBIOLOGY

Microorganisms are ubiquitous components of all ecosystems. They cause disease, decompose organic matter producing nutrients, change pH and redox potential, change the oxidation state of ions, and affect the solubility of metals. Microbiological investigations in the OCS must consider the effect of hydrocarbons and trace elements on the normal functioning of the microbiota and, to a lesser degree, the effect the microbiota may have on the environment and other organisms under the influence of OCS development.

Heterotrophic organisms include those capable of decomposing petroleum and its components. Virtually nothing is known about the behavior of oil decomposers under cold conditions or close to ice. In addition, North Slope coastal lagoons have extreme temperature ranges with unknown consequences for oil decomposers. Early efforts will consist of reconnaissance surveys of the normal microbiota, as well as laboratory studies to determine the effect of temperature and other stresses on organic decomposition and the effect of hydrocarbons on pathogenic and non-pathogenic organisms.

Task E-15

Characterize marine microbiological communities with regard to the normal biota of heterotrophs, chemotrophs, and pathogens.

The overall microbial communities in ice, water, and sediment will be characterized quantitatively (enumeration of bacterial and fungal populations) and qualitatively (using numerical taxonomy and cluster analysis). Populations of indicator organisms (oil-degrading microorganisms, coliform bacteria, vibro, pseudomonads, clostridia) in ice, water, and sediment will also be quantified. The normal functioning of microbiological communities (e.g., denitrification, nitrification, cellulose decomposition, protein decomposition) are likely to be affected by OCS development, and particularly by chronic hydrocarbon contamination.

Task E-16

Determine the behavior of heterotrophic microorganisms, pathogens, and chemotrophs and their response to normal environmental stresses in arctic and sub-arctic waters.

The degree of adaptation by microorganisms to normal environmental stress in the arctic and sub-arctic is poorly known. Additional stresses due to OCS development can be estimated in the laboratory.

SEA-ICE HABITAT

For long periods of the year, sea ice is the dominant feature of the Beaufort Sea, the Chukchi Sea and the Northern Bering. It provides an ever-replenishing matrix for primary productivity, functioning at the same time as a substrate breeding ground, climatic barrier, and migratory route for mammals and birds.

During the winter, seasonal ice may extend as far south as the Cape Sarichef-Pribilof line, effectively covering the Bering Sea Continental

Shelf. At this time, much of the ice-associated fauna is distributed throughout the ice covered area, and associated with ecological divisions within the ice area, e.g., ice front, pack ice, or areas of semi-permanent open water. During the summer, the ice-associated subfauna move northward to the Arctic Ocean for the most part. Mammals of the Beaufort and Chukchi Seas live on and about the ice as a vital part of their ecology and are dependent on the yearly cycle of ice coverage and retreat.

Questions related to the distribution and movements of ice-inhabiting biota must be dealt with in terms of the areal extent, location, and structure of the ice itself (Task D-8). A very important aspect of sea ice habitat is the associated production system at the ice front in the Bering Sea and in ice leads farther north. This aspect will be dealt with under section "Ecological Process Studies."

Task E-17

Determine the relationship of living resources to the ice environment (including the edge of drifting ice, land fast ice, and inner pack ice), and examine the biological activities (species associations, food habits) under land fast ice on a seasonal basis in the Bering, Chukchi, and Beaufort Seas.

The distribution of seals, whales, and walruses depends heavily on the position of the souther ice front and summer leads, which can also concentrate spilled oil and lead to very high mortalities. Ice location and movement data with respect to lease areas and transportation routes, and the associated mammal populations, require an intensive effort. There is evidence that in winter, seals in particular are concentrated under the ice in regions of thin cover.

4.6.4.6 Task F.

WHAT ARE THE EFFECTS OF CONTAMINANTS AND ENVIRONMENTAL ALTERATIONS RELATED TO OCS OIL AND GAS ACTIVITIES ON INDIVIDUAL ORGANISMS, POPULATIONS AND ECOLOGICAL SYSTEMS?

Knowledge of the effects of petroleum on marine organisms is an essential part of the environmental assessment process. The OCSEAP will attempt to determine the deleterious effects of petroleum exposure and the threshold concentrations that cause these effects. Then, in conjunction with knowledge of the distribution and abundance of organisms, one can estimate the potential risks of releasing petroleum contaminants into the environment.

This approach is limited, however, in that controlled laboratory conditions and real field conditions are dissimilar, and there is much uncertainty about how added stress from contaminant exposure will interact with other biological/ecological stresses, such as those associated with reproduction, growth, and predation (including fishing pressure by man). We can probably never experimentally quantify the effects that will actually prevail from a particular level of contamination in the marine environment. However, it is possible to surmise that if effects are observed in laboratory experiments using the best state-of-the-art design, then similar effects may quite likely be encountered in nature. Such extrapolations are probably best for acute toxicity tests. Their direct applicability then decreases (but not in potential importance) through chronic toxicity tests to sublethal physiological effects.

Once the most important species of the marine ecosystem have been surveyed for lethal and sublethal effects of contaminant exposure, a test will be made for applicability of the results to a field situation through the use of controlled spill experiments. To take advantage of the growing body of information on ecosystem structure and function derived from OCSEAP's biological program, these experiments are planned for FY 1979 and succeeding years. These controlled spills will be conducted only after adequate planning and coordination with cognizant groups.

This effort will be guided by other biological elements of the study program. In selecting the relatively few species for testing, there will be considered (not in order of priority): (1) species of direct value to man, i.e., commercial and sports organisms, (2) species found to be important forage organisms, (3) species that are abundant and may control ecosystem structure or species composition through their own predatory or grazing activity, (4) species deemed "endangered" or "rare" or otherwise of aesthetic value, (5) species that are readily available and compatible with laboratory maintenance. Experimental organisms will be tested at every life stage considered important.

The effects program will document the chemical composition of (1) the contaminants used in exposure experiments, and (2) the contaminants contained in the organisms showing the effects. Effects studies, to be most readily applied to environmental circumstances, will use analytical chemistry techniques comparable to those used by environmental chemists measuring contaminant levels in the environment.

Although studies tend to be non-area specific, they do have broad applicability to all lease areas where the test organism occurs. The initial program emphasizes acute toxic effects of contaminants on individuals of selected species. As the program develops, this emphasis will shift toward the effects of chronic exposures on populations and ecosystems.

Task F-1

Review and evaluate the available literature and unpublished data on toxicity of crude oils and crude oil components (including toxic metals) on the basis of species, life stage, temperature at exposure, water source, oil source, geographic source of organisms, and presence of toxic metals.

This critical evaluation of existing information will serve to (1) form a coherent basis for preliminary assessment of potential impacts of contaminant releases into Alaskan OCS and coastal waters; and (2) guide the setting of priorities for further research on the acute and chronic effects of petroleum exposure in Alaskan marine organisms and ecosystems.

Task F-2

Determine the acute and chronic effects of crude oil and its component fractions, toxic metal components of drilling muds, and other petroleum-associated chemicals on survival, growth, reproduction, and selected physiological and behavioral mechanisms of selected arctic and subarctic organisms.

Although there is some literature on the toxicity of crude oil and its components, very few data have been obtained under arctic or sub-arctic conditions. The biological impact of petroleum hydrocarbons in this region, however, can be speculated to be more long-lasting and serious than in the more temperate regions of the earth because of the slower rate of evaporation of petroleum, including the more toxic aromatic fractions, its possibly slower rate of weathering, and the lower reproductive potentials of arctic and subarctic organisms. The absence of previous exposure is also a cause for concern, since arctic and subarctic organisms may lack defense mechanisms that have evolved in animals living in more highly variable environments.

Organisms and life stages selected as "important" or "critical" will be tested for sensitivity to potentially realistic exposure regimes (concentration and duration) for various classes of petroleum-associated toxicants. Thus, for the highly volatile and water-soluble benzenes and naphthalenes, acute toxicity tests are most appropriate; but for the potentially toxic polynuclear aromatic fractions, which are very poorly soluble, exposures to low concentrations should be maintained for as long as is technically feasible to determine accumulation rates and effects. The most sensitive life stages of important organisms will also be determined for various types of contaminants and exposure regimes.

Research on sublethal effects will focus principally on those physiological or behavioral parameters that can be related most directly to survival or productivity of the organism: growth rates, metabolic rates, reproductive potential, food-locating ability, migratory behavior. In addition, effort will be placed on identifying biochemical, pathological, and subcellular morphological effects of petroleum exposure, particularly when these observations can be correlated with known effects of other contaminants or with normal characteristics of the wild population as a function of petroleum exposure history.

Task F-3

Determine the effects of crude oil on the thermoregulatory mechanism and other functions of marine birds and mammals.

Coating by oil represents a major hazard, especially to marine birds and mammals. Oil reduces the air holding capacity and the insulating quality of fur and feathers and this results in excessive loss of body heat and a breech of critical physiological defense. All fur-bearing mammals and young hair seals are especially vulnerable because, until they have developed a thick layer of fat, they are completely dependent for thermal insulation on a fine layer of hair. Further biological damage is possible as the animal attempts to remove the oil through preening or other grooming activities.

Effects of oil-coating on insulating quality of skins will be determined for several species of marine mammals and birds. Where possible, experiments will also be conducted to determine the physiological effects of oil coating on live animals (effects on body temperature, respiratory rate, feeding or diving behavior).

Task F-4

Determine by laboratory experiments the potential release of toxic metals from oil-impacted sediments, the occurrence of soluble and non-soluble toxic metals in sediments (with emphasis on organo-metallic complexes), and the relative importance of these toxic metals on various species in terms of uptake and effects on biota.

Since sediments are a major reservoir of trace heavy metals in the marine environment, it is necessary to determine the effects that petroleum exposure may have on natural distributions of metals among water, sediments, and biota. Experimentation is necessary to verify if potential changes in bioavailability or toxicity of heavy metals may result from OCS petroleum development.

Task F-5

Determine by laboratory experiment the bioaccumulation and relative effects of petroleum hydrocarbons and other OCS-related contaminants presented through various exposure pathways, including soluble forms, food chain exposure, suspended-particulate-borne contaminants and sediment-adsorbed contaminants.

Experiments are required to assess the relative effectiveness of various exposure pathways for eliciting contaminant effects in different forms of biota. Such research is necessary to ensure that baseline analytical efforts, as well as acute and sublethal challenge experiments, are properly designed to measure the most important or sensitive parameters.

Task F-6

Conduct laboratory and field studies to determine recovery rates of selected organisms and ecosystems from perturbations caused by either contamination or other disturbances associated with petroleum development.

The degree and speed of recovery of organisms exposed to contaminants will be examined whenever possible in all experiments under Tasks F-2 to F-5. After exposure to the challenging contaminant, the contaminant will be removed from the system, and the physiological and behavioral parameters being tested will be examined for response to this removal. In addition, exposed organisms will be measured for depuration or removal of bioaccumulated contaminants to determine turnover rates of the contaminants or clearance times for the organisms' recovery.

By using both accidental petroleum spills and carefully controlled experimental exposures in the field, these effects on total communities or ecosystems will also be examined. Design criteria will be developed for experimental petroleum spills in various types of controlled marine ecosystems. Sampling design should be suitable for testing how potentially sensitive ecological parameters (trophodynamics--i.e., pathways and rates of energy flow, distribution and abundance of organisms, species diversity, growth and reproduction of organisms, accumulation and turnover of contaminants in organisms and in the whole system, and biological productivity of the system) respond to various exposure regimes (acute, pulsed, chronic) of petroleum hydrocarbon introduction. The study design should include post-exposure measurements to demonstrate the speed and extent of ecosystem recovery from the contaminant impacts.

Task F-7

Determine the types and incidences of diseases presently occurring in fish, shellfish, birds, and mammals for use in (a) evaluating future impacts of petroleum-related activity, and (b) designing experiments to test the effects of contaminant exposure to disease-susceptibility.

Limited knowledge is presently available concerning the pathology of species in, or associated with, the North Pacific and Arctic Ocean marine environments. Particularly lacking is information on diseases of fish; much of the research on this subject has related to bacterial diseases of salmon held in pens or to skin tumors of flatfishes. Petroleum contains components that have been demonstrated to be carcinogens in mammals, and compounds that are immuno-suppressives (those which decrease disease resistance and adaptive responses). Exposure of marine animals to such compounds may have a profound effect on tumor incidence, susceptibility to infectious disease, and ultimate survival.

During regular biological sampling schedules, specimens suspected of being diseased will be preserved for examination. Incidence of pathological types in the natural population will be determined as baselines against which future changes can be compared. Tissues samples from marine birds, mammals, fish, and shellfish will be obtained for baseline chemical analyses of hydrocarbon and metals. Data will be examined for correlations between incidence of disease and levels of contaminants.

Task F-8

Determine the potential ecological effects of alternative countermeasures to oil spills.

Although cleanup and countermeasures against oil spills will be difficult and perhaps impossible due to severe environmental conditions and logistics difficulties in Alaskan coastal areas, we must determine the potential impacts of various countermeasures, including burning of petroleum and the use of detergents. This task will use both laboratory and field efforts on effects and synthesize those results with information on structure and function of ecosystems and population dynamics developed under Task E in order to determine preferred types of countermeasures. Studies will determine the relative extent of environmental impact by location, season, and environmental conditions.

Task F-9

Describe, analyze and verify the ecological community structure and productivity of selected coastal ecosystems with respect to potential impacts of OCS oil and gas development.

The geographic boundaries of these studies are determined by the physical setting including circulation patterns and the constraints of logistics and funding. The scientific boundaries of these studies are set with the intent to focus as rapidly as possible on determining which populations and processes are at risk from OCS oil and gas development.

The principal strategy for conducting ecological process studies will consist of assembling an interdisciplinary team to plan, conduct, and report on an integrated investigation. Research elements to be included in any investigation will be:

a. Descriptions of the distribution and abundance of the principal organisms (on the basis of activity, and food web position, potential susceptibility to impact) and their food webs.

b. Assessment of how such items as currents, ice formation, movement, and melting, waves, storm surges, freeze-thaw cycles, and oil and gas originated sediment affect the biota.

c. Document the ecological and physiological tolerances of biota to "normal" and unusual stress and disturbance.

d. Quantify the trophodynamics of the food-webs.

e. Describe the system qualitatively and quantitatively with regard to feeding and reproductive niches, trophodynamics, and factors controlling productivity.

f. Describe habitat dependencies and habitat and uniqueness, fragility, distribution, abundance, and availability.

g. Develop observational and experimental designs to detect impact of OCS oil and gas development and develop causal relationships.

h. Provide data in suitable format for ecological models and/or use such models as exist for data analysis.

i. Make calculations using these models to determine the effect of impact from OCS oil and gas activities on the biological component of the ecosystem.

The information and data products are intended to be available in time for the writing of operating orders, regulations and stipulations. Although the most useful data will not be available in quantity for some lease areas (Lower Cook, NEGOA) before leasing and tract selection, an attempt will be made in these areas to acquire early data that will address the question of acceptable loss.

Task F-10

Describe, analyze, and verify the ecological community structure of the ice-front production system with respect to potential impacts of OCS oil and gas development.

The seasonal ice-front of the Bering Sea constitutes one of the most productive systems in the world, particularly where it overlies the Continental Shelf break. Preliminary results suggest that the large stocks of fish in the "golden triangle" between the Aleutian Islands and the Pribilof Islands exist because the ice-front acts as a conveyor belt for nutrients, a second benthic substrate, and reinforces the effect of slope upwelling. Since the ice-front and its leads can concentrate both oil and organisms, the vulnerability of the system to OCS oil and gas development must be assessed.

Task F-11

Describe, analyze and verify the community ecology of coastal detritus systems with respect to OCS development impacts.

Detritus system exist in coastal regions in which large inputs of organic production from vascular plants and macroalgae are bacterially decomposed before becoming available as food for higher trophic levels. The interaction between suspended detritus and dissolved or suspended hydrocarbons has not been investigated. The adsorption of oil on detrital particles could affect their palatability, nutritional value, and transport. Detritovores, feeding on oiled particles, could assimilate hydrocarbons primarily by this route and pass them to higher trophic levels.

4.6.5 DATA MANAGEMENT

4.6.5.1 INTRODUCTION

Data Management is concerned with the quality of data collected, from the planning of data collection through the storage and archiving of those data in a data base system that will support the requirements of data users. It includes the orderly flow of data and the assurance of data quality through such mechanisms as intercalibration, standardization, and effective experimental design.

The overall management and coordination of the data management program is provided by the OCSEA Program Management Staff in Boulder. The Project Data Managers at the Juneau Project Office are responsible for the timely flow of data from investigators and are the single point of contact for direct contact with investigators on data management matters. The Environmental Data Service (EDS), NOAA, has been designated as the data center for the development of a data base and archive for all environmental data resulting from OCSEAP.

Each investigator prepares such data in accordance with the guidelines described in this section and forwards those data to EDS, via the respective Project Data Manager. EDS reviews the data and their documentation and on acceptance archives and services requests for the data.

4.6.5.2 DATA FLOW AND DATA MANAGEMENT RESPONSIBILITIES

4.6.5.2.1 Principal Investigator:

a. ensures that his contract with the OCSEAP Office includes adequate funding to satisfy data management requirements in total:

b. provides and documents quality control, validation and verification procedures for all data, and provides calibration documentation;

c. submits a cruise report/data inventory to the Project Data Manager within 10 days of the completion of each data collection phase on internationally approved inventory forms.

d. submits processed data to the Project Data Manager within 90 days of the completion of a cruise or a 3-month data collection period;

e. retains or provides for the retention and inventory of all primary data and documentary materials (i.e., original logs, analog records, etc.) for at least five years after processed data are forwarded;

f. retains for at least one year, a duplicate of each magnetic tape, card deck, log form or other material that has been submitted to the Data Manager.

g. provides for bilateral exchange of data with other PIs;

h. submits quarterly reports to the Project Office within three weeks of the end of the quarter.

i. submits the data documentation form (D.D.F) with all data from the P.I.

4.6.5.2.2 The data management responsibilities of the Project Data Manager are to:

a. determine data collection and processing schedules, and assure that all Program elements are made aware of them;

b. monitor the progress of data and sample flow;

c. provide records of data inputs to be prepared by investigators and status of data flow and provide the data and monthly updates of other field information for the use of the tracking system;

d. ensure that the contracts and other agreements are adequate to ensure proper data management;

e. define requirements for processing support to investigators and arrange for support;

f. specify format requirements which encourage the use of the least number of different data submissions format (i.e., that investigators taking similar data.

g. assess the adequacy of field calibrations, intercomparisons, observational procedures and quality control procedures and make reports and recommendations to program management staff;

h. provide data management forms to investigators.

4.6.5.2.3 The Program Data Manager of the Management Staff provides the overall management and coordination of the OCSEAP Data Management Program, including:

a. furnishing a periodic assessment of the status of the data management;

b. advising the Program Director of problems in the implementation of any part of the data management plan and recommending corrective actions;

c. defining data products required by the Program from the data base;

d. establish and administer Quality and Reliability Assurance policy procedures;

e. updating the data management plan;

f. reviewing all proposed investigator work statements to ensure that data management plans have been properly developed and ensuring that EDS receives copies of all reviewed work statements;

g. reviewing overall performance of investigators in meeting contractual data management requirements.

4.6.5.2.4 The OCSEAP Data Center is responsible for the following:

a. providing assistance to program participants on data management requirements;

b. developing data formats for OCSEAP data using the specifications developed by the Project Office and when necessary, through direct contact with cognizant principal investigators. All formats and changes will be submitted to Project Office for approval and distribution and to the Program Office for review;

c. specifying the standard media that will be most compatible with EDS storage/retrieval systems;

d. the development and compilation of fully processed digital data files, recognizing that the development of an integrated data base is dependent on the nature of the types of data products required by the program;

e. organizing and maintaining a data file of nondigital data to include analog records, data reports, maps, charts, and photos;

f. maintaining a data tracking system;

g. preparing a catalog of available Program data and data products;

h. servicing OCSEAP user requests for OCSEAP data;

i. maintaining catalog of analog, photo and other nondigital information collected as part of the OCSEAP field efforts;

j. providing data processing services to investigators;

k. serving as a distribution point to other non-OCSEAP users.

4.6.5.3 DATA FLOW

The actual flow of data is shown in Figure 4-2. This flow is carefully monitored by both the Project Data Managers and the Program Data Manager.

Data collected in the OCS Program is archived by NOAA's Environmental Data Service (EDS) and is available to all scientists. The investigator has no proprietary rights to the data collected in the OCS Program.

Data is provided from the data base to all OCSEAP investigators who require such data for their work. Other scientists may obtain any data from the data base at the cost of retrieval, handling, and mailing. A catalog of the data available is prepared and updated regularly to enable users to order the data products they require.

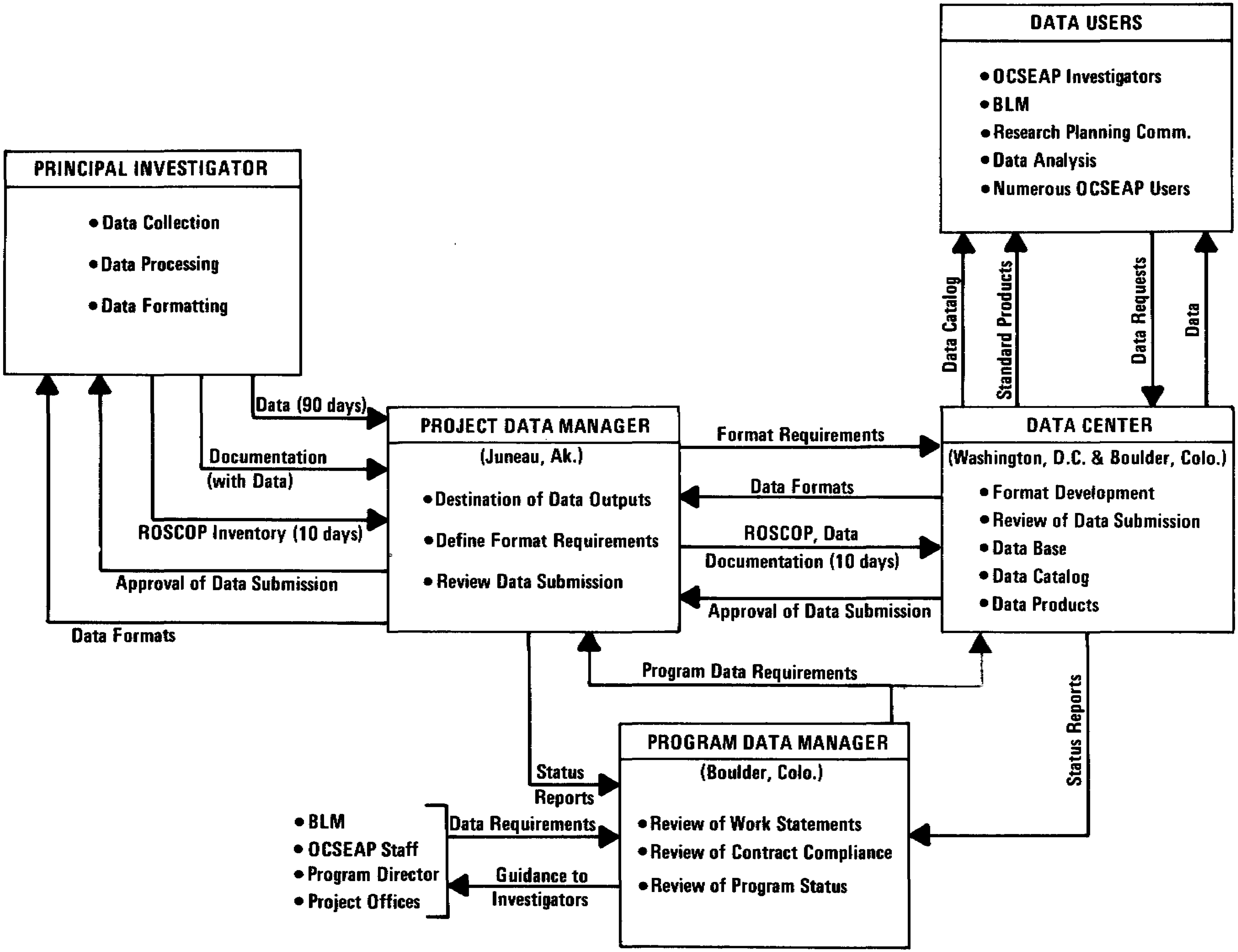

Figure 4-2 DATA FLOW DIAGRAM

4.6.5.4 DATA ANALYSIS

The Program Management Staff monitors the accumulation of data in the data bank, and arranges for special analyses, correlations, and summaries of the data for BLM and PI use. These analyses are conducted by NOAA itself, by special contract or agreement, and by the principal investigators, as well as by the Program Management Staff in its synthesis, integration, and planning roles.

4.6.5.5 PETROLEUM ANALYSIS INTERCALIBRATION PLAN

Because of the importance of petroleum hydrocarbon chemistry, the Alaskan program has provided three standards (homogenized pristine sediment, contaminated sediment, and *Mytilus*) for distribution among investigators. (Because of difficulties in analytical chemistry, no certified hydrocarbon bearing water standards are yet prepared.) Investigators submit their analysis data for these standards as well as for their samples. For dissolved hydrocarbons, at least ten percent of all samples are analyzed concurrently by NBS for extractable HC concentration.

The certified sediment and *Mytilus* intercalibration samples are available to BLM contractor laboratories. In addition, NOAA hydrocarbon contractors are to participate in the BLM hydrocarbon quality control program.

4.6.6 SYNTHESIS AND INTEGRATION

4.6.6.1 OBJECTIVE

It is an objective of the Synthesis and Integration Effort (SIE) to organize, process and present the information being gathered in the manner, format and timing most useful to decision makers. The implementation of the SIE is the direct responsibility of the Program Management Staff. Its functions are to:

1. Seek new knowledge and analysis concerning operation and interaction of the Alaskan marine systems. It accomplishes this insofar as possible using its own resources and those of the principal investigators or special contracts to insure that the data obtained from different projects are analyzed and correlated.

2. Seek a comprehensive understanding of each lease area and identifies the impacts and effects that are related to oil and gas development. It accomplishes this by organizing and reviewing information by lease area, involving principal investigators in synthesizing the total overall understanding, and finally highlighting potential problems and deficiencies for consideration by BLM.

4.6.6.2 METHODS OF SYNTHESIS AND INTEGRATION

The OCSEAP has adopted the following means for achieving program integration and information *synthesis and integration*:

1. Upon receipt from the field, reports are collated by OCSEAP according to Task A through F in this plan, under the general categories of:

Task	Sample Disciplines
A-Chemical Baselines	Chemistry
B-Sources	Development sequences
C-Hazards	Ice, extreme wind, waves, etc.
D-Transport	Wind, currents, mixing, etc.
E-Receptors	Birds, fish, mammals, etc.
F-Effects	Toxicity studies

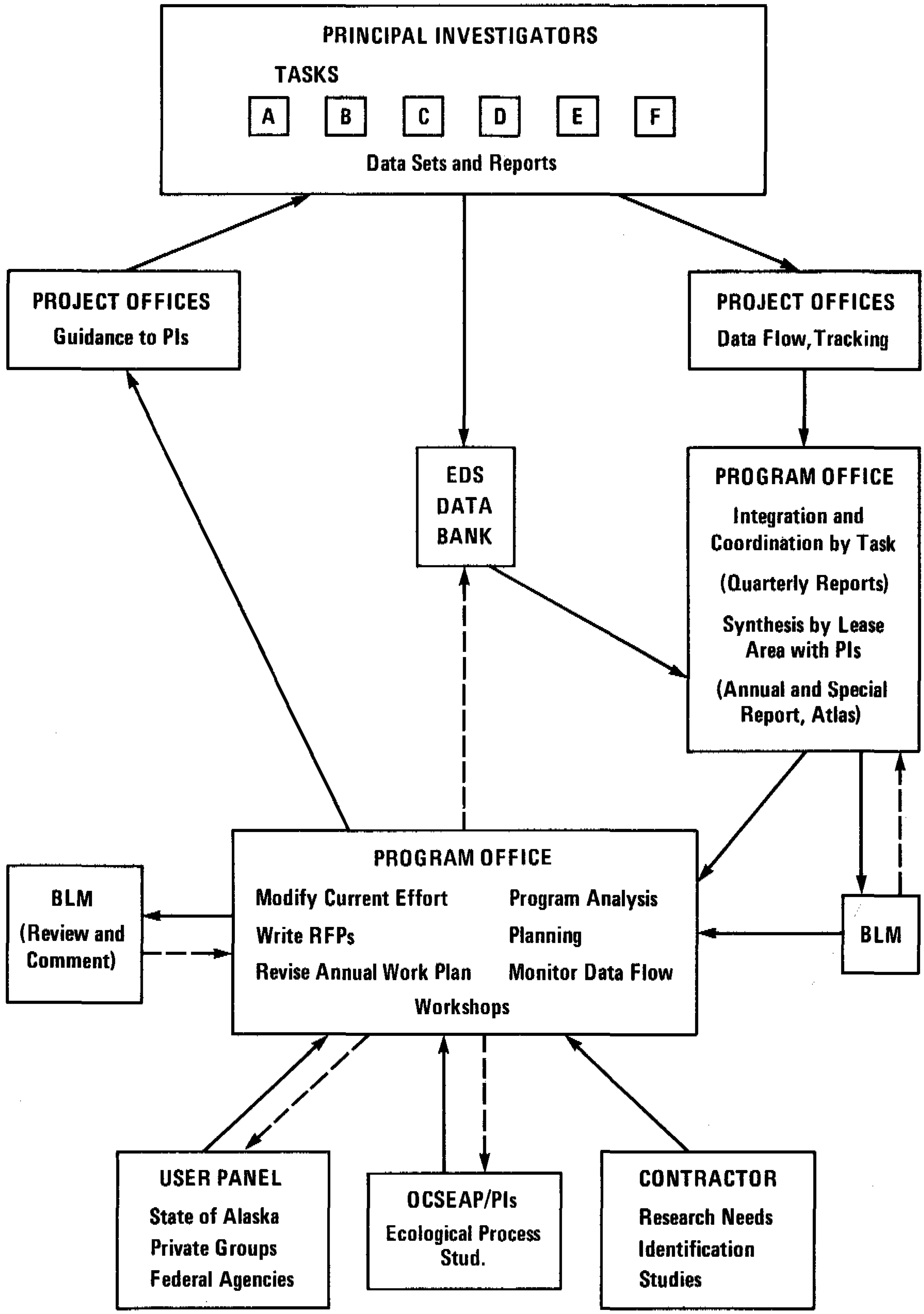

Figure 4-3. SYNTHESIS AND INTEGRATION EFFORT

An organization of information using these categories is not substantially different from an organization by disciplines but it does facilitate orientation toward the applied problem.

2. The reports are distributed to investigators in the same and allied categories to promote interaction among investigators.

3. Subject-specific workshops are held for the purposes of coordination and information; interdisciplinary workshops are held for purposes of integration and synthesis of results; and special workshops are held as needed to plan program content for future geographic and topical areas of emphasis and to discuss specific scientific problems.

4. The investigators' reports and data (typically discipline oriented) are reviewed and the information rewritten into interdisciplinary reports by lease area. These reports collate and organize knowledge on terms of source, transport, hazards, receptors, and effects studies for each lease area. The information used includes that derived from the BLM Alaskan studies in the context of information from other sources. These are part of the annual scientific report to BLM. Successive synthesis reports build upon the preceding ones and thus are more comprehensive and useful to impact statement writers and decision makers.

5. The Program Management Staff arranges meetings with investigators, during which the annual draft reports for lease areas are critiqued and new information provided. The reports are then rewritten and submitted to BLM.

6. The OCSEAP Research Planning Committee reviews reports throughout the year, as well as annual synthesis reports, for the purpose of making recommendations to the Program Director regarding future program emphasis and content.

7. "Research Needs Identification" projects are funded wherein the contractor analyzes the data and models available to determine their adequacy for assessing environmental effects from hypothesized chronic and acute releases and other insults. Analysis includes sensitivity tests to determine the weakest links in the source - transport - receptor - effects relationship in each lease area. The contractors interact regularly with the OCSEAP staff so that priorities and content of the research program can be adjusted to meet program needs.

8. A special tool to achieve synthesis of data on an area-by-area basis will be a five-volume atlas for the Alaskan OCS. By use of charts, graphs, overlays, text, and references, the atlases will display in comprehensible form, data developed in the BLM-OCS program and elsewhere. Final selection of the material to be presented, the format in which it will be presented and the layout to be utilized will be coordinated with the BLM Alaska OCS Office prior to initiation of any actual chart preparation.

9. The Program Management Staff monitors the accumulation of data in the data bank, and arranges for special analyses, correlations, and summaries of the data for BLM and PI use.

10. Ecological Process Studies, as described earlier, identify and study key species, functions, and processes susceptible to oil and gas development insults. They concentrate on understanding relationships and processes affecting species within a particular environment. Such studies are wholly dependent on the complete integration of all scientific disciplines and the close linkage between laboratory and field studies. A word or computer model is used to help in the organization and integration of information, identification of important relationships and effects, and establishment of priorities and project emphasis. In order to insure that the necessary integration takes place and that all relevant data are available for utilization, a special project manager is used for each of these studies. This project manager will usually be a staff member located in the appropriate Project Office.

4.6.7 END PRODUCTS AND DELIVERABLES

The OCSEAP studies are designed and managed to provide in a timely manner products that are directly and immediately applicable to BLM needs for prediction, assessment, setting stipulations, and regulation. These products are identifiable both within the reports routinely submitted by investigators, and as separate volumes, operational capabilities, and items "on the shelf" on call. Identifiable products from these studies include:

- Models

  a. For calculating oil transport on water, including vertical mixing, evaporation, weathering, biodegradation, and dispersion. This model permits transition from an oil spill to prediction of the characteristics and concentration of oil exposing biota downstream.

  b. For changes in wind with distance from mountainous shorelines for use in calculating oil transport on water.

  c. Of oil transport in ice covered areas. Oil moves both in leads and with the ice when trapped beneath it. The ice movement differs from that of the water currents, so special models are needed for ice conditions.

  d. For estimating and quantifying biological damage. These models can be used in tandem with the transport models to obtain assessments.

  e. Of processes in ecosystems and the relationship between species, used for assessing and predicting impacts from released oil, and recovery rates.

  f. Of the modification of permafrost by man's activities. These models make it possible to estimate the hazards of permafrost to OCS development.

  g. Of ice strength and movement, for use in permitting and in judging industry technology.

- Maps and Charts

  a. Of sediment character and stability, potential slump areas, etc., for use in selecting tracts and in specifying further studies to be done in advance of permits.

b. Of earthquake epicenters, and of faults, active and inactive, for the same purposes as above.

c. Of permafrost distribution, for the same purpose as above.

d. Of location, character, and movement of sea ice.

e. Of biological parameters, including food and nutrient distri bution, habitats, migratory routes, spawning areas, mortality, major colonies and hauling grounds, seasonal distributions of threatened, endangered and commercial species, and others, for purposes of selecting sites and assessing impacts, and for design of monitoring programs.

f. Of ocean currents, for use in predicting oil transport through the use of models and for use in determining passive migration of plankton and juvenile fish thru the lease area.

g. Of petroleum, toxic compounds, and metal distributions in the water column, biota, and sediments, for use as a baseline for future assessment of effects.

h. Of possible sources of oil to the environment for use in assessing impact and designing monitoring programs.

i. Of sea floor topography.

- Statistical Probability Distributions

a. For wave heights.

b. For storm surges for use in facility siting and for estimating transport onto the land of marine oil.

c. For depth and frequency of ice gouging in prospective pipeline corridors.

d. For wind speed including extreme winds.

e. Of usual climatological parameters, for use in planning operations and siting.

f. Of atmospheric stability, for use in assessing air pollution from oil and gas development.

g. Of effects on different species from different hydrocarbons and metals associated with oil and gas development, for use in setting standards for concentrations and in regulating sources.

h. Of types and incidence of mortality and disease in biota for later use as background information when monitoring the effects of production.

- Data Sources and Collations

  a. Of data that should be digitized in standard format. This data will be available for future analysis to meet BLM needs not yet identified.

  b. Of data which should not be digitized, but which will be kept in raw form or in smoothed form according to its nature, to meet future BLM needs.

  c. Of biological and physical specimens, for future use in verifying conclusions of investigators, for use in possible legal actions, and in obtaining new chemical analyses.

- Data Summaries and Collations

  a. Collected, summarized, graphed, and plotted data, sometimes subjected to statistical analysis and smoothing, for use in DEIS, FEIS, PDOD, permitting, etc.

  b. Special data products or presentations on request to BLM, such as required input to impact assessment computer models and data syntheses reports.

- Engineering Input Data

  a. Strength, location, movement, and character of sea ice useful for judging adequacy of industry design and for setting stipulations.

  b. Depths and frequencies of bottom gouging by sea ice for input to pipeline specifications.

PART V

5.0 SCHEDULES

5.1 GENERAL

This part contains listings and charts of the OCSEAP program and management milestones. The milestones listed in this PDP are those considered to mark only significant events. This is particularly true of programmatic or operational milestones, since a more detailed set of annual milestones is provided in each TDP.

5.2 PROGRAM TIMING

The timing of the program is keyed to the leasing and development schedule prepared and provided by the Bureau of Land Management (Figure 5-1),* the lead time required (Section 5.2.1) and the duration of the production phase (Section 5.2.2). The relation of the timing of data needs to the phases of development is detailed in Section 5.2.3. The Study Sequence used for scheduling studies in concert with the BLM schedule is described in Section 5.3. The resultant associated operational, synthesis and reporting schedules are given in Part VI, the management plan. Significant program milestones are listed in Section 5.4.

5.2.1 LEAD TIME

A lead time of several years is generally required to discover, develop, and market oil or gas in a usable energy form. Generally by the time a lease is issued, most of the detailed geological and geophysical investigations have been completed. If a lease does prove productive, statistics show that the discovery usually will be made 1.5 to 4.5 years after the lease sale. In response to a 1974 survey by the Bureau of Land Management, 25 oil

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* At the time of writing, a new draft lease schedule had been issued that delayed most lease sales in Alaska. See Figure 5-3, added in press.

PROPOSED OCS PLANNING SCHEDULE

JUNE 1975
(REVISES NOVEMBER 1974 SCHEDULE)

SALE AREA		1974 J	A	S	O	N	D	1975 J	F	M	A	M	J	J	A	S	O	N	D
SOUTH TEXAS	37		DES	PH		BSI FES		N	Sale					S	A	L	E		H
CENTRAL GULF	38	ND			T		DES	PH		FES	N	Sale							S
CENTRAL GULF	38A	ND			T		DES	PH		FES	N			Sale					
SOUTHERN CALIF.	35		T						DES			PH	BSI		FES	N	Sale		
COOK INLET	1/	F	E	D	E	R	A	L		-		S	T	A	T	E		S	A
GULF OF ALASKA	39	BSI				C	ND			T			DES		PH		FES	N	Sale
GULF OF MEXICO (GENERAL)	41						C	ND		T				DES		PH			FES
MID-ATLANTIC	40									C			BSI ND		T		DES		PH
NORTH ATLANTIC	42												C		ND	BSI	T		
GULF OF MEXICO (DRAINAGE)	44																		T
SOUTH ATLANTIC	43													C			BSI ND		
GULF OF ALASKA (INCLUDING KODIAK)	46													BSI			C		ND
BERING SEA (ST. GEORGE)	45						C	ND				BSI		T					
GULF OF MEXICO (DEEP)	47																		
SO. CALIFORNIA	48																		
MID-ATLANTIC	49																	BSI	
BEAUFORT SEA	50											BSI							
OUTER BRISTOL BASIN	51											BSI							
NORTH ATLANTIC	52															BSI			
CALIFORNIA GENERAL INCL. WASH. & OREGON	53																		
SOUTH ATLANTIC (BLAKE PLATEAU)	54																		
BERING SEA (NORTON BASIN)	55																		
GULF OF ALASKA – ALEUTIAN SHELF	56													BSI					
CHUKCHI SEA HOPE BASIN	57																		

SALE AREA		1976 J	F	M	A	M	J	J	A	S	O	N	D
SOUTH TEXAS	37	E	L	D		I	N		F	E	B	R	U
CENTRAL GULF	38	A	L	E		H	E	L	D		I	N	
CENTRAL GULF	38A												
SOUTHERN CALIF.	35												
COOK INLET	1/	L	E		-		D	A	T	E		U	N
GULF OF ALASKA	39												
GULF OF MEXICO (GENERAL)	41	N	Sale										
MID-ATLANTIC	40			FES	N	Sale							
NORTH ATLANTIC	42	DES		PH			FES	N	Sale				
GULF OF MEXICO (DRAINAGE)	44			DES		PH			FES	N	Sale		
SOUTH ATLANTIC	43	T			DES		PH			FES	N	Sale	
GULF OF ALASKA (INCLUDING KODIAK)	46		T			DES		PH			FES	N	Sale
BERING SEA (ST. GEORGE)	45								DES			PH	
GULF OF MEXICO (DEEP)	47	C		ND			T			DES		PH	
SO. CALIFORNIA	48			C		ND			T			DES	
MID-ATLANTIC	49					C		ND			T		
BEAUFORT SEA	50							C		ND			T
OUTER BRISTOL BASIN	51									C		ND	
NORTH ATLANTIC	52											C	
CALIFORNIA GENERAL INCL. WASH. & OREGON	53								BSI				
SOUTH ATLANTIC (BLAKE PLATEAU)	54	BSI											
BERING SEA (NORTON BASIN)	55			BSI									
GULF OF ALASKA – ALEUTIAN SHELF	56												
CHUKCHI SEA HOPE BASIN	57							BSI					

SALE AREA		1977 J	F	M	A	M	J	J	A	S	O	N	D
SOUTH TEXAS	37	A	R	Y		1	9	7	5				
CENTRAL GULF	38	M	A	Y		1	9	7	5				
CENTRAL GULF	38A												
SOUTHERN CALIF.	35												
COOK INLET	1/	C	E	R	T	A	I	N					
GULF OF ALASKA	39												
GULF OF MEXICO (GENERAL)	41												
MID-ATLANTIC	40												
NORTH ATLANTIC	42												
GULF OF MEXICO (DRAINAGE)	44												
SOUTH ATLANTIC	43												
GULF OF ALASKA (INCLUDING KODIAK)	46												
BERING SEA (ST. GEORGE)	45	FES	N	Sale									
GULF OF MEXICO (DEEP)	47		FES	N	Sale								
SO. CALIFORNIA	48	PH			FES	N	Sale						
MID-ATLANTIC	49	DES		PH			FES	N	Sale				
BEAUFORT SEA	50			DES		PH			FES	N	Sale		
OUTER BRISTOL BASIN	51		T			DES		PH			FES	N	Sale
NORTH ATLANTIC	52	ND			T			DES		PH			FES
CALIFORNIA GENERAL INCL. WASH. & OREGON	53	C		ND			T			DES		PH	
SOUTH ATLANTIC (BLAKE PLATEAU)	54			C		ND			T			DES	
BERING SEA (NORTON BASIN)	55					C		ND			T		
GULF OF ALASKA – ALEUTIAN SHELF	56							C		ND			T
CHUKCHI SEA HOPE BASIN	57									C		ND	

SALE AREA		1978 J	F	M	A	M	J	J	A	S	O	N	D
SOUTH TEXAS	37												
CENTRAL GULF	38												
CENTRAL GULF	38A												
SOUTHERN CALIF.	35												
COOK INLET	1/												
GULF OF ALASKA	39												
GULF OF MEXICO (GENERAL)	41												
MID-ATLANTIC	40												
NORTH ATLANTIC	42												
GULF OF MEXICO (DRAINAGE)	44												
SOUTH ATLANTIC	43												
GULF OF ALASKA (INCLUDING KODIAK)	46												
BERING SEA (ST. GEORGE)	45												
GULF OF MEXICO (DEEP)	47												
SO. CALIFORNIA	48												
MID-ATLANTIC	49												
BEAUFORT SEA	50												
OUTER BRISTOL BASIN	51												
NORTH ATLANTIC	52	N	Sale										
CALIFORNIA GENERAL INCL. WASH. & OREGON	53		FES	N	Sale								
SOUTH ATLANTIC (BLAKE PLATEAU)	54	PH			FES	N	Sale						
BERING SEA (NORTON BASIN)	55	DES		PH			FES	N	Sale				
GULF OF ALASKA – ALEUTIAN SHELF	56			DES		PH			FES	N	Sale		
CHUKCHI SEA HOPE BASIN	57		T			DES		PH			FES	N	Sale

BSI Baseline Studies Initiated
C Call for Nominations
ND Nominations Due
T Announcement of Tracts
DES Draft Environmental Statement
PH Public Hearing
FES Final Environmental Statement
N Notice of Sale
1/ State May Conduct Sale

Baseline studies scheduled are contingent upon scientific personnel and equipment being available to perform the studies.
Sales are contigent upon technology being available for exploration and development. A decision whether to hold any of the lease sales listed will not be made until completion of all necessary studies of the environmental impact and the holding of public hearings; as a result of the environmental, technical, and economic studies employed in the decision – making process, a decision, may, in fact, be made not to hold any sale on this schedule.

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

DEPARTMENT OF THE INTERIOR
March 3, 1849

Curt Berklund

Director,
Bureau of Land Management

Fig. 5-1

and gas (or related) companies made estimates of the time period required, after discovery, to achieve initial and peak production in 17 major OCS areas. The companies estimated that it would take 2.5 to 6.5 years to attain production and 5.5 to 9.5 years to reach peak production. Thus, the total time after a lease sale to achieve initial production would be four to eleven years and to attain peak production would be seven to fourteen years.

5.2.2 DURATION OF STUDIES

The Environmental Studies Program, as it is currently envisioned, is long-term in the sense that it will continue for the duration of any production activity. Original BLM budgeting and planning was based on an initial three year period of intensive study in each area, a decrease in funding over the succeeding two years, and a maintenance or sustaining level of funding for an indefinite number of years to monitor the effects of OCS oil and gas exploration and development activity over the long term, to prepare for successive leases in the same area. With experience this has been modified to some extent to extend the initial period because there remain many unsolved problems, and some baselines are particularly difficult to establish. All funds are obligated on an annual basis even though programs may be planned for longer periods of time. This provides flexibility in the parameters chosen for measurement, re-evaluation of the location of sampling stations, evaluation of the contractor's performance, and evaluation of the data.

This policy is reflected in the planned funding Resources, Section 7.3.

5.2.3 TIMING OF DATA NEEDS

5.2.3.1 PRE-EXPLORATORY PHASE

Prior to the date of sale, information is required to identify areas that should receive special attention due to their unique characteristics, conditions that might be hazardous to OCS development, and areas where possible conflicts of use might arise if development occurred. This information is used in the selection of tracts and in the decisions to place stipulations on particular leases or to modify the OCS operating orders.

5.2.3.2 EXPLORATORY PHASE

Following the sale and issuance of a lease, a plan for exploration must be submitted by the lessee and approved by USGS for each lease block before any exploratory drilling can be initiated on that block. Drilling is usually initiated within one year, although the actual commencement time may vary between three and eighteen months. Exploratory drilling can continue intermittently on a tract up to five years or longer, although such drilling on one tract beyond five years would be the exception rather than the rule. A plan for drilling, however, must be submitted within five years of the issuance of the lease, or rights to that tract are forfeited. Exploratory rigs are on a single site for as little as 15 days and as long as 150 days. Usually a single hole is drilled on one site, testing is completed, and the well is either abandoned or capped and left for future completion. The rig is then moved to another site. If there are strong indications of petroleum, additional wells may be drilled to delimit the extent and nature of the reservoir. In a given lease area, the most extensive aspect of the exploratory drilling phase could last for five years or longer.

Rig emplacement and initial placement of the well-casing results in only a slight disturbance of the sediments. Few materials are introduced into the environment from this operation. Drill cuttings, formation waters, drilling muds, and fluids resulting from the testing of wells can escape into the environment during the drilling operations. The bulk of these materials, however, are naturally occurring and are diluted quickly by the surrounding currents. Any harmful effect would be expected to be quite localized. Oil-based drilling muds, generally used only in the deeper sections of a well, are required to be taken ashore and disposed of properly. Water-based muds, on the other hand, while often recycled, may be thrown overboard after the removal of oil. EPA regulations currently specify that these muds contain no more than 48 ppm petroleum hydrocarbons when disposal occurs.

The exploratory drilling phase presents fewer possibilities for significant environmental damage than the later stages of oil and gas development. Nevertheless, because of the necessity of obtaining data over many years (especially those data used as a benchmark) and the very slight possibility that some environmental change might result, the benchmark and descriptive data collection programs are required to be underway by the time exploratory drilling commences.

5.2.3.3 DEVELOPMENT PHASE

If any area appears to have economically significant quantities of oil and gas, plans are made for development. These plans include the design of a production platform, drilling methods, etc., and must be submitted to USGS for approval. Usually construction of platforms is not begun until sufficient data are available on the field to estimate reserves. The actual design and construction of a production platform averages about two years from the date of order to the date of delivery. The minimum time until delivery can be as short as one year; however, it is generally 3-4 years after a sale before a production platform is placed on a tract. After the platform is set, production wells are drilled to further define the reservoir. Each well generally takes two to four months to complete. Eventually, an average of 15-30 wells are drilled from each platform.

During this phase, the drilling of more wells increases the probability of contaminants being introduced into the environment. Thus, it is important to have a large descriptive data base for the OCS environment that can be used as a reference for interpretation of monitoring data collected after these activities are underway. Toxicity data from several years' experiments should also be available to provide essential information for interpreting monitoring data. More extensive information on geological hazards such as seismic risk, engineering properties of sediments, faults, and sediment mobility should be collected and analyzed prior to the time the platform is to be emplaced so that any changes in operating orders can be made. Thus, the maximum safety of design can be assured. By this time, information on the fate of oil spills should be available, as well as nearshore benchmark data.

5.2.3.4 PRODUCTION PHASE

Once it is ascertained that located reserves may be recovered economically, planning is begun for the transportation of the oil to shore. In most cases, transport to shore is through pipelines, rather than by barge or tanker. The BLM generally requires that all pipelines in waters shallower than 60 m (200 feet) must be buried. In certain regions, lease stipulations may require all pipelines to be buried when technically and economically feasible to prevent hazards to other OCS operations. The route of the pipeline is determined by many factors such as sediment stability, location of production field, location of onshore facilities, and granting of rights-of-way.

The time between submission of a request for siting a pipeline and the actual pipeline completion is generally two or more years. Frequently, actual production on a specific tract is delayed until sufficient reservoirs in the area are developed to make it profitable to bring a pipeline ashore. Thus, production on a limited scale will most likely not begin until about seven years after the date of sale with peak production for a lease area probably not occurring until ten or fifteen years after sale.

Also, during the production phase, some drilling activity on the platforms may result from the necessity to workover existing wells or to drill additional wells.

By the time production begins, several years of benchmark data on the specific tracts must be available as a reference for monitoring possible changes in the surrounding environment. Specific information on those areas proposed as pipeline corridors must also have been collected and analyzed so that sound decisions on permits can be made. Linked with these data should be the capability to predict the fate and effects of pollutants if an accident should occur, so that efficient and effective preventive measures can be taken.

Data needs, as outlined above, are satisfied through the use of historical information, on-going programs and newly initiated programs. These are continuously reviewed, updated and incorporated into the design of future studies, as described elsewhere in this plan (Sections 4.6.7, 6.4.4.1.2 and 6.10.1).

5.3 STUDY SEQUENCE, TYPICAL LEASE AREAS

The sequence of study progression in the Alaskan program reflects the BLM concepts of baseline, special studies, and monitoring as three program elements. In figure 5-1, these three elements are posed in the six objectives described earlier and portrayed against the time scale for a typical lease area. The figure shows a time progression of the nature of the program keyed to BLM needs. It shows a continuing program in the lease area throughout the production phase to provide information for identification and regulation of effects and for assessments in advance of successive sales in the same lease area.

The sequence calls for a reconnaissance begun as soon as possible of contaminants, (Task A) and biological elements (Task E). The results of the reconnaissance studies are used both as a baseline for the future, and as an input to design of site specific studies and specific ecosystem studies. These specific studies are located after information is available on the probable location of impact from oil and gas development, as determined by the EIS, sale, and the research from Task B. Also used in the design of ecological studies is the information learned in the biological baseline studies on habitat dependence and population dynamics (Task E).

Task C on hazards is emphasized very early in each lease area because the output is critical to the choice of tracts, to stipulations on drilling and production, and to siting and design of facilities.

In order to provide data for BLM to assess probable impacts, the program provides source term information (Task B), transport data such as winds and currents (Task D), and data on effects (Task F). Initially the transport studies are conducted offshore to provide a context and boundary conditions for the later mesoscale and inshore work. Addition of inshore work

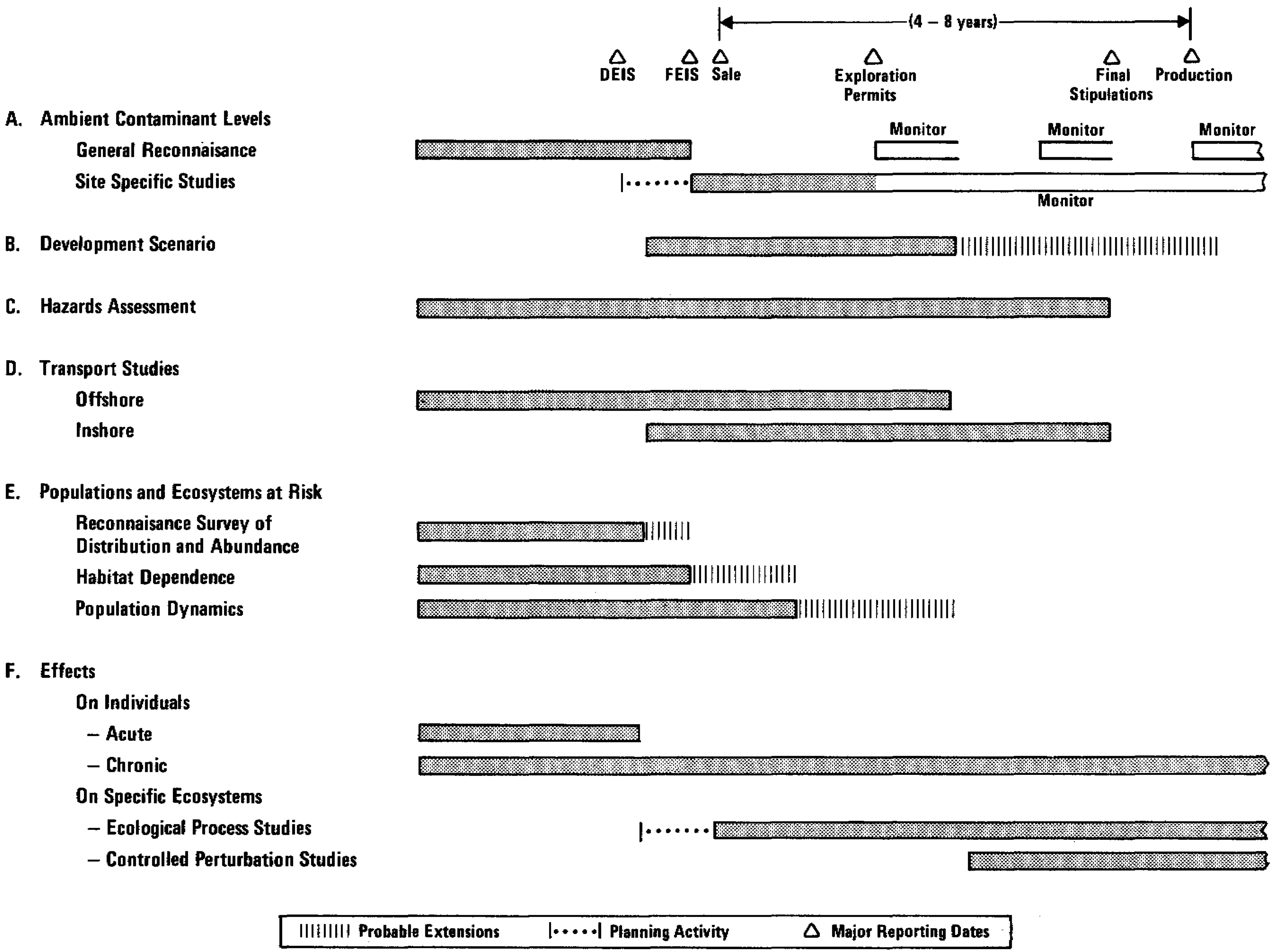

Figure 5 - 2. STUDY SEQUENCE – TYPICAL LEASE AREA

is much more difficult and calls for a different combination of size and nature of platforms. The biological program also tends toward more emphasis on the inshore areas with time, although this is not shown explicitly on the figure.

The effects studies (Task F) consist of both laboratory and field work. The initial studies use acute toxicity exposures in order to better define the more susceptible species and mechanisms, and thus give input to design of more realistic studies using chronic effects level exposures. The effects field work is of two types: ecological process studies and controlled perturbation experiments. These both fall in the BLM category of special studies.

The ecological process studies are conducted using representative lease area ecosystems. They are designed to understand the impact resulting from the insults and perturbations caused by oil and gas development. Both the ecosystem and the insults vary between lease areas, so that if funding permits there will be one or more for each lease area. The figure shows a transition in emphasis on Task E, which may be thought of as biological baselines, toward emphasis on understanding effects on the scale of entire lease areas, Task F, Subtasks F-9, F-10 and F-11.

The controlled perturbations studies, most of which are controlled oil spill experiments, occur later in the program when a better knowledge of the ecological processes and of effects levels is available for their design. These controlled studies which have no lasting effects on the environment, are carefully designed to verify the speculations obtained from the laboratory effects studied and to verify the impact models obtained from the ecological process studies. Until this verification is accomplished, confidence in assessments will be low.

The relative effort between Tasks will vary between lease areas according to the characteristics of each area and previous information available (see Section 4.6.2). A specific program for each lease area is presented in the Technical Development Plans.

5.4 SIGNIFICANT PROGRAM MILESTONES

Based upon the availability of resources and the Department of Interior lease schedule dated June 1975, the following significant milestones are planned. Changes in the lease schedule will affect these milestones. These milestones represent the initiation of specific studies in the lease areas and/or the submission of data and information in order to meet BLM and/or USGS environmental requirement for leasing, development or production schedules.

* Initiate Baseline Studies/Northeast Gulf of Alaska	1/74
* Submit Environmental Data for NEGOA DEIS	3/75
* Initiate Baseline Study/Bering Sea-St. George	5/75
* Initiate Baseline Study/Beaufort Sea	5/75
* Initiate Baseline Study/Outer Bristol Basin	5/75
* Initiate Baseline Study/Gulf of Alaska (Aleutian Shelf)	7/75
* Initiate Baseline Study/Gulf of Alaska (Kodiak)	8/75
* Data Submission for NEGOA FEIS	10/75
* Initiate Baseline Study/Bering Sea (Norton Basin)	3/76
* Recommendations Regarding Risk Assessment for PDOD/NEGOA	3/76
* Submit Environmental Data for GOA/Kodiak DEIS	5/76
* Initiate Baseline Study/Cook Inlet	6/76
* Initiate Phase I Ecological process Studies-Beaufort Sea	6/76
* Initiate Baseline Study/Chukchi Sea	7/76
* Submit Special PI Reports for Cook Inlet FEIS and Kokiak EIS	10/76
* Initiate Ecological Process Studies-Bering Sea	2/77
* Submit Environmental Information for St. George Bosin DEIS	2/77

* Submit Environmental Data for Bering Sea/Outer Bristol Basin DEIS	2/77
* Recommendations Regarding Risk Assessment for PDOD/Cook Inlet	2/77
* Submit Environmental Data for Beaufort Sea DEIS	2/77
* Submit Environmental Data for Bristol Bay DEIS	4/77
* Submit Environmental Data for GOA/Kodiak FEIS	5/77
* Submit Environmental Data for Bering Sea-St. George FEIS	5/77
* Submit Environmental Data for Beaufort Sea FEIS	5/77
* Recommendations Regarding Risk Assessment for PDOP/GOA-Kodiak	7/77
* Submit Environmental Data for Outer Bristol BAsin FEIS	8/77
* Recommendations Regarding Risk Assessment for PDOD/Bering Sea-St. George	9/77
* Recommendations Regarding Risk Assessment for PDOD/Beaufort Sea	9/77
* Initiate Ecological Process Studies GOA/Kodiak and Cook Inlet	10/77
* Submit Environmental Information for Norton DEIS	11/77
* Recommendations Regarding Risk Assessment for PDOD/Outer Bristol Basin	11/77
* Recommendation on Risk Assessment for Bristol Bay PDOD	1/78
* Submit Environmental Data for GOA/Aleutian DEIS	2/78
* Submit Environmental Data for Chukchi Sea DEIS	5/78
* Submit Environmental Data for Bering Sea/Norton FEIS	5/78
* Submit Environmental Data for Bering Sea/Norton FEIS	5/78
* Recommendations Regarding Risk Assessment for PDOD/Bearing Sea-Norton	7/78
* Submit Environmental Data for GOA/Aleutian FEIS	8/78
* Submit Environmental Data for Chukchi Sea FEIS	8/78
* Recommendations Regarding Risk Assessment for PDOD/GOA-Aleutian	9/78
* Recommendations Regarding Risk Assessment for PDOD/Chukchi Sea	11/78

PROPOSED OCS PLANNING SCHEDULE

January 1977
(Revises June 1975 Schedule)

SALE AREA	1976						1977											
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
44 Gulf of Mexico		F		N	S													
CI Cook Inlet		P			F		N	S										
47 Gulf of Mexico					E	P		F	N	S								
42 North Atlantic				E		P			F		N	S						
43 South Atlantic								E		P		F		N	S			
46 Kodiak									E		P			F		N	S	
45 Gulf of Mexico							T			E		P			F		N	S
48 Southern California	C		D				T						E		P			F
49 Mid-Atlantic					C		D			T						E		P
Beaufort Sea (near shore)									State - Federal Sale									
51 Gulf of Mexico							C		D			T						E
53 General Pacific							C		D					T				
54 S. Atlantic Blake Plateau											C		D			T		
50 Beaufort Sea 2/													C		D			T
55 Northern Gulf of Alaska																C		D
52 North Atlantic																	C	
56 South Atlantic																		
58 Gulf of Mexico																		
57 Bering - Norton																		
59 Mid-Atlantic																		
60 Bering Sea St George																		
61 Cook Inlet																		
62 Gulf of Mexico																		
63 General Pacific																		
64 Kodiak - Aleutian																		

SALE AREA	1978											
	J	F	M	A	M	J	J	A	S	O	N	D
44 Gulf of Mexico												
CI Cook Inlet												
47 Gulf of Mexico												
42 North Atlantic												
43 South Atlantic												
46 Kodiak												
45 Gulf of Mexico												
48 Southern California		N	S									
49 Mid-Atlantic			F		N	S						
Beaufort Sea (near shore)		1/										
51 Gulf of Mexico		P			F		N	S				
53 General Pacific		E		P			F		N	S		
54 S. Atlantic Blake Plateau				E		P			F		N	S
50 Beaufort Sea 2/						E		P			F	
55 Northern Gulf of Alaska			T						E		P	
52 North Atlantic	D			T						E		P
56 South Atlantic		C		D			T					
58 Gulf of Mexico			C		D			T				
57 Bering - Norton					C		D			T		
59 Mid-Atlantic								C		D		
60 Bering Sea St George										C		D
61 Cook Inlet												
62 Gulf of Mexico												
63 General Pacific												
64 Kodiak - Aleutian												

SALE AREA	1979											
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CI Cook Inlet												
47 Gulf of Mexico												
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43 South Atlantic												
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49 Mid-Atlantic												
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54 S. Atlantic Blake Plateau												
50 Beaufort Sea 2/	N	S										
55 Northern Gulf of Alaska		F		N	S							
52 North Atlantic			F		N	S						
56 South Atlantic	E		P			F		N	S			
58 Gulf of Mexico		E		P			F		N	S		
57 Bering - Norton				E		P			F		N	S
59 Mid-Atlantic	T						E		P			F
60 Bering Sea St George			T						E		P	
61 Cook Inlet	C		D			T						E
62 Gulf of Mexico		C		D			T					
63 General Pacific				C		D			T			
64 Kodiak - Aleutian					C		D			T		

SALE AREA	1980											
	J	F	M	A	M	J	J	A	S	O	N	D
44 Gulf of Mexico												
CI Cook Inlet												
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43 South Atlantic												
46 Kodiak												
45 Gulf of Mexico												
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54 S. Atlantic Blake Plateau												
50 Beaufort Sea 2/												
55 Northern Gulf of Alaska												
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56 South Atlantic												
58 Gulf of Mexico												
57 Bering - Norton												
59 Mid-Atlantic		N	S									
60 Bering Sea St George		F		N	S							
61 Cook Inlet		P			F		N	S				
62 Gulf of Mexico	E		P			F		N	S			
63 General Pacific			E		P			F		N	S	
64 Kodiak - Aleutian				E		P			F		N	S

Director, Bureau of Land Management

C - Call for Nominations
D - Nominations Due
T - Announcement of Tracts
E - Draft Environmental statement
1/ State May Conduct Sale

P - Public Hearing
F - Final Environmental Statement
N - Notice of Sale
S - Sale
2/ Within 60 Foot Isobath or Technology Capability

Sales are contingent upon technology being available for exploration and development. A decision whether to hold any of the lease sales listed will not be made until completion of all necessary studies of the environmental impact and the holding of public hearings; as a result of the environmental, technical, and economic studies employed in the decision making process, a decision may, in fact, be made not to hold any sale on this schedule.

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Figure 5-3

PART VI

6.0 MANAGEMENT PLAN

6.1 SCOPE

The purpose of the Management Plan is to define the relative responsibilities and authorities of NOAA as the managing agency for the program and BLM as the sponsoring agency, and to establish the organizational relationships and mechanisms for effectively carrying them out.

6.2 PROGRAM MANAGEMENT

The responsibility of NOAA as the management agency is to design, implement, direct, and control an interdisciplinary program of scientific studies that will satisfy BLM needs and objectives.

To effect such a program necessitates a program oriented organizational structure that provides for efficient and effective management with well-defined responsibilities and authorities. Within this structure, mechanisms for direction and control must be established to insure that the program is performed in a timely manner and that the desired results are attained. Special attention must be given to the identification and control of factors that insure the scientific integrity of the interdisciplinary aspects of the program. To achieve such results requires maximum coordination and communication between BLM and NOAA, as well as among the participants in OCSEAP, other Federal scientific agencies, the State of Alaska, the general scientific community, and the public, in not only the planning phases, but also throughout the program to maximize data quality and utility. Consequently, mechanisms must also be established to guarantee that such processes occur.

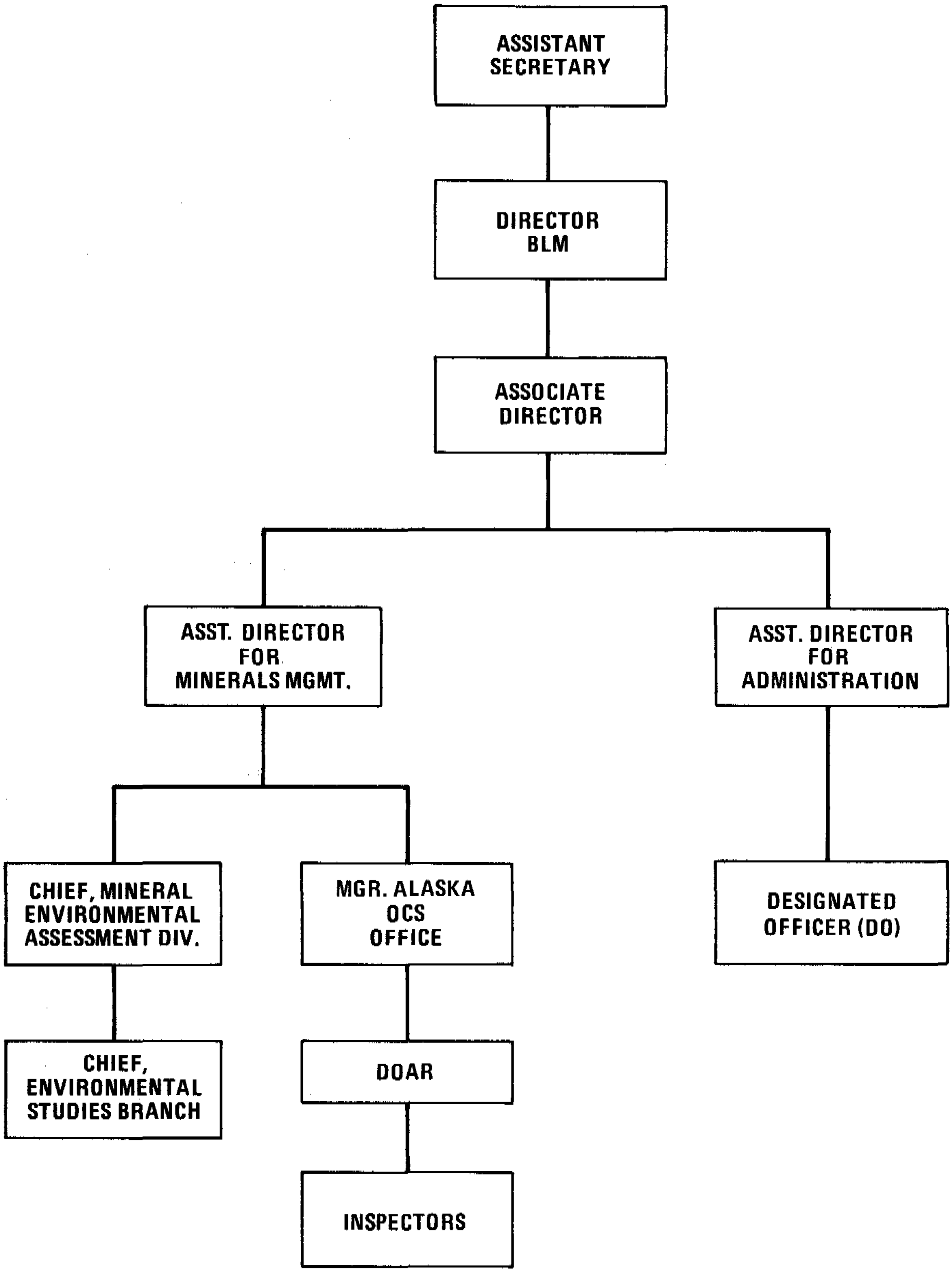

Figure 6 - 1. BUREAU OF LAND MANAGEMENT ORGANIZATIONAL STRUCTURE

The organizational structure and responsibilities of both NOAA and BLM are discussed in the following sections, as well as OCSEAP's planning and operational documents, schedules, reports, reviews, and mechanisms for accomplishing the program objectives in a timely manner.

6.3 BLM ORGANIZATIONAL STRUCTURE AND RESPONSIBILITIES

The organizational structure within BLM that is concerned with the environmental studies program is shown in Figure 6-1. The program responsibilities of key offices are discussed in the following sections.

6.3.1 ASSISTANT DIRECTOR, MINERALS MANAGEMENT

Supervises the Bureau of Land Management (BLM) minerals management program, including environmental assessment, studies, leasing, economic evaluation and scheduling. Is responsible for minerals policy development and guidance, and will provide overall continuity between elements of the BLM program. He will co-sign the Basic Agreement and any modifications thereto, and will make final decisions for BLM to resolve policy interpretations, or disagreements related to the B.A. Is accountable for commitments made by BLM under the B.A. The Deputy Assistant Director, Minerals Management assumes the responsibilities of the AD, when officially acting for him.

6.3.2 CHIEF, BRANCH OF ENVIRONMENTAL STUDIES

Responsible for the development and implementation of the Outer Continental Shelf (OCS) environmental studies program. Develops long term planning and budgeting consistent with minerals program policies. Develops policies, procedures and technical standards governing conduct of studies. Provides technical overview and assistance in preparation of statement of work, Reqeust for Proposals (RFP's), interagency agreements, negotiations and program reviews. Assures that studies are consistent with program objectives. Interfaces with NOAA's Chief, Office of Marine Environmental Protection on matters pertaining to policy. The Chief, Branch of Environmental Studies is the principal headquarters point for contact on technical policy matters relating to this program and will be responsible for bringing policy matters to prompt resolution.

6.3.3 DESIGNATED OFFICER (DO)

Coordinates development and negotiation of the Basic Agreement. Coordinates, negotiates, signs and administers interagency agreements. Negotiates modifications as necessary. Assures funds are available. Processes payment. Is primary contact on all legal and business matters relating to the agreements. Coordinates action on any matter which requires modification or official interpretation of the language of the B.A. or I.A.

6.3.4 DESIGNATED OFFICER'S AUTHORIZED REPRESENTATIVE (DOAR)

Monitors performance under the Basic Agreement. Reviews Technical Development Plan (TDP), and assists in negotiation of interagency agreements. As designated by the Designated Officer (DO), provides technical administration of the I.A.'s, i.e., monitors performance, assures compliance with terms, schedules and specifications, and reviews deliverables. Provides total interface with Outer Continental Shelf Environmental Assessment Program (OCSEAP) Director and Project Managers on I.A.'s. Reports problems, need for changes, etc., to the Designated Officer. Is responsible for commitments made by BLM under I.A.'s.

6.3.5 ALASKA OCS MANAGER

Responsible for implementing the environmental studies program in Alaska, as contained in approved interagency agreements. Provides overall guidance and interface with Environmental Research Laboratory Director on matters relating to implementation of the basic agreement and interagency agreements. Provides general overview of work under interagency agreements and Designated Officer's Authorized Representatives (DOAR's) and Principal Investigators' (PI's) activities to insure consistency of interpretation and overall program progress. Provides information regarding most current official leasing status so that studies schedules may be kept responsive to BLM information needs. Under his aegis, the OCSEA documents are reviewed for consistency with other studies, timeliness, technical adequacy, and responsiveness to BLM needs.

6.3.6 INSPECTORS

Monitors and inspects work efforts funded with BLM monies including site visits to principal investigators, review of work progress and progress reports. Inspectors report any unusual problems to the Designated Officer's Authorized Representative (DOAR) and where appropriate, recommend actions to the DOAR that may affect the subtasks or research units.

6.4 NOAA MANAGEMENT

6.4.1 NOAA ROLE

The NOAA, through Basic Agreement with the BLM, has responsibility for the definition, design and development of the OCS Environmental Studies Program in Alaska and authority for carrying out its implementation with funding by reimbursement from BLM. The organizational structure established to carry out this program is shown in Figure 6-2.

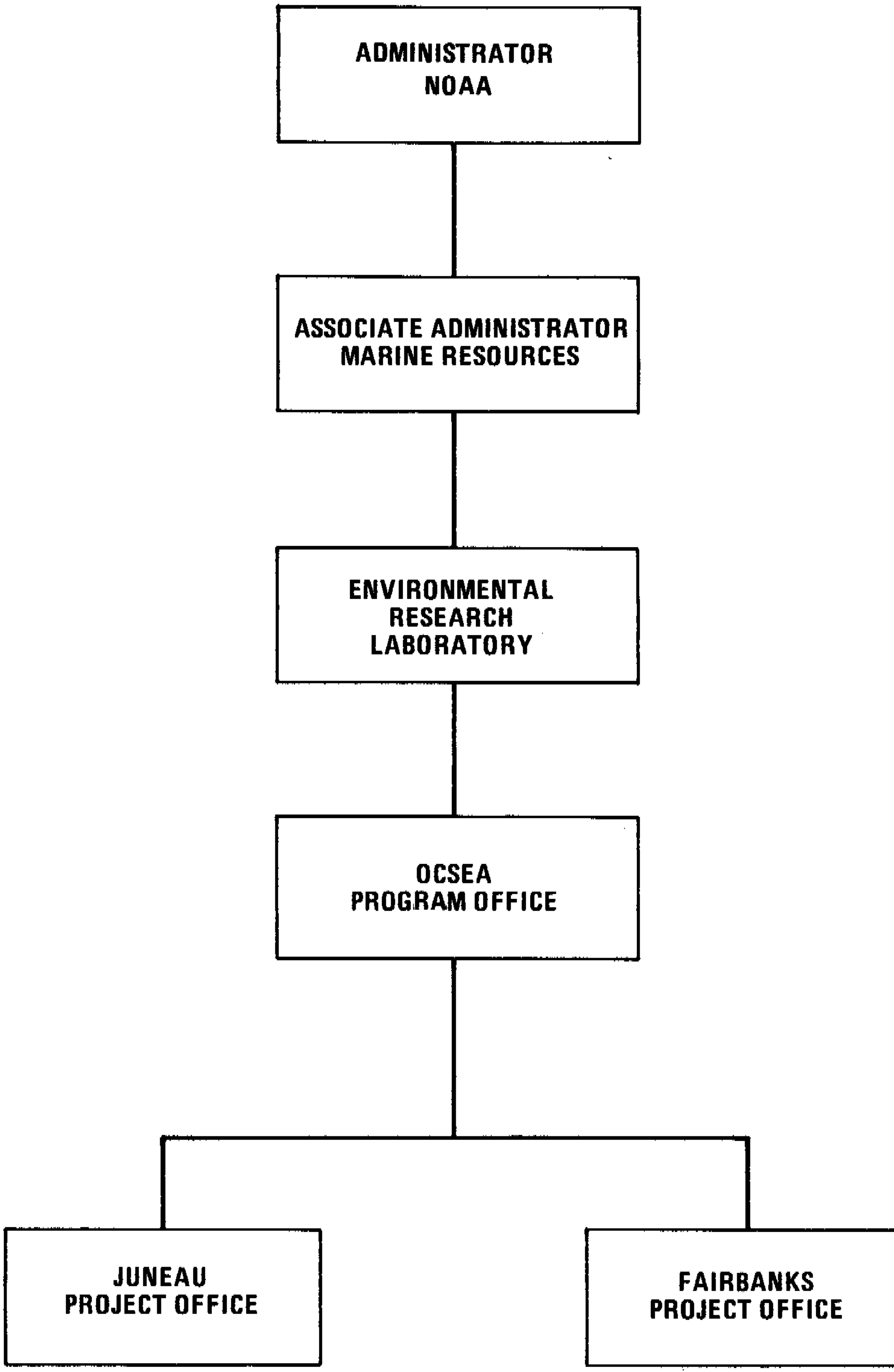

Figure 6 - 2. NOAA ORGANIZATIONAL STRUCTURE

6.4.2 NOAA HEADQUARTERS

In carrying out the NOAA role, the overall program direction and policy guidance for the OCSEAP is the responsibility of the Associate Administrator for Marine Resources (AAMR) with the Associate Administrator for Environmental Monitoring and Prediction (AAEM&P) providing guidance and advice on the design and implementation of applicable portions of monitoring programs. The AAMR will co-sign the Basic Agreement, Interagency Agreements, and any modifications of these documents. He is accountable for commitments made by NOAA pertaining to OCSEAP and will interpret for NOAA any disagreements relating to the Basic or Interagency Agreements. The Chief, Office of Marine Environmental Protection on the staff of the AAMR is the point of contact for BLM's Chief, Branch of Environmental Studies.

6.4.3 NOAA ENVIRONMENTAL RESEARCH LABORATORY DIRECTOR

Direct management responsibility for the supervision of OCSEAP is assigned to the Director of the Environmental Research Laboratories (ERL). In addition, the Director insures that the directives from NOAA Headquarters are carried out. He also provides the necessary administrative support services to OCSEAP. The Director interfaces with the Manager of the Alaska OCS office on matters relating to implementation of the Basic Agreement and Interagency Agreements.

6.4.4 OCSEA PROGRAM ORGANIZATIONAL STRUCTURE

An Alaskan OCSEA Program Office has been established within the Environmental Research Laboratories. The organizational structure of the OCSEAP, shown in Figure 6-3 consists of a Program Office, located in Boulder, Colorado, and Project Offices in Juneau and Fairbanks, Alaska.

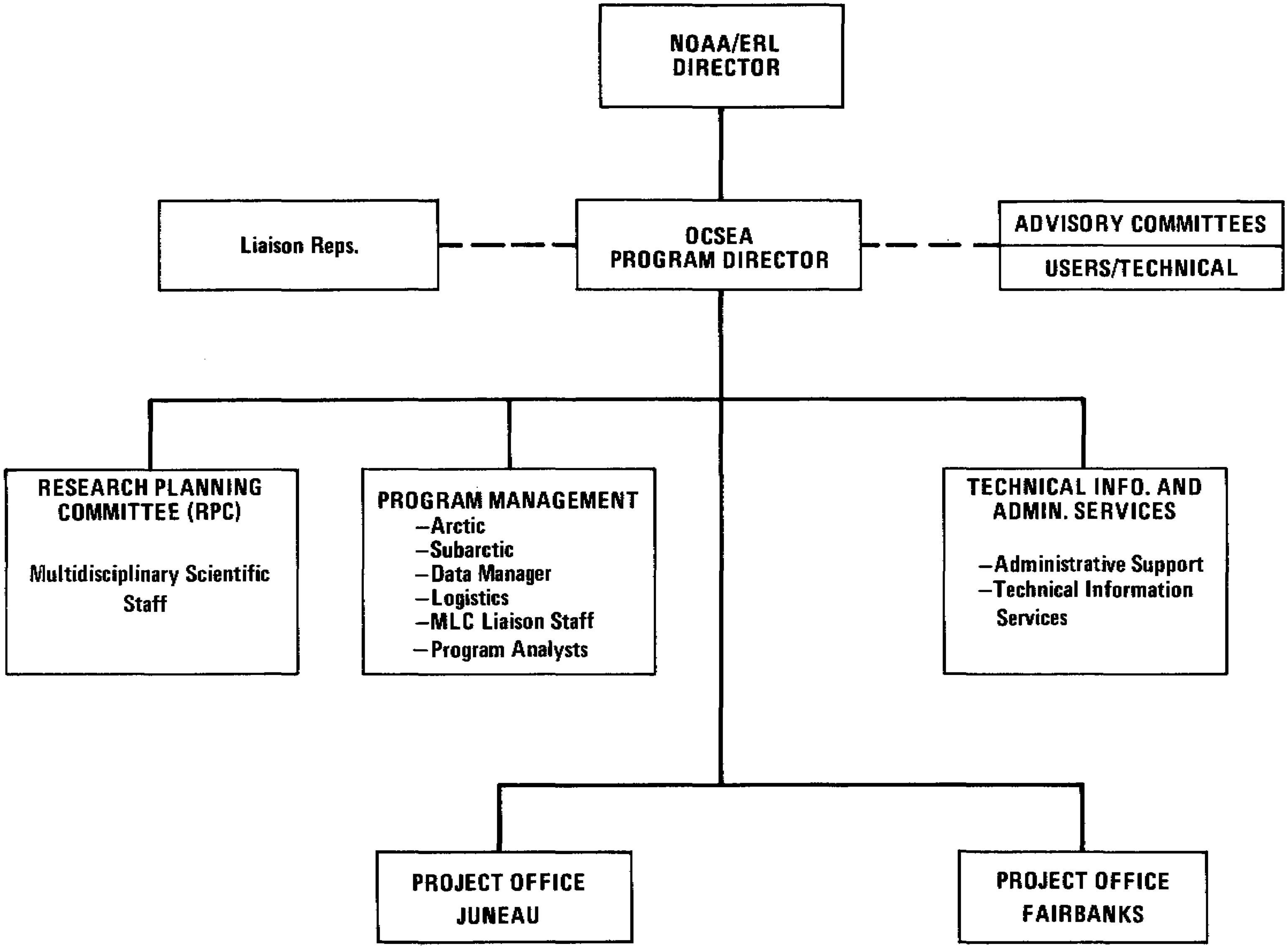

Figure 6 - 3. OCSEA PROGRAM ORGANIZATION

6.4.4.1 OCSEA PROGRAM OFFICE

The OCSEA Program Office is responsible for overall program development, planning, organization, staffing, direction, control, selection of investigators and coordination. This office is responsible for direct interaction with the BLM-OCS Office in Anchorage in program management and implementation. To insure implementation of these basic management responsibilities, the Program Office is functionally structured as follows:

6.4.4.1.1 OCSEA PROGRAM DIRECTOR

The Program Director's fundamental responsibility is to insure that OCSEAP is developed and implemented as indicated in the PDP and is capable of satisfying the program objectives. He will have the authority and resources as specified in the Basic and Interagency Agreements to direct or redirect activities in accordance with the best interests of the program as it develops and progresses. It is his responsibility to insure that the program and its elements are developed in the most cost-beneficial manner. His responsibility will be to insure that the program will function efficiently and satisfy the requirements to the maximum degree achievable within the constraints of available resources and time. The basic management technique by which the OCSEA Program Director will plan, monitor, direct and control the program are described in the Sections entitled:

- Management Plans (Section 6.7)
- Management Reports (Section 6.8)
- Management Reviews (Section 6.9)

6.4.4.1.2 RESEARCH PLANNING COMMITTEE

The Research Planning Committee (RPC) serves in an advisory capacity to the Program Director. It is composed of an interdisciplinary senior scientific staff which provides the Program Office with the scientific capabilities to identify needs, define objectives, establish scientific requirements and priorities necessary to carry out the program objectives. This group will function as follows:

- Provide the Program Director with interdisciplinary scientific planning support by designing future studies, and recommending modification of existing studies or realignment of priorities as the necessary basis for each year's TDP's.
- Define proposed projects in terms of objectives, recommended approach, relationship to other projects (by lease area and discipline), priorities schedule, leasing schedule, resource requirements, deliverables, cost, performance milestones, required R&D, and operational activities.
- Identify and recommend program requirements to achieve program objectives.
- Provide the Program Director with scientific and technical reviews and evaluations of program direction, needs, and accomplishments.

6.4.4.1.3 PROGRAM MANAGEMENT STAFF

The Program Management Staff is responsible for providing the Program Office with review and evaluation of program activities and recommending necessary corrective action to insure optimum utilization of program resources and the achievement of program objectives. This staff provides direct support to the Program Director for management decisions, with individuals acting for him in their areas of expertise.

In carrying out its responsibilities, the Program Management Staff will function as follows:

- Maintain a current awareness of all activities within or outside NOAA which may affect the accomplishment of the OCSEA Program.
- Develop the annual TDP's for the Program utilizing scientific input from the RPC, logistics information from the Project Offices, and the necessary management support, including but not limited to, cost estimates, milestones, data assurance and management controls, and interdependencies of program elements.
- Design and implement the OCSEAP Data Management Plan.
- Coordinate and integrate program activities necessary to realize maximum beneficial results within available resources and time constraints.
- Maintain continuous monitoring of progress of field work, data flow, cost performance, intermediate milestones, and deliverables for on-going projects and implementation of new projects.
- Identify any deviations from planned schedules and milestones and recommend corrective action to the Program Director when necessary.
- Maintain a continuous review and evaluation of technical performance and reliability and recommend corrective action as necessary.
- Establish and administer Quality and Reliability Assurance (Q&RA) policy and procedures which, when implemented, will provide for effective Q&RA provisions from the initial concept through completion of all OCSEAP activities.
- Evaluate completed scientific studies and operational activities to provide the Program Director with an analytical report and recommendations for follow-on courses of action.
- Monitor scheduled office operations and unscheduled action items as assigned, advising the Director on problems of timing or

performance, and suggesting corrective actions.

- Elicit feedback from specific users and beneficiaries of the Project results for future program planning.
- Provide for the integration and synthesis of scientific information acquired in the conduct of the program.

6.4.4.1.4 TECHNICAL INFORMATION AND ADMINISTRATIVE SERVICES

This staff is responsible to the Program Director for ensuring that NOAA and BLM policies and regulations in the areas of Budget, Finance, Contracting, Procurement, Publications, and Information dissemination are adhered to. The staff is functionally divided into Technical Information Services and Administrative Support, providing the necessary support for the Program Office in these areas. In carrying out these responsibilities, the Group functions as follows:

- Administers management information that will provide visibility of the interrelationships, priorities, and status of all program activities; assures promulgation of management and administrative policy; interfaces with the responsible ERL Headquarters Office on policy, requirements, and procedures relating to personnel and safety.
- Provides budgetary guidance and coordinates the preparation of budget submission and financial operating plans; develops and administers a financial control system; maintains control over financial resources in accordance with approved program and schedule requirements; maintains status of program financial activities providing the Program Director with status and analysis reports.

- Develops, implements, and administers program contracting and procurement policy and plans within established regulations; negotiates, executes and administers contracts for equipment, facilities, and services necessary to support all program activities; sends copies of proposal solicitations, contracts and interagency agreements to BLM Designated Officer.
- Submits initial budget recommendations and revisions as required.
- Identifies alternative non-BLM sources for the financing of special unbudgeted program requirements when such are outside BLM authorities or requirements.
- Insures that program support elements maintain appropriate technical monitoring over the quality, timing, and costs of work placed with outside contractors of government agencies.
- Develops and initiates program reports and reviews required by the BLM, ERL, and NOAA management as described in Sections 6.8 and 6.9 of this PDP.
- Develops for the Program Director reports as established in the Management Plan or as requested.
- Insures that data, technical information and publications resulting from the Program are disseminated in accordance with program policies and procedures.

6.4.4.2 OCSEAP PROJECT OFFICES

OCSEAP Project Offices, with policy and program guidance from the Program Office, are responsible for the implementation of the Technical Development Plans for those OCS Environmental Studies under their cognizance. As such, these Project Offices insure the interdisciplinary integrity of the program in accordance with Program Office guidelines and are the principal focal point of communication with the investigators. The Program Office has established two field Project Offices, one at Juneau, Alaska, responsible for subarctic Frontier Areas and the other at Fairbanks, Alaska, responsible for arctic Frontier Areas. The Beaufort and Chukchi Seas are the two arctic areas; the other seven are considered subarctic.

The subarctic Project Office was established first because field operations for the Alaskan studies were initiated in the Northeast Gulf of Alaska (NEGOA). Juneau was selected as the site primarily to provide close interaction with the Alaskan State government, which was essential at the outset and continues in importance.

The Arctic Project Office was established at Fairbanks because most of the arctic investigators are based there or pass through there. Furthermore, it is a logistics center and transportation terminal for most of the Federal, State and industry operations in the Alaskan Arctic.

The Project Offices interact directly with the BLM-OCS Office in Anchorage to provide data, reports, and various forms of assistance to BLM in its role of monitoring the technical progress of the program.

The Project Offices, in carrying out their responsibilities, function as follows:

- Provide scientific guidance, management, administrative and fiscal control for OCSEAP projects under the purview of their office to insure the interdisciplinary integrity and accomplishment of the program.
- Provide detailed logistical scheduling and direct logistical support to investigators.

- Plan, schedule, implement and manage through tracking, review, evaluation, and corrective action, the operational activities necessary to accomplish OCSEAP technical objectives, insuring that optimum results are obtained from each project in a timely manner.
- Maintain, monitor and coordinate project management and operating plans and schedules developed by the Project Office within the guidelines provided by the Program Office to insure that intermediate cost and performance milestones are being met.
- Perform analysis of ongoing projects to determine the needs for their redirection, expansion or reduction based upon technical assessment of the project to that point.
- Provide data, principal investigator reports, and various assistance to BLM-OCS Office in Anchorage in monitoring the technical progress of the program.
- Coordinate and act as an interface with universities, and state and Federal agencies which collaborate with OCSEAP on joint activities within the geographic areas under the purview of the respective offices.
- Provide Management with status reports in compliance with the guidelines provided by the Program Office.

The organization of the Project Offices will be as follows:

6.4.4.2.1 PROJECT MANAGERS

The OCSEAP Project Managers' prime responsibilities are to insure that the projects' objectives are operationally met in a timely fashion and in accordance with the Technical Development Plans (TDP) and program guidelines for those areas under their cognizance. They have the authority to direct or redirect project activities and resources in accordance with the best interests of a project as it develops and progresses within the limits delegated by the Program Director. Under the general guidance of the Program Director, they are responsible for overall scientific and technical guidance to investigators in the areas of experimental design, data management and data analysis. They direct the project implementation, oversee day-to-day management operations, and maintain appropriate control over technical quality, scheduling, and financial aspects of the project, see to the delivery of products required by the contracts, and make recommendations to the Program Director for appropriate action.

6.4.4.2.2 SCIENTIFIC SUPPORT

Following the completion of an agreement between the OCSEAP and a contractor or agency, the scientific staff within each Project Office administers the scientific studies. The responsibilities of the scientific staff include overall direction and assistance to each project in the areas of research emphasis, experimental design, and data management. This is accomplished by frequent direct interaction with principal investigators.

6.4.4.2.3 OPERATIONS SUPPORT

Operational support is provided by an Operations Officer within each Project Office who reports directly to the Project Manager. The Operations Officer's prime responsibility is to provide logistic support, including coordinating ship operations and other platform operations, conducting and coordinating multifaceted scientific operations aboard NOAA and contract research vessels and platforms and accounting for the Project's equipment.

An Operational Plan is developed annually to schedule projects requiring operational support. The preparation of such a plan is the responsibility of the Operations Officer and it must be approved by the Project Manager and the Program Director.

6.4.4.2.4 DATA MANAGEMENT SUPPORT

Each Project Office has a Data Manager whose responsibility is to ensure efficient data and information management, and dissemination of data. He is responsible for enforcing the Data Management Plan that will ensure availability and maximum utilization of OCSEAP data and information by all concerned individuals and institutions. A further responsibility of the Project Office Data Manager is to establish and maintain rapid, adequate, and accurate communications with users of OCSEAP project data and information. The Fairbanks Project Office Data Manager is physically located in Juneau to work under the supervision of and in conjunction with the Juneau Data Manager in order to avoid duplication of equipment and tracking schemes and assure compatible data formats and policies. Specific OCSEAP data management policies and procedures were developed within the NOAA Environmental Data Service (EDS) consistent with EDS/BLM established policies and procedures and incorporated into the Data Management Plan. These guide the Data Manager in performing his duties.

6.4.4.2.5 ADMINISTRATIVE SUPPORT

The Project Office administrative staff is responsible for:

- Budget and finance
- Contracts and procurement
- Administrative services

This responsibility is carried out within policy procedures established by NOAA and ERL and is consistent with Department of Interior policies and procedures.

6.4.5 INTERACTION WITH PRINCIPAL INVESTIGATORS

Communication and coordination with the principal investigators (P.I.s) beyond the scope of contractual procedures is essential to the OCSEAP. Throughout the program there is a constant exchange of information between OCSEAP personnel and the P.I.s. OCSEAP provides the P.I.s with program guidance, relevant BLM information related to leasing and other OCS studies, information pertaining to other Alaska studies, both OCSEAP and non-OCSEAP Alaska OCS projects, and mechanisms whereby investigators may exchange ideas and information with each other and Management relating to the OCSEA Program.

The P.I.s play an important contributory role in the program, not only because of the data resulting from their OCSEAP research, but also because of the insight they have gained from participating in the program. They provide a source of new ideas that is important in maintaining the relevance and optimizing the output of the program. Their input is used in the planning of each year's programs, in the evaluation and redirection of program elements, as appropriate, and in the identification and implications of interrelationships and interdependencies of collected data within and external to OCSEAP that is synthesized in reports to BLM. The Project Offices are the principal focal point of communication with the investigators; however, in some instances, the Program Office is also involved in discussions with the P.I.s. The Program Office is the principal focal point of communication with investigators during the identification and definition of new projects and contracts.

The BLM Designated Officer's Authorized Representative or other BLM Authorized Representatives may also interact with P.I.s in their roles of monitoring project progress. Their activities, however, are limited to information gathering and will respect the privy of contract between NOAA and its contractors. A number of mechanisms presently used to insure this active dialogue between OCSEAP and the P.I.s includes:

- Periodic meetings with investigators, by discipline and lease area, to review synthesis reports, identify future research needs, evaluate results against BLM needs, identify operational problems and exchange information with other investigators participating in OCSEAP. Such meetings also serve as a forum of discussion on program direction and objectives.
- Regular personal and telephone contact between OCSEAP Project staff and investigators.
- Newsletters and bulletins published by Project Offices.
- Quarterly and annual reports.
- "P.I. Handbook" to be printed in FY77 containing an overview of the program, objectives, policies, directives, formats, schedules, and other pertinent information consistent with NOAA and BLM policies, and not duplicated in the PDP.
- Distribution of this PDP to investigators.

6.5 INTERAGENCY PROGRAM PARTICIPATION

6.5.1 INTERAGENCY LIAISON

To insure coordination of the capabilities of other government agencies participating in the Alaskan OCS studies conducted through OCSEAP, liaison positions have been established by the USGS, USFWS, EPA, and the State of Alaska. These people serve as the principal interface between the OCSEAP and each respective agency, providing an avenue for information exchange relating to ongoing programs. Such a mechanism helps to avoid duplication of effort and to develop, where possible, complementary programs. Liaison representatives also provide an additional source of input to the Program Director regarding recommended program content, timing, and direction.

6.5.2 INTERAGENCY AGREEMENTS

Where appropriate, the OCSEA Program develops interagency agreements with other government agencies for the accomplishment of the various study elements. To date, interagency agreements have been implemented between USGS, EPA, USFWS, and USN.

6.6 ADVISORY COMMITTEES

The OCSEA Program Director utilizes established and ad hoc advisory committees and assembles others as necessary to provide him with advice and recommendations on the program requirements, scope, direction, priorities, schedules and technical adequacy. Advisory committees readily identifiable include the following:

6.6.1 USERS ADVISORY COMMITTEE

Although BLM needs are paramount in the program planning, consideration is given to utility of the program to other users when possible.

A Users Panel has been established with membership representing major user constituencies including public and industry groups, environmental institutions, and government and community interests. This Panel meets at least twice yearly to provide an update of user needs. This provides the Program Office with an essential element in the annual review of study gaps prior to development of the TDP's for the upcoming fiscal year.

6.6.2 OCS ENVIRONMENTAL STUDIES ADVISORY COMMITTEE

As a matter of course, the BLM is required to coordinate study plans with the OCS Environmental Studies Advisory Committee (OCSESAC). This is a body consisting of a chairman and scientists designated by the twenty-one coastal states, EPA, NOAA, NSF, and USCG. Also, not more than six scientists from the private sector are appointed by the Secretary of the Interior to achieve balance of views. The responsibility of this committee is to review all plans, and to advise DOI and the Outer Continental Shelf Advisory Board on the design and implementation of environmental studies related to oil and gas exploration and development on the OCS. The Committee meets at least once every quarter, and may hold special meetings, if necessary. At the request of the BLM Assistant Director, NOAA prepares briefings for this committee and receives recommendations through BLM from OCSESAC regarding OCSEAP.

6.6.3 AD HOC ADVISORY COMMITTEES

Ad hoc advisory committees are created at the direction of the Program Director to provide recommendations on possible scientific or technical approaches to specific problems defined by the OCSEAP staff. Such a procedure provides great flexibility and allows the utilization of the best scientific talent in addressing special aspects of the program.

6.7 MANAGEMENT POLICY AND PLANS

6.7.1 GENERAL

The sequence for program planning and implementation of the OCSEA

Program involves the essential elements of policy, goals and objectives, long-term plans, short-term plans emphasizing technical elements, and related funding and work implementation as required.

The basis of program planning and implementation strategy is described in this Program Development Plan. Technical Development Plans (TDP) are prepared annually identifying the short-term needs with justifications and priorities. In each TDP the research units or tasks are described in detail including funds required and a schedule of activities and events. A description of TDPs and other pertinent documents follows. Figure 6-4 indicates the relative responsibilities for development, review and approval of these documents by BLM, NOAA and ERL Headquarters, OCSEAP Program and Project Offices, and participants.

6.7.2 MANAGEMENT POLICY

The Department of Interior is responsible for providing overall policy guidance for the program. Responsibility for policy on scientific and technical design of the program is assigned to NOAA. The OCSEA Program Director is responsible for implementing these policies and for deriving policy concerning individual studies and investigators.

6.7.3 PROGRAM DEVELOPMENT PLAN

The Program Development Plan is the basic document setting forth a multi-year program to reach the goals and objectives of the BLM/NOAA Alaskan OCS Marine Environmental Program. When approved by the Administrator of NOAA and the Director of the Bureau of Land Management, and incorporated into a Basic Agreement, the Plan becomes the working program document between NOAA and BLM.

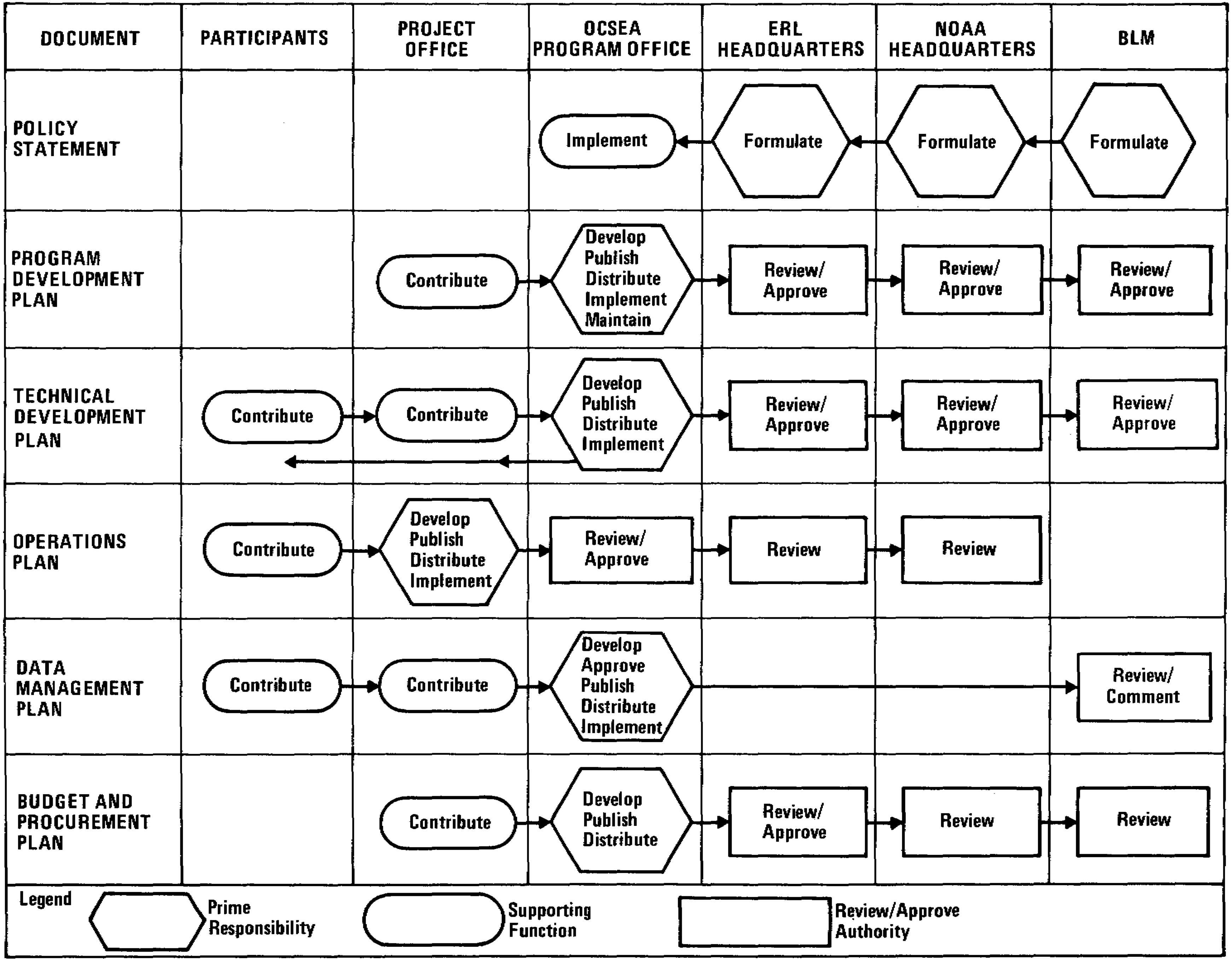

Figure 6-4. MANAGEMENT PLANS RESPONSIBILITY

6.7.4 TECHNICAL DEVELOPMENT PLAN

Technical Development Plans (TDPs) are written annually for each of the nine study areas and a tenth plan is written for non-area specific studies that are applicable to all areas. New TDPs are developed each year by OCSEAP and when approved by BLM are the major implementation mechanisms for the PDP. These TDPs follow the Technical Approach described in Part IV of this PDP and provide: A more detailed description of the specific work to be undertaken each fiscal year; a description of how the work in the individual TDP addresses the overall objectives of the program; a planned schedule; required funding and, finally, how that year's work fits into the long-term study for the area. Specifically, the TDP shall include, but not be limited to, the following (not necessarily in this order):

- The relationship of the individual TDP to the PDP. Specifically, the relation of the TDP objectives and milestones to those in the PDP and the relative responsibilities for each TDP's management and logistics.
- General description of each study area, any unusual problems or features, the subtasks to be undertaken, and the general schedule for duration of each subtask in each area.
- The scope, objectives and applicability of the subtasks to be undertaken for that area.
- Rationale for selection and level of effort of the subtasks and research units (RU) to be undertaken during the year.
- Intra- and inter-area relationships of RU, subtasks, tasks, and objectives and interdependencies, where appropriate.
- Funding levels required by subtask or RU.
- Schedule at subtask and RU level for that year's effort, providing intermediate milestones.

- The logistics support to be provided by the Government to the subtask level if known.
- Data products and deliverables, and a schedule for that year's delivery, the relationship or interdependence of those deliverables to one another and to BLM's needs.
- Variations, if any, in program activities from those described in the PDP and data management plan.

6.7.5 OPERATIONAL PLANS

Annual Operational Plans are developed by the Operations Officer within each Project Office. When approved by the respective Project Managers, these plans are forwarded to the Program Office for final approval. The plans are reviewed by the Logistics Coordinator on the Management Staff of the Program Director to determine consistency with policy, feasibility, and adequacy, and to identify any required coordination for the program as a whole. Final approval is by the Program Director.

The basis for development of the plans are the TDP's and the Logistics Requirements questionnaires submitted by each principal investigator. The plan for each Project Office is a coordinated plan for all studies under the cognizance of that office for the fiscal year. The plan will include:

- Detailed schedule of events and proposed operational accomplishments.
- Integrated ship support requirements.
- Integrated aircraft support requirements.
- Integrated quarters and subsistence support requirements.
- Identification and resolution of special logistics problems.
- Scheduled movement and deployment of personnel, equipment, ships and aircraft.

- Details, timing and requirements for logistics support facilities.
- Identification of required funding and source.
- Contingency plans to provide flexibility in meeting operational objectives.

6.7.6 DATA MANAGEMENT PLAN

The basis for the Data Management Plan are the NOAA data management policies and procedures developed within the NOAA Environmental Data Service (EDS) and the data acquisition systems quality assurance policies and procedures being developed within the NOAA Office of Ocean Engineering. The EDS developed policies and procedures are consistent with the EDS/BLM policies and procedures established for lower forty-eight OCS areas.

The overall management and coordination of the data management program is provided by the OCSEA Program Management Staff. The Project Data Managers are responsible for the timely flow of data from investigators and are the only liaison for direct contact with investigators on data management matters. The Environmental Data Service (EDS), NOAA, has been designated as the data center for the development of a data base and archive for all environmental data resulting from OCSEAP. The Data Management Plan (detailed in Section 4.6.5) includes:

- Data quality assurance policy and procedures from program design to data archiving.
- Data flow and data management responsibilities.
- Media and formats for archiving.
- Labeling and exchange procedures.
- Data availability policy and procedures.
- Available types of data output.

6.7.7 BUDGET AND PROCUREMENT PLAN

An annual Budget and Procurement Plan is developed by the OCSEA Program Office to assure efficient and timely operation in the areas of Budget and Finance, and Contracts and Procurement. An information copy is sent to the BLM Designated Officer.

6.7.7.1 BUDGET AND FINANCE

This section of the Budget and Procurement Plan provides budgetary guidance to the Program Office Staff and Project Offices and provides for the coordination and preparation of budget submissions and financial operating plans by the Administrative Services Staff, documents the system for maintaining the status of program financial activities, and provides the Program Director with status and analysis reports and schedules of activities related to budget development and submission. These procedures are based on NOAA policy and procedures.

6.7.7.2 CONTRACTS AND PROCUREMENT

This section of the Budget and Procurement Plan describes the program contracting and procurement policy and plans within established Federal procurement regulations, and provides a schedule of activities for procurement and contract monitoring.

6.8 MANAGEMENT REPORTS

6.8.1 GENERAL

This section describes the several management reports compiled by the OCSEA Program. The responsibilities for these documents are shown on Figure 6-5 and the distribution of these reports to BLM in Table 6-1.

DOCUMENT	PARTICIPANTS	PROJECT OFFICE	OCSEA PROGRAM OFFICE	ERL HEADQUARTERS	NOAA HEADQUARTERS	BLM
ANNUAL TECHNICAL SUMMARY REPORT	Contribute	Contribute	Prepare Publish Distribute	Review/ Approve	Review/ Approve	Review/ Comment
QUARTERLY STATUS REPORT	Contribute	Contribute	Prepare Publish Distribute	Review	Review	Review
FINANCIAL REPORT			Prepare Approve Publish Distribute	Review	Review	Review
BUDGET REPORTS			Prepare Approve Publish Distribute	Review	Review	
TECHNICAL PAPERS	Prepare Publish Distribution	Review	Review/ Approve	Review	Review	Review/ Comment

Legend: (hexagon) Prime Responsibility; (oval) Supporting Function; (rectangle) Review/Approve Authority

Figure 6 - 5. MANAGEMENT REPORTS RESPONSIBILITY

	DISTRIBUTION				
	BRANCH OF ENVIRONMENTAL STUDIES (733)	BRANCH OF CONTRACT OPERATIONS (551)	ALASKA OCS OFFICE	DEPT. OF INTERIOR, MAIN LIBRARY	DEPT. OF INTERIOR, ALASKA RESOURCE LIBRARY
ANNUAL TECHNICAL SUMMARY REPORT	10	Cover letter only	15	3	3
ANNUAL PRINCIPAL INVESTIGATOR REPORTS (unedited)	1	--	2	--	--
ANNUAL PRINCIPAL INVESTIGATOR REPORTS (edited)	2	Cover letter only	7	3	3
ANNUAL EXECUTIVE SUMMARY	10	1	25	3	3
QUARTERLY REPORTS	2	Cover letter only	5	--	--
TDP	2	1	7	--	--

Table 6-1. BLM REPORT DISTRIBUTION

6.8.2 ANNUAL TECHNICAL SUMMARY REPORT

The OCSEAP Director will prepare an Annual Technical Summary Report for BLM and NOAA to document the significant program achievements and technical progress to date. The report will include a synthesis of the scientific reports presented to OCSEAP by principal investigators and participating agencies (State and Federal) and evaluate and interpret the past year's efforts in light of the total program, past and future. As a minimum, the report will discuss scientific results in relation to: (1) program objectives, implications and recommendations pertaining to OCS oil and gas development; (2) areas where data are lacking; (3) assumptions upon which data interpretations, implications, and recommendations are based; and (4) differences between study areas.

6.8.2.1 ANNUAL PRINCIPAL INVESTIGATOR REPORTS

Principal investigators submit an annual report for the preceding 12 months of effort on April 1. This report is a scientific report on the data, analyses, and interpretations resulting from the year's effort. If appropriate, the report will integrate these results with previous year's efforts. There will also be a final report of the same nature, should the project terminate. The contents of these reports are detailed in the format below.

I. Summary of objectives, conclusions and implications with respect to OCS oil and gas development.

II. Introduction

  A. General nature and scope of study
  B. Specific objectives
  C. Relevance to problems of petroleum development

III. Current state of knowledge

IV. Study area

V. Sources, methods and rationale of data collection

VI. Results of the past year (as much visual material as possible would be appreciated)

VII. Discussion

VIII. Conclusions

IX. Needs for further study

X. Summary of 4th quarter operations

   A. Ship or laboratory activities

      1. Ship or field trip schedule
         a. Dates, name of vessel, aircraft, NOAA or chartered

      2. Scientific party
         a. Names, affiliation, role

      3. Methods
         a. Field sampling or laboratory analysis

      4. Sample localities/ship or aircraft tracklines (use figures where possible)

      5. Data collected or analyzed
         a. Number and types of samples/observations
         b. Number and types of analyses
         c. Miles of trackline

XI. References and bibliography (Include presentations and papers in preparation and in press.)

6.8.2.2 ANNUAL EXECUTIVE SUMMARY

The OCSEAP Director will also prepare annually an executive summary of the annual Technical Summary Report to inform the general public in a concise manner (i.e., less than 50 pages per lease area) of the previous year's efforts. It will include a statement of the purpose and objectives, a synthesis of the background information, significant findings, interpretations, and conclusions, and recommendations for future studies.

CONTENTS

Figure 6-6. Sample Table of Contents, Quarterly Report

6.8.3 QUARTERLY REPORTS

OCSEAP will prepare a quarterly report for submission to BLM. This report will document significant program achievements, findings, and technical progress, identify hazards and report significant problem areas that occurred during the preceding fiscal quarter. The format and content of this report, after coordination with BLM, are specificed by the OCSEAP Director. A sample Table of Contents is included as Figure 6-6.

6.8.3.1 QUARTERLY PRINCIPAL INVESTIGATOR REPORTS

Investigators submit a report quarterly based on the previous 3 months of operations and sampling. (The fourth quarterly report is incorporated into the annual report.) The contents of these reports are indicated in the following format:

I. Abstract of highlights of quarter's accomplishments

II. Task objectives

III. Field or laboratory activities

   A. Ship or field trip schedule
      1. Dates, name of vessel, aircraft, NOAA or chartered

   B. Scientific party
      1. Names, affiliation, role

   C. Methods
      1. Field sampling and/or laboratory analysis

   D. Sample localities/ship or aircraft tracklines (use figures where possible)

   E. Data collected and/or analyzed
      1. Number and types of samples/observations
      2. Number and types of analyses
      3. Miles of trackline

IV. Results - Any format the scientist wishes, but includes indication of reliability and precision. Attach data tables, graphs, maps, etc. These results are to identify achievements during the quarter, but may include other and earlier information as appropriate and useful.

V. Preliminary interpretation of results

VI. Problems encountered/recommended changes

VII. Estimate of funds expended

VIII. Bibliography of references, papers, in press or preparation, and presentations

6.8.4 FINANCIAL AND BUDGET REPORT TO OCSEAP DIRECTOR

The OCSEAP Administrative Services Staff will prepare monthly, and on request, a financial and budget report containing costs and obligations to date, commitments and projected costs for the remainder of the fiscal year, financial actions since the last report, actions pending, listing of unbudgeted items anticipated for the future (such as recommended unsolicitated proposals, increases in fuel costs, etc.), and such other information as may be requested by the Director or as may be useful to the Director. The report will include an analysis and staff recommendations. The analysis will include presentations by agency, discipline, task and lease area, and breakout management, logistics and other items.

6.8.5 FINANCIAL REPORT TO BLM

Annually, and upon request, the Administrative Services Staff will prepare a report of expenditures (obligations plus costs) categorized by lease area for transmission to BLM.

6.8.6 PUBLICATION POLICY AND TECHNICAL PAPERS

OCSEAP uses the same publication policy adopted by other Federal agencies and consistent with the Freedom of Information Act (FIA). It is OCSEAP policy to use investigators' names when reporting on the program. It is also OCSEAP policy that every author is responsible for what he writes, and every statement purporting to represent an organization's position must be approved by that organization. Further, documents will carry authorship. BLM shall be cited as the funding agency. It is OCSEAP policy that:

- Authors on OCSEAP supported projects submit two (2) courtesy copies to OCSEAP of manuscripts submitted for publication, one of which will be transmitted to BLM 60 days prior to publication. BLM will provide any comments within 30 days after receipt of the manuscript. Authors will consider BLM comments prior to publication.
- Disclaimers or other indication (such as authorship) be placed on documents including annual P.I. reports so that statements therein will not be mistakenly attributed.
- The FIA applies to data as soon as it appears on paper (tabular, unedited, unverified numbers).
- Any citizen or group will have access to data, even unedited and unverified, if they want it. Such data, if released, will be identified and appropriately labeled.
- Unpublished data sets are not the property of the scientist(s) who collect data. (Since public dollars are spent in collecting the data, such unpublished data sets are subject to FIA.)
- Publication in the open literature is encouraged.

6.9 MANAGEMENT REVIEWS

6.9.1 PROGRAM REVIEWS

The OCSEAP Director will conduct periodic review of the overall program as shown in Figure 6-7. The content, frequency and recipients are given below.

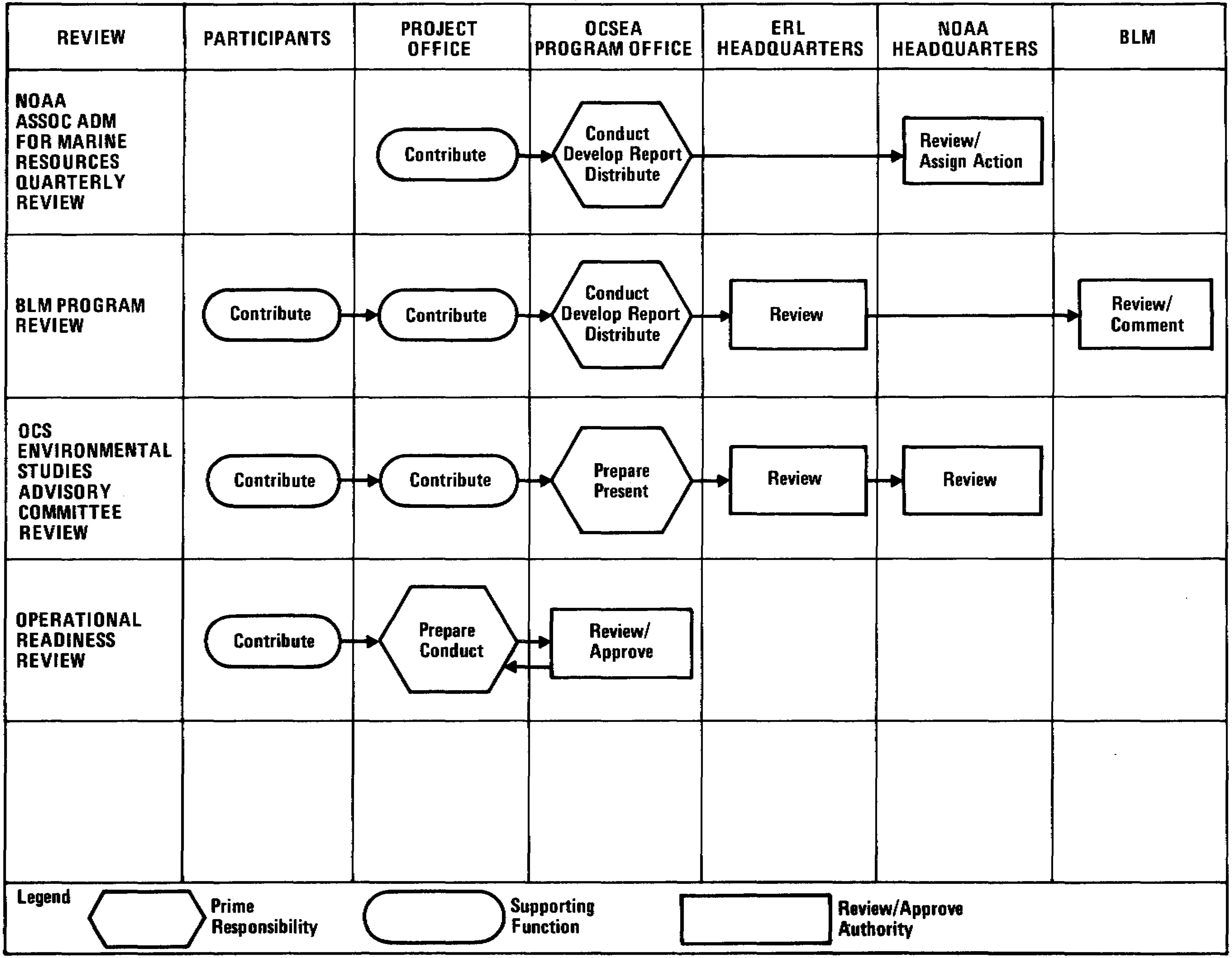

Figure 6 - 7. MANAGEMENT REVIEWS RESPONSIBILITY

6.9.1.1 NOAA QUARTERLY REVIEWS

The OCSEAP Director will provide on request a review of the program for the Associate Administrator for Marine Resources and NOAA management. This oral presentation will include technical progress, accomplishments and problems, schedule status and problem areas, cost status and resource requirements. OCSEAP Office elements and Project Offices will provide inputs to these reviews and participate as necessary.

6.9.1.2 BLM PROGRAM REVIEWS

The OCSEAP Director will provide reviews of the program at the request of the Associate Director of the BLM. The scope, format, and content of this review shall cover the same subject categories as the NOAA Reviews.

6.9.2 OCS ENVIRONMENTAL STUDIES ADVISORY COMMITTEE REVIEW

The OCSEAP Director will conduct a program review for the OCS Environmental Studies Advisory Committee at the request of the BLM. The scope, format, and content will be established in coordination with the Chairman and requests will be coordinated between the Chairman and BLM.

6.9.3 OPERATIONAL READINESS REVIEWS

Prior to initiation of operations for each field season, a comprehensive review will be conducted to verify that all planning, acquisition, and integration activities required have been completed. These reviews will be conducted approximately one month prior to the scheduled start of each year's field operations. They will be conducted for the OCSEA Program Director by the individual Project Managers with participation by those responsible for specific action under the Operational Plans.

6.10 IMPLEMENTATION SCHEDULES

6.10.1 OCSEA PROGRAM PLANNING AND IMPLEMENTATION SCHEDULE

** Dec. 1	BLM provides NOAA statement of desired program direction, priorities among lease sale areas, types and timing of information needed within each area, tentative budget guidance, and any other pertinent information that will aid NOAA in its program planning for the following fiscal year.
Dec.	NOAA commences preparation of annual TDPs.
Jan. 5	BLM provides NOAA with initial funding guidance of program level for plans for the next fiscal year. It will be based on the Presidential Budget submitted to Congress.
Apr. 15	NOAA submits draft TDPs to BLM with Annual Principal Investigators reports.
** June 15	BLM provides NOAA with a statement of comments and recommendations on each TDP.
July 30	Final TDPs are transmitted to BLM for approval.
Aug. 15	BLM shall provide NOAA with information concerning the program funding level for the following fiscal year based on BLM appropriation legislation, and approving final TDPs by preparation and signing of the Interagency Agreements (IA).
Oct. 1	IA and contracts are executed and work for new fiscal year commences, contingent on funding allocation or continuing resolution.

6.10.2 OCSEAP OPERATIONAL SCHEDULE

Feb.	Readiness review of OCSEAP Operational Plans for coming field season.
Mar.	Operational field season for vessels normally commences.

Mar. Logistic planning initiated for field season of next fiscal year.

July OCSEAP Project Offices submit Operational Plans to Director, OCSEAP.

Oct. Approval of Operational Plans by Director, OCSEAP.

Nov. Operational field season for vessels normally terminates.

6.10.3 OCSEAP REPORT SCHEDULE

Jan. 1 Quarterly Progress Reports received by NOAA from principal investigators.

Feb. 20 Quarterly Status Report submitted by NOAA to the BLM designated person with Quarterly Progress Reports of principal investigators.

Apr. 1 Annual Progress Reports, including report of previous quarter, received by NOAA from principal investigators and forwarded to BLM on April 15 with TDPs.

May 20 Quarterly Status Report submitted by NOAA to the BLM designated person.

July 1 Quarterly Progress Reports received by NOAA from principal investigators.

Aug. 1 Annual Technical Summary Report submitted by NOAA to BLM designated person with edited Annual Progress Reports of principal investigators.

Aug. 20 Quarterly Status Report submitted by NOAA to the BLM designated person with Quarterly Progress Reports of principal investigators.

Oct. 1 Quarterly Progress Reports received by NOAA from principal investigators.

Oct. 1 Executive Summary to Annual Report submitted by NOAA to BLM designated person.

Nov. 20 Quarterly Status Report submitted by NOAA to the BLM designated person with Quarterly Progress Reports of principal investigators.

** Within two weeks, BLM and NOAA will meet for amplification of guidance and/or resolution of issues, as required.

PART VII

7.0 RESOURCES

7.1 SCOPE

Resources information is provided in this section based upon best estimates as of October 1976. It covers personnel, funding, facilities, vessels, and aircraft.

7.2 PERSONNEL

The following table gives the present (FY 1977) and estimated OCSEAP staffing requirements for the next four years in the full-time permanent (FTP) and other-than-full-time-permanent (OTFTP) and non-ERL employment categories.

FISCAL YEAR	FTP (ERL)	OTFTP (and other non-ERL gov't emp.)
77	30	29
78	33	29
79	35	29
80	35	29

7.3 FUNDING

The funding presented in this section is that targeted or planned subject to available funding from BLM. They do not include the NOAA contribution which is predominately ship support. They are guided by the BLM policy statement, Section 5.2.2.

AREAS	Estimates ($ Million) FY77*	FY78**	FY79**	FY80**
Aleutian Islands	1.6			
Beaufort Sea	3.8			
Bristol Bay	2.0			
Chukchi Sea	1.8			
Kodiak Island	2.3			
Lower Cook Inlet	1.4			
Northeast Gulf of Alaska	1.8			
Norton Sound	1.6			
St. George Basin	1.2			
Non Site Specific	7.0			
	24.5*	25.0**	25.0**	25.0**

* Totals include logistics, management and data management. These are also the funded programs in FY77 consisting of 21.1 million authorized in FY77 and 3.4 million of FY77 projects funded in FY76.

** Planning totals for FY78, FY79, and FY80 are based on the rationale of Section 5.2.2.

7.4 FACILITIES

7.4.1. OFFICES

The NOAA OCSEA Program Office is located in the Environmental Research Laboratories (ERL) headquarters building (RB3) in Boulder, Colorado. In addition to office space for Program staff, a library, conference space and an auditorium are available. The resources of the ERL Personnel Services and Graphics and Audio Visual Divisions, as well as Contracting and Procurement services provided by the National Bureau of Standards through cross-servicing agreement, are fully available to NOAA.

The NOAA/OCSEAP Juneau Project Office is located in the Federal Building in Juneau, Alaska. Among other Federal Agencies, this building houses the U. S. Coast Guard Seventeenth Coast Guard District headquarters through which much support has been obtained for the Program.

The NOAA/OCSEAP Fairbanks Project Office is located in the University of Alaska Geophysical Institute Building in Fairbanks, Alaska. Resources of the University of Alaska, such as procurement are thus available to the Program. The COAR for University of Alaska projects is located in NOAA rather than on the Fairbanks Project Office staff.

7.4.2. SUPPORT FACILITIES

The NOAA/NOS Pacific Marine Center (PMC) in Seattle, Washington is the home port for NOAA vessels providing support to the Alaskan OCSEA Program. Complete services to the fleet are handled by this facility including electronic and general maintenance of OCS program equipment and necessary calibration of program equipment. All support is provided in direct response to program needs as defined by the Program and Project Offices.

The NOAA/ERL Research Facilities Center (RFC) in Miami, Florida is the headquarters for ERL controlled aircraft support missions and is responsible for the conduct of the ERL/OCSEAP helicopter support. In addition to establishing and monitoring maintenance and safety procedures, this facility offers extensive ingenuity in dealing with the Department of Defense procurement systems, thus helping to minimize operating expenses. As in the case of PMC, all support is provided in direct response to program needs as defined by the Program and Project Offices.

The Kodiak, Alaska staging facility consists of docking space and general support at the U.S. Coast Guard base (as arranged under support agreement between PMC and the USCG) and warehouse space at Gibson Cove (as arranged by support agreement between the Juneau Project Office and the National Marine Fisheries Service). A NOAA Corps Officer from one of the NOAA OCSEAP support vessels is detailed to Kodiak to coordinate activities at this staging facility.

The US Navy/ONR Naval Arctic Research Laboratory (NARL) at Barrow, Alaska is the primary support facility for all Arctic OCS operations. All resources of the Laboratory are available to the Program in accordance with a formal Interservice Support Agreement between NOAA/ERL and USN/ONR. Resources include fixed wing aircraft support, small vessel support, field camp support and quarters and subsistence for investigator personnel. Coordination of support is handled by an onsite employee of the OCS Fairbanks Project Office.

The V&E Construction Camp at Deadhorse (Prudhoe Bay), Alaska provides program support not provided by NARL in this area of the Arctic. This support is provided under contract with the OCS Program Office and includes quarters and subsistence for investigator personnel, vehicle maintenance, and other types of general support as needed. As in the case of NARL, coordination of support is handled by an onsite employee of the Fairbanks Project Office during the field season.

7.5 VESSELS

NOAA provides primary vessel support to the Alaskan OCSEA program with ships of the NOAA Fleet. Approximately 540 base-funded sea days (actual days at sea) have been provided primarily on the NOAA Class I ships DISCOVERER and SURVEYOR, and Class II Ship MILLER FREEMAN. A limited amount of additional NOAA vessel time may be available for purchase by the Program if required in the future. These vessels are operated by the National Ocean Survey out of the Pacific Marine Center in Seattle, Washington.

Additional vessels are chartered to support the Program on an as-needed basis, as determined by the Program and Project Offices. These have included, but are not limited to the following:

R/V LEE operated by the U. S. Geological Survey

R/V SEA SOUNDER operated by the U.S. Geological Survey

R/V KARLUK - operated by the U. S. Geological Survey

USNS SILAS BENT - operated by the U.S. Navy

R/V ALUMIAK - operated by the Naval Arctic Reserach Labs

R/V NATCHIK - operated by the Naval Arctic Research Labs.

R/V ACONA - operated by the University of Alaska

R/V MOANA WAVE - operated by the University of Hawaii.

An air cushion vehicle (ACV) or hovercraft is being considered to provide the special platform needed for essential studies that cannot be conducted from other ships or aircraft. Amortization and operating costs for the ACV are comparable to those for helicopters.

7.6 AIRCRAFT

NOAA operates a helicopter support mission in direct support of the Program. This mission presently includes three helicopters - one leased five-passenger model for primary operation off the NOAA Ship SURVEYOR and two ten-passenger HUEY class helicopters on loan from the Army for heavier lift requirements throughout the Program area. This mission is managed by the ERL Research Facilities Center and is directly responsive to program needs as directed by the Program and Project Offices.

Fixed wing aircraft support has been provided primarily by the Naval Arctic Research Laboratory (NARL) under the terms of the Interservice Sup port Agreement and by the Interior Department's Office of Aircraft Services (OAS) in Anchorage, Alaska. NARL can provide Twin and Single Otters, Cessna 180's, and C117's. OAS can provide a Grumman Goose.

Considerable additional fixed wing aircraft and helicopter support has been and will continue to be obtained on an as-needed basis through locally available commercial charter.

APPENDIX A

LEASE AREA DESCRIPTIONS

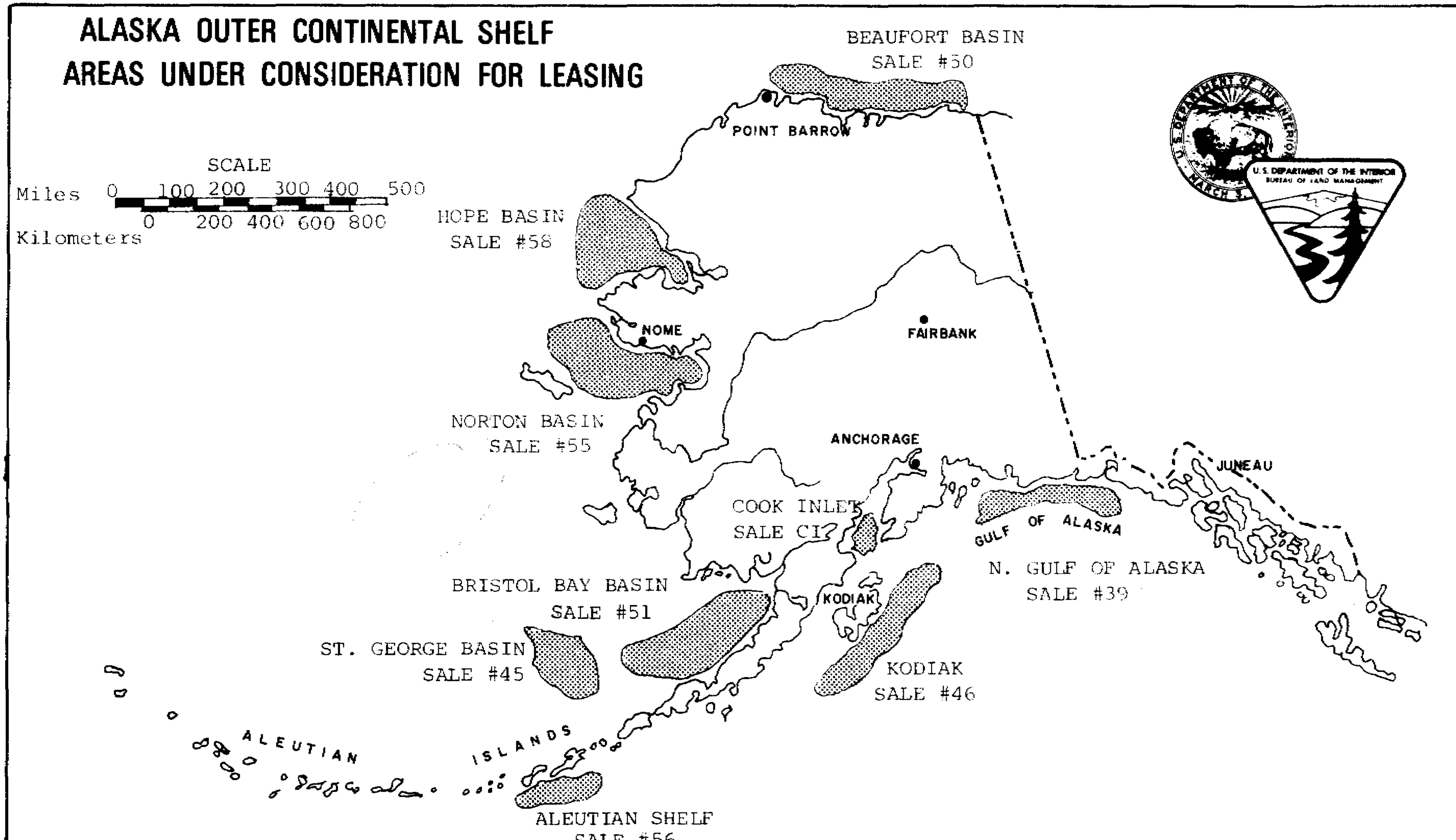
ALASKA OUTER CONTINENTAL SHELF
AREAS UNDER CONSIDERATION FOR LEASING
SCALE
Miles 0 100 200 300 400 500
0 200 400 600 800
Kilometers
BEAUFORT BASIN
SALE #50
POINT BARROW
HOPE BASIN
SALE #58
NOME
FAIRBANK
NORTON BASIN
SALE #55
ANCHORAGE
JUNEAU
COOK INLET
SALE CI
GULF OF ALASKA
N. GULF OF ALASKA
SALE #39
BRISTOL BAY BASIN
SALE #51
KODIAK
ST. GEORGE BASIN
SALE #45
KODIAK
SALE #46
ALEUTIAN ISLANDS
ALEUTIAN SHELF
SALE #56
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Fig.A-1

APPENDIX A

A.1 BEAUFORT SEA

A.1.1 Physical Environment

The Beaufort Sea, part of the Arctic Ocean, has a very narrow continental shelf which extends 48 to 96 kilometers off the northern coast of Alaska, where depths are less than 200 meters. The water mass is greatly influenced by circulation patterns of the Arctic Ocean. The onshore region is characterized by the flat lowlands of the arctic coastal plain and dotted with numerous marshes and thaw lakes. The Colville, Kuparuk, Sagavanirktok, and Canning Rivers carry sediments that, combined with those eroded from coastal banks, are distributed by local longshore currents and formed into beaches and offshore barrier islands by wave action. Some evidence suggests that offshore islands and barriers are tundra remnants. The barrier islands are the distinctive feature of this coast. Estuarine-type waters exist between the islands and the deltas.

Ocean currents in the Beaufort Sea flow westward between Mackenzie Bay and Point Barrow. Along this section of coast, the slow westerly drift formed by the clockwise Beaufort Gyral flows directly against the continental land mass. Local winds, however, may reverse the westward drift and set the current easterly in nearshore reaches. The wind exerts great impact; it affects water levels more than tides and moves the ice pack either shoreward or offshore toward the Arctic Basin. The extent of ice-free open water affects the amount of wave action on the permafrost coast, thus influencing its erosion rate. Storms are frequent, particularly during summer, and occasionally generate storm surges that strongly impact the Arctic Coast.

Offshore sediments in the Beaufort Sea are sorted by the general westward transport of the Arctic Gyral, with coarser and more poorly sorted sediments to the east and finer, sorted sediments to the west.

Tidal range in the Beaufort Sea is very small. At Flaxman Island the maximum tide measured only 0.3 meter, while mean tide there is even less.

Ice cover in the Beaufort Sea is essentially complete in winter except for leads and polynyas--water areas, other than navigable passages, enclosed by ice. Winter ice, including winter pack ice and landfast ice, extends from the limit of polar pack to the coast. Landfast ice extends from a few kilometers to as much as 50 kilometers offshore and is frozen to the bottom nearshore. The moving winter ice pack shears against the stationary landfast ice, forming an extensive shear pressure ridge system.

Sea ice freezes from 1.8 to 2.4 meters thick in one season, with local variations determined by winter temperatures. Normally, polar ice is about three to four meters thick at the end of winter and decreases to 1.8 to three meters by the end of summer.

Pressure ice (ridges and hummocks) may exceed nine meters in height and may be lifted to 12 or more meters by onshore winds along the coast. The underside of the pack generally reflects its surface topography. A high pressure ridge is matched by protuberances beneath the surface which are usually 12 to 18 meters deep but occasionally exceed 30 meters.

The coast is subject to polar ice action throughout the Beaufort Sea region. In some cases offshore barrier islands and shorefast ice protect the mainland, but they may be overridden by the polar pack in years of severe stress.

The surface of the continental shelf is affected everywhere by dragging ice blocks. Large chunks of floating sea ice, occasional pieces of broken ice islands, and deep keels of pressure ridges become grounded in the shelf sediments and form deep gouges in the sea floor. Ice gouges have been found as far out as the edge of the continental shelf, though they are more numerous in shallower waters, especially along the ice shear zone.

Freezeup and breakup dates are variable and unpredictable. At Point Barrow, freezeup may occur anytime between early September and late November. Breakup has occurred as early as mid-June and as late as late August.

Offshore from rivers, spring runoff flows over the ice, eventually melts holes in the shorefast ice, and swirls down through them, creating other scour depressions in the shallow sea bottom for a few miles offshore. The shelf is probably underlain by continuous thick permafrost below an active layer as deep as three meters.

The slight precipitation, about 25 to 28 centimeters yearly, occurs mostly as snow, although some light rain may fall during the warm season. Fog is prevalent along the coast, particularly when waters are ice-free. Winds tend to persist along the coast, and high velocities are not unusual. Air temperature may be as high as 20^{o} C in the summer and as low as minus 55^{o} C during winter.

Surface water characteristics in the Beaufort Sea are influenced primarily by seasonal freezing and melting. Temperatures average minus 1.4^{o} C. in summer and minus 1.7^{o} C in winter, with a salinity range of 28 to 32 parts per thousand. In summer, river flows influence the inshore waters by spreading warmer waters of low salinity from the river deltas over the colder, more saline ocean waters. Beyond the narrow continental shelf the deeper waters are warmer and more saline. In winter, river discharge slows as headwaters and tributaries freeze. As a result, saline oceanic waters intrude the river system. In the case of the Colville, saline waters may intrude as far as 48 kilometers.

A.1.2 Biotic Resources

The variety and distribution of marine animals along the Beaufort Sea coast reflect the combined effects of water and ice movements, water mass and bottom characteristics, and the availability of suitable food. The presence or absence of ice profoundly affects fish, bird, and marine mammal movement and behavior in this region. Many of these species congregate near the edge of the pack ice and move in response to ice motion.

Biologically, the shallow coastal environment along and within the barrier island chain is more productive than the open seas. During summer, phytoplankton and zooplankton increase markedly in coastal waters, but species are few and food webs more simple than in temperate seas. Plankton populations are concentrated at the lower surface of the floating pack ice and appear to play a very important role in the food relationships of coastal biota. The macrofauna of coastal areas includes crustaceans, molluscs, and polychaetes, with few species responsible for most of the abundance and biomass. Flatfish, cod, and bearded and ringed seals feed on these bottom-dwelling invertebrates. The limited number of fish species includes Arctic char, whitefish, cisco, cod, smelt, flatfish, and sculpins. An occasional pair of chum or pink salmon spawns in rivers emptying into the Beaufort Sea. Only a small number of animal species can tolerate life in the intertidal zone where they experience harsh contact with moving sea ice and are constantly subject to the shifting soft beach sediments.

The nearshore waters are critical to most waterfowl in the Arctic, although the tides do not fluctuate enough to create the broad intertidal areas associated with high productivity elsewhere. This habitat is the first marine water open in spring and is used by waterfowl for feeding and resting throughout the short summer. The protected lagoons behind the barrier islands are particularly important since two-thirds of the bird population of the Canadian Arctic islands pass this way, including large numbers of black brant, oldsquaws, gulls, and shorebirds. These lagoons also provide habitat for a million or so migrating eiders as well as for loons and other water birds. They are also important feeding and molting areas. Eider ducks, shorebirds, and gulls nest in high densities on some of the barrier islands in some years. Snow geese are known to nest in Alaska only at the mouth of the Sagavanirktok River on Howe Island near Prudhoe Bay. Shorebirds, swans, ducks, (mainly oldsquaws), geese, loons, jaegers, snowy owls, and others, nest in great abundance near ponds of the coastal tundra.

Marine mammals of the area include seals, mainly bearded, ringed, and harbor; whales, mainly bowhead, gray, and beluga; and a few walrus which do not go east of Barrow in large numbers. Bowhead and beluga whales follow the ice leads in spring and can be seen from shore as far east as Barrow at this time. In winter such animals as the walrus and many of the bearded seals migrate south, while the polar bear, ringed seal, and occasionally, bearded seals are found along the shorefast ice. Polar bears frequent the ice pack and pregnant female bears den in heavily snowdrifted areas along the coast as far as 40 km inland. Arctic foxes also occur on sea ice, following the bears to scavenge their kills.

A.1.3 Human Occupancy

The population centers of Alaska's Arctic Slope are largely along the coast at sites historically occupied for subsistence livelihood. Villages are predominantly Eskimo--Niuqsiut, Kaktovik, and Barrow, which is the seat of the North Slope Borough and a distribution center for the region. The exceptions are the new petroleum development camp settlements at Prudhoe Bay and deadhorse. Two inland Eskimo villages, resettled Atkasook on the Meade River and Anaktuvuk Pass on a major caribou migration route, also depend heavily on subsistence resources. Intervillage and interregional travel is almost exclusively by air. Steady employment has increased since World War II, and some natives are able to work at state and federal agencies and in pipeline related activities to supplement their traditional lifestyle.

A.2 CHUKCHI SEA

A.2.1. Physical Environment

The Chukchi Sea is a shallow body of water lying between the Arctic Ocean and Bering Strait. Its western boundary is near Wrangell Island, USSR,at 180 degrees west longitude while the eastern boundary lies at Point Barrow, Alaska, at 156 degrees west longitude. The Alaskan and Siberian coasts border the Chukchi south to Bering Strait.

The Chukchi Sea averages 45 to 55 meters in depth, and the bottom is a flat, featureless plain connecting the Alaskan landmass to the Siberian landmass. The sea floor slopes gently range from three meters per km to nearly unmeasurable slopes. The surface of the shelf is affected in most areas by dragging sea ice chunks and keels of pressure ridges, especially near shore. The shelf is probably underlain by continuous thick permafrost below an active layer as deep as three meters. Characteristic of the low-lying Alaskan coast of the Chukchi Sea is a somewhat broken, beadlike, series of lagoons along much of the coastline from Cape Prince of Wales to Point Barrow. The environment of the lagoons is estuarine during summer, subject to freshwater influx from land and mixing with marine water from nearshore areas. The onshore region is low and marshy with numerous lakes and small streams and is underlain by discontinuous thin to continuous moderately thick permafrost.

Kotzebue Sound, from Cape Espenberg to Cape Krusenstern, is a shallow, sediment-filled embayment with no natural harbor. The Kobuk and Noatak Rivers empty into the sound, contributing the major portion of its sediments and reducing its salinity to ranges from 16 to 31 parts per thousand. The floor in the sound is very flat, with depths averaging 12 to 14 meters. The entrance to the sound is cut by a channel between Cape Krusenstern and Cape Espenberg which trends northwestward toward the submarine head of Hope Sea Valley in the northcentral Chukchi Basin and becomes indistinct west of Cape Krusenstern.

Sediment-laden waters from the Yukon River flow into the Chukchi Sea through Bering Strait. This north-flowing current provides most of the sediment found in the Chukchi basin. Wave erosion of shoreline cliffs and ice rafting and wind action also contribute sediments.

Ocean currents in the Bering Strait flow predominantly northward from the Bering Sea into the Chukchi Sea and Arctic Ocean (mean annual transport rate of 1.5 million cubic meters per second). At times, a southerly flow occurs in the western part of the strait, but the volume of arctic water outflow is low. The northward coastal currents, together with a westward drift along the southern margin of the arctic ice pack, combine to establish a broad counterclockwise circulation in the Chukchi Sea. The velocity of the northward current is greatest along the coast at Cape Prince of Wales where the normal range is 1.5 to 4.4 kilometers per hour with extremes of 7.4 kilometers per hour. Once through Bering Strait the watermass diverges along the eastern Chukchi Sea and coast as far north as Barrow and centrally through the Chukchi until confluence with the Beaufort Gyre currents north of Wrangell Island. Currents in Kotzebue Sound are largely tidal, although winds may alter water flow locally. A net inflow occurs near Cape Espenberg and a net outflow past Cape Krusenstern. Current velocities through the Sound range from 0.01 to 0.05 knots.

Tides are semidiurnal in the Chukchi Sea and tidal range is minimal, as reflected by the maximum range of 1.3 meters at Kotzebue. Tidal action has minor influence on the scouring movements of sea ice on the beach.

Sea ice coverage in the Chukchi varies greatly from year to year. Furthermore, it is not a solid mass; polynyas and leads are present in both the polar and winter pack, and in summer open water areas become extensive along the entire coast, especially in the southern part of the region. North of Icy Cape, sea ice freezes to thicknesses of 1.8 to 2.4 meters in one season with local variations determined by winter temperatures. The coast is subject to polar ice action as far south as Icy Cape. Normally, polar ice is about three to four meters thick at the end of winter, decreasing to 1.8 to three meters during summer. Pressure ice may exceed nine meters in height and along the coast may be lifted 12 meters or more by onshore winds. Beneath the ice, pressure ridge keels may extend more than 18 meters and occasionally as much as 30 meters in depth.

West and south of Icy Cape the normal situation is one-year ice. From Bering Strait to Icy Cape the winter ice grows to thicknesses to about 0.6 to 1.2 meters. At Icy Cape the polar ice pack generally lies about 16 kilometers offshore and then swings northwest toward Wrangell Island. The northward-flowing current from Bering Strait keeps the coast ice-free throughout September as far north as Cape Lisburne. The average dates for breakup and freezeup at Wales are June 8 and December 3; at Kotzebue, May 3 and October 23; at Point Hope, June 20 and November 11.

Wave heights and storm surges are more severe in the Chukchi than in the Beaufort Sea, primarily due to the longer reaches of open water in summer and fall when storm patterns can produce coastal flooding in many low-lying areas such as Point Hope and Point Lay. Larger waves and swells move from the north or northwest, the direction of longest fetch.

Waters adjacent to the coast can be as warm as 10° C and of low salinity, less than 31 parts per thousand (ppt), partly due to river influx along the coast. Central and western waters are cold (3° C) and have higher salinities (33 ppt). Water salinity in Kotzebue Sound ranges from 20 to 30 ppt in summer, remaining near 32 to 34 ppt in winter. Because of the shallowness of the Chukchi Sea, constant mixing of the waters in summer results in relatively uniform chemical and physical properties.

A.2.2 Biotic Resources

The variety and distribution of marine animals along the Chukchi Sea coast reflect the combined effects of water and ice movements, watermass and bottom characteristics, and the availability of suitable food. The presence or absence of ice profoundly affects fish, bird, and marine mammal movement and behavior in this area. Many of these species congregate near the edge of the pack ice and move with it. Plankton, invertebrates and fish,which thrive at the ice edge in great abundance, provide food for the concentrations of marine birds and mammals.

Nutrient concentrations are relatively high, especially in recently upwelled waters and deeper layers. Northward-flowing currents result in plankton in the southeastern Chukchi Sea very similar to that in the Bering Sea and Norton Sound. Productivity of the Chukchi Sea is poorly documented, although it appears that summer phytoplankton populations are sufficient to provide forage for diverse populations of zooplankton. General features indicate higher zooplankton volumes in offshore waters in association with major currents, while inshore waters such as Kotzebue Sound have lower plankton volumes. Benthic biota also are diverse and invertebrate species dominate. Echinoderms, tunicates, crustaceans, molluscs, and polychaete annelids are the most common benthic forms. Small tanner crabs and shrimp occasionally are encountered in this area. Fishery resources of the area are primarily benthic or demersal. Arctic cod, Bering flounder, and sculpins are the predominant species. Pelagic fish species are few, typically sand lance and capelin, although herring, salmon, Arctic char, and smelt are frequently present. All five Pacific salmon are present, with pink and chum salmon dominant. Salmon runs in the Chukchi Sea support a commercial fishery centered in the Kotzebue area with major escapements to the Kobuk and Noatak River systems. The run of chum salmon to the Noatak River alone exceeds one million fish in some years. Most other moderate to large rivers along the coast contain fair to good escapements of chum salmon. Anadromous species such as Arctic char and inconnu inhabit coastal waters for a short period each year.

Coastal lagoons of the Chukchi Sea are important feeding and nesting areas for migrating birds. Most of the million or so eider ducks and numerous oldsquaws and other birds that pass Point Barrow also pass along this coast. Marshes on the Seward Peninsula and adjacent to Kotzebue Sound are nesting grounds of numerous water birds and shorebirds. Geese, brant, and swans congregate in Eschscholtz Bay, Hotham Inlet, and Selawik Lake prior to fall migration. Seabird colonies are found on Chamisso and nearby Puffin Islands in Kotzebue Sound, part of the existing Chamisso National Wildlife Refuge. Horned puffins, murres, kittiwakes, and gulls nest on Puffin Island and its associated islets and the neighboring cliffs. To the north, Cape Lisburne supports the northernmost major bird colony on the west coast of North America, about a million birds being raised annually. Cape Thompson has at least five colonies containing 400,000 seabirds. These birds are believed to take 13,000 metric tons wet weight of food from the sea in a single breeding season.

The Chukchi Sea provides habitat for marine mammals that tend to follow the edge of the pack ice in its seasonal advance and retreat. Polar bears, walrus and seals (mainly bearded, ringed, and harbor seals), are abundant along the edge of the ice pack and the coast. Marine mammals are seasonally important in estuaries. In spring, bowhead, gray, beluga, and other whales migrate north along leads close to the Alaskan coast, the bowhead and beluga, in particular, staying close to the edge of the pack ice. Belugas calve in Eschscholtz Bay and feed at the mouths of such salmon streams as the Buckland and Noatak Rivers during spawning runs. Spotted seals haul out in great numbers on beaches and are particularly conspicuous at Cape Espenberg.

Arctic foxes also hunt and scavenge on the ice pack. Pregnant female polar bears may travel many kilometers inland seeking den sites in deeply drifted snow banks.

A.2.3 Human Occupancy

Most residents of the Chukchi Sea coast are Eskimos, although Kotzebue and Barrow, the largest population centers, have substantial non-Native populations. The smaller communities of Kivalina, Point Hope, Point Lay, and Wainwright are almost entirely Eskimo except for personnel of Air Force Distant Early Warning stations. Nearly all residents of the Chukchi Sea coast depend heavily on marine resources, particularly walrus, seal, and whales, although considerable commerce and industry occur at both Kotzebue and Barrow. Subsistence fisheries are most important in the area south of Cape Lisburne. Residents of the small villages earn some cash income from jobs elsewhere in Alaska, at Air Force stations along the coast, and from some commercial activities at Kotzebue.

A.3 NORTHERN BERING SEA-NORTON SOUND

A.3.1 Physical Environment

The northern Bering Sea is a dynamic system, heavily influenced by seasonal ice cover much of the year. This region is bounded on the south by Nunivak and St. Matthew Islands, on the west by Siberia's Gulf of Anadyr, and on the north and east by Bering Strait and Norton Sound, respectively.

St. Matthew Island can be characterized as a succession of hills and low valleys with a rocky coastline. The shore of St. Lawrence Island is characterized by low sandy beaches and grassy tundra with numerous freshwater lakes, and several large barrier island-lagoon complexes. These islands are of volcanic origin and rise abruptly from the Bering Sea platform.

The Yukon-Kuskokwim delta is the major river delta system of Alaska, composed largely of glacial sediments and characterized by extensive meandering river channels and marshy ponds. Shorelines along Norton Sound and the Seward Peninsula are generally abrupt with steep bluffs and a few cliffs interspersed with small stretches of low-lying, sandy or silty beaches. Bering Strait effectively marks the northern extreme of the Bering Sea. The strait, 70 kilometers wide between Alaska and Siberia, is the gateway through which Bering Sea water drifts northward into the Chukchi Sea and the Arctic Ocean. The coast is generally low with extensive tidal shorelines.

This entire region is underlain by discontinuous permafrost, which becomes continuous north of the mountainous backbone of the Seward Peninsula.

The northern Bering Sea is entirely continental shelf which is generally shallow and of low relief. Norton Sound is a subarctic embayment, averaging 20 meters deep. The sea floor in Norton Sound slopes gently downward to the west and at approximately 168° west longitude rises to form St. Lawrence Island. From here to Bering Strait the shelf remains relatively flat. Bering Strait has an irregular bottom with depths to 60 meters. Just south of the strait the floor abruptly rises, forming cone-shaped island promontories--the Diomede Islands and Fairway Rock.

Surface currents in this area reflect the general northward drift of water toward Bering Strait. Currents in Norton Sound are affected primarily by winds and freshwater input from the Yukon River. Wind mixing may extend to the bottom of the sound, and may drive significant currents. Surface waters flow northward past the west end of Norton Sound and a deep influx of Bering Sea water flows inward along the bottom of the sound.

Surface currents in the adjacent northern Bering Sea are relatively complex, but the general set is northerly. During summer two major currents predominate--a north-flowing current along the Alaskan coast and a south-flowing current along the Siberian coast. A major system of eddies occurs between these currents. In winter a similar regime prevails, but some deflection of the water flow occurs at the pack ice edge, where surface currents tend to shift westward. Current velocities average one knot in the northern Bering Sea and increase in velocity as they converge near the geographic constriction of Bering Strait.

Sea ice is a common condition in the northern Bering Sea, covering the entire area from late autumn through early spring. Wind-induced ice movement causes ice ridge and hummock formation by convergence of ice floes, although ridges probably do not attain a great height because there is extensive thin one-year ice on the northwest coast. Ice thicknesses range from 71 to 122 centimeters in the Northern Bering Sea and Norton Sound. In Bering Strait extensive ice pressure may build up due to its constriction.

Tides are mixed in the Bering Sea with small mean ranges, generally from 0.9 to 1.5 meters. Tides cause some coastal ice scouring, and influence water movements in Norton Sound. Tidal currents vary from 0.5 to 1.7 knots, but in Norton Sound may reach 2.0 knots. Here tidal current direction changes from east to west with flood or ebb, respectively.

Sea temperatures vary considerably with season from above 12°C in summer to minus 2° C in winter. Summer water characteristics are influenced by river input, wind transport and mixing, and tidal action; winter conditions are largely controlled by thermohaline convection. Marine waters of Norton Sound frequently are well mixed to the bottom, primarily due to wind action.

Ocean currents and bottom and coastal topography strongly influence salinity distribution throughout this region. Generally, salinity increases from east to west, reflecting the influence of fresh-water runoff from the Alaska coastal landmass. Summer salinities vary from 13 to 19 parts per thousand (ppt) in eastern Norton Sound and increase to 32 to 33 ppt in the northern Bering Sea. Winter salinities in this region generally vary from 31 to 34 ppt.

Influx of sediments into Norton Sound and the northern Bering Sea results primarily from river runoff, particularly from the Yukon and Kuskokwim Rivers. The Yukon contributes 90 percent of the total river sediment input to the entire Bering Sea, amounting to about 100 million metric tons a year. Rivers carry sediments scoured from banks or drained from adjacent land surfaces and deposit them generally near the river mouths. The tremendous deltas of the Yukon and Kuskokwim Rivers are impressive examples of sediment deposition. Reworking of shallow marine bottom sediments by wind mixing and current action is also important to the sediment regime in this region, since resuspended materials are often transported and distributed into adjacent areas. Waves formed along the north shore of Norton Sound during severe storms probably roil sediments extensively and mass movement of sediments occurs during these episodes.

A.3.2 Biotic Resources

The variety and distribution of marine animals along the Chukchi Sea coast reflect the combined effects of water and ice movements, water mass and bottom characteristics, and the availability of suitable food. The presence or absence of ice profoundly affects fish, bird, and marine mammal movement and behavior in this area. Many of these species congregate near the edge of the pack ice and move in response to ice motion. Plankton, invertebrates, and fish that thrive at the ice edge in great abundance provide food for the concentrations of marine birds and mammals.

An algal community at the ice edge makes a significant contribution to the overall primary production in this area beginning in March and becoming increasingly important until the ice melts. Northward flowing currents result in plankton in Norton Sound, these populations being very similar to those of the southern Bering Sea. This area is characterized as having moderate standing crops of zooplankton. In Norton Sound, prominent plankters include Tortanus discaudatus, Epilabidocera amphitrites, and Centropages mcmurrichi. Important factors affecting benthic fauna distribution are salinity, depth, water temperature, dissolved oxygen concentration, and nature of the bottom substrate. Echinoderms, tunicates, crustaceans, molluscs, and polychaete annelids are the most common benthic forms. Although molluscs and polychaete annelids are the most diverse groups, amphipod crustaceans and echinoderms are the most abundant in number. Polychaete annelids comprise approximately 50 percent of the total biomass of benthic organisms in Norton Sound. Small tanner and king crabs inhabit this area. Several species of shrimp are common.

Predominant demersal fish in Norton Sound are members of the flatfish family. Fish in this area are generally small and sparsely distributed. Rock and yellowfin soles, saffron cod, and several species of sculpin are common demersal fishes. Smelt and herring are the more common pelagic fishes. All five species of Pacific salmon inhabit this area. Large pink salmon runs occur in the Shaktoolik, Unalakleet, Ungalik, Inglutalik, and Niukluk Rivers. Chum salmon escapements are fair to good in most moderate to large rivers along the coast. Arctic char are abundant and spawn in many of the rivers in this area.

Walrus, four species of seals and 10 species of whales inhabit this area. Walrus, all seals other than one subspecies of harbor seal, and beluga and bowhead whales normally stay near the sea ice. Killer, gray, humpback, fin, and minke whales and the harbor porpoise have some contact with sea ice. Polar bears sometimes pass southward through Bering Strait, but seldom as far as St. Lawrence Island. The general movement pattern of marine mammals is northward in spring as the ice edge retreats and southward in fall with the advance of the ice. Little information is available on numbers of marine mammals in the area.

Coastal marshlands along the south coast of the Seward Peninsula, especially near Solomon, Golovin, Koyuk, and Shaktoolik, are important stopovers for migrating swans, snow geese, Canada geese, sandhill cranes, and shorebirds. In offshore areas, murres, guillemots, puffins, auklets, jaegers, fulmars, and others feed in and beneath the ice edge and rest upon it. Little Diomede Island and Fairway Rock in Bering Strait, King Island, Sledge Island, Egg and Besboro Islands in Norton Sound; and Cape Denbigh, Bluff, Rocky Point, and Cape Darby on the southern coast of the Seward Peninsula support seabird colonies. The colony at King Island may contain more than a million birds including more than seven species.

A.3.3. Human Occupancy

Eskimos have occupied the northern Bering Sea coast for thousands of years. There are now over twenty coastal villages where traditional subsistence ways predominate. The people depend on the marine resources of the Bering Sea for most of their livelihood. Sealing, walrus hunting, and fishing are the subsistence base of the area. Bowhead whales are taken at St. Lawrence Island. Nome (pop. 2,500) on Norton Sound, is the major town and has a large non-Native population, but few permanent jobs exist in Nome or in the smaller villages. Fisheries-related seasonal employment is high, but few families earn enough in the short period to survive on a cash economy basis.

A.4 BERING SEA-ST. GEORGE BASIN

A.4.1 Physical Environment

The Bering Sea is a large, relatively confined area of 2,300,000 square kilometers. It is an extension of the north Pacific Ocean, separated from the main water mass by the 2,000 kilometer Aleutian Island arc. The narrow Bering Strait connects the Bering Sea and the Chukchi Sea to the north.

Coastal physiography varies greatly. To the south the Bering Sea is bounded by the Alaska Peninsula and the Aleutian chain. Passes between the Aleutian Islands, which vary in depth and size, allow movement of Pacific water northward. Shorelines of the Alaskan Bering Sea coast vary widely. The northern shore of the Alaska Peninsula and Aleutian Islands has a predominantly gentle slope with wave-washed sand beaches and large, brackish lagoons along the Alaska Peninsula. To the north the Pribilof Islands are characterized by steep cliffs and rocky shorelines.

The continental shelf, accounting for 44 percent of the total Bering Sea area, is one of the largest in the world and extends more than 600 kilometers offshore in the northeast sector. It is a flat, gently sloping plain with an average depth of less than 100 meters. Thirteen percent of the sea is continental slope incised by submarine canyons. To the west the remaining 43 percent of the sea is ocean basin as much as 4,000 meters deep with a smooth, almost featureless floor divided into two subbasins by the Bowers Bank, or Rat Island, submarine ridge. Near the Pribilofs the normal depths of the continental shelf are broken by numerous reefs and some islands. Shallow water extends offshore and rocky ledges protrude eight to 10 kilometers to the northeast and west of the islands.

Water entering the Bering Sea through Aleutian passes is generally warmer and more saline than the northern part of the sea, although surface water characteristics vary greatly during the ice-free season and are influenced by seasonal inflow from large, freshwater rivers and melting sea ice. Brief, violent storms can occur in any season and cause great mixing of water types.

The St. George region of the Bering Sea is situated within a portion of the northeastern Pacific Ocean dominated by subarctic Pacific waters. One unique feature of these waters is a salinity structure characterized by a surface minimum, by increasing salinity with depth, and by a sharp halocline between 100 and 200 meters depth.

The major ocean circulation pattern of the Bering Sea is cyclonic, flowing eastward along the north side of the Aleutians, northward in the eastern portions of the Bering Sea and southward along the Siberian coast. The eastward moving current north of the Aleutians mixes with waters flowing northward through various Aleutian passes. Locally, the surface currents are influenced by prevailing winds and therfore vary greatly depending upon the weather. Nearshore currents are chiefly tidal and current velocities may attain 3.5 knots or more in the area near Unimak Island and Pass.

Upwelling occurs along large areas of the continental shelf margin, particularly at heads of submarine canyons and north of major

Aleutian passes. Bottom water brought to the surface in this way has high nutrient concentrations.

Carbon dioxide concentrations vary greatly within the sea. Undersaturation occurs in the northcentral areas and supersaturation in the east.

Generally, the maximum southern limit of sea ice in the Bering Sea is from Bristol Bay to the vicinity of St. George Island in the Pribilofs. North of this boundary the Bering Sea has a 50 percent ice cover for five months of the year. The ice is one-year winter ice; little polar ice travels southward through Bering Strait. The ice cover is generally less than one meter thick with many open areas of water and a hummocky surface due to the variable winds, currents, and tides. Ice formation begins in this area in early winter and is at its maximum in February and March. General northward retreat of ice begins in April.

The mean range of diurnal tides in the western and central Aleutians is one meter. Mixed tides occur along the Alaska Peninsula with a range of one to 1.5 meters.

Sea conditions are rough in the ice-free season when waves are generated by severe local storms. Maximum wave heights are limited by the general shallow depth of the continental shelf waters. The Aleutians are also subject to tsunamis. Fog is common all year.

Sediments from rivers draining the Alaska Peninsula and Bristol Bay uplands accumulate rapidly in the Bering Sea. Nearshore areas are covered with sand, silt-sized particles become more predominant towards the continental slope, and clayey oozes occur in the deep ocean basins.

A.4.2 Biotic Resources

Despite what may appear to be a harsh climate for phytoplankton growth, this shelf region supports phenomenally high primary production. Even the undersurface of the ice is highly productive during some periods of the year. Generally, productivity in offshore areas, such as the St. George area, is less than that near adjacent coasts.

Zooplankton standing crops are less than in Bristol Bay to the east. Benthic invertebrates are typically of low density in the area and are primarily made up of echinoderms and molluscs. Shrimp abound in isolated areas near the Pribilof Islands, and Japanese fishing vessels trap several species of edible marine snails in the area. Fisheries in the Bering Sea are world-renowned, large stocks of herring, pollock, Pacific cod, Pacific Ocean perch, sablefish, and several species of flatfish support lucrative commercial fisheries. All five species of Pacific salmon migrate through this area, many traveling to and from the productive Bristol Bay region.

Offshore, marine mammals are not as abundant as in coastal areas. The entire northern population of fur seals breeds on the Pribilof Islands. In late spring, males enter the Bering Sea from the south through passes in the Aleutian chain; females follow shortly thereafter. Individual seals occasionally forage for food as far east as outer Bristol Bay. Sperm, gray, and minke whales pass through this area regularly. Sea otter and Steller sea lion are locally abundant in the Pribilofs.

Major seabird colonies in the Pribilof Islands are inhabited by crested auklets, common and thick-billed murres, red-legged and black-legged kittiwakes, red-faced and pelagic cormorants, and tufted and horned puffins. In addition, offshore waters are populated by slender-billed shearwaters, fulmars, and forked-tailed petrels.

A.4.3. Human Occupancy

Communities bordering the St. George basin are small, predominantly Aleut coastal villages. They include St. George and St. Paul in the Pribilof Islands, and the villages of Nikolski, Unalaska, Akutan, False Pass, and Nelson Lagoon on the Alaska Peninsula. Sealing, fishing, and berry-picking are the traditional subsistence base of the Pribilof Islands; in addition, hunting and trapping are important on the Peninsula. The traditional subsistence economy has been modified by several economic forces in the last 100 years, at first by the Russian fur hunters, later by the whalers, and now the cash economy based on state and federal government agencies dominates. This is particularly true in the Pribilofs where Natives harvest and process seals for subsistence as well as for the world market. St. George and St. Paul are typical "company towns" (total population about 800) since they are under the jurisdiction of the U.S. Department of Commerce for the conservation, management, and protection of the fur seals.

Throughout the region, employment is seasonal in character. There are few permanent jobs, little regular transportation between the villages, and there are no deepwater ports.

A.5 BERING SEA-BRISTOL BAY

A.5.1 Physical Environment

Bristol Bay is a large, comparatively shallow bay of the Bering Sea, bordered by rugged mountains up to 1,500 meters elevation, lake-dotted tundra, and many rivers. The Nushagak and Kvichak Rivers are the major drainages into the bay.

The coastline is relatively regular and marked by numerous sandy beaches. Older coastal deposits with some modern beaches, spits, and bars extend around the coastline and are prevalent on the Nushagak Peninsula and around Ugashik Bay. Some cliffs, ridges, and low hills bridge the bay between Cape Newenham and Kulukuk Bay. Low terrace and alluvial fan deposits occupy sites along the modern floodplains of the lowland rivers, and many of the rivers have tidal estuaries. Shorelines of inner Bristol Bay are also low but of finer sediments. Westward to the Kuskokwim River delta, low shores and lagoons alternate with cliffs and high bluffs.

Bristol Bay has a surface area of over 150,000 square kilometers and is one of the most important salmon fishing grounds in the world. It is extensively used for navigation purposes in the ice-free season, providing essential contact with the villages of the area as well as major navigational routes from the orient. The bay is part of a large continental shelf which is remarkably flat, with minimal variation in relief. The average depth of the bay is 40 meters.

On the basis of surface circulation patterns, the bay may be divided into a predominantly estuarine inner area and an outer bay with a more oceanic character. The fundamental circulation pattern in outer Bristol Bay during ice-free months appears to be a simple counterclockwise gyre, driven by a combination of wind, tide, and estuarine effects. North Pacific waters enter the bay through the Aleutian Island passes, although the waters of the inner bay are brackish.

Tidal range around the periphery of Bristol Bay varies considerably. Amplification of the tide toward the head of Bristol Bay occurs due to the funnel-shaped configuration of the bay. The mean range varies from 0.6 to 5.6 meters. Tides are the mixed type, exhibiting large inequalities in heights and durations of successive high and low waters. Tidal currents often reach six knots and have an important influence on water movement and winter ice conditions.

Bristol Bay lies at the southern boundary of the area influenced by true seasonal ice, and the ice cover generally consists of a mass of irregularly shaped floes. Ice formation begins in mid-October in the sheltered lagoons of the inner bay. The most extreme conditions occur in February and March. Ice may often persist into late spring and usually stays in the bays and around islands longer than in the open sea.

Most waves in the bay appear locally generated, despite the great fetch available to the west and to the north. Few waves over 5 meters have been reported, although the area is characterized by brief, severe storms.

The surface waters of Bristol Bay have a great variability during the ice-free season caused by the intermixing of local runoff from large rivers with the north Pacific surface waters and the large size and shallow depth of the bay. Local violent storms can cause upwelling or downwelling of large volumes of water. Nutrient concentrations are high throughout the bay.

Contemporary sediments cover the entire floor of Bristol Bay and are distributed systematically, from coarser sands inshore to very fine sand further offshore. Quartz and feldspar sands dominate.

A.5.2 Biotic Resources

Primary productivity is generally higher in the lagoons and coastal basins of Bristol Bay than in the adjacent offshore waters. A significant phytoplankton population develops near the bottom surface of sea ice in late spring. Major phytoplankton species appear to be oceanic diatoms. Eelgrass in Izembek Lagoon yields between one and eight grams of carbon per square meter per day. The largest eelgrass beds in the world border the Bering Sea. Numbers and species of zooplankton are highly variable depending upon the degree of penetration of north Pacific water into the bay in early spring. These zooplankton are more abundant in the clearer offshore waters of the outer bay than in the more turbid inshore waters of either the inner or outer bays. Development of diverse intertidal communities is hampered by extreme tidal ranges that expose vast expanses of shoreline twice daily, by variable salinities, by irregular currents and current velocities, and by winter ice which scours tidal flats and coastal lagoons. The benthic fauna of Bristol Bay is sparse. The central part of the bay supports a biomass which rarely exceeds 10 grams per square meter. Density of the benthic invertebrates increases on the periphery of the bay. Echinoderms, molluscs, and polychaete annelids comprise most of the biomass. In addition, amphipods, sponges, hydroids, and bryozoans are common. Tanner crab and king crab are also commercially important. Drainages entering Bristol Bay comprise some of the world's most productive salmon habitats. The sockeye salmon run in tributaries to Bristol Bay sometimes produces an annual harvest of 30 to 50 million kilograms, the Kvichak-Naknek and Nushagak Rivers being particularly productive. The other four species of Pacific salmon are also abundant in Bristol Bay. Although the United States focuses almost entirely on the salmon fishery, foreign nations harvest vast quantities of pollock, Pacific cod, turbot, and rock, flathead and yellowfin soles from these waters. Halibut and herring migrate annually through the bay, leaving in autumn as waters cool.

The coastal lagoons and abundant plankton support one of the densest populations of water birds in the world. Nesting seabirds such as kittiwakes, guillemots, murres, gulls, auklets, and puffins comprise some of the largest seabird rookeries in the world. The entire Pacific population of black brant gathers prior to fall migration in the Bristol Bay area, feeding almost exclusively in the coastal eelgrass lagoons, accompanied by hundreds of thousands of emperor geese, Canada geese, greater scaup, oldsquaw, pintail, eiders, and other ducks, geese, and shorebirds. Offshore may be found slender-billed shearwaters, fulmars, and fork-tailed storm-petrels.

Marine mammals of the Bristol Bay coast are diverse and numerous. Baleen whales, including several endangered species, migrate here in summer. Killer whales and beluga are the common toothed whales along the shoreline. The Steller sea lion occurs all along the rocky coast of outer Bristol Bay, while the harbor seal prefers the gentler slopes and sandy beaches. The formerly endangered sea otter is common along the southern Bristol Bay, especially close to shore near kelp beds. The Walrus Islands summer several hundred bull walrus.

A.5.3 Human Occupancy

Some twenty villages and small towns are situated along the shores of Bristol Bay. Half of the region's population lives in the Bristol Bay Borough (Naknek, King Salmon, and South Naknek) and in Dillingham. The population is two-thirds Native of which some 60 percent is Eskimo. The majority of the non-Native population is located around the Air Force Base at King Salmon. Outside the main population centers which are important hubs of transportation and communication, the economy is based on fishing, hunting, and trapping. The only significant source of private employment is the fishing industry during the annual six-week salmon runs. At this time, there is a marked regional movement of population to the coastal villages. At the end of the run, these people return to a modified subsistence economy in their own villages, which are often outside the region altogether.

A.6 GULF OF ALASKA-ALEUTIAN COAST

A.6.1 Physical Environment

The coastal topography of the southern Alaska Peninsula from Shelikof Strait to Unimak Island is heavily dissected by inlets and fjord estuaries and a few narrow embayments. Many areas have high rugged cliffs with offshore reefs and islands along this coast, while other areas are low with shoals extending offshore.

The continental shelf extends seaward approximately 200 kilometers and narrows to 50 kilometers off Unimak Island. The shelf is marked by broad troughs and dotted with islands of varying size. Beyond the shelf the continental shelf descends steeply to the Aleutian Trench. Relief on the shelf is due primarily to tectonic processes modified by erosion and deposition. Shallow shelf areas range to 50 meters deep and contain many reefs and submerged coastal slopes. Further offshore the plateaulike shelf ranges to 120 meters in depth. This region is relatively smooth but is interrupted in places by isolated banks and shoals that rise above the general level of the bottom. Some of these rises occur to above sea level, forming islands or reefs. These sea-floor rises are irregular and of dissected relief. The south Aleutian continental shelf is continuous with the Kodiak shelf and of similar character.

The Alaska Stream is a continual current of considerable strength following the coast from Shelikof Strait to the Aleutian Islands. This current flows westward at an average velocity of 25 to 50 centimeters per second and may attain 75 centimeters per second. Numerous eddies occur in this current west of Kodiak Island. The Alaska Stream eventually flows either north through Aleutian Island passes or south to join the counterclockwise gyre in the Gulf of Alaska.

The Alaska Stream moderates the south Alaska Peninsula coast by providing warmer waters than are found in outer Bristol Bay. Northeast storms strengthen this current while westerly winds weaken it.

Tides are important factors moderating nearshore circulation. They are of the typical west coast mixed form with large inequalities in heights and durations of successive high and low waters. Amplitudes vary from two to four meters and drive tidal currents of several knots.

In offshore waters a clearly developed pycnocline (vertical gradient in density) occurs between 100 and 150 meters in depth. The thermocline appears at a more shallow depth and responds dramatically to seasonal influences. Wind mixing and heat loss during winter produce a thick isothermal surface layer, generally below 3.5° C. This layer is about 100 meters thick and is rapidly warmed during summer months. In summer, surface waters may exceed 12° C. Winter salinity is about 32.8 parts per thousand (ppt), and the halocline occurs at approximately 100 to 200 meters. Deep water may exceed 33.7 ppt salinity. In summer the influence of runoff and precipitation significantly lowers the surface salinity.

Upwelling occurs to some extent in this region, usually between April and August, but may be of minor importance to nutrient regeneration in these waters. The principal mechanisms of replenishment in surface waters of the shelf appear to be storm-wind-induced mixing, turbulent mixing where the Alaska Stream or tidal currents are perturbed by irregular shelf topography and by the introduction of nutrients from terrestrial runoff.

Intense storms move eastward across this region into the northern Gulf of Alaska in winter. Sea heights generated by storms are great, with waves of 3.6 meters amplitude occurring every winter. Heights to 9.0 meters have been reported. Gales are frequent in winter, generally from the north or west. In summer, winds occur from the southeast. Rainfall is considerable--the annual amount at Chignik averages 323 centimeters. Fog may occur along this coast at any time of the year, but is most prevalent from June through August.

All areas on the south side of the peninsula are free from ice throughout the year except for some sheet ice formation in protected bays and harbors.

The distribution and composition of bottom sediments in the study area display considerable variation. Sediments are generally thin and are composed mostly of terrigenous material eroded from adjacent mountain areas during glacial periods and deposited by glacial-fluvial processes. Sediments on the shelf contain varying amounts of volcanic debris from nearby eruptions, and fine grained glacial debris brought in from Cook Inlet also make a significant contribution. At present all sediments are being reworked and redistributed by contemporary marine processes.

In nearshore shelf areas sediments vary from coarse materials along rocky beaches to finer sands and muds in deep bays and fjords. Outer shelf surfaces are covered with thin layers of pebbles, gravel, and sand.

A.6.2 Biotic Resources

Total annual primary production may be two to four times greater near the coast than in the open ocean. Eastward from Unimak Island over the continental shelf maximum productivity may approach values indicative of active upwelling. Winter productivity (November through March) is very low. Eastward from Unimak Island, phytoplankton standing crops decrease, possibly indicating larger zooplankton populations and intense grazing. Copepods compose approximately 75 percent of the zooplankton biomass throughout the year, while chaetognaths, amphipods, and euphausiids form most of the remainder. Large kelp beds are infrequently encountered in this area.

Little study has been conducted on the intertidal life in this area, and species and their distribution are poorly known. Benthic invertebrate density is highest in Unimak Pass and south of Sanak Island. Dungeness, tanner, and king crab are abundant throughout this area. Four species of shrimp occur in commercial quantity. Noncommercial fish common to the area are smelt, sculpin, ronquils, rockfish, and grenadiers. Commercial species such as pollock, Pacific cod, sablefish, herring, Pacific Ocean perch, halibut, turbot, and rex, rock and flathead sole, as well as all five species of Pacific salmon, are abundant in this area. The Chignik River basin is particularly known for its Chinook, coho, and sockeye salmon. Many small drainages along the Alaska Peninsula support substantial chum and pink salmon stocks. Anadromous Dolly Varden char are widespread and a significant steelhead run occurs in the Chignik River.

Diversity of waterbirds is limited and the majority migrate south for the winter. Birds of a single species often number more than a million. The world population of emperor geese winter in the Aleutians and the southwest Gulf of Alaska, where some frequent lagoons and bays of the south coasts. Thousands of ducks migrate through the area with pintail, mallard, and green-winged teal most common. Numerous seabird colonies dot the coastline. Major residents are pelagic and red-faced cormorants, tufted and horned puffins, black-legged kittiwakes, murres, pigeon guillemots, fulmars, and storm-petrels.

Sea otters are abundant in this area with concentrations in the Shumagin Islands, Sanak Island, south of Deer Island, and in the vicinity of Kujulik Bay and Sutwik Island. Numerous Steller sea lion rookeries and hauling grounds are scattered throughout the area with the largest at South Rock near Sanak Island, Clubbing Rocks, Jude Island, Atkins Island, and Chowiet Island. Harbor seals are common throughout the area while northern fur seals pass offshore on their migration between the Pribilofs and wintering areas to the southeast. Harbor and Dall porpoises and killer, sperm, fin, sei, minke and gray whales are encountered offshore.

A.6.3 Human Occupancy

Seven coastal villages are situated along the southern Aleutian coast, between the Kodiak shelf and the southern end of Unimak Island. These villages are predominantly Native, both Aleut and Eskimo, and rely on subsistence hunting and fishing. The villages of Sand Point and King

Cove are important processing centers for the seasonal fishing industry but primarily serve the local area. Reindeer herds exist on Unimak Island but are used only for subsistence purposes. Transportation and trade in this area center around Cold Bay and Dutch Harbor-Unalaska, which are foci of air and water transportation. The Cold Bay International Airport is a major transportation hub for the Aleutian chain and a key refueling station for trans-Pacific flights. The other villages are served much less frequently by scheduled service because of the weather.

A.7 GULF OF ALASKA-KODIAK

A.7.1 Physical Environment

The Western Gulf of Alaska extends from Middleton Island south of Prince William Sound to the south side of the Kodiak Island archipelago. The coastal region encircling the northwest Gulf of Alaska typically is rugged with a fjord-indented coastline. Few narrow beaches interrupt the generally steep, rocky shore. Along the southwestern part of Kodiak Island the coastline is relatively smooth with no major fjord indentations. Erosion is slow due to the resistant nature of the bedrock cliffs, but in some Tertiary sediment areas erosional rates are more rapid.

The continental shelf near Kodiak Island extends to about 240 kilometers offshore and is marked by numerous rises, valleys, and smooth plains. Relief is due primarily to warping and buckling of the earth's crust, which is modified by erosional and depositional processes. Outer continental shelf areas are typified by plateaulike surfaces with depths ranging from 60 to 100 meters and of gentle slope. These underwater plateaus are interrupted in places by many isolated banks and shoals that rise above the shelf surface. The plateaus are separated from each other by large sea valleys that are flat-bottomed depressions with gentle slopes--a typical example is Shelikof Strait, although the shelf is also incised by several other deep channels.

The coastal zone from Prince William Sound westward is prone to frequent and severe earthquakes. During the last 70 years, eight seismic events have equaled or exceeded magnitude 8. The earthquake of March 1964, the largest recorded on the North American continent, was centered beneath Prince William Sound.

Circulation in the western Gulf of Alaska is generally westward, influenced by the counterclockwise gyre in the gulf proper. The Alaska current flows north past southeast Alaska and shifts westward over the western gulf, averaging 0.3 knots. Surface currents are influenced greatly by strong winds associated with frequent storms in the gulf, and by tidal action, particularly in nearshore areas. Eddies and meanders also occur at the inshore margin of the Alaska Current.

Tidal activity is of the mixed form with large inequalities in heights and durations of successive high and low waters. Amplitudes typically range from 1.8 to 3.6 meters. Heavy tide rips occur at many points along the coast, particularly adjacent to the Kodiak Islands. Flood velocity commonly exceeds ebb tide velocity.

Nearshore temperatures and salinities are moderated significantly by coastal runoff, particularly during summer. Offshore, summer salinities average 32 parts per thousand (ppt) and temperatures range from 5 to 10° C. In winter, salinities increase slightly due to reduced coastal runoff, and surface waters cool to a relatively uniform temperature of 3° C.

Upwelling, coastal runoff, and wind and turbulent mixing maintain relatively high nutrient levels in surface waters, particularly during spring and early summer. Significant terrigenous materials enter this region from Cook Inlet outflow.

Many significant waves are generated by large storms in the north Pacific. These waves tend to travel westward or northeastward parallel to the continental margin. Winds associated with these storms may exceed 50 knots with a duration of 30 to 40 hours. Waves may be generated to reach nine to 10 meters in height with a wave period of about 18 seconds.

Sea ice is found primarily in Cook Inlet, and occasional large ice cakes formed by tidal action may enter Shelikof Strait. Some local shore-fast ice is found in protected bays, inlets, and harbors, particularly where streams flow into them.

The distribution and composition of offshore sediments vary because of bottom relief, sediment sources, and size of materials. The sediments in the offshore areas have been derived mainly from adjacent mountain areas during periods of glacial activity. In some localities volcanic material makes up a large portion of the sediments. Materials are dumped by rivers and streams onto nearshore areas where they are sorted and redeposited by waves and currents. Particle size decreases seaward, producing a graded distribution of sediments. Sediment layers are characteristically thin and irregular in thickness, and bedrock is exposed at the sea bottom surface; this indicates that uplift and erosion are now actively occurring offshore as well as onshore.

A.7.2 Biotic Resources

The marine waters and associated continental shelf of the western Gulf of Alaska are among the most productive in the North Pacific. Spring and summer additions of freshwater runoff and offshore upwelling are primarily responsible for such productivity. Phytoplankton blooms may be heavy during these seasons while grazing zooplankters of diverse composition abound. Shorelines and tidal flats provide extensive habitats for intertidal plants and animals. Typical subarctic zonation of the intertidal prevails, while more gently sloping, extensive sand and mud flats host large populations of clams and associated biotic communities. Offshore neritic benthos populations are large and include starfish, clams, scallops, sea urchins, and snails. These organisms provide abundant forage for the important, commercially-sought crab and bottomfish resources.

The continental shelf in this area supports major fisheries for king, Dungeness and Tanner crab, shrimp, and a variety of bottomfish, including Alaska pollock, Pacific cod, blackcod, halibut, and a variety of other flatfish. Waters over the shelf also abound with Pacific salmon, and all five species are found in abundance. The entire outer oceanic region is an important feeding ground for maturing salmon, which in spring and summer transit the western Gulf enroute to spawning grounds in Prince William Sound, Cook Inlet, Kodiak, and southern Alaska Peninsula drainages. Other pelagic fish inhabiting coastal and offshore waters include Dolly Varden char, steelhead trout, Pacific Ocean perch, and herring.

Harbor seal and Steller sea lions inhabit coastal areas. Numerous toothed whales are also found in the area, harbor porpoises, Dall porpoises, and killer whales are the most common. Some sperm whales will occasionally pass through these waters. Baleen whales also inhabit offshore waters with the minke whale most common. Other baleen whale species present include the fin, Sei, gray, and blue whale, but the latter is rarely sighted.

Many species of marine birds pass over this region in spring, migrating to nesting grounds in northern Alaska. Common species include cormorants, horned and tufted puffins, guillemots, black-legged kittiwakes, gulls, slender-billed shearwaters, and the common murres. Coastal or open sea birds include the oldsquaw, harlequin, Steller's and king eiders, crested auklet, murrelet, and surf, white-winged and common scoter. Many thousands of ducks assemble along the shoreline during winter.

A.7.3 Human Occupancy

The City of Kodiak (pop. 4,000) is the major center of population, commerce, trade, and transportation of the Kodiak Region and has a large non-Native population. Some 15 outlying Eskimo communities along the coasts and islands have varying degrees of social and economic dependence on the city and are served by transportation based in Kodiak. Cattle ranching exists on the island but the main livelihood is based on the marine resources of the area. Fish and shellfish harvesting and production exceed that of any other industry and strongly affect the pattern of community development. The importance of the fishing industry, with its inherent seasonality, is one factor producing the relatively high unemployment in the region.

A.8 LOWER COOK INLET

A.8.1 Physical Environment

Cook Inlet is a large tidal estuary off the Gulf of Alaska to the east of the Alaska Peninsula. The estuary is shallow, averaging only 60 meters deep, and is a drowned extension of the Cook Inlet-Susitna lowland to the north. Active deltas are being built by the Susitna, Matanuska, and Knik Rivers and at the head of Turnagain Arm, a branch of the inlet. These rivers add vast quantities of glacial sediment to inlet waters particularly in summer. The Kenai Peninsula forms the eastern shore of the inlet and consists of a glaciated lowland of outwash plains with rugged mountains and a fjord-indented coastline. To the west is the Aleutian-Alaskan Range, averaging 2,130 to 2,740 meters in elevation. Five active volcanoes, Augustine, Spurr, Redoubt, Iliamna, and Douglas, border the inlet to the west side, making tsunami and volcanic risk slightly higher in this area of Alaska. Lower Cook Inlet is a high velocity channel containing turbid water that is well-mixed vertically, but the turbidity limits biological productivity.

South of the East and West Forelands and Kalgin Island, the bottom slopes downward to a depth of more than 200 meters just south of the Cook Inlet entrance east of the Barren Islands. Relatively deep areas, apparently caused by scouring, lie between the Forelands and east of Harriet Point. Kamishak Bay in the lower inlet is generally much shallower.

Cook Inlet tides are semidiurnal with a marked inequality between successive low waters. The mean diurnal range on the east side of the lower inlet 5.8 meters and on the west side, 5.1 meters. The maximum current velocity is measured at 6.5 knots resulting from these tidal extremes.

Ice may form in the lower inlet early in December and break up is in late March or early April. The ice often extends as far south as Cape Douglas. Fast ice extends up to three miles offshore in Kachemak Bay. Most of the ice in the inlet is floe ice with cakes as much as 1.2 meters thick. It is usually mixed with smaller brash ice. Large piles of ice (stamukhi) are formed on the tidal flats where fast ice breaks free. These are deposited higher on the flats and frozen to the underlying mud. Stacks of layered ice of considerable height (up to 12 meters) formed in this way may go adrift in abnormally high tides. Fluvial ice in the upper inlet is denser and more brittle than sea ice.

Inshore circulation is complex and influenced by tides and winds. The lower inlet is characterized by a counterclockwise circulation formed by a net inward movement of cold saline oceanic water up the eastern shore and a net outward movement of fresh water from Knik Arm and the Susitna River along the western shore. Lateral separation of these two water masses is maintained, resulting in a shear zone in mid-inlet. However, the magnitude of the tidal gyre is generally greater than the net inflow and outflow of surface waters. The Alaska Current has little effect on Cook Inlet waters except peripherally as the gyre moves southwesterly along the Alaska Peninsula past the Barren Islands and through Shelikof Strait.

Sea state within the inlet is essentially a factor of tidal currents and winds rather than storm tracks and sea currents. Seas can often be steep and rough when currents counter the wind.

Cook Inlet receives large quantities of glacially derived sediment from the Knik, Matanuska, Susitna, and other rivers, which is redistributed by intense tidal currents. Most of the fine-grained sediment is carried offshore through Shelikof Strait and is deposited in the trench beyond Kodiak Island. Throughout the lower inlet, the bottom sediments are largely gravelly sand with minor silt and clay components.

Phytoplankton blooms in the lower inlet modify the general water chemistry pattern by increasing oxygen and organic carbon locally, at the same time reducing nutrients such as phosphate, nitrate, and silicate. During spring and summer runoff, nutrients and sediments enter the inshore areas with large quantities of fresh water, whereas during winter more oceanic conditions exist.

A.8.2 Biotic Resources

The numbers and abundance of phytoplankton species increase from the upper inlet oceanward. Diatoms are the dominant primary producers. In the northern inlet, primary production appears limited by reduced light penetration resulting from high suspended sediment loads. Zooplankton in this area are poorly known. Intertidal areas are broad due to extreme tidal fluctuation, and fauna is sparse resulting from the abrasive action of ice each winter. King and Tanner crab are abundant in the lower inlet with major concentrations approximately midway between Augustine Island and the Barren Islands. Dungeness crab inhabit coastal areas. Five species of shrimp are commercially abundant with larger concentrations found within Kachemak Bay and midway between Augustine Island and the Barren Islands. Scallops also are found in the same waters in mid-inlet. More than 25 species of fin fish are common in Cook Inlet. Most abundant are pollock, turbot, and butter and yellowfin soles. Dolly Varden char, steelhead trout, and eulachon ascend the inlet to spawn in freshwater streams. Halibut inhabit the lower inlet from May through August after which most migrate to wintering areas offshore. All five species of Pacific salmon utilize streams entering Cook Inlet for spawning. Pink salmon appear more abundant in even-numbered years. Major sockeye salmon spawning systems are the Kenai-Russian, Kasilof, and Susitna Rivers and Fish Creek. Pink, coho, and chum salmon spawn in numerous small drainages throughout the lower inlet.

Approximately 105 species of birds have been observed in Cook Inlet and along its shores. Fulmars are most abundant near the Barren Islands and to the northeast. Scoters and eiders are numerous in Kamishak Bay. Also abundant are black-legged kittiwakes, tufted puffins, glaucous-winged gulls, and common murres. Numerous ducks and geese use coastal marshes as resting areas during spring and fall migration. Some nesting of these species occurs.

Lower Cook Inlet is habitat for several species of marine mammals. More than 1,000 sea otters are distributed along the west side of the inlet from Shakum Rocks to Chinitna Point. These animals are mainly concentrated in the vicinity of Augustine Island and Cape Douglas.

About 1,000 additional sea otters inhabit the Barren Islands. Several hundred harbor seals may at times occupy Augustine and Shaw Islands. These seals occur along the entire west side of the inlet but seldom reach north of Kachemak Bay on the east side. A concentration of more than 1,000 harbor seals inhabits Sud Island in the Barren Islands. From 6,000 to 10,000 Steller sea lions are year-round residents of the Barren Islands. Pupping takes place on Sugar Loaf Island in June and July. Killer whales and Dall and harbor porpoises are occasionally observed in the lower inlet. Cook Inlet has a summer population of 300 to 400 beluga whales. Belugas penetrate as far north in the inlet as the Susitna River and Ship Creek at Anchorage.

A.8.3 Human Occupancy

The Cook Inlet region has Alaska's most diversified and developed economy and was one of the first areas to be permanently settled by non-Native peoples. Anchorage, at the head of the inlet, is the government, military, and economic center of southcentral Alaska and of the state.

Homer, Kenai, and Soldotna are important subregional centers of population and commerce in lower Cook Inlet and have a large non-Native population. Kenai is an important industrial center based on Cook Inlet oil and gas. Port Graham, Seldovia, English Bay, Ninilchik, and Kasilof are predominantly Native villages, consisting of Tanaina Indians and Chugach Eskimos. These villages have a mixed economy; commercial fishing for crab, shrimp, and salmon, as well as tourism are very important.

A.9 NORTHEAST GULF OF ALASKA

A.9.1 Physical Environment

Most of the Gulf of Alaska shoreline is deeply incised and rocky, but from its eastern extension to Prince William Sound only a few inlets intervene, the most important being Yakutat Bay. This shoreline is characterized by wave-washed beaches and sedimentation from glacier-fed streams. Several glaciers and their terminal moraines are present along the coast from Cape Spencer to Cape Suckling. The Copper River delta, composed of glacial sediments, is the most prominent feature. Prince William Sound has a deeply incised, rocky coastline and many rocky islands and glacial fjords. The barrier islands of the Sound are dominated on the ocean side by wave-washed beaches.

The continental shelf includes approximately 52,000 square kilometers, varying in width from 13 to 105 kilometers. Generally, the shelf topography is of gently undulating relief with clearly defined submarine valleys. Prominent shoal areas rise above the general relief of the shelf--Fairweather Ground, Middleton Platform, and Tan Bank--and have depths of 37 to 100 meters. Several submarine canyons or valleys dissect the continental shelf. The continental slope is relatively smooth and steep, descending to 2,000 to 4,000 meters east of Kayak Island and 4,500 meters to the west.

Circulation in the gulf is dominated by the relatively warm Alaska Current that flows counterclockwise, roughly paralleling the coastline, then continues westward along the Aleutian Chain, where it splits. Some of the water flows northward into the Bering Sea, while the remainder returns eastward as the Subarctic Current. The entire system is called the Alaska Gyral.

The Alaska Current flows north and west along the Gulf of Alaska coast. Nearshore, the general westward drift is influenced by tides, local winds, river and glacial discharge, and topography. Nearshore current velocities average eight to 10 centimeters per second. A large eddy occurs in the shelter of western Kayak Island which projects far into the gulf. At the continental shelf edge currents increase by 25 to 50 centimeters per second.

Tides are of the typical west coast mixed type with large inequalities in heights and durations of successive high and low waters. Tidal amplitudes range from two to four meters, and tides influence water circulation patterns, especially within estuaries or between island passes. Coupled with major storms, tidal currents can prove hazardous in shallow straits.

The Gulf of Alaska is well known as an area of cyclogenesis, producing frequent storms. A maritime zone, it is characterized by slight temperature variations and high humidity, precipitation, clouds, and fog. Icing of both surface vessels and aircraft is common. Sea heights as great as nine meters have been reported during storms.

Sea temperatures follow a seasonal climatic trend of cool summers and mild winters. The average sea temperature varies from 2.3 to 2.5° C in winter to 5.5 to 5.7° C in summer. In summer, the warm, north-flowing Alaska Current moderates surface temperatures and keeps the coast free of ice in winter except in protected waters. The entire region is generally free of ice.

Coastal and fjord glaciers calve occasional icebergs, and some sheet ice forms during winter in inlets, fjords, and harbors.

Oceanic circulation patterns influence the salinity regime in this region. A general increase in salinity occurs with distance offshore to a maximum in the central Alaskan Gyre. In summer, salinities are generally lower, ranging from approximately 31.0 parts per thousand (ppt) in nearshore waters to 32.5 ppt in offshore regions. In winter, salinities increase to approximately 32.0 ppt nearshore and 33.0 ppt offshore. Fresh water drainage from runoff, glacial ice-melt, and abundant precipitation dilute saline waters along the coast.

The Alaska Current transports water into the northern gulf with chemical properties determined from more southern locations in the north Pacific Ocean. Seasonal upwelling may bring deep, cold, nutrient-rich oceanic waters to sunlit nearshore waters, providing conditions for rapid phytoplankton growth.

Sediment plumes form along the coast around river mouths and tidal inlets and are significant at the mouth of the Copper River. These plumes usually are entrained in the upper few inches of the water column and become less dense with distance from the mouth as the sediments disperse and settle out. Bands of turbid water may sometimes be observed several hundred kilometers offshore.

These local sources determine the types of bottom sediments in any given location. Glacial deposits are probably the most conspicuous on the continental shelf bordering the coastal region, except where large rivers have contributed a fine-grained sediment.

A.9.2 Biotic Resources

Marine photosynthesis in the northern gulf varies seasonally in proportion to available light as at all high latitudes. Carbon fixation by phytoplankton is negligible in winter, but spring produces a "bloom" as early as March in the south of the area that extends to mid-gulf by June or July. Primary production has been measured within the range of 250 to 500 milligrams of carbon per square meter per day. Grazing by zooplankton probably controls productivity.

The benthic invertebrate biomass in the eastern Gulf of Alaska is less than in the western part of the area because of weaker currents and increased glacial siltation. This is also reflected in the dominance of filter-feeders in the western region. The major feeding groups in the north and east are detritus eaters. Polychaetes, echinoderms, molluscs, and crustaceans are the major species of benthic fauna found in the northern Gulf of Alaska. The highest standing stocks of benthic animals are found on the continental shelf and upper slopes in rocky areas and in areas of muddy sand with incorporated gravel and pebbles. The estimated numbers of benthic foraminifera range from one to 1,000 individuals per 50 grams of sediment.

All five species of Pacific salmon are harvested by U.S. fishermen in the Gulf of Alaska, as well as halibut, sablefish, herring, king, Tanner, and Dungeness crabs, and several species of shrimp. Clams and scallops occur in harvestable quantities, but commercial harvests are small at present. Foreign trawl fisheries are also active in the region, primarily seeking Pacific Ocean perch, sablefish, Pacific cod, pollock, and several species of flatfish.

Nearshore areas are important spawning and feeding grounds, and immature forms of many deepwater species live there. Intertidal and subtidal benthic invertebrate fauna support numerous birds and marine mammals.

More than 100 nesting colonies of alcids, kittiwakes, and other gulls, several types numbering in the hundreds of thousands, occur in the rocky cliffs of the gulf. Intertidal mud flats are stopover points for migrant shorebirds that number in the millions. Marshes bordering the gulf are important nesting grounds for ducks, geese, trumpeter swans, and numerous other water birds. The Copper River delta is the nesting ground for the entire world population of dusky Canada geese. Large populations of birds that nest farther north winter in the waters of the gulf and along its shores. Diving ducks, loons, alcids, and gulls are conspicuous. Bald eagles live in the region year-round and concentrate along salmon streams during spawning runs.

Twenty-three species of marine mammals have been recorded in the region. Such marine mammals as harbor seals, sea lions, several species of baleen and toothed whales, and several species of porpoises congregate in the nearshore waters and along the rocky coasts. Sea otters occur in Prince William Sound. The gulf is also an oceanic feeding ground for fur seals and whales.

A.9.3 Human Occupancy

The predominantly non-Native coastal communities of Cordova, Seward, Whittier, and Valdez contain the majority of the population of the northeast Gulf of Alaska. These communities depend on marine transportation; only Valdez and Seward are directly linked to the State's highway system, although Whittier is connected by rail. Commercial fisheries, port, and railroad operations are important to these communities, which depend on marine and coastal biotic resources for subsistence. The smaller communities have mostly native residents--Aleuts, Eskimos, and Indians, and include Eyak, Chenega, Tatilek, Yakataga, and Yakutat.

APPENDIX B

BASIC INTERAGENCY AGREEMENT

The Program Development Plan, as approved, shall serve as the basic operating document for the marine environmental studies program to be carried out under the Basic Agreement (AA550-BA7-4) between NOAA and BLM.

David H. Wallace
National Oceanic and
Atmospheric Administration

JAN 12, 1977
Date

Frank A. Edwards
The Bureau of Land Management

Jan. 12, 1977
Date

BASIC AGREEMENT

Between

The Bureau of Land Management

and

The National Oceanic and Atmospheric Administration
AA550-BA7-4

I. Background

The Department of the Interior has initiated a broad program for the exploration and development of the energy resources contained within the outer continental shelves of our Nation as part of our Nation's program for achieving energy independence. The minimization of environmental risk is of paramount importance in the planning and conduct of this program. Legislative initiatives have prescribed authorities, responsibilities, and procedures pertaining to this program and have been implemented within the Department of the Interior and the Bureau of Land Management.

NOAA, as a result of its statutory responsibilities in marine resource assessment, and in coastal zone and resource management, has developed the necessary expertise and capabilities for conducting large scale marine environmental studies. The design and implementation of interdisciplinary scientific studies required to meet NOAA's on-going program requirements are directly applicable to the BLM environmental studies.

A. Legislative Authority of BLM. In 1953, the Outer Continental Shelf (OCS) Lands Act (67 Stat. 462) was passed establishing Federal jurisdiction over the submerged lands of the continental shelf seaward of State boundaries. The Act charged the Secretary of the Interior with the responsibility for the administration of the mineral exploration and development of the OCS. It also empowered the Secretary to formulate regulations so that the provisions of the Act might be met. In conjunction with this authority, the Department adopted three overall minerals management goals:

1. receipt of fair market value for the minerals leased;
2. orderly development of resources;
3. protection of the environment.

Subsequent to the passage of the OCS Lands Act of 1953, the Secretary of the Interior designated the Bureau of Land Management (BLM) as the administrative agency for leasing submerged Federal lands, and the Geological Survey for supervising production. The Bureau of Land Management was also designated by the Secretary as lead agency for all environmental actions pertaining to the development of the minerals resources of the OCS.

The Submerged Lands Act (67 Stat. 29) set the inner limit of authority of the Federal Government by giving the coastal states jurisdiction over the mineral rights in the seabed and subsoil of submerged lands adjacent to their coastline out to a distance of three nautical miles. There are two exceptions, Texas and Gulf Coast of Florida, where jurisdiction extends to three (3) leagues based on terms for admission.

In 1969, the National Environmental Policy Act was implemented. This act required all Federal agencies to utilize a systematic, interdisciplinary approach that will insure the integrated use of the natural and social sciences in any planning and decision-making which may have an impact on man's environment.

Congressional Appropriations Bills give to BLM those monies required to carry out its required tasks. The BLM's marine environmental studies program has received funds identified as specific line items in FY 75, FY 76, and FY 77 budgets.

In addition to these Acts, there have been a number of other reports by The Council on Environmental Quality ("OCS and Gas An Environmental Assessment"), the Stratton Commission Report, National Academy of Sciences Studies, and others, that have recommended studies of this type be performed.

B. Legislative Authority of NOAA. NOAA likewise has responsibilities on the OCS under the following legislation: The Marine Protection Research, and Sanctuaries Act of 1972 addresses ocean dumping, comprehensive marine environmental research programs, and special protection to unique coastal areas. Title II, Section 202, of the Act assigns to the Secretary of Commerce (NOAA) responsibility for initiating comprehensive and continuing programs of research with respect to the possible long-range effects of pollution, overfishing, and offshore development activities.

Title III of the Act states that the Secretary of Commerce, (NOAA) after consultation with appropriate Federal and State departments and agencies, may designate as marine sanctuaries those coastal areas that he determines necessary for the purpose of preserving or restoring such areas for their conservation, recreational, ecological, or aesthetic values.

The Coastal Zone Management Act of 1972, administered by NOAA, addresses management of the Nation's coastal zone in a coordinated and uniform basis. The Act declares that it is national policy to preserve, protect, develop and, wherever possible, to restore or enhance the resources of the Nation's coastal zone for this and succeeding generations. The objectives of the Act are: (1) to encourage and assist the States to develop and implement coastal zone management programs; (2) to foster Federal-State cooperation and joint participation in effectuating the purposes of the Act; and (3) to promote broad participation in the development of State coastal zone management programs.

Amended in 1976, it provides for financial assistance to coastal states to study, plan for, manage, and control the impact of energy resource development and production affecting the coastal zone. The Marine Mammal Protection Act of 1972 limits the taking of marine mammals. The Secretary of Commerce or the Secretary of the Interior, depending on the species, may waive this prohibition only if he receives scientific evidence that the waiver would not endanger the species to be taken. The legislation has for its primary purpose the protection and preservation of mammals in order to maintain the health and stability of the marine ecosystem as a whole.

The special Energy Research and Development Act of 1975, provided for the reactivation of three NOAA vessels "...for the purpose of conducting surveys, investigations and research connected with the environmental effects of off-shore energy-related activities." Specifically, all government agencies are to give preference to the use of these vessels in conducting environmental assessment studies in connection with OCS energy development.

C. BLM Environmental Program Objectives. To satisfy the requirements of these acts, the BLM laid out broad program objectives for leasing and impact analyses. The objectives for the environmental aspects of the program are:

1. to provide information about the OCS environment that will enable the Department and the Bureau to make sound management decisions regarding the development of mineral resources on the Federal OCS;

2. to acquire information which will enable BLM to identify those aspects of the environment which might be impacted by oil and gas exploration and development;

3. to establish a basis for prediction of impact on the environment of OCS oil and gas activities; and

4. to acquire impact data that may result in modification of leasing regulations, operating regulations, or OCS operating orders to permit more efficient resource recovery with maximum environmental protection.

D. Aspects of the BLM Environmental Impact Assessment Programs. The BLM efforts in fulfillment of the program objectives are Environmental Impact Statements (EIS), environmental assessment teams, environmental studies, literature surveys, socio-economic studies, public conferences on problems affecting man's environment, special studies that contribute to an understanding of the processes affecting this environment, the establishment of environmental baselines, and programs for monitoring operational impacts.

E. Implementation of OCS Environmental Programs. The BLM implements its OCS environmental programs through in-house efforts, cooperative agreements with States and Federal agencies, and contracts with States, Federal agencies, and the private sector.

II. Purpose

This document sets forth the agreement between the National Oceanic and Atmospheric Administration (NOAA) and the Bureau of Land Management (BLM) for the design, management, and conduct of a program of marine environmental data acquisition and analysis in the Alaskan continental shelf areas identified by the BLM for oil and gas exploration.

III. Objectives

NOAA agrees to design, manage, and conduct an interdisciplinary program of applied sciences for the Alaska continental shelf which will be directed toward fulfilling the tasks listed below:

A. Determination of the pre-development distribution and concentration of potential contaminants commonly associated with oil and gas development.

B. Identification and estimation of the potential hazards posed by the environment to petroleum exploration and development.

C. Determination of the ways in which contaminant discharges move through the environment and how they are altered by physical, chemical and biological processes.

D. Determination and characterization of the biological populations and ecological systems that are subject to impact from petroleum exploration and development.

E. Determination of the effects of hydrocarbon and trace element contaminants on individuals, populations, and ecological systems.

Such a program will optimize the synoptic interdisciplinary acquisitions of data and insure the scientific integrity of the interdisciplinary nature of these data.

IV. Scope

A. Program Development Plan. The Program Development Plan (PDP), entitled "Environmental Assessment of the Alaskan Continental Shelf" dated December 1976 shall serve as the basic operating document for the marine environmental studies program to be carried out under the authority of this Agreement. Changes made in the PDP must be agreed to by both agencies. Ambiguities or contradictions between the PDP and this agreement shall be resolved by the language of this agreement.

B. Technical Development Plans. A set of Technical Development Plans (TDPs) shall be developed annually by NOAA based on funding guidance and priorities provided by BLM. A separate TDP shall be developed for non-area-specific studies and for each Alaskan Outer Continental Shelf lease area which shall describe the scope of the annual program.

C. Physical Area. The NOAA will conduct its investigations in relation to the following marine areas of Alaska:

1) Northeastern Gulf of Alaska
2) Western Gulf of Alaska
3) Lower Cook Inlet
4) Outer Bristol Basin
5) Bering Sea (St. George)
6) Bering Sea (Norton Basin)
7) Chukchi Sea (Hope Basin)
8) Beaufort Sea
9) Gulf of Alaska (Aleutian Shelf)

And such other areas as may be agreed to by BLM and NOAA.

D. Exclusions. Several aspects of the total scope of the BLM's OCS environmental program for Alaska are retained for in-house management and are not included within the scope of this Basic Agreement. These items are the preparation of environmental assessment statements, all social science studies and assessments, development scenarios, regulatory scenarios, on-shore facilities impact studies, site-specific monitoring, and basic research. No BLM funds may be expended for any of the excluded activities under this Basic Agreement unless specifically approved in advance by the Designated Officer.

This exclusion in no way prohibits NOAA from conducting any such activities with other than BLM funds, recognizing NOAA's statutory responsibilities in resource and coastal zone management.

V. Responsibilities

A. BLM. The BLM has the responsibility for providing program policy, priorities, and scope of work. The BLM has an obligation to insure that NOAA is kept informed as to those significant matters which affect NOAA's activities under this agreement, such as, BLM budget estimates for the Alaska OCS Marine Environmental Program, priorities among lease sale areas, types and timing of information needed within each area, long-range program guidelines, and current official leasing information. BLM shall keep NOAA informed as to its internal management of this effort in terms of structure, authority, responsibility, lines of communication, and coordination.

B. NOAA. The NOAA is responsible within the limitations of this document and the PDP, for the scientific design of the program, the initiation of all aspects of the work, the timely accomplishment of the effort, and the scientific validity of the findings. NOAA shall keep the BLM informed as to its internal management of this effort in terms of structure, authority, responsibility, lines of communication, and coordination.

VI. Funds.

The BLM funds are annual operating appropriations and by legislative intent and history are for gathering of data on the continental shelf. The funds must be obligated within the fiscal year in which they are appropriated.

VII. Work Authorizations

A Technical Development Plan (TDP) shall be prepared by NOAA for each Alaskan Outer Continental Shelf lease area and a separate TDP for a program of non-area-specific studies. The plans shall be submitted to BLM annually for approval in accordance with the approved PDP. The TDP's shall describe each Research Unit or sub-task in sufficient detail to enable the BLM to evaluate the relevance and value of each element to BLM objectives. The level of expenditures for each element of the program, logistics, management, and the schedule for accomplishing each element of work shall be discussed. Approval of TDP's will be accomplished by the preparation and signing of Interagency Agreements which incorporate the approved TDP's and authorize the initiation of work contingent upon the availability of funds. When funds are appropriated and available, the Interagency Agreement's will be modified to authorize the transfer of funds. The parties agree that no work, procurement or interagency agreements shall be initiated by NOAA prior to approval of the TDP except by mutual agreement.

A. Implementation. The parties agree that NOAA is responsible for all delegations of work required to implement approved TDP's and that the following regulations and statements of executive policy are applicable:

1. Federal Procurement Regulations. The provisions of this regulation shall apply to all contracts with States and the private sector.

2. Economy Act, 31 U.S.C. 686. The provisions of this act shall apply to all work contracted to another Federal agency.

3. OMB Circular A-76. The provisions of this document shall apply to all work performed by NOAA which falls within the provisions of the document.

4. OMB Circular A-101. The provisions of this document apply to contracts with educational and non-profit research institutions.

5. OMB Circular A-109. The provisions of this document shall apply to the description of requirements except when the BLM or the NOAA determines that a policy for stating certain requirements in specific "how to" terms is essential to the achievement of program objectives.

B. BLM Review Period. The NOAA shall submit to the BLM ten (10) copies of each TDP for the BLM review and approval. The BLM shall review each TDP within sixty (60) days after receipt. The submission of TDPs shall be accompanied by the submission of unedited Annual Principal Investigator Reports for the applicable areas. Copies of the TDP shall be distributed as follows: two (2) copies to BLM (733), one (1) copy to BLM (551), and seven (7) copies to the Alaska OCS office. Copies of the unedited Annual Principal Investigator Reports shall be distributed as follows: two (2) copies to the Alaska OCS Office and one (1) copy to BLM (733).

F. Program Schedule:

January 5	BLM provides NOAA with initial funding guidance of program level for planning for next fiscal year. It will be based on Presidential Budget submitted to Congress.
February 20	Quarterly Status Report submitted to BLM with Quarterly Progress Reports of Principal Investigators.
April 15	Draft TDP's submitted to BLM with Annual Principal Investigators reports.
May 20	Quarterly Status Report submitted to BLM.
** June 15	BLM provides NOAA with a statement of comments and recommendations on each TDP.
July 30	Final TDPs are transmitted to BLM.
August 1	Annual Technical Summary Report submitted by NOAA to BLM. Edited Annual Progress Reports of Principal Investigators submitted to BLM.
August 15	BLM shall provide NOAA with information concerning the program funding level for the following fiscal year based on BLM appropriation legislation, and approving final TDPs by preparation and signing of Interagency Agreements.
August 20	Quarterly Status Report submitted to BLM with Quarterly Progress Reports of Principal Investigators.
October 1	Interagency Agreement modification providing funds.
November 20	Quarterly Status Report submitted to BLM with Quarterly Progress Reports of Principal Investigators.
** December 1	BLM provided NOAA statement of desired program direction, priorities among lease sale areas, types and timing of information needed within each area, tentative budget guidance, and any other pertinent information that will aid NOAA in its program planning for the following fiscal year.

** Within two weeks, BLM and NOAA will meet for amplification of guidance and/or resolution of issues, as requried.

VIII. Program administration

A. Program Management.

1. NOAA and BLM agree that the management of this highly complex program is a major undertaking and requires the establishment of a program oriented approach to management. The management scheme should be formalized in terms of its structure, information base, and controls. The parties agree that a formal structure which describes the functions, responsibilities, and authority of key personnel at all levels as well as the flow of information and lines of communication comprise an essential element of the scheme. Standard procedures for acquiring information which will enable managers at all levels to function effectively are a key element of the management scheme. Cost and technical performance data can best be acquired by the application of systematic procedures for estimating, budgeting, monitoring (interim milestones for cost and performance), reporting, and cost identification to the lowest level of supervised work. The identification of the relationship of each unit of work to all others is critical information if the allocation of resources by managers to problem solving is to optimize program performance. The management scheme will procedurally address all aspects of the program which require special attention or control in order to insure the scientific integrity and quality of all data developed in the light of the purposes for which the data were developed. The identification and control of factors which insure the scientific integrity of the interdisciplinary aspects of the program is considered significant.

2. NOAA agrees to develop procedures for identifying and predicting variance from the budgeted cost for each of the scientific sub-tasks contained in the approved TDP's. The procedures must be capable of predicting and reporting a program underrun annually on or before June 30th to the BLM Designated Officer.

3. NOAA agrees to maintain a program office with complete program overview and direction. The Program Director shall be located in this office and shall not be assigned or assume any other responsibilities which may detract from his/her ability to manage this program.

B. Solicitation, Contracts, and Agreements. NOAA agrees to provide the BLM with copies of all proposal solicitations, contracts, and agreements which are to be funded in whole or in part by BLM funds.

C. Changes.

1. BLM Directed Changes.

a. The Designated BLM Officer may, at any time, after consultation with the NOAA Program Director, by written order designated or indicated to be a change order, make any change in the work within the general scope of the Interagency Agreements in any one or more of the following:

(1) in the specifications;

(2) in the method or manner of performance of the work;

(3) in the place of inspection, delivery, or acceptance.

b. Any other written order from the Designated Officer which causes any such change, shall be treated as a change order under this clause, provided that NOAA gives the Designated Officer written notice within thirty (30) calendar days stating the date, circumstances and source of the order and that NOAA regards the order as a change order.

c. Except as herein provided, no order, statement, or conduct of the Designated Officer shall be treated as a change under this clause or entitle the NOAA to an equitable adjustment hereunder.

d. If any change under this clause causes an increase or decrease in NOAA's cost of, or the time required for, the performance of any part of the work under any Interagency Agreement, whether or not changed by any order, an equitable adjustment shall be made and the Interagency Agreement modified in writing accordingly.

e. NOAA will respond with an assessment of the impacts of directed changes on the adequacy of the technical program within 14 calendar days. If NOAA intends to assert a claim for an equitable adjustment under this clause, they must, within 30 calendar days after receipt of a written change order under a. above, or the the furnishing of a written notice under b. above, submit to the Designated Officer a written statement setting forth the general nature and estimated monetary extent of such a claim, unless this period is extended by the BLM. The statement of claim hereunder may be included in the notice under b. above.

f. The BLM shall, prior to the issuance of change orders hereunder, notify the NOAA Program Office of the scope and extent of all change orders and shall discuss the impact of such changes on the overall program. In the event the BLM issues a change under the provisions of this clause which cannot be accomplished by NOAA because of manpower ceilings, funding, or other causes beyond NOAA's control, NOAA shall immediately notify the Designated Officer that the change cannot be accepted and the reasons therefore.

2. NOAA Initiated Changes. NOAA may make changes to NOAA initiated contracts or Interagency Agreements which changes do not change the general scope and objectives for that research unit as approved

in the TDP without the prior approval of the BLM whenever the total dollar effect of any such change does not exceed 30% of the approved TDP budget for that research unit. The total dollar effect shall be calculated by adding the estimated cost of the deleted work to the estimated cost of the added work. All other technical and budget changes require the prior consent of the BLM Designated Officer. This clause shall not be construed to authorize obligations greater than the total amount transferred by BLM to NOAA on any Interagency Agreement.

D. Reports of Work. NOAA agrees to provide reports of work in addition to those specified in the PDP as deemed necessary by the BLM Designated Officer. An equitable adjustment in cost and schedule shall be made.

E. Inspection. The BLM, through authorized representatives, has the right at all reasonable times, to inspect, or otherwise evaluate the work performed or being performed hereunder and the premises in which it is being performed. If any inspection, or evaluation is made by the BLM on the premises of the NOAA, contractor, or other Federal participants, the NOAA shall provide and shall require its contractors to provide all reasonable facilities and assistance for the safety and convenience of the BLM representatives in the performance of their duties. All inspections and evaluations shall be performed in such a manner as will not unduly delay the work. The BLM representatives shall respect the privy of contract between NOAA and its contractors. The DOAR shall give prior notification to Program Manager of all inspections.

IX. Program Review

NOAA agrees to perform or cause to be performed reviews and/or evaluations, in addition to those reviews and/or evaluations specified in the PDP, of aspects of the program being conducted by NOAA when requested to do so by the BLM Associate Director. An equitable adjustment shall be made in cost and schedule.

X. Coordination

NOAA shall, at the request of the BLM Assistant Director for Minerals Management, prepare briefings on the program. Coordination with the OCSESAC regarding the Alaska OCS Marine Environmental Program shall be through the BLM. This includes requests for review, comment, or any other advice on the program. This shall in no way abrogate any rights or responsibilities of the NOAA in their role as a member of the OCSESAC. Both agencies will keep each other advised concerning presentations to third parties which have implications with regard to the studies or policy related to the Alaska OCS Marine Environmental Program.

XI. Data

A. Data Rights. Unlimited rights to all data acquired wholly or partially with BLM funds shall be reserved to the BLM unless the prior written consent of the BLM Designated Officer is obtained for the acquisition of limited rights. The unlimited right to the possession of the original form of the data shall be similarily reserved to the BLM. Data is defined as recorded information regardless of form or character, of a scientific or technical nature. It may, for example, document research, experimental, development or engineering work; or be usable or used to define a design or process to procure, produce, support, maintain, or operate material. The data may be graphic or pictoral delineations in media such as drawings or photographs; text in specifications or related performance or design type documents; in machine forms, such as punched cards, magnetic tape, computer printouts; or may be retained in computer memory. Examples of technical data include research and engineering data, engineering drawings and associated lists, specifications, standards, process sheets, manuals, technical reports, catalog item identifications, and related information.

The BLM, or its authorized representatives, shall have the right to request any data or information, the acquisition of which was funded by BLM funds, either in the central repository or in the hands of investigators.

B. Data Archival. NOAA shall develop and maintain a system for cataloging, storing, and preserving all original data in a manner which will insure its ready retrieval and use. NOAA and all participating organizations shall have unrestricted use of all such data unless it has been specifically excluded from public disclosure.

All data will be formatted and transmitted to the Environmental Data Service or other appropriate data archives as determined by BLM, for cataloging, indexing and archiving in accordance with the data management portion of the approved PDP.

XII. Publications

All publications or presentations of or pertaining to technical or scientific data developed under BLM funds shall acknowledge BLM sponsorship and be submitted to the BLM at least sixty (60) days prior to its release. The release of such information within a period less than sixty (60) days shall be made only with the prior written consent of the BLM Designated Officer.

XIII. News Release

Each agency shall apprise the other prior to release to the news media of any news release pertaining to any aspect of this program.

XIV. Statutory Responsibility

Nothing contained in this Agreement shall abrogate the statutory responsibilities or authorities of either agency signatory to this agreement.

XV. Termination

Either the BLM or the NOAA may terminate this Agreement by giving thirty (30) days written notice to the other. NOAA agrees to assist the BLM during the transition period when BLM assumes management of the contracts and agreements funded under authority of this Agreement. BLM agrees to reimburse NOAA for costs incurred during the transition. This hereby terminates Basic Agreement 08550-IA5-18.

XVI. Points of Contact

The NOAA Designated Officer is the Director, Environmental Research Laboratory.

The BLM Designated Officer is the Contracting Officer for the Alaska Continental Shelf Office.

U.S. Department of Commerce
National Oceanic and
Atmospheric Administration

David H. Wallace
Associate Administrator
for Marine Resources

JAN 12 1977
Date

U.S. Department of the Interior
Bureau of Land Management

Frank A. Edwards
Assistant Director, Minerals Management

Jan. 12, 1977
Date