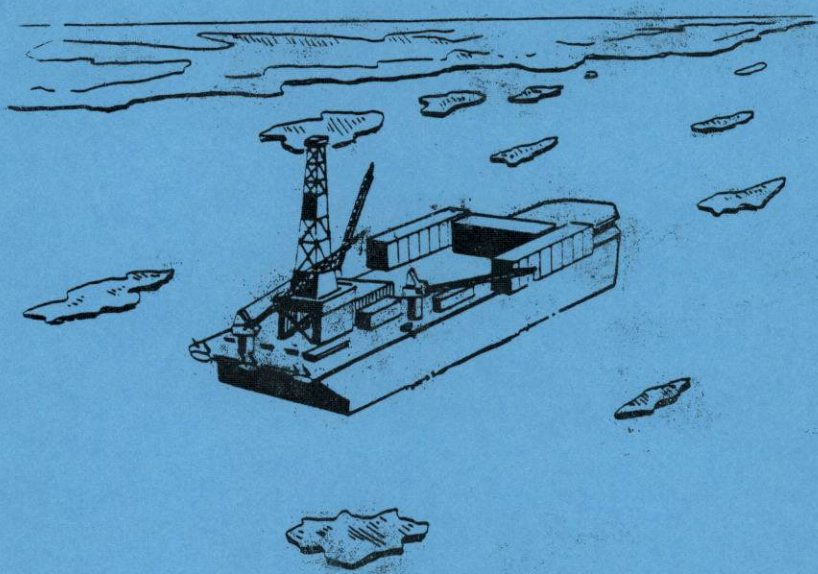
Exploration Plan

Fireweed Prospect
Block OCS-Y-0267
Beaufort Sea, Alaska



Prepared for

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EXPLORATION PLAN

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1.0 INTRODUCTION

1.1 General

This Exploration Plan is submitted by ARCO Alaska, Inc. (ARCO) and covers proposed exploratory oil and gas drilling activities for the Fireweed Prospect in Outer Continental Shelf (OCS) Leases OCS-Y-0267 and OCS-Y-0268 in Sale Area 71 in the western Alaska Beaufort Sea (Figure 1-1).

This Exploration Plan has been prepared under the revised 30 CFR, Parts 250 and 256, "Oil and Gas and Sulphur Operations" published in the April 1, 1988 Federal Register. The format presented in the Final Rule has been used throughout this document to retain consistency. In accordance with this new guideline, information which would have been previously provided within a separate Environmental Report is now presented in the twenty-one attachments to this Exploration Plan; however, documentation referenced in the attachments which is extensive or proprietary is provided as a separate exhibit.

1.2 Type and Sequence of Exploration Activities

This Exploration Plan covers the drilling of the Fireweed Prospect exploratory wells in leases in the western Beaufort Sea. The "Application for Permit to Drill" (APD) will be submitted prior to the drilling of the exploratory well and will contain the specific drilling program for that well. The APD will address the drilling fluids program, formation evaluation program, cementing program, hydraulics program, blowout prevention procedures and other engineering material to be presented in detail.

Figure 1-2 shows the presently defined sequence of exploration activities for the Fireweed Prospect well. Variations in this proposed schedule may occur due to factors such as early or late breakup and/or freeze-up; major interferences from masses of multi-year ice; dramatic changes in sea state or ice conditions; or impositions of government restrictions. New data obtained from drilling records and seismic surveys could also alter the drilling schedule.

ARCO intends to begin exploratory drilling in late September or early October of 1990 using the Single Steel Drilling Caisson (SSDC), a bottom founded mobile offshore drilling unit (MODU) owned and operated by Canadian Marine Drilling Ltd.(CANMAR).

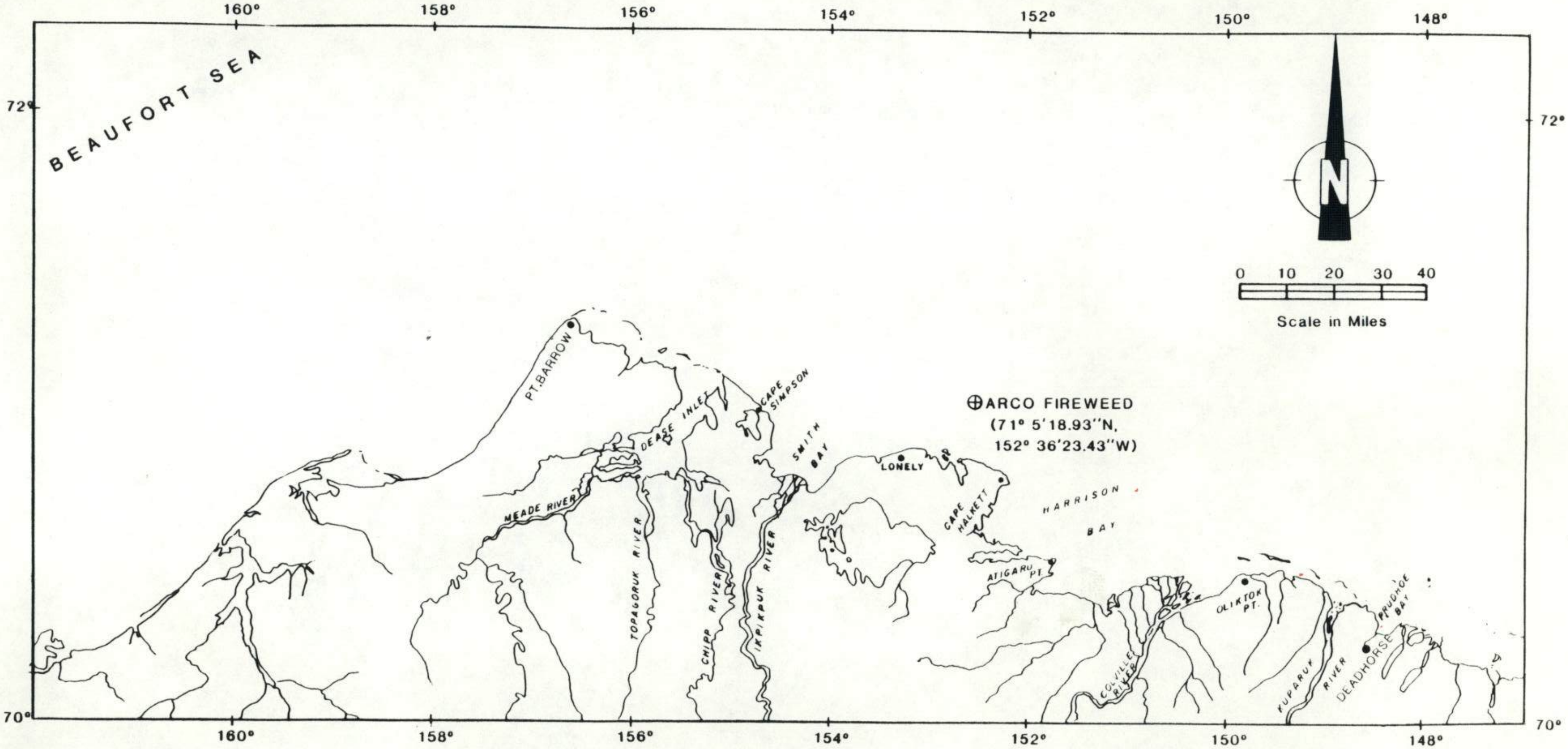


Figure 1-1. Location Map.

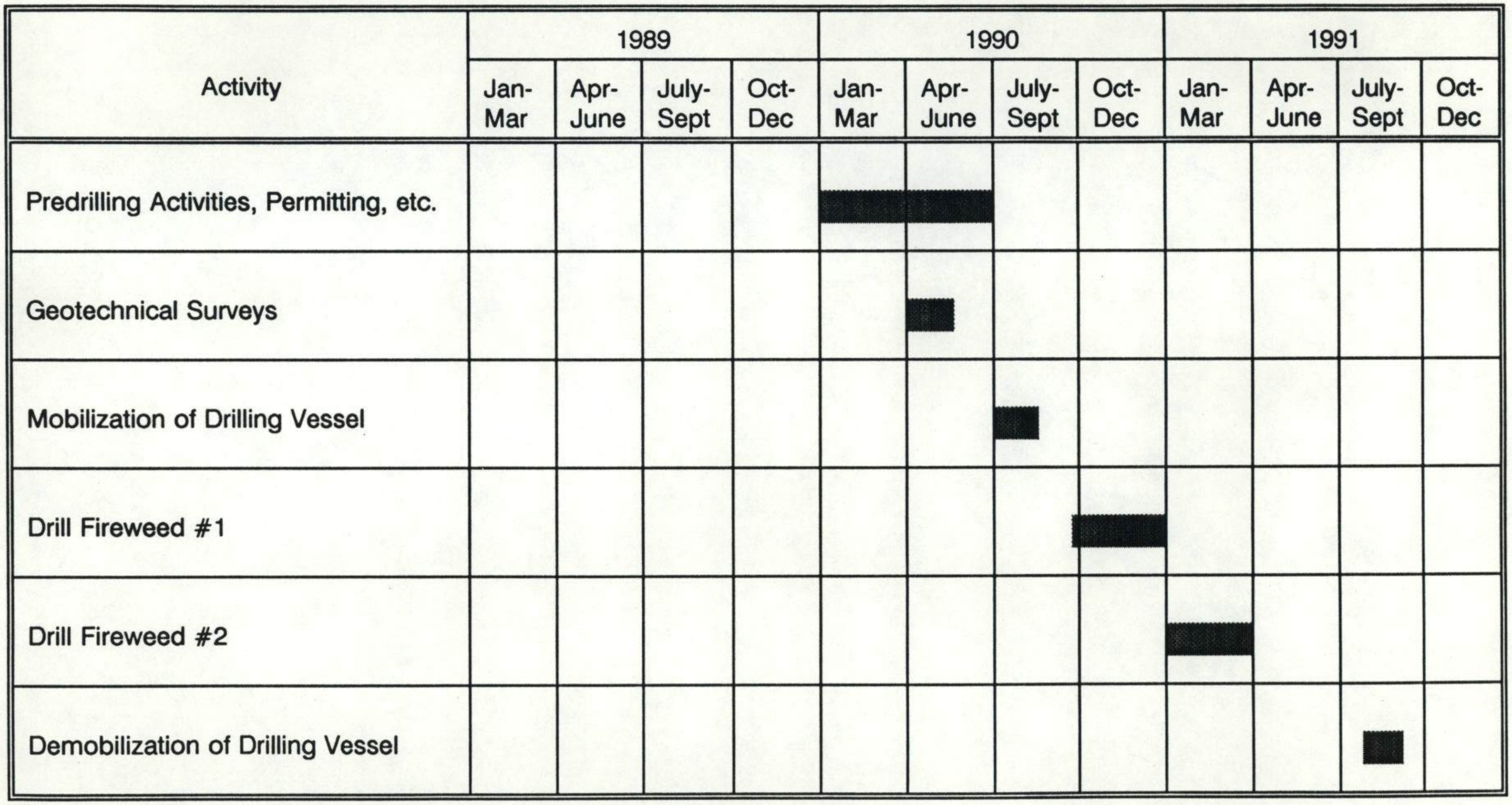


Figure 1-2. Proposed Schedule of Exploration Activities.

The water depth at the drillsite location is approximately 65 feet MLLW based on a review of nautical charts. Geotechnical and other site specific surveys scheduled for April 1990 will confirm water depths at the drilling location.

ARCO plans to tow the drilling unit from its current location in Canada to the Fireweed Prospect location and ballast it to the seafloor in August 1990. The exact timing will depend on the actual length of the open water season; however, current plans call for the SSDC to be on location and ready to drill no later than the end of September. Two to three tugs and/or supply vessels will tow the unit to and from the drillsite; they will not remain on location.

The drilling unit will be stocked with sufficient supplies in Canada to allow operations throughout the winter with only helicopter support (Bell 212, 412, or equivalent) possibly supplemented by Rolligons. Some additional supplies may also be transported to the SSDC by barge from an assembly point at Prudhoe Bay during open water periods. The SSDC will be demobilized from the site during July or August of 1991, as determined by ice conditions.

2.0 DESCRIPTION OF THE DRILLING UNIT AND SUPPORT VESSELS

2.1 General

The bottom-founded, mobile offshore drilling unit, SSDC (Single Steel Drilling Cassion) operated by CANMAR will be used to drill the exploratory well covered by this Exploration Plan. The drilling unit will be supported by icebreaking tugs/supply vessels during the mobilization and demobilization of the SSDC.

The SSDC is designed to carry out exploratory, year-round drilling under arctic environmental conditions. Support vessels include the M/V Kigoriak, the M/V Supplier and the M/V Supplier II (or equivalents). These tugs will tow the unit to and from the drillsite; they will not remain on location during actual drilling operations.

The following sections provide brief descriptions of both SSDC and CANMAR support vessels. Additional information is provided in the appendices.

2.2 SSDC Specifications

2.2.1 General

The SSDC was designed for year-round drilling in harsh offshore arctic environments. It has an overall length of 663 feet, 11 inches. At the waterline, the main body of the structure is approximately 531 feet long and 174 feet wide and has a height of 83 feet. The unit has been designed to drill in water depths of 30 to 75 feet. The hull has been reinforced with 1-meter thick concrete and supports and can be towed and ballasted down at the drillsite.

2.2.2 Hull Description

On its first two deployments in the Canadian Beaufort, the SSDC was supported by subsea gravel berms. For its third deployment, Tenneco's Phoenix Prospect in Harrison Bay, the MAT, a new steel base, was constructed to support the SSDC in lieu of the gravel berms. The new steel base configuration allows for deployment of the SSDC in water depths of 30 to 75 feet without bottom preparation. A general configuration of the SSDC/MAT is provided on Figure 2-1 and a more complete description is provided in Appendix A.

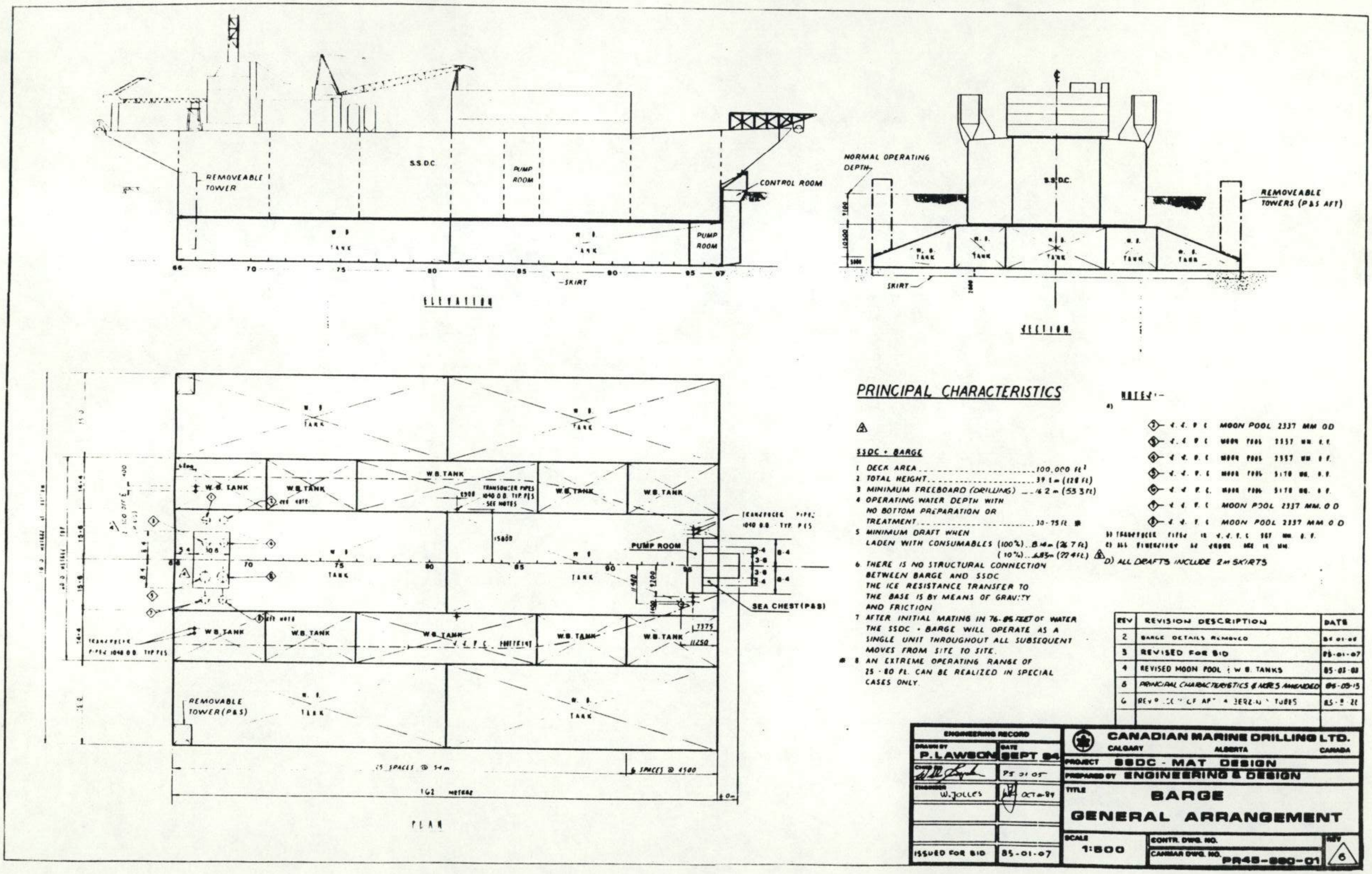


Figure 2-1. General SSDC/MAT Configuration.

2.2.3 Power

Power is provided by:

1. Five (5) Caterpillar D399 turbo-charged diesel engines, each rated at 746 KW.

2. Five (5) KATO 6P5-3150 AC generators, each rated at 1,500 KW.

3. Emergency power is provided by one (1) Caterpillar D399 turbo-charged diesel engine.

2.2.4 Mooring System

The SSDC is a bottom founded mobile offshore drilling unit (MODU) which does not require a mooring system. During mobilization of the MODU, the SSDC/MAT is towed to location as a single unit and ballasted to rest on the seafloor. By overballasting the SSDC/MAT, it maintains sufficient pressure on the seafloor to offset potential horizontal ice loads during winter months.

2.2.5 Accommodations

The SSDC has accommodations for 93 persons plus an additional 35 persons in an emergency. The unit also includes offices, galley and messhall, recreation room, conference room and hospital.

2.2.6 Ice Management

The SSDC is designed to withstand anticipated point and global loading from Beaufort Sea ice conditions. Safety against extreme events will be assured through appropriate alert procedures which will be submitted as part of the APD.

2.3 SSDC Drilling Equipment

2.3.1 General

The SSDC is equipped with a modern drilling rig -- the CANMAR Beaufort Island Rig #2 (CBIR #2), built by Dreco and rated to a drilling depth of 26,000 feet. The rig components include a drawworks driven by a National 1625 electric driven motor rated at 3,000 horsepower; a 500-ton National 6500 block; a National C-495 rotary table driven by a GE 752 electric motor; and a Dreco Cantilever 147 foot mast.

2.3.2 Mud System

The SSDC's mud system is comprised of two National Supply 12-P-160 triplex mud pumps, each driven by two GE 752-R DC motors, and a total tank capacity of 1,999 bbls. Solids removal is accomplished by a Brandt triple tandem shale shaker, a Brandt model 53-23 desander, Shiffner tandem mud cleaner, a Wagner Sigma 150 centrifuge, and a Burgress Magna-Vac degasser.

2.3.3 Cement System

The cement system consists of five 1700 ft^3 tanks; two 2300 ft^3 tanks; and three 70 ft^3 tanks (one for cement and 2 for barite). Bulk material is transferred by means of a low pressure Vackonveyor (Model 36) system and two low pressure air blowers.

2.3.4 Other Systems

Detailed descriptions of blowout preventers, marine risers, diverters, and other drilling operations-related equipment can be found in Appendix B.

2.4 Description of Support Vessels

Three Canadian flag support vessels will accompany the SSDC for mobilization and demobilization activities. The M/V Kigoriak will be the primary vessel, specifically designed as an Arctic Shipping Pollution Prevention Regulations (ASPPR) Ice Class III icebreaker. The M/V Supplier and M/V Supplier II are similar ships and are designed as ASPPR Ice Class II. Principal duties of these vessels will include towing, positioning and ice management. These tugs will tow the SSDC/MAT unit to the drillsite. Once the SSDC/MAT is set in place, they will depart. Detailed information of support vessels is presented in Appendix C.

2.5 Specialized Safety Systems and Pollution Prevention

2.5.1 Mud Logging

Primary well control will be maintained by over-balancing formation pressure with drilling fluid. Automatic and manual monitoring equipment will be installed to detect any abnormal variations in the mud system and drilling parameters. A mud logging unit, manned by experienced personnel will be in continuous use throughout the drilling operations and will monitor formation pressure, hydrocarbon shows, and loss or gain in mud tanks.

2.5.2 Hydrogen Sulfide

The area covered by this Exploration Plan is not known to contain hydrogen sulfide in the stratigraphic section to be drilled. However, a Hydrogen Sulfide Contingency Plan is included as a separate document, Exhibit 5-1. Personnel safety is the prime concern of this plan. If hydrogen sulfide gas is encountered, procedures will be in place to handle the situation.

The Hydrogen Sulfide Contingency Plan will thoroughly familiarize all personnel with the following:

- Training for H_2S emergencies including identification of safe briefing areas.
- Visible H_2S warning system.
- H_2S detection and monitoring system.
- Personnel protective equipment.
- Ventilation equipment.
- Metallurgical equipment considerations and adjustments to the mud program.
- Flare systems.
- Rig evacuation procedures.

The basic premise for the protection of both personnel and the environment is planning. In the remote event of any accidental release of H_2S gas, all safeguards and control procedures will be adhered to by all personnel.

2.5.3 Oil Spill Contingency Plan

The prevention of pollution is given a high priority, exceeded only by the protection and safety of personnel. Proper equipment is provided on the rig, on support craft, and at onshore facilities, so as to avoid the possibilities of pollution. Personnel are trained in the use of this equipment and made aware of the potential consequences of spills. Good housekeeping practices will be emphasized and cleanup equipment will be provided at several locations on the rig to handle spills before they can escape from the drilling vessel. The equipment and procedures for responding to oil spills in the Beaufort Sea are detailed in the Oil Spill Contingency Plan, which is submitted as a separate document.

2.5.4 Fuel Transfers

It is currently unknown whether the SSDC will arrive at the Fireweed Prospect fully loaded with Arctic grade diesel. As such, additional diesel fuel may need to be loaded onto the SSDC after it is on location. If required, additional diesel fuel will be barged from the Prudhoe Bay and/or Oliktol Point area.

2.5.5 Fire Drills

Procedures for emergencies such as fires will be posted on the rig and in the quarters. Specific emergency responsibilities for crew members will also be posted at appropriate conspicuous places on the drilling rig. Fire, abandon rig, and H_2S drills will be conducted periodically for all crew members.

2.5.6 Safety Meetings

Safety meetings will be conducted periodically to make crews aware of safety procedures as well as to review potential sources of accidents and the means of preventing them. Accident causes and corrective measures to be taken in the event of accidents will be discussed. An emergency medical technician (EMT)/radio operator/ environmental monitoring person will be on the rig at all times and will coordinate the safety program with supervisory personnel.

2.5.7 Testing Program, Disposal of Produced Test Fluids

If a decision is made to test the wells, a testing program will be written at that time based on the known downhole conditions. Produced gas will be flared. It is planned that produced fluids (including oil) will be reinjected either back into the formation from which they originated or at other depths as approved by the Minerals Management Service (MMS). Flaring of produced fluids is not anticipated, but if neccesary, it will be conducted as approved by the MMS.

As stated previously, the specific program for each exploratory well will be defined in the APD which will be submitted in advance of each well to be drilled. All permit restrictions and stipulations will be observed during any of these operations.

2.5.8 Qualifications of Key Personnel

All wellsite operations will be under the direct supervision of an on-site drilling foreman. Geologists will also be on-site to supervise, as necessary, mud logging, sample collection, and core recovery. Additional operations personnel will be at the wellsite as specific specialized activities dictate, i.e., wireline logging operations, testing, etc.

The Anchorage, Alaska office of ARCO Alaska, Inc. will receive daily reports and frequent telephone and data fax communications to monitor activities at the wellsite.

Company and contractor personnel involved directly in drilling operations (including rotary helpers and derrickmen) will be trained in surface well control methods and in detection of abnormal pressures. Such training will be completed in approved company or industry schools before drilling commences. Blowout prevention drills will also be conducted as required by the MMS.

A list of personnel and their completed MMS training will be maintained on the drilling rig and will be available on request. All supervisory drilling personnel will be MMS certified as operator's representatives both in surface and subsea applications.

Appropriate personnel engaged on the project will receive oil spill containment and cleanup training as specified in the Oil Spill Contingency Plan (Exhibit 2-1).

3.0 EMERGENCY SITUATIONS RELATING TO ALASKA OCS REGION

The following paragraphs discuss preparedness for emergency situations which are common to all wells drilled under this Exploration Plan. These include relief well considerations, loss or disablement of the drilling unit, loss or damage to support craft, and severe weather operations.

3.1 Relief Well Considerations

All operating procedures on the rig, whether automated or controlled by company or contractor personnel, are specifically designed and operated to prevent a loss of well control. The primary method of well control utilizes the hydrostatic pressure exerted by a column of drilling mud of sufficient density to prevent an undesired flow of formation fluid into the well bore.

In the unlikely event it becomes necessary to elevate from primary to secondary control, the blowout prevention system will be utilized to maintain secondary control while primary control is re-established. For example, in the event that the well kicks, the blowout preventers will be used to shut in the well immediately and confine the well fluids within a closed system. The casing programs are designed so that any anticipated formation pressure can be shut in at the surface. The operator's representative assigned to the drill site will have extensive training, including MMS approved blowout prevention training, as well as actual experience in controlling and killing kicks. Such training is an ongoing program of ARCO. These personnel will be further supported by well-trained rig crews approved by the operator. Pressure resulting from a kick will be circulated out using industry approved methods and the well will be restored to its normal operating condition.

Leakoff tests or formation competency tests will be made below surface and intermediate casings, both for well control information, and as an indicator of the depth at which the next string of casing will be required.

In the highly unlikely event that primary and secondary well control are lost, and a blowout occurs which cannot be contained, the rig may have to be abandoned to prevent loss of life. This is an extremely remote possibility, due to the extensive precautions taken to prevent such an occurrence. Fundamental to these precautions is the training required for all personnel involved in exploratory drilling operations and the safety equipment on the rig itself. All crew and supervisory personnel will be trained in accordance with MMS/OCS regulations. A list of personnel and training received will be available on the rig.

In the event of a blowout, every effort would be made to regain control of the well through mechanical means using well control specialists such as the Red Adair Company or Boots and Coots Company. Relief well mobilization plans would begin simultaneously. The primary relief well option employed would be dependent upon several factors existing at the time of the blowout. These factors are: 1) blowout well depth, 2) ice and meteorological conditions at the drill site, and 3) conditions onboard the SSDC. The primary relief well option would be to employ a helicopter transportable rig, positioned on the bow of the SSDC/MAT over the existing "relief well slot." This slot is strategically located over 100 yards from the drill floor and would provide the necessary working area to drill the relief well. The SSDC/MAT is equipped with a partitioned metal fire wall, which could be installed, if necessary, to secure the relief well area.

Sufficient wellhead assemblies, tubulars, and materials (i.e., mud, cement, bits, fuel, etc.) are available in Alaska or on the West Coast to rapidly mobilize for a relief well program. The Relief Well Plan is discussed further in the Oil Spill Contingency Plan.

3.2 Loss or Disablement of Drilling Unit

If the drilling unit becomes partially or totally disabled while under contract to ARCO, the priorities for action in all cases will be:

- Personnel safety and evacuation, if required.
- Prevention of pollution.
- Minimize property and rig damage.
- Regulatory agency and ARCO management notification.

All contingency plans are developed with these objectives in mind. If the drilling vessel is damaged to the point where it cannot be repaired on location, then after both evacuation of non-essential personnel (if necessary) and any securing or plugging of the well in progress, the rig will mobilize to the nearest suitable harbor (or dry dock) facility for repairs. If the rig is damaged beyond repair, a new rig will be brought in, if necessary, to continue drilling or plug and abandon the well. Re-entering an offshore well in this fashion is a routine procedure as long as the conductor pipe and wellhead are not severely damaged. Debris removal from the seafloor would be done in accordance with U.S. Coast Guard (USCG) regulations and other agency requirements.

3.3 Loss or Damage to Support Craft

The same priorities for emergency response in the event of a boat or helicopter accident will be followed as for a rig mishap. Since a number of helicopters and other forms of transportation are available to ARCO in the Deadhorse area, there will be strong back-up capability to provide assistance in the event any one of these support craft requires help. Assistance for search and rescue operations could also be provided by other active operators, the North Slope Borough Search and Rescue Unit, and by the USCG along with other military organizations.

3.4 Severe Weather Operations

Drilling or marine operations are affected when the ice, weather, and/or sea state conditions approach the design limits of the drilling rig or drilling vessel. These operations include ballasting/deballasting, drilling, coring, running casing, logging or other wireline operations, and testing.

The most probable factors that could result in the curtailment of drilling operations at the Fireweed site will be winds, waves, and ice. Specific limits for critical operations onboard the SSDC are defined in the Critical Operations and Curtailment Plan (Exhibit 6-1) which is being submitted separately as supporting documentation. This Exhibit is proprietary and therefore not included in this public document.

As a general rule, no drilling operations will commence or be conducted when any of the following conditions exist:

- The ARCO Drilling Supervisor is not satisfied that the rig is properly positioned, ballasted, and rigged up to begin operations. The Drilling Supervisor will make an entry in the International Association of Drilling Contractors (IADC) Report regarding the above.
- There is an insufficient supply of drilling fluid materials on board to control the well.
- Sufficient emergency containment and cleanup equipment is not available or is not maintained in good working order.
- The manpower required to safely conduct the drilling operation is not available.
- Any critical machinery needed to assure a normally safe operation is not operative.

IMPORTANT: The above list is only a guideline. The decision as to what action to take during a given emergency, no matter what the cause, must be based on the judgement of the ARCO Drilling Supervisor, the Drilling Contractor, Offshore Installation Manager (OIM), and the Marine Supervisor.

APPENDIX
A

APPENDIX A. SSDC SPECIFICATIONS

A.1 General

The SSDC is a bottom founded mobile offshore drilling unit (MODU). It is designed for year-round drilling in harsh arctic environments. The main body of the structure is approximately 715 feet long, 174 feet wide, and 129 feet high. The deck has been cantilevered to provide additional deck space. The unit has been designed to drill to depths of 26,000 feet in water depths between 25 and 80 feet.

A.2 Principal Dimensions and Operating Ranges

Length overall	715'-6"
Length on waterline	551'-2"
Depth	128'-7"
Design Draft (normal operating range)	25 - 80 feet

A.3 Design Criteria

The SSDC was designed to perform exploratory, year-round drilling in shallow water (25 to 80 feet) arctic environments. It is able to withstand ice forces encountered in such locations.

A.4 Hull Description

The SSDC was designed by CANMAR in 1982 and an independent design check was performed by Swan Wooster Engineering Company of Vancouver, British Columbia, Canada. The drilling unit was constructed by modifying the forward section of an ocean-going, very large crude carrier ("VLCC"). The modifications were performed in the Hitachi Shipyards in Japan under the survey of Det Norske Veritas ("DNV"). The stability of the system under ice loading is provided by water ballasting of the original cargo tanks. Shotcrete has been applied to the base of the unit to increase its coefficient of friction.

The MAT was built in 1985/86 by Hitachi Zosen Corporation, Japan and has a seafloor dimension of 531 by 361 feet with a height of 44 feet. It was designed to transmit the forces exerted upon the SSDC by ice loads to the seabed when the unit is operating in deeper water, as well as withstand the ice loads which would directly impact on the MAT when in shallower water depths. The base of the MAT has a system of skirts which penetrate the seabed to provide the necessary mechanism to transmit ice loads. The MAT structure was fabricated from low temperature steel and was designed for higher than the anticipated ice loads. The top of the MAT is coated with a layer of urethane foam to provide a friction interface with the shotcrete coating on the bottom of the SSDC. A permanent ice-strengthened tower on the forward end of the MAT provides access from the SSDC to the ballast valves and deballast pumps which are located there.

A.5 Ballast System

A ballast system for immobilization exists that allows the SSDC unit and MAT to rest on the ocean floor and supplies a stable system under ice-loading conditions.

A.6 Storage Capacities

Bulk Barite (14 silos)	3,990 m^3 (141,000 ft^3)
Bulk Cement	
- Permafrost (4 silos)	1,140 m^3 (40,300 ft^3)
- Class "G" (2 silos)	570 m^3 (20,100 ft^3)
Sack Storage area	800 m^2 (8,660 ft^2)
Liquid Mud	305 m^3 (1,900 bbls)
Fuel	1,900,000 U.S. gal.
Potable Water	110 m^3 (29,000 U.S. gal.)
Drill Water	1,825 m^3 (482,000 U.S. gal.)
Casing	2,500 tonnes (2,460 tons)
Drill Pipe	250 tonnes (246 tons)

A.7 Bulk Materials Handling System

There are 20 bulk gravity silos which can be used either for barite or cement. Each silo has a capacity of 10,000 cubic feet. The bulk barite system consists of two pneumatic, vertical, hopper type surge tanks; each has a 70 cubic foot capacity. The cement system consists of one surge tank, five 1,700-cubic foot pressure tanks for the pneumatic system, and two 2,300 cubic foot tanks. All cement tanks are supplied as part of the leased cement system.

Compressed air for movement of bulk materials is supplied by means of a low pressure Vackonveyor (Model 36) system and two 800 cfm/10 psi bulk air blowers. These transfer the bulk materials from the bulk silos to the pressure tanks. From there, the two leased cement air compressors of the unit transfer the bulk to the surge tanks for mixing.

A.8 Accommodations

Accommodation has been provided for 93 people in 28 cabins (camp units). An additional 35 people can be served on an emergency bunk basis. The vessel also features:

- Drilling Supervisor's office
- Hospital
- Radio room
- Superintendent's office
- Conference room
- Company office
- Chief Steward's office
- General office
- Washrooms
- Geologist's office
- Change house
- Laundry/linen unit
- Kitchen/freezer unit
- Fully-equipped steel shop
- Movie/recreation room

A.9 Helideck

The helideck has capacity for an S-61 or similar helicopter. The helideck meets Det Norske Veritas (DNV) rules governing foam-dry chemical fire suppression systems with fire fighting and refueling systems.

A.10 Power Plant

The SSDC has the following power plants onboard:

- Engines: Five (5) Caterpillar D399 turbo-charged diesels, each rated at 746 kW.

- Emergency Power: One (1) Caterpillar D399 turbo-charged diesel.

- Five (5) KATO 6P5-3150 AC generators, each rated at 1,500 kW.
- Four (4) Ross Hill SCR 2,000 amp DC converters.

A.11 Air Compressors

The following air compressors are onboard the SSDC:

- Two (2) Rig Air Compressors - Sullair Model 20-125H mounted, c/w 125 HP (93 KW) electric motors, single stage, heavy duty, asymmetrical rotary screw compressors, each to deliver 445 SCFM (12.7 m^3 (st)/d) of free air at 125 psig (860 kPa), complete with inlet silencer, filter, aftercooler, instrumentation, control panel.
- Two (2) Sullair Model 20-125H rotary screw type main line compressors complete inlet silencer, filter, aftercooler instrumentation, control panel, and enclosure.
- Two (2) Halliburton 465 rented compressors.
- One (1) Sully skid mounted, cold start compressor with air receiver, fuel tank, and electric start system.
- Two (2) 125 cubic feet air receiver.
- One (1) Stonebor C6PR alcohol injection pump.
- One (1) Pure Aire model P5 1000 skid-mounted refrigent-type air dryer, with absorbent-type prefilter.

A.12 Vessel Pumps (non-drilling application)

The following pumps are onboard the drilling unit:

- One (1) alcohol injection pump.
- Three (3) waste heat recovery circulating pumps.

A.13 Potable Water System

The potable water system includes the following:

- One (1) Aqua-Chem S-600 fresh water tank, capacity 6,600 U.S. gallons.

- One (1) Aqua-Chem S-600 saltwater tank, capacity 5,800 U.S. gallons.

- Two (2) Young heat exchangers (parallel installations) to provide jacket water cooling with seawater.

- Three (3) Aqua-Chem S-600, Spec E, produces distilled water, capacity 600 U.S. gph.

A.14 Boilers

- Two (2) Lister automatic 100 HP boilers, each with chemical water treating pot for deionization.

- One (1) Lister, 4 x 106 Btu/h, indirect-fired, skid-mounted air heater.

- One (1) Tank, Tank Steam Heat Exchanger, and three (3) Verreo pumps with one 25 HP (18 KW) and two (2) 40 HP (30 KW), 600 Volt, 1,750 RPM explosion-proof motors.

- One (1) Waste heat recovery circulating skid, tank capacity of 754 U.S. gallons. This unit used in conjunction with engine/generator units waste heat recovery.

A.15 Sewage and Waste Treatment Systems

The sewage and waste treatment system includes the following:

- Two (2) Red Fox 7500 waste treatment systems with cold start compressor and electrical distribution equipment. Each treatment system has capacity for 120 people.

A.16 Cranes and Cargo Handling Equipment

The following cranes and cargo handling equipment are onboard the SSDC:

- Two (2) API 1500 FMC Diesel Hydraulic Cranes, each with a 120 foot boom and a 10 foot extension, each rated at 63 tons.
- One (1) addition pedestal is provided.
- One (1) API 238A FMC Diesel Mechanical Crane with a 120 foot boom and a 10 foot extension, rated at 35 tons.
- One (1) Beebe Bros. (bridge type) handling cranes rated at 50 tons, substructure mounted.
- Two (2) Beebe Bros. (bridge type) handling cranes rated at 25 tons, substructure mounted.
- One (1) J&B Crane with trolley.
- One (1) API, HSP-8022, FMC Link Belt mobile crane with 91 feet of boom and GM-4-53 diesel engine.
- One (1) Caterpillar 930 fork lift with 218 inch mast and pallet lifter.

A.17 Personnel Safety and Lifesaving Equipment

Boats onboard the SSDC include:

- Two (2) 50-man totally enclosed WaterCraft lifeboats.
- Two (2) 58-man totally enclosed FISKAR lifeboats.
- One (1) WaterCraft rescue/pickup boat.
- Five (5) 25-man deck inflatable life rafts.

Personnel embarkation equipment includes:

- Four (4) scramble nets.
- Ten (10) life rings.

Flotation and rescue equipment includes:

- 240 life jackets
- 180 exposure suits
- 120 immersion suits

All the above appliances meet COGLA and/or USCG requirements. All personnel will receive full training in emergency use of these systems and will be required to participate in weekly abandon ship drills.

A.18 Fire Suppression Equipment

A.18.1 Fire Water System

The fire water system is a salt water system which provides high volumes of water to all vessel locations for fire suppression. In this case the Viking sprinkler system consists of two independent systems, one for each floor. The system consists of:

- Two (2) dry pipe valves
- One (1) water gong
- One (1) air compressor
- Two (2) shut-off valves
- Eighteen (18) auxiliary drain valves
- Two (2) inspection valves
- Two (2) maintenance valves

- Two (2) pressure operated switches

- Two (2) monitoring switches

A.18.2 Halon 1301 Fire Extinguishing System

The halon system provides positive fire suppression in compartments where the use of water is either dangerous or would have limited effectiveness and damage the equipment located within the compartment. Halon itself has low toxicity and is electrically non-conductive. It is suitable for electrical, oil, fuel, paint and other similar fires. The Halon system provides protection for the following areas:

- Camp utilities, CU1, CU2, CU3

- Generators, U2 and U3

- Electrical Room, U6

- Mud areas, M7, M8 and M9

- DA trailers

- Radio room

- Pumproom

A.18.3 Fixed Dry Powder Fire Extinguishing System

The fixed dry powder extinguisher system provides areas of high fire susceptibility with ready access to volumes of dry powder for fighting fires too large to be quickly handled by portable extinguishers. The fixed dry powder fire system consists of hose reel Ansul extinguishers, both 30 lb. and 20 lb. types are located in areas of easy access throughout the rig. Two (2) wheeled 350 lb. dry powder extinguishers are located onboard the SSDC. One is located in the welding shop and the other is located in the production testing area.

A.18.4 Miscellaneous Fire Fighting Equipment

Portable extinguishers (CO_2) are located for use within areas with sensitive electrical equipment.

A.18.5 Fire Detection/Alarm System

The fire alarm system is on an auxiliary power system and consists of a main fire alarm panel which is a Pyrotronics System 3. The panel was custom built with individual zones for separate areas. Each zone has a separate alarm and trouble indicator. The panel is programmed so that suppression systems, such as sprinklers and Halon 1301 systems, can be monitored. The overall fire detection system is arranged as follows:

- In areas where the hazard is electrical, smoke detectors are used for detection.
- In all Class B areas, rate compensated detectors are used for alarm.
- In all areas protected by Halon 1301 Systems, a manual discharge switch is located by all exit doors.
- Bells are located throughout the complex; tone generator is in public address system.
- In areas where there is no suppression, breakglass stations are provided by all exit doors.
- A zonal graphic is provided by the control panel.

A.18.6 Gas Detection/Alarm System

The gas alarm system includes the following components:

- MSA Model 516 main panel in SCR room.
- MSA gas detectors.
- Alarms set at 20 percent and 60 percent LEL (Lower Explosive Level).
- Trouble indication at main panel.

All fire and safety equipment will be modified as necessary to meet current USCG regulations.

APPENDIX

B

APPENDIX B. SSDC DRILLING EQUIPMENT

B.1 Derrick and Crown

The Dreco cantilever-type derrick has a clear working height of 147 ft, a leg spread of 34 ft, and a gross nominal capacity of 650 tons. Key components include:

- Swivel - National Model P500, API rated dead load capacity 500 tons and API bearing rating 367 tons at 100 rpm.

- Crown Block - 500 ton hook load with 12 lines 1-1/2 inch strung, six 60-inch sheaves, National Type G500, API rated dead load capacity, with sheave guards.

B.2 Substructure

The substructure includes a Dreco posted vertical box consisting of four 32 ft x 7 ft 10 inches x 12 ft (9.73 m x 2.38 m x 3.65 m) vertical boxes, 2 skid beams 55 ft x 7 ft 10 inches x 3 ft (16.72 m x 2.38 m x 0.91 m), 38 ft (11.6 m) high floor, 400 ton (363 tonne) rotary capacity with 500,000 lbs (222,000 daN) simultaneous set back area. The substructure is complete with a skidding system with a floor and mast in the working position. The racking area is designed for 240 stands of 5 inch (127 mm) drill pipe plus 10 stands of drill collars. The weather enclosure for the substructure is steel with fiberglass insulation. Floor windwalls are also of steel, extending 50 ft (15.2 m) above the drill floor. The SSDC is designed to carry out year-round exploratory drilling.

B.3 Drawworks

Drawworks on the SSDC include:

- Drawworks - National 1625-DE electric driven, rated to 3000 HP (2240 kW) unitized, skid-mounted, with accessories for operation including console panel for operating brake clutches, sand-line assembly, driven by two GE752 electric motors, air controlled cathead, cradle assembly for Elmagco 7838 brake and crown saver.

- Drawworks Brake - Elmagco Model 7820 system capable of 100,000 ft-lb (135,000 joules) torque to 50 rpm - Model 7838 brake, model PWM 20 electrical control system including model D39040 drillers control, model C39766-1 enclosure, and 6600-32-0157 power transformer. Brake driven by two General Electric Model GE752 DC drilling motors.

B.4 Rotary Table

The rotary table includes:

- National Supply C-495 with 49.5-inch diameter table opening with 53.5-inch centerline space complete with mounts.

- One (1) General Electric D.C. motor Model GE752 with independent rotary drive D1632.

- Rated deadload capacity 800 tons.

- Casing insert bushings for casing sizes up to 42 inches.

B.5 Pipe Handling System

The pipe handling system includes:

- One (1) Mereco pipe handler with angle hydraulic power unit and two control consoles for racking area and drill floor.

- Two (2) Ingersoll Rand K6ULAB derrick floor winches (pneumatic operated) with automatic brake.

- One (1) racking platform winch electrically operated with automatic brake.

B.6 Kellys

Kellys include:

- Two (2) hex kellys 7-3/4 inch OD by 42 ft.

- One (1) Hydril 1004880-5 upper kelly cock.

- Two (2) Hydril 1001880-2 lower kelly cocks.

B.7 Rotary Hoses

Rotary hoses include:

- Two (2) 3-1/2 inches x 75 ft long with 4-inch N.P.T., built in leak-proof male connections, test pressure 10,000 psi complete with safety hobbles.

B.8 Standpipe Manifold

The standpipe manifold includes:

- Dreco dual manifold with Demco values, misalignment unions and 160° goosenecks, 5 inch, 5000 psi working pressure.

B.9 Air Winches

Air winches onboard include:

- One (1) Ingersoll Rand K6ULAB derrick floor winches operated with automatic brake.

B.10 Rig Floor Instrumentation

Rig floor instrumentation includes:

- Martin-Decker AWEG-1 Type "EB" weight indicator and sensor unit.
- Automatic driller complete with control unit and rate of penetration cutoff switch.
- Mud gauge assemblies, 6000 psi range and 10,000 psi range.
- Tong torque indicating system complete with load cylinder.
- Rotary table tachometer system complete with signal generator suitable for use in Class 1, Group D, Division 1 areas.
- Pump stroke SPM tachometer system complete with signal generators suitable for use in Class 1, Group D, Division 1 areas.
- Rotary table electric torque meter complete with signal current transformer.

B.11 Drilling Tools on Derrick Floor

Drilling tools on the derrick floor include:

- One set of two B.J. Type SDD manual drill pipe tongs, range 4 to 17 inch O.D., 60,000 to 100,000 ft-lb torque.
- One set of two B.J. Type B manual drill pipe/casing tongs c/w range 3-1/2 to 24 inch O.D., 30,000 to 55,000 ft-lb torque.
- One set of two B.J. Type C manual drill pipe tongs, range 2-3/8 to 10-3/4 inch O.D., 35,000 ft-lb torque.
- One Farr model KT 20000 power casing tong, range 8-5/8 to 20 inch, 10,000 ft-lb to 55,000 ft-lb torque, c/w jaws 9-5/8, 13-3/8, 16 and 20 inch.

- One Farr model LW 13375 power casing tong, range 3-1/2 to 13-3/8 inch, 200 to 4,000 ft-lb (high gear) to over 20,000 ft-lb torque, c/w jaws 4-1/2, 5, 7, 9-5/8 and 13-3/8 inch.

- One International A6C-2, Pneumatic operated, power sub.

- Two Varco 350 ton, manual drill pipe elevators, for 5 inch drill pipe.

- Two Varco 250 ton, manual drill pipe elevators, for 3-1/2 inch drillpipe.

- B.J. manual side door collar type elevators, type SLX, 150 ton capacity for 6-1/2, 8 and 9 inch O.D. drill collars.

- B.J. type SLX side door, casing type elevators, 150 ton capacity, for 7, 9-5/8, 13-3/8, 16 and 20 inch casing.

- One set 15833 Varco elevator links, 144 inch long, 500 ton capacity for casing elevators.

- One set 16967 Varco elevator link 132 inch long 350 ton capacity for tubing elevator.

- One 6600-1 Varco MPCH master casing bushing.

- One 6609 Varco MPCH inset bowl No. 2 for 10-3/4 to 9-5/8 inch casing.

- One 6610 Varco MPCH insert or equal bowl No. 1 for 13-3/8 to 11-3/4 inch casing.

- B.J. type "SJ" single joint casing type pick up elevator for 7, 9-5/8, 13-3/8, 16 and 20 inch casing.

- One 10187 Varco CB casing bushing for 20 inch casing with 6127 insert bowl for 16 inch casing.

- One 3650-52 Varco 27 HDP Kelly drive busing c/w wrench and wiper assembly for 5-1/4 inch Hex kelly.

- One 16953-5 Varco Kelly busing safety guard assembly c/w perforated side.

- One 15520 Varco SDXL manual rotary slip c/w inserts 5-1/2 x 5 inch.

- One 2550 Varco DCS-R manual drill collar slip, 5-1/2 to 7 inch c/w circular buttons.

- One 2507 Varco DCS-L manual drill collar slip, 8 to 9-1/2 inch c/w circular buttons.

- One 5329 Varco CMS-XL manual casing slip, 20 inch maximum O.D. c/w circular buttons.

- Varco MP-R multipurpose safety clamp, 5-1/2 to 7 inch and 8 to 9-1/4 inch.

- Gavel mud saver bucket c/w 5 inch outlet and 5 x 4-1/2 inch hose.

- King Quick Release Type 3AR, wireline stripper.

- Two combination Varco air operated 500 ton casing elevators and spider. Interchangeable segments, from 7 to 13-5/8 inch.

- One 5SC, 6,000 psi working pressure, king circulating head, 4-1/2 I.F. pin connection, 3 inch line pipe hose connection. 4 inch female line pipe top connection.

- Two 4-1/2 inch circulating heads, I.F. Pin 2 inch line pipe thread.

- Totco 8° and 12° clocks, complete with 1-5/8 inch BBL. and sinker bars.

B.12 SubSea and Surface Blowout Prevention (BOP) Equipment

The low pressure stack includes:

- Annular Preventer - One 21-1/4 inch Hydril, MPS (539 mm), 2000 psi (20.7 MPa), API R.T.J. studded top and 20-3/4 inch (527 mm), 3000 psi (13.8 MPa), API R.T.J. flanged bottom, stainless steel lined ring grooves, and packoff element.

- Ram Preventers - Two (2) 20-3/4 inch Hydril (527 mm), 3000 psi (20.7 MPa) API, R.T.J. studded top double ram preventer, stainless steel lined ring grooves, side outlets, 1 set blind rams, 1 set pipe rams, handwheels, extensions, universal joints and wrenches. Four 3-1/16 inch, 5000 psi flanged outlets.

- Low Pressure Valves - One check valve, 3-1/8 inch (79 mm), 3000 psi (20.7 MPa). Three gate valves, 3-1/8 inch (79 mm), 3000 psi (20.7 MPa). One gate valve 3-1/8 inch (79 mm), 3000 psi (20.7 MPa).

The high pressure stack includes:

- Annular Preventer - One 13-5/8 inch (356 mm), Hydril 5,000 psi (34.5 MPa) API, R.T.J. studded top and 13-5/8 inch (346 mm), 10,000 psi (69.0 MPa), Cameron clamped hub bottom, stainless steel lined ring grooves, and packoff element.

- Ram Preventers - Three Hydril single ram preventers 13-5/8 inch (346 mm), 10,000 psi (69.0 MPa). Cameron clamped hub top and bottom, stainless steel lined ring grooves, 2 side outlets each ram 3-1/16 inch (77.8 mm), 10,000 psi (69 MPa) flanged, 1 set blind or shear rams, 2 sets pipe rams, automatic multiposition locks.

- High Pressure Valves - Seven gate valves 3-1/16 inch (78 mm), 10,000 psi (69.0 MPa) API R.T.J. flanged, handwheel operated. One gate valve 3-1/16 inch (78 mm), 10,000 psi (69.0 MPa) API, R.T.J. flanged, hydraulic operated. Two check valves 3-1/16 inch (78 mm) 10,000 psi (69.0 MPa) API, R.T.J. flanged, swing type.

The drilling spool includes:

- Drilling Spool - One 13-5/8 inch (346 mm), 10,000 psi (69.0 MPa) Cameron clamped hub top and bottom complete with two 3-1/16 inch (77.8 mm), 10,000 psi (69 MPa) flanged side outlets.

- Adaptor Spool - One 13-5/8 inch (346 mm) 10,000 psi (69.0 MPa) Cameron clamp hub top and 13-5/8 inch (346 mm) 10,000 psi (69.0 MPa) API flanged bottom, complete with Starilex Steel lined ring grooves.

The control system includes:

- BOP Control Panel - (Hydril drill floor) 8 station electric, explosion proof complete with selected Diverter Control Functions. BOP activation is via an electric/pneumatic/ hydraulic system.

- Accumulator - Hydril Valvcon 240 gal (908 litres) capacity twenty-two 15 US gal (57 litres) bottles with 8 station control manifold, 6 bottle Nitrogen emergency backup, electric drive triplex piston pump, 3 air pumps.

- BOP Control Panel (Hydril) - Toolpush office, 9 station electric, non-explosion proof.

- Diverter Control Panel (Hydril) - submounted, 7 station manual control.

- Choke Control Panel - Wagner Master Choke - hydraulic operated 10,000 psi (69.0 MPa).

The choke and kill lines include:

- Fittings and valves downstream of the chokes, 10,000 psi (69.0 kPa).

The fill-up line includes:

- One (1) 3 inch (76 mm) fill-up line.

The kill and choke manifold includes:

- Pacific Oilfield complete with Barton valves, two each Willis Masterflo chokes, 10,000 psi (69.0 MPa) one Wagner hydraulic adjustable choke, one HRC Gutline valve, valves, flanges, fittings, spools, gauges, buffer chamber, target flanges and all necessary studs, nuts, and ring gaskets to assemble complete unit.

Freeze protection systems include:

- The BOP, related control equipment, and choke and kill manifold located in heated areas. Freeze depressed control fluids are also used ensuring operation should the heating system malfunction.

- All BOP systems will be tested and maintained as per manufacturer's specifications. Testing will be carried per OCS #2 and API RP53.

Safety equipment includes:

- Inside BOP (Float Valve) - One Gray 62035 assembly with 5 inch XH pin and box connections.

- Inside BOP Releasing Tool - One Gray 62330 for Gray 62035 inside BOP with 5 inch XH pin and box connectors.

- TTV trip tank volume system with chart recorder and audible/visual alarm.

- Combustible gas detectors.

- Automatic driller with penetration rate cutoff switch.

- Mud totalizing and flow system records cumulative volume of the six tanks, mud flow, cumulative pumps stroke indicator, gain/loss gauge, chart recorder and alarm.

The diverter assembly includes:

- One (1) Regan KFDJ 500 psi (3.5 MPa) W.P. support housing for 49-1/2 inch (1257 mm) rotary table complete with two 12 inch (305 mm) 500 psi (3.5 MPa) ANSI flanged outlets, one 3 inch 500 psi (3.5 MPa) ANSI flanged outlet, and locking dog assembly. Min. Bore = 47 inches (1194 mm).

- One (1) Regan KFDJ 500 psi (3.5 MPa) W.P. diverter assembly for 49-1/2 inch (1257 mm) rotary table complete with flowline spool, two pressure energized packer seals. Solid Jay slot insert packer unit 28 inch (711 mm) bore. Bottom connection is 39 inch (991 mm) EC-6 pin with 36-1/2 inch (927 mm) min. bore.

- Spacer spools and an overshot provide the flow path for the mud from the BOP stack to the diverter. The overshot contains a seal which seals on a BOP stack mandrel.

B.13 Drilling Fluid System

The drilling fluid system includes:

- H.P. Mud Pumps - Two each National 12-P-160 triplex, 1600 HP (1200 kW) rating, max. discharge pressure of 5000 psi (35 MPa) at 567 GPM (35.8 L/s) and max. flow rate of 772 GPM (48.7 L/s) at 3200 psi (16.40 MPa) (calculated at 120 strokes per minute), max. piston diameter and stroke length 7-1/4 inch x 12 inch (184 mm x 305 mm) and including the following:

    - 150 ANSI flanged 10 inch (250 mm) suction manifold complete with suction dampener.

    - 5000 psi (35 MPa) API discharge manifold unit.

    - unitization for two top mounted General Electric D.C. motors model GE752 per pump.

    - chains and sprockets lubricated with explosion proof, 3 HP (2.2 kW) motor driven oiling system.

    - liner spray pump, explosion proof, 3 HP (2.2 kW) electrically driven.

- Pulsation Dampener - Two (2) Hydril K-20-5,000, 5000 psi (35 MPa) working pressure with 4 inch (100 mm) 5000 psi (35 MPa) API R.T.J. connection.

- Safety Relief Valves - Two (2) Cameron 3 inch (76 mm) female NPT connection 5000 psi (35 MPa) max. set pressure.

- Pressure Gauges - Two (2) Cameron O, 5000 psi (35,000 kPa) range, 2 inch (50 mm) female NPT connection.

- Circulating Pumps

    - Charge Pumps - Two (2) Mission Magnum 6 inch x 5 inch x 11 inch (152 mm x 127 mm x 279 mm), 9-1/2 inch (295 mm) impeller, with 75 HP (56 kW) 1750 rpm motors, unitized.

- Mixing Pumps - Three (3) Mission Magnum 6 inch x 5 inch x 11 inch (252 mm x 127 mm x 279 mm), 10-1/4 inch (257 mm) impeller with 75 HP (57 kW) 1750 rpm motors, unitized.

- Transfer Pump - One (1) Mission Magnum 6 inch x 5 inch x 11 inch (152 mm x 127 mm x 279 mm), 10-1/4 inch (267 mm) impeller, 75 HP (56 kW) 1750 rpm motor, unitized.

- Desander Pump - One (1) Mission Magnum 8 inch x 6 inch x 14 inch (203 mm x 152 mm x 350 mm), 11-1/2 inch (286 mm) impeller, with 125 HP (93 kW) 1750 rpm motor, unitized.

- Desilter Pump - One (1) Mission Magnum 6 inch x 5 inch x 14 inch (152 mm x 127 mm x 350 mm), 10-3/4 inch (279 mm) impeller, with 100 HP (75 kW) 1750 rpm motor, unitized.

- Hole Fill Pump - One (1) Mission Magnum 3 inch x 2 inch x 13 inch (76 mm x 51 mm x 330 mm), 7-1/4 inch (184 mm) impeller with 10 HP (7.5 kW), 1750 rpm motor, unitized.

- Mud Cooling Pump - One (1) Mission Magnum 6 inch x 5 inch x 14 inch (152 mm x 127 mm x 356 mm), 11 inch (279 mm) impeller with 125 HP (93 kW) 1750 rpm motor, unitized.

• Agitators

  - Mud Agitators - Six (6) Abcor 20 HP (15 kW) 1150 rpm electric motor complete with 44 inch (1118 mm) impeller.

  - Mud Agitators - Five (5) Abcor 10 HP (7.5 kW) 1150 rpm explosion proof electric motor complete with 36 inch (914 mm) impeller.

  - Mud Agitator - One (1) Abcor 5 HP (3.7 kW) 1150 rpm explosion proof electric motor complete with 32 in (813 mm) impeller.

- Mud Agitator - One (1) Abcor 5 HP (3.7 kW) 1150 rpm explosion proof electric motor complete with 28 inch (711 mm) impeller.

- Mud Guns - Fourteen (14) 3 inch (75 mm) low pressure 150 psi (1030 KPa) Dreco bottom type.

• Mud Treatment

  - Mixing Hoppers - Three (3) Geosource Sidewinder Mixer Model 800 with sliding gate type valve, sack table, hopper, unitized.

  - Shale Shaker - One (1) Brandt triple tandem with screens, 5 HP (3.7 kW) explosion proof motors, 3 discharges, skid.

  - Desander - Brandt [S3-12 3 x 12 inch (305 mm) cones], capacity 1500 USGPM (5678 L/min) at 75 ft (23 m) head.

  - Desilter/Mud Cleaner - Shiffner Tandem Mudslinger [24 x 4 inch (102) mm) cones], capacity 1200 USGPM (4542 L/min) at 75 ft (23 m) head.

  - Centrifuge - Wagner Sigma 150 GPM (568 L/min) complete with 50 HP (37.5 kW) explosion proof electric motor, unitized. Capacity 20-150 USGPM (75.7-570 L/m) unweighted mud complete with dual electrically driven extended shaft progressing cavity (Salamander) feed pumps. 3 HP (2.2 kW) each.

  - Degasser - Burgess Magna-Vac 20 HP (15 kW) vacuum degasser complete with 20 HP (15 kW) explosion proof motor, rated 211 USGPM (800 L/min).

  - Mud Gas Separator - cylindrical vessel (fabricated).

  - Cuttings Washer System - Auger type system located at shale shaker.

- Tanks

  - Trip Tank - 50 bbl (8.0 m^3) capacity, fabricated, with electronic drillfloor volume indicator plus manual readout (weighted w/sheave cap read out).

  - Mud Tanks - 3 skids, 1930 bbl (306.5 m^3) capacity as follows:

Settling tank capacity	=	37 bbl (5.9 m^3)
Suction tank capacity	=	203 bbl (32.3 m^3)
Suction tank capacity	=	197 bbl (31.4 m^3)
Reserve tank capacity	=	203 bbl (32.3 m^3)
Three reserve tanks, capacity	=	197 bbl (31.4 m^3) each
Two reserve tanks, capacity	=	208 bbl (33.2 m^3) each
Degasser tank capacity	=	112 bbl (17.9 m3)
Desander tank capacity	=	121 bbl (19.3 m^3)
Mudcleaner tank capacity	=	121 bbl (19.3 m^3)
Underflow tank capacity	=	40 bbl (6.5 m^3)
Mud cooler tank capacity	=	121 bbl (19.3 m^3)
Active tank capacity	=	141 bbl (22.4 m^3)
Premix tank capacity	=	87 bbl (3.8 m^3)
Pill tank capacity	=	49 bbl (7.7 m^3)

- Bulk Mud Surge Tank - Two (2) pneumatic vertical hopper bottom atmospheric tank, 70 ft^3 (2.0 m^3) capacity, complete with all associated piping and accessories.

- Mud Coolers - Two (2) plate and frame heat exchangers, Alfa Laval utilizing seawater, 1000 gpm (3.8 m^3/min) at 100 psi (700 kPa) to cool drilling mud at 1200 gpm (4.54 m^3/min) at 45 psi (315 kPa).

- Standpipe Manifold - Dreco dual manifold with Demco valves, misalignment unions and 160° goosenecks, 5 inch (125 mm), 5000 psi (35 MPa) working pressure.

- Cementing Standpipe - Two (2) Hammer unions at rig floor.

- Rotary Hose - Two (2) 3-1/2 inch (89 mm) x 75 ft (22.9 m) long with 4 inch (100 mm) NPT built in leak-proof male connections, test pressure 10,000 psi (69.0 MPa) complete with safety hobbles.

B.14 Drill String

Drillpipe includes:

- 12,000 ft (3658 m) of 5 inch (127 mm) OD x 19.50 lb/ft (29.07 kg/m) IEU Grade "G" Range 2 with 6-3/8 inch (162 mm) OD x 8-1/2 inch (89 mm) ID 18° Taper Hughes extra hole tool joints (4-1/2 IF), and internal plastic coating.

- 12 joints of 5 inch (127 mm) OD Hevi Wate Heavy Wall range 2, 30.5 ft (9.3 m) overall length with 6-1/2 inch (165 mm) OD x 3-1/8 inch (79 mm) ID 18° Taper Drilco extra hole tool joints (4-1/2 IF), internal plastic coating and hardbanding.

- 8,000 ft (2438 m) of 5 inch OD x 19.5 lb/ft, Grade "E", Range II, with 4-1/2 IF extra hole tool joints, internal plastic coating and hardbanding.

Drill Collars include:

- Ten (10) 4-3/4 inch OD x 2 inch ID with NC-35 connections with 12 inch hardband on each end.

- Thirty (30) spiral grooved, 6-1/2 inch (165 mm) OD x 2-13/16 inch (71 mm) ID x 30 ft (9.1 m) approx. overall length, with 4-1/2 inch IF box to pin connections, Drilco bore back on boxes and API stress relief on pins, double zipped lift elevator and slip recesses.

- Thirty (30) spiral grooved, 8 inch (203 mm) OD x 2-13/16 inch (71 mm) ID x 30 ft (9.1 m) approx. overall length, with 6-5/8 inch Reg box to pin connections, Drilco bore back on boxes and API stress relief on pins, single zip lift slip recess.

Miscellaneous:

- Casing Racks - Mounted on the deck area are racks for casing and rotary tubulars. Storage capacities of these racks meet the requirements for two 16,400 ft (5000 m) Beaufort Sea wells.

- Pipe Handling System - All sizes up to 42 inch (1067) mm) casing handling capacity. Mereco pipe handler complete with single hydraulic power unit and two control consoles for racking area and drill floor.

- Derrick Floor Winches - Two (2) pneumatic operated with automatic brake, Ingersoll Rand K6ULAB on drill floor.

- Racking Platform Winch - Electrically operated with automatic brake.

B.15 Auxiliary Equipment

Well test equipment includes:

- Wire Line Unit - Abcor hydraulic drive motor, variable speed transmission, skidder brake, type "O" measuring device, 20,000 ft (6096 m) of 0.092 inch (2.3 mm) regular wireline installed on drum, Neoprene cover and Hay pulley.

- High Pressure Piping - All oil, gas, water lines manifolded for treater, heater, testing, and flare booms.

- Production Test Flare Booms - Two (2) 75 ft (23 m) flare booms with king posts and piping.

APPENDIX

C

APPENDIX C. SUPPORT VESSELS DESCRIPTIONS

The SSDC will be supported by three (3) arctic class icebreaking tug/supply vessels of Canadian registry during mobilization and demobilization activities at the Fireweed Prospect. Although the specific vessels to be used have not yet been finalized, they are expected to be of similiar size and configuration to the M/V Kiogoriak and the M/V Supplier and M/V Supplier II. Specifications of these support vessels are described below.

C.1 M/V Kigoriak

Specifications for the M/V Kigoriak (Figure C-1) are as follows:

1) General Information:

Port of Registry	Vancouver, B.C.
Vessel type	Icebreaking, Anchor Handling, Supply Vessel
Date Commissioned	1979
Classification	Lloyds 100 A1 Icebreaker, anchor handling, supply tug supply, Arctic Class 3

2) Principle Dimensions:

Dimensions	LOA 90.7 m Beam (moulded) 17.25 m Depth (moulded) 10.0 m Draft 8.5 m
Tonnage (ST)	3646.5 gross 1240.6 net
Deadweight	1976 tonnes
Fuel Capacity	1329 m^3

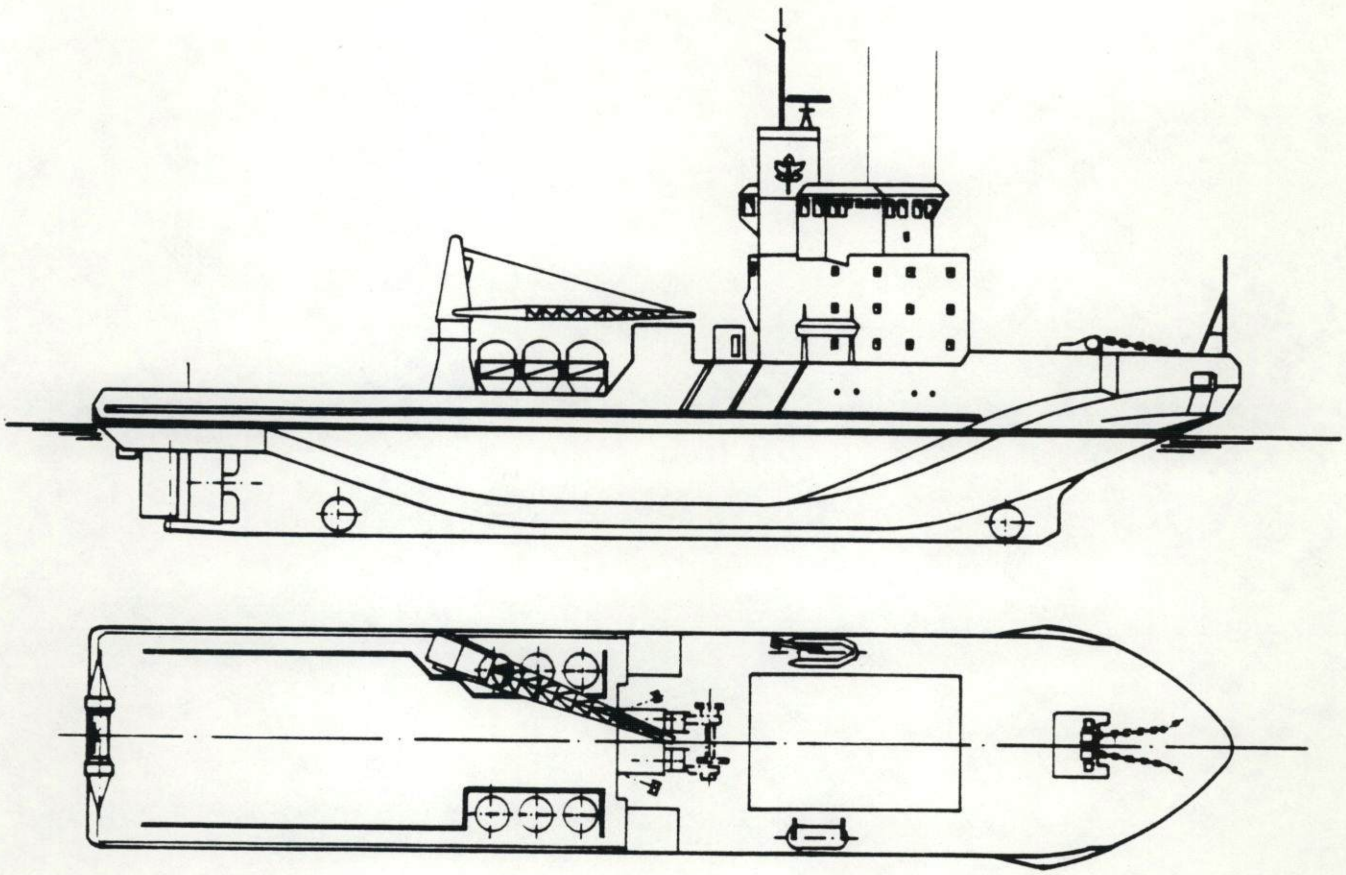


Figure C-1. Schematic of the M/V Kigoriak.

2) Principle Dimensions (Cont'd):

Accommodations	Total 34 (19 crew)

3) Propulsion:

Main Propulsion	Two Sulzer 12ZV30/48 turbo-charged 8,400 BHP each throng Renk gearbox to one shaft and 4 blade LIPS C.P. in nozzle
BHP (Registered)	16,800
Auxiliary Machinery	Four CAT 353, each 300 Kw
Thrusters	Two 1200 HP through LIPS 4 blade C.P. electric drive
Speed	16.5 knots

4) Deck Equipment:

Deck Machinery	Two tugger winches 9 tonnes
	Two Smatco storage reels
	Two capstans 12 tonnes
	One electrohydraulic trip drum type anchor handling/two winch of waterfall type
	One crane 20 tonnes lift

5) Bridge Equipment: Modern to IMO and MOT standards

Two gyro compasses

One auto pilot

Four maneuvering positions

One winch control position with T.V. monitors

One X band radar

One S band radar with one slave

Eight search lights

Two SSB transceivers

One watch receiver

Two air to ground radios

Two multi-channel VHF radios with 2 slaves

One CB radio

One echo sounder

Two doppler speed logs

Six VHF portable radios

One D/F receiver

One facsimile receiver

One mobile PBX phone with fax transceiver

One mini ranger navigator

5) Bridge Equipment (Cont'd): One survey type Sat Nav

One Loran C navigator

C.2 M/V <u>Supplier</u> and M/V <u>Supplier II</u>

Specifications for the M/V Supplier and M/V Supplier II (Figure C-2) are as follows:

1) General Information:

Vessel type	Icebreaking, Anchor Handling, Supply Vessel
Date Commissioned	1979
Classification	Lloyds +100 A1 Ice Class I Arctic Class 2

2) Principle Dimensions:

Dimensions	LOA 62.5 m Beam (moulded) 13.7 m Depth (moulded) 5.6 m Draft 4.3 m
Tonnage (ST)	1190 gross 387 net
Deadweight	1010 tons
Fuel Capacity	471 m^3
Accommodations	Total 16 (13 crew)

3) Propulsion:

Main Propulsion	Nohab Polar F216V-D825-3520 BHP x 2 Ka Me Wa C.P. propellers in fixed nozzles

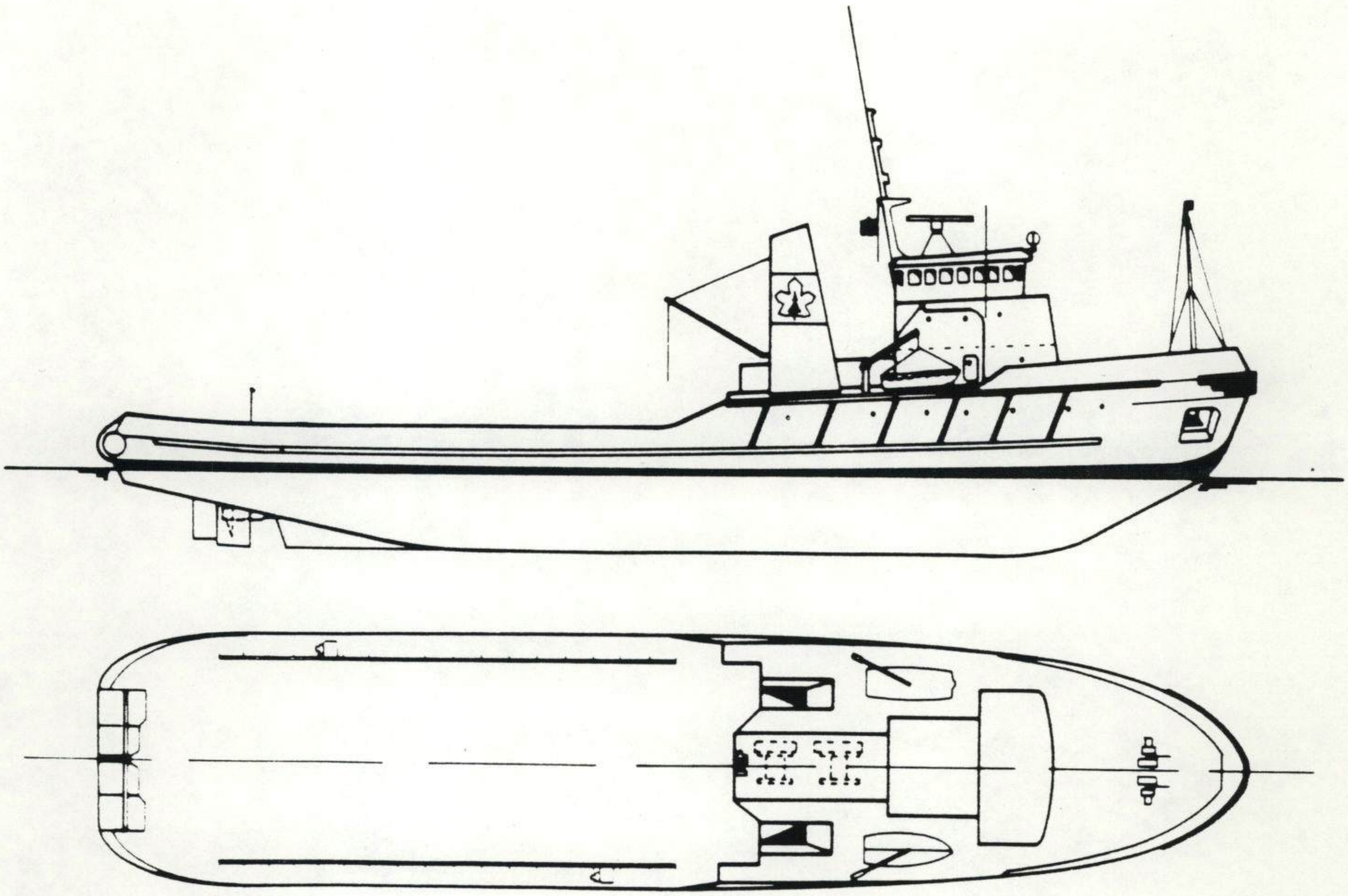


Figure C-2. Schematic of the M/V Supplier and M/V Supplier II.

3)	Propulsion (Cont'd):	
	BHP (Registered)	7040
	Auxiliary Machinery	Two Cat D343 A generators 200 Kw continuous output
	Thrusters	Hydraulic Brunvoll S.P.K. 350 Thrust 3175 kg
	Speed	14 knots
4)	Deck Equipment:	
	Deck Machinery	Four 4536 kg line pull tugger winches
		Two 6804 kg line pull capstans
	Towing and Work Winch	Hydraulic double drum of waterfall type
		Maximum pull bare drum 136,080 kg
		Capacity towing drum 914.4 m of 5.7 dia. wire
		Capacity work drum 487.7 m of 5.7 cm dia. wire
5)	Bridge Equipment:	Modern to IMO and MOT standards
		One gyro compass
		One auto pilot
		One facsimile receiver
		One D/F receiver
		One Omega receiver

5) Bridge Equipment (Cont'd): Four maneuvering control stations

One S band radar

One X band radar

Two SSB transceivers

Two VHF multi-channel radios

Four VHF portable radios

One air to ground radio

One CB radio

Two search lights

EXPLORATION PLAN

LIST OF ATTACHMENTS

ATTACHMENT

1

1.0 GEOLOGICAL AND GEOHAZARDS INFORMATION

This Exploration Plan covers the Fireweed Prospect wells located in OCS-Y-0267 and OCS-Y-0268 in Lease Sale Area 71. The surface location for both wells are at the following geographic coordinates:

Latitude	71° 5' 18.93" N
Longitude	152° 36' 23.43" W

General geological information requested under 30 CFR 250.33(b)(1)(i-vii) for the site is provided in Exhibit 1-1. Geotechnical surveys for the Fireweed Prospect are scheduled to be conducted during April 1990 and these data will be provided as Exhibit 1-2 as they become available. Geohazards surveys have previously been conducted by Shell Western E&P, Inc. and will be provided as Exhibit 1-3. All of these exhibits are proprietary documents.

ATTACHMENT

2

2.0 OIL SPILL CONTINGENCY PLAN

An Oil Spill Contingency Plan (OSCP) has been prepared in conformance with 30 CFR 250.42. This Plan is provided separately as Exhibit 2-1.

ATTACHMENT

3

3.0 LEASE STIPULATIONS

This section discusses lease stipulations for ARCO's proposed activities at the Fireweed Prospect wells. Pertinent stipulations for this plan are those from OCS Lease Sale 71.

Stipulation No. 1 - Royalty Rates

This stipulation is related to royalty rates for production activities and is not applicable for exploration activities covered under this plan.

Stipulation No. 2 - Protection of Archaeological Resources

Available side scan sonar records from site surveys to be conducted in April 1990 will be reviewed; evidence of potential archaeological resources (including shipwrecks) will be noted in any of the records. In addition, no indication was provided in the EIS for Sale 71 and 97 that archaeological resources will occur in any of the lease blocks to be drilled.

North Slope Borough, state, and federal records have been reviewed and no record has been found of archaeological resources at onshore staging and logistical support sites that will be utilized by the proposed activities.

Stipulation No. 3 - Orientation Program

ARCO's proposed orientation program includes a video presentation and a pocket environmental guide. This program is provided as a separate submittal.

The video program will be viewed at least once a year by all personnel involved in on-site exploration or development and production activities and by all supervisory and managerial personnel involved in lease activities.

Stipulation No. 4 - Pipelines

Pipelines/commercial transport of hydrocarbons is not anticipated as part of the proposed exploration activities. Consequently, this stipulation does not apply to the activities covered by this Exploration Plan.

Stipulation No. 5 - Fall Bowhead Whale Migration

ARCO is requesting permission to conduct drilling activities above the threshold depth (approximately 2,500 feet TVD) starting in late September or early October 1990, which will overlap with the timing of fall bowhead whale migration (generally between September 1 through October 31). If this permission is granted, ARCO will implement a monitoring program , which will both increase the database on bowhead whales and provide a means of detecting the presence of bowheads in the vicinity of the proposed drilling operations.

The details of the monitoring program are presently being finalized, but will contain the following components:

1. Passive acoustic monitoring using hydrophones at two locations--one near the SSDC and another at another location in the mid-Beaufort Sea. The hydrophones are designed to record bowhead whale calls; and range, bearing and travel direction can also be determined.

2. Aerial surveys will be conducted to expand the areal coverage of the two acoustic monitoring systems.

3. Consultation with local whaling communities, primarily Barrow and Nuiqsut, prior to drilling activities, to determine and possibly mitigate local concerns. These activities have already been initiated.

The program will be particularly significant in that direct effects of drilling from a bottom-founded structure on bowhead whales in the Alaskan Beaufort Sea can be monitored on a controlled experimental basis.

The complete monitoring plan for bowhead whales and summaries of local consultation activities will be submitted to MMS for review and comment at least 60 days prior to commencing approved drilling operations.

Stipulation No. 6 - Drilling in Broken Ice Conditions

ARCO's preparedness to respond to broken ice conditions is demonstrated in the Oil Spill Contingency Plan (Exhibit 2-1).

Stipulation No. 7 - Effluent Discharges

Effluent discharges will be conducted in conformance with the modified EPA NPDES General Permit for the Beaufort Sea (No. AKG284100) as described in Section 4.0.

Stipulation No. 8 - Protection of Biological Resources

Exploration activities proposed by ARCO are not expected to adversely affect identified areas of special biological sensitivity.

The RSFO has not yet determined if biological surveys are required for the site.

Stipulation No. 9 and 10 - Disputed Tracts

The Fireweed Prospect drillsite is not located in any of the lease tracts included in this stipulation.

ATTACHMENT

4

4.0 DRILLING FLUIDS

Only EPA approved generic muds and specialty additives will be discharged from the proposed exploratory operations. It is currently anticipated that Type 1 muds, freshwater polymer muds, will be used for the proposed activities (see Table 4-1). Other authorized mud types and specialty additives contained in Tables 4-1 and 4-2 may be required depending on actual drilling conditions encountered.

All drilling muds and cuttings will be disposed of through the solids disposal trough located near the stern and extending downward from the side of the SSDC. Seawater is continuously pumped through the trough to ensure the removal of solids.

An estimated 10,000 barrels of drilling mud and cuttings will be discharged from the exploratory well. The maximum discharge rate for drilling muds, cuttings, and washwater during open water and/or broken ice periods will be 750 bbl/hr for the wells; water depths are 20 to 40 meters.

Mineral oil pills, if required, will consist of components authorized by EPA and indicated in Table 4-3. Mineral oil pills and drilling muds potentially contaminated with mineral oil will be handled in a manner consistent with the modified General NPDES Permit.

All other requirements as covered in the modified General EPA Permit No. AKG284100 will also be strictly adhered to.

Table 4-1. Authorized Drill Mud Types

Components	Maximum Allowable Concentration (lb/bbl)	Components	Maximum Allowable Concentration (lb/bbl)
1. **Seawater/Freshwater/Potassium/Polymer Mud**		4. **Non-Dispersed Mud**	
KCl	50	Bentonite*	50
Starch	12	Acrylic Polymer	2
Cellulose Polymer	5	Lime	2
Xanthum Gum Polymer	2	Barite	180
Drilled Solids	100	Drilled Solids	70
Caustic	3	Seawater/Freshwater	As needed
Barite	575		
Seawater/Freshwater	As needed		
2. **Seawater/Lignosulfonate Mud**		5. **Spud Mud**	
Bentonite*	50	Lime	2
Lignosulfonate, Chrome or Ferrochrome	15	Bentonite*	50
Lignite, Untreated or Chrome-treated	10	Caustic	2
Caustic	5	Barite	50
Lime	2	Soda Ash/Sodium Bicarbonate	2
Barite	575	Seawater	As needed
Drilled Solids	100		
Soda Ash/Sodium Bicarbonate	2		
Cellulose Polymer	5		
Seawater/Freshwater	As needed		
3. **Lime Mud**		6. **Seawater/Freshwater Gel Mud**	
Lime	20	Lime	2
Bentonite*	50	Bentonite*	50
Lignosulfonate, Chrome or Ferrochrome	15	Caustic	3
Lignite, Untreated or Chrome-treated	10	Barite	50
Caustic	5	Drilled Solids	100
Barite	575	Soda Ash/Sodium Bicarbonate	2
Drilled Solids	100	Cellulose Polymer	2
Soda Ash/Sodium Bicarbonate	2	Seawater/Freshwater	As needed
Seawater/Freshwater	As needed		

* Attapulgite, sepiolite, or montmorillonite may be substituted for bentonite.

Table 4-2. Authorized Mud Components/Specialty Additives.

Product Name	Generic Description*	Maximum Allowable Concentration (lb/bbl, unless otherwise noted)**
Aktaflo-S	Aqueous solution of non-ionic modified phenol (equivalent of DMS)	3 (3)**
Aluminum stearate	--	0.2+
Ammonium nitrate	--	200 mg/l nitrate or 0.05 lb/bbl
Aqua-Spot	Sulfonated vegetable ester formulation	1% by vol.
Bara Brine Defoam	Dimethyl polysiloxane in an aqueous emulsion	0.1
Baratrol	Sulfonated asphalt residuum	6
Barazan	Xanthum gum polymer	2
Ben-Ex	Vinyl acetate/maleic anhydride copolymer	1 (1)**
Bit Lube II	Fatty acid esters and alkyl phenolic sulfides in a solvent base	2
Calcium carbide	--	As needed+
Cellophane flakes	--	As needed+
Chemtrol-X	Polymer treated humate	5 (4)**
Con Det	Water solution of anionic surfactants	0.4 (0.25)**
D-D	Blend of surfactants	0.5 (0.25)**
DMS	Aqueous solution of nonionic modified phenol	3 (3)**
Desco	Chrome-free organic mud thinner containing sulfomethylated tannin	0.5
Duovis	Xanthan gum	2

NOTE: Any of the additives listed below may be discharged in generic muds 2 through 6. Those additives marked "+" may be discharged in generic mud 1.

Table 4-2. Authorized Mud Components/Specialty Additives (Cont'd).

Product Name	Generic Description*	Maximum Allowable Concentration (lb/bbl, unless otherwise noted)**
Durenex	Lignite/resin blend	6 (4)**
Enviro Torq	Liquid triglycerides in vegetable oil	6
Flakes of silicate mineral mica	--	45+
Gelex	Sodium polyacrylate	1 (1)** and polyacrylamide
Geltone, Geltone II	Organophilic clay	12
Glass beads	--	8+
LD-8	Aluminum stearate in propoxylated oleylalcohol	10 gal/1500 bbl
Lube-106	Oleates in mixed alcohols	2
Lubri-Sal	Vegetable ester formulation	2.0% (by vol)
MD (IMCO)	Fatty acid ester	0.25 (0.25)**
Milchem MD	Ethoxylated alcohol formulation	0.4 gal/bbl or 0.3 (0.25) lb/bbl**
Mil-Gard	Basic zinc carbonate	As needed+
Nut hulls, crushed granular	--	As needed+
Oxygen scavenger	Ammonium bisulfate	0.5
Phosphoric acid esters and triethanolamine	--	0.4
Plastic spheres	--	8+
Poly RX	Polymer treated humate	4 (4)**
Resinex	Reacted phenol-formaldehyde-urea resin containing no free phenol, urea, or formaldehyde	4 (4)**

NOTE: Any of the additives listed below may be discharged in generic muds 2 through 6. Those additives marked "+" may be discharged in generic mud 1.

Table 4-2. Authorized Mud Components/Specialty Additives (Cont'd).

Product Name	Generic Description*	Maximum Allowable Concentration (lb/bbl, unless otherwise noted)**
Selec-Floc	High molecular weight poly-acrylamide polymer packaged in light mineral oil	0.25
SID	Demethyl polysilorane in an aqueous emulsion	0.1
Soldium chloride	--	50,000 mg/l chloride
Sodium nitrate	--	200 mg/l nitrate or 0.05 lb/bbl
Sodium polyphosphate	--	0.5+
Soltex	Sulfonated asphalt residuum	6
Sulf-X ES	Zinc oxide	As needed
Therma Check	Sulfono-acrylamide copolymer	1
Therma Thin	Polycarboxylic acid salt	4
Torq-Trim II	Liquid triglycerides in vegetable oil	6
Vegetable plus polymer fibers, flakes, and granules	--	50+
VG-69	Organophilic clay	12
XC Polymer	Xanthan gum polymer	2
X-Tend II	Vinyl acetate/maleic anhydride copolymer	1 (1)**
XO_2	Ammonium bisulfite	0.5
Zinc carbonate and lime	--	As needed+

NOTE: Any of the additives listed above may be discharged in generic muds 2 through 6. Those additives marked "+" may be discharged in generic mud 1.

* Any proprietary formulation that contains a substance which is an intentional component of the formulation, other than those specifically described, must be authorized by the Director.

** If a listed product will be used in combination with other functionally equivalent products, the maximum allowable concentration (MAC) for the sum of all of the products is the lowest MAC for any of the individual products. Four examples of functionally equivalent products are: (1) Aktaflo-S and DMS, MAC = 3 lb/bbl; (2) Ben-Ex and Gelex, MAC = 1 lb/bbl; (3) Chemtrol-X, Durenex, Poly RX, and Resinex, MAC = 4 lb/bbl, and (4) Con Det, D-D, MD (IMCO), and Milchem MD, MAC = 0.25 lb/bbl. For these examples, the MAC for any combination of the products is given in parentheses. For guidance on whether other products are considered to be functional equivalents, contact the regional office of EPA.

Table 4-3. Authorized Mineral Oil Pill Components

List A - Spotting Compounds

Black Magic SFT
EZ Spot[NT]
Kenol ES
Kwikspot
Pipelax SF
Halliburton Pill*
  Halliburton MO-55
  Halliburton MO-56
  Hyflow IV
  Mineral Oil from List B

List B - Mineral Oil Products

Conoco LVT
DOS 3
Gulf Mineral Seal Oil
LVT
Mentor 28
Vista OOC

Pre-Mixed Mineral Oil Pills

Black Magic LT**

* The Halliburton Pill has been authorized according to the formulation listed above.

** Black Magic LT is a complete mineral oil pill that is pre-mixed.

NOTES:

1. These lists were compiled by Region 10 based on the products requested and authorized under previous general permits for the Alaskan OCS.

2. None of the listed products may be discharged in generic mud 1. Refer to Sections 11.8.1.e and f of the permit for discharge requirements.

3. One product from List A and one product from List B may be combined to formulate a mineral oil pill. Products from List B may also be used individually as a spot.

4. Any mineral oil pill components not listed above must be authorized by Region 10 <u>prior</u> to discharge.

5. Any deviations from this will be authorized previously by the appropriate agencies.

ATTACHMENT

5

5.0 HYDROGEN SULFIDE PLAN

The probability of H_2S at the Fireweed Prospect is currently unknown, however, based on regional considerations, H_2S is not expected. In any event, an H_2S Contingency Plan has been prepared in accordance with 30 CFR 250.67 and is provided as Exhibit 5-1.

ATTACHMENT

6

6.0 NEW OR UNUSUAL TECHNOLOGY

Equipment and technology proposed for the drilling operations have been in use in arctic conditions for the past decade and are considered to be neither new or unusual.

Certain operational procedures manuals and data available to ARCO or its contractors are considered proprietary. Specifically these include:

1. Single Steel Drilling Caisson (SSDC), Critical Operations and Curtailment Plan (Exhibit 6-1)

2. Fireweed Geological Data (Exhibit 1-1)

3. Fireweed Geotechnical Data (Exhibit 1-2)

4. Fireweed Geohazards Survey Data (Exhibit 1-3)

ATTACHMENT

7

7.0 SUPPORT FACILITIES

7.1 General

Exploration drilling activities will be directed from the ARCO Alaska, Inc. office located at 700 "G" Street, Anchorage, Alaska. Drilling operations will be supported by ground, aviation and limited marine logistics activities. Operations will be supported entirely using existing facilities and no new facilities will need to be constructed.

7.2 Aviation Logistics Activities

Crews and other support personnel and supplies will be flown to Deadhorse using available commercial or chartered aircraft from Anchorage, Fairbanks or Canada. Personnel and equipment will then be transferred by helicopter transport to the drill site. Should helicopter operations be delayed by weather or other factors, personnel will be temporarily housed in existing ARCO and commercial facilities available in the Deadhorse/Prudhoe Bay area.

Aviation support will be accomplished with helicopters based at the existing ERA facility at Deadhorse. Although the final helicopter selection has not yet been made, it will likely be Bell 212's, 412's or their equivalent. These helicopters accommodate 10 to 13 passengers, have the required range, fly at 110 to 115 knots, and are instrument-rated aircraft.

Helicopter flights will average one or two per day for handling crew changes and hauling food or other supplies to the drill unit. Flight patterns used will follow a direct route between the Deadhorse and the Fireweed Prospect as indicated on Figure 7-1. During the fall bowhead whale out-migration period (September 1 through October 31), helicopters will use a more southerly route to minimize over-water flight time. The flying time to make the 100 mile trip to the SSDC will require a flying time of just under one hour.

The helicopter operations will be supported by a crew of approximately 10 to 12 persons at any one time and will include primarily pilots and mechanics. This support staff will be housed in existing ERA facilities at Deadhorse. Hanger and other storage facilities are available at the ERA camp to support the helicopter operations.

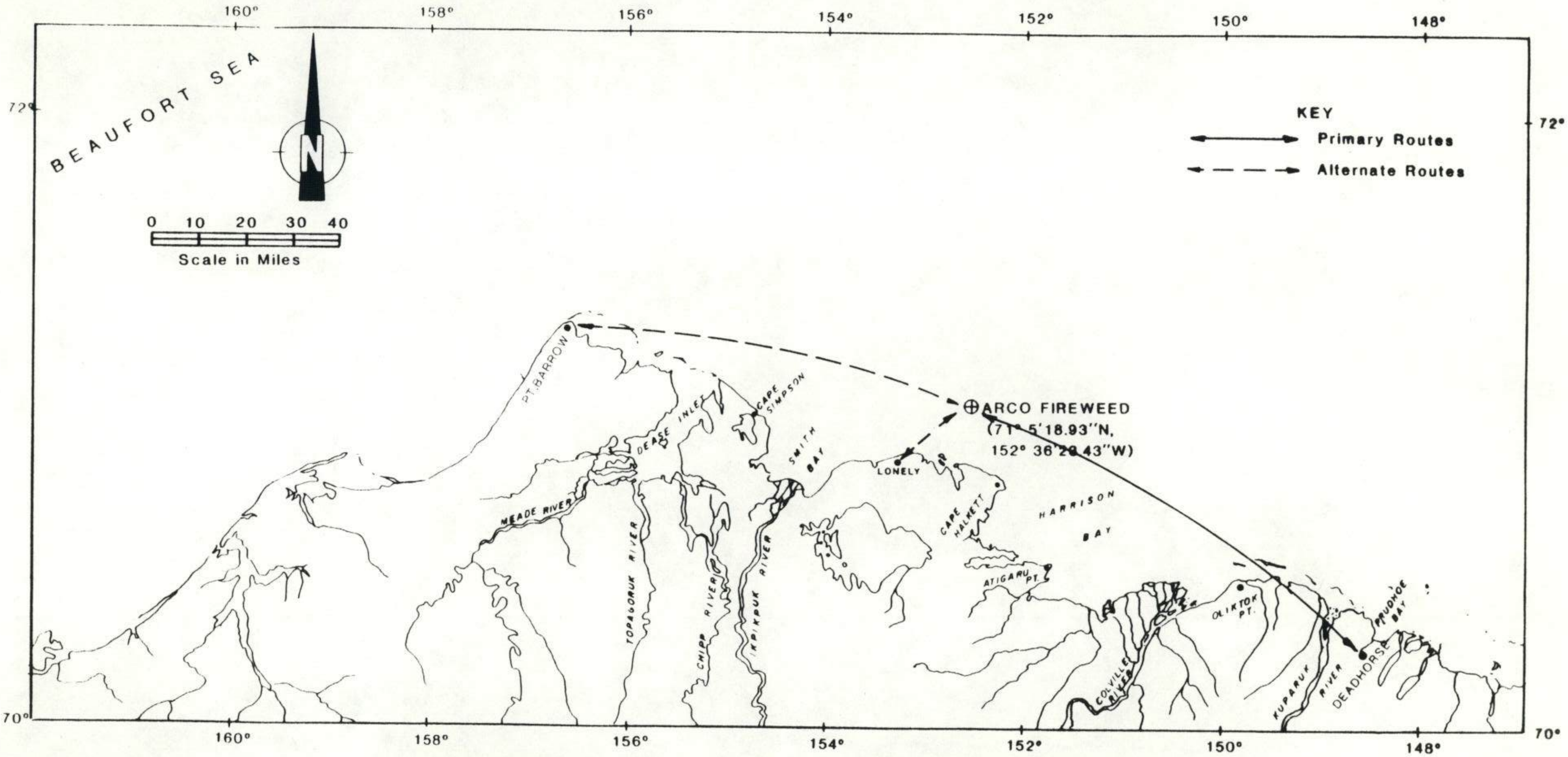


FIGURE 7-1 Flight Patterns

The Deadhorse/Prudhoe Bay area is designated as the principal base-of-operations for aviation logistics to drill sites. However, to accommodate the uncertainty of weather conditions along the flight corridor, Lonely and Barrow are designated as potential alternative helicopter landing sites. Existing facilities at Lonely include a 5,100-foot gravel airstrip and aircraft parking aprons.

A dedicated temporary helicopter fuel tank may be required at Lonely, depending upon aircraft type. Barrow has extensive existing commercial and private facilities. Scheduled or chartered fixed-wing aircraft routing schedules are also available if necessary.

7.3 Ground Transportation

Although helicopters will be the primary means of support for the SSDC, ground transportation may be required to haul large or heavy items to or from the SSDC during periods of solid ice cover. If necessary, Rolligons will be used as the primary mode of ground transport. As ground transportation requirements are expected to be minimal, construction of an ice road is not anticipated. Rolligons and other such ground support will be provided from existing contractors located in the Deadhorse area.

7.4 Marine Logistics Activities

Marine transportation activities will be limited to those activities required primarily for placement and recovery of the SSDC on and off the Fireweed Prospect. For these activities, it is expected that 2 to 3 CANMAR ice breaking tugs will be required for less than a one-week period for each activity (e.g. deployment and recovery). These vessels will not remain in the area during the winter drilling program.

It is anticipated that most drilling supplies, including the fuel necessary to complete the activities, will be stored onboard the SSDC. Should additional fuel or items which are too large for helicopter transport be required during open water periods, these items will be hauled from the Prudhoe Bay and/or Oliktok Point areas using available U.S. flag vessels. Resupply vessels will follow fairly direct routes between the resupply point and the SSDC.

ATTACHMENT

8

8.0 ONSHORE SUPPORT

Onshore support operations for the Fireweed Prospect will be provided primarily through the extensive facilities available in the Deadhorse/Prudhoe Bay region. Although specific arrangements have not yet been finalized for the project, facilities available include those at ARCO's Prudhoe Bay Operations Center (PBOC) and ARCO's Main Construction Camp (MCC), as well as a number of commercial facilities in the Deadhorse area. These existing onshore facilities will be used primarily to provide logistical support for manpower transfer, resupply of perishable goods, and staging for resupply of expendable materials used in support of the drilling activities.

Marine support, if required, will likely be accommodated from either the West Dock at Prudhoe Bay or possibly from existing facilities at Oliktok Point.

Ground support, during periods of solid ice, will be accommodated using existing facilities in the Deadhorse area.

Camp Lonely may also be considered as a forward support/resupply facility. The camp, leased by Cook Inlet Region, Inc. (CIRI), is located on a 10-acre gravel pad which includes housing, offices, support services, and bed space for approximately 100 people. The camp has been mothballed since 1981; however, portions of the camp could be reactivated, if necessary.

The use of all proposed facilities will not require the acquisition, expansion, or construction of additional onshore support facilities. Air emissions from the operation of all onshore support facilities are not expected to vary significantly during the operations period from those air emissions produced during routine camp operations.

ATTACHMENT
9

9.0 DISCHARGES

9.1 General

The solid and liquid wastes likely to be generated by the offshore and onshore operations as well as the transportation operations are presented under two categories: 1) NPDES regulated discharge from drilling activity and 2) other wastes generated by drilling activity support operations. These are summarized in the following sections.

9.2 Offshore Drilling Discharges

The most prominent, regulated drilling discharges have been presented under Section 4.0. Drilling fluids and cuttings will not be discussed under Section 9.0. Drilling muds and cuttings are considered the major discharges associated with exploratory drilling activities. Other discharges, such as sanitary waste, grey water waste, desalination wastewater, boiler blowdown, well test fluids (no-oil), ballast or bilge water, deck drainage, etc. are considered minor discharges.

Of the minor discharges, deck drainage is expected to be a large volume discharge with an estimated average of 13,000 to 25,000 gallons per day (GPD). Sanitary discharges are estimated at 7,000 to 11,000 GPD. Another minor discharge includes desalination at an estimated 15,000 GPD of seawater with higher than ambient seawater salinity. Other small volume discharges are considered insignificant (i.e., ballast or bilge waste discharges).

In any event, all offshore discharges from exploratory drilling support operations will be monitored under the provisions of General NPDES Permit AKG 284100, including chemical inventory, testing, monitoring, and reporting.

9.3 Offshore Transportation Discharges

The limited marine transportation carriers will produce domestic (grey water), sanitary, and non-contact cooling water liquid wastes. These marine support vessels required for mobilization and demobilization of the SSDC will discharge liquid wastes after onboard treatment in accordance with currently mandated legislation.

Solid wastes will be generated on the marine support vessels and the SSDC. Solid wastes are classified as combustible and non-combustible. The SSDC is expected to produce a total of 350 to 500 pounds per day of combustible and non-combustible solid wastes in addition to solid waste drilling discharges. It must be noted that intermittent increases in daily amounts will occur, particularly during rig setup, demobilization, and during the use of crated drilling muds.

All solid wastes not incinerated onboard will be transported to shore for proper disposal in the Deadhorse/Prudhoe Bay area. No solid wastes will be discharged offshore.

9.4 Onshore Discharges

Onshore discharges will primarily be confined to the camp facilities, which are currently serviced by existing utility systems and package treatment plants. Helicopter maintenance items, such as solvents and oils, will be segregated at the shop facility and stored for proper treatment and disposal in accordance with current regulations.

Solid wastes associated with onshore facilities are expected to normally produce 75 to 150 pounds per day, but may experience daily fluctuations. Onshore operations are fully capable of supporting solid waste disposal in Deadhorse, Alaska.

ATTACHMENT
10

10.0 METEOROLOGY

10.1 General Weather Patterns

The Fireweed Prospect on the Alaskan arctic coast is normally influenced by Arctic air masses, and as such, has a relatively harsh climate throughout the year.

Winter temperatures are consistently cold, and summer temperatures are cool. The well area is unusual in that it has a maritime climate during the summer and fall when the ocean is open and has a modified continental climate during the winter and spring when sea ice covers the area. Moisture is plentiful and fog and low clouds are common, although precipitation is light. The number of cloudy days for the coastal area averages 200 per year with the maximum cloudiness occurring in July through September and the maximum clear days occurring in February and March. Gale force winds blow frequently along the coastal area and hurricane velocities have been recorded.

Barrow (about 90 miles to the west) and Barter Island (about 235 miles to the east) have the longest weather data records for Beaufort Sea locations, and these data have been used to infer general conditions at the site. Shorter-term data sets are available from Prudhoe Bay and are also used in this section. Summaries of meteorological data from these three sites are provided in Tables 10-1 through 10-3.

Air Temperatures

At Prudhoe Bay, the mean annual maximum temperature (daily average) is 16.5°F (-8.6°C), and the mean annual minimum is 3.3°F (-15.9°C). The highest temperature recorded is 70°F (21°C); the lowest temperature is -57°F (-49°C) (Leslie, 1989).

The temperatures at Barrow and Barter Island are very similar in range; Prudhoe Bay, on the other hand, is shown to have cooler winter and warmer summer temperatures, indicating a climate of a more continental type. All stations show mean monthly temperatures below freezing except in June, July, and August. July temperatures are the warmest and February temperatures are the coldest.

Table 10-1. Climatic Summary for Barrow from 1949 to 1987 (Leslie, 1989).

LATITUDE 71 18 N — LONGITUDE 156 47 W — ELEVATION 20 FEET

	TEMPERATURE (DEGREES F)												PRECIPITATION (INCHES)									
	MEANS			EXTREMES				MEAN # DAYS				HEAT DEGREE DAYS				MEAN # DAYS PRECIP EXCEEDED			SNOW			
								MAX		MIN												
MTH	MAX	MIN	MTH	REC HI	YR	REC LO	YR	70+	32-	0-	32-	MTH MEAN	MEAN MTH TOT	MAX DAY	YR	0.5	.25	0.1	MEAN MTH TOT	MAX DPTH	YR	MEAN DAYS 1.0
JAN	-7.4	-19.9	-13.7	36.0	74	-53.0	51	0.0	30.9	28.8	31.0	2450.9	0.20	0.47	62	0.0		0.4	2.3	22.0	62	31.0
FEB	-13.3	-25.1	-19.2	36.0	82	-54.0	64	0.0	28.2	27.2	28.2	2380.5	0.18	0.30	59	0.0		0.3	2.2	29.0	62	28.3
MAR	-9.2	-21.5	-15.4	33.0	67	-52.0	71	0.0	31.0	30.1	31.0	2500.6	0.15	0.70	63	0.0		0.3	1.8	30.0	62	31.0
APR	4.8	-9.0	-2.2	38.0	67	-38.0	86	0.0	29.3	23.6	30.0	2015.4	0.20	0.42	63	0.0		0.5	2.4	30.0	62	30.0
MAY	23.8	14.0	18.9	43.0	79	-19.0	84	0.0	27.4	2.9	30.9	1421.8	0.16	0.29	62	0.0		0.2	1.9	25.0	63	29.8
JUN	37.8	29.5	33.7	63.0	61	4.0	69	0.0	4.9	0.0	24.1	933.8	0.36	0.82	55	0.0	1.0	0.9	0.7	14.0	50	5.2
JUL	44.7	33.4	39.0	75.0	60	26.0	56	0.1	0.1	0.0	14.7	797.9	0.87	1.28	87	0.2	0.0	2.7	0.4	1.0	61	0.0
AUG	42.3	33.3	37.9	76.0	68	21.0	56	0.1	2.3	0.0	15.6	834.4	0.97	0.83	60	0.1	0.0	3.4	0.7	2.0	55	0.3
SEP	33.9	27.2	30.6	62.0	57	1.0	57	0.0	13.1	0.0	24.9	1029.8	0.64	0.56	59	0.0	1.5	2.1	3.9	7.0	87	7.2
OCT	19.1	9.9	14.5	43.0	54	-32.0	70	0.0	28.8	7.4	30.8	1567.7	0.51	0.45	72	0.0	0.0	1.1	6.3	12.0	64	28.6
NOV	4.8	-6.2	-0.7	37.0	50	-38.0	56	0.0	29.9	21.5	30.0	1977.5	0.27	0.39	58	0.0	0.0	0.6	3.4	14.0	51	30.0
DEC	-6.0	-17.6	-11.8	32.0	72	-51.0	74	0.0	31.0	28.9	31.0	2387.1	0.17	0.21	67	0.0	0.0	0.3	2.1	16.0	65	31.0
	AVE	AVE	AVE	REC		REC		TOT	TOT	TOT	TOT	TOT	TOT	REC		TOT	TOT	TOT	TOT	REC		TOT
YEAR	14.6	4.0	9.3	76.0		-54.0		0.2	256.8	170.5	322.3	20297.4	4.67	1.28		0.4	2.5	12.9	28.2	30.0		252.4

Table 10-2. Climatic Summary for Barter Island from 1947 to 1987 (Leslie, 1989).

LATITUDE
70 07 N

LONGITUDE
143 40 W

ELEVATION
40 FEET

	TEMPERATURE (DEGREES F)												PRECIPITATION (INCHES)									
	MEANS			EXTREMES				MEAN # DAYS				HEAT DEGREE DAYS				MEAN # DAYS PRECIP EXCEEDED			SNOW			
								MAX		MIN												
MTH	MAX	MIN	MTH	REC HI	YR	REC LO	YR	70+	32-	0-	32-	MTH MEAN	MEAN MTH TOT	MAX DAY	YR	0.5	.25	0.1	MEAN MTH TOT	MAX DPTH	YR	MEAN DAYS 1.0
JAN	-7.8	-20.5	-14.2	39.0	62	-54.0	75	0.0	30.8	28.6	31.0	2465.0	0.48	2.25	62	0.1	0.5	1.0	5.0	43.0	50	31.0
FEB	-13.9	-26.4	-20.1	37.0	82	-59.0	50	0.0	28.1	27.1	28.3	2407.1	0.23	1.22	55	0.0	0.0	0.6	2.7	43.0	50	28.2
MAR	-8.5	-22.4	-15.5	36.0	67	-51.0	73	0.0	31.0	30.0	31.0	2495.8	0.22	0.54	67	0.0	0.0	0.7	2.6	47.0	55	31.0
APR	6.8	-9.5	-1.3	43.0	58	-44.0	87	0.0	29.3	23.6	30.0	1992.6	0.19	0.44	63	0.0	0.0	0.3	2.4	47.0	55	30.0
MAY	26.2	15.4	20.8	52.0	64	-16.0	64	0.0	24.3	3.0	30.9	1359.0	0.30	0.73	54	0.1	0.0	0.8	3.0	40.0	50	28.4
JUN	38.3	30.2	34.3	68.0	76	13.0	74	0.0	3.0	0.0	22.8	912.5	0.52	1.20	52	0.1	0.0	1.5	1.6	35.0	55	5.8
JUL	45.3	34.7	40.0	78.0	74	24.0	67	0.2	0.0	0.0	9.0	765.5	1.00	1.64	71	0.3	0.7	3.3	0.5	2.0	54	0.1
AUG	43.9	34.4	39.2	72.0	57	20.0	86	0.1	0.9	0.0	10.8	794.8	1.08	0.90	48	0.3	0.7	3.4	1.3	3.0	69	1.0
SEP	35.4	27.9	31.6	66.0	86	4.0	70	0.0	10.2	0.0	24.7	993.1	0.68	0.91	57	0.1	0.3	2.2	5.0	20.0	54	6.0
OCT	20.5	10.3	15.4	46.0	69	-26.0	83	0.0	29.1	6.7	31.0	1539.0	0.77	1.98	54	0.1	0.7	1.7	9.0	24.0	54	25.7
NOV	5.6	-6.2	-0.2	37.0	50	-51.0	48	0.0	29.8	20.0	30.0	1962.3	0.41	0.43	54	0.0	0.3	1.0	4.9	24.0	50	30.0
DEC	-6.0	-18.5	-12.1	37.0	73	-51.0	61	0.0	30.9	28.1	31.0	2389.9	0.26	0.52	49	0.0	0.7	0.7	3.3	26.0	49	31.0
YEAR	AVE 15.5	AVE 4.1	AVE 9.8	REC 78.0		REC -59.0		TOT 0.2	TOT 247.3	TOT 167.0	TOT 310.4	TOT 20076.7	TOT 6.12	REC 2.25		TOT 1.2	TOT 3.8	TOT 17.0	TOT 41.2	REC 47.0		TOT 248.2

Table 10-3. Climatic Summary for Prudhoe Bay from 1986 to 1987 (Leslie, 1989)

LATITUDE 70 15 N

LONGITUDE 148 20 W

	TEMPERATURE (DEGREES F)													PRECIPITATION (INCHES)									
	MEANS			EXTREMES				MEAN # DAYS				HEAT DEGREE DAYS					MEAN # DAYS PRECIP EXCEEDED			SNOW			
								MAX		MIN												
MTH	MAX	MIN	MTH	REC HI	YR	REC LO	YR	70+	32-	0-	32-	MTH MEAN	MEAN MTH TOT	MAX DAY	YR	0.5	.25	0.1	MEAN MTH TOT	MAX DPTH	YR	MEAN DAYS 1.0
JAN	-8.9	-22.0	-15.5	22.0	87	-47.0	87	0.0	31.0	30.0	31.0	1749.0	0.04	0.03	87	0.0		0.0	1.0	4.0	87	31.0
FEB	-16.2	-32.0	-24.1	17.0	87	-57.0	87	0.0	28.0	28.0	28.0	1750.5	0.07	0.05	87	0.0		0.0	1.5	5.0	87	28.0
MAR	-9.0	-23.7	-16.4	23.0	87	-50.0	87	0.0	31.0	28.0	31.0	1763.5	0.05	0.04	87	0.0		0.0	1.5	4.0	87	31.0
APR	0.4	-16.4	-8.0	23.0	87	-40.0	87	0.0	30.0	28.0	30.0	2195.5	0.03	0.04	87	0.0		0.0	1.5	5.0	87	30.0
MAY	25.0	13.9	19.5	39.0	87	-2.0	87	0.0	28.5	0.5	31.0	1406.0	0.08			0.0		0.0	2.3	4.0	87	30.0
JUN	41.8	31.6	36.7	50.0	87	26.0	87	0.0	4.5	0.0	19.0	842.0	0.30	0.56	87	0.5		0.5	3.5	7.0	87	5.0
JUL	52.2	37.6	44.9	70.0	87	33.0	87	0.5	0.0	0.0	2.0	617.5	0.66	0.29	87	0.0		2.0	0.0			0.0
AUG	50.7	36.9	43.8	62.0	87	30.0	87	0.5	1.0	0.0	6.0	651.5	0.92	0.13	87	0.0		4.0	0.0			0.0
SEP	42.0	30.0	36.0	45.0	87	21.0	87	0.0	4.5	0.0	19.5	865.0	0.57	0.16	87	0.0		3.0	1.5	1.0	87	1.5
OCT	24.6	11.6	18.1	39.0	87	0.0	87	0.0	29.0	5.0	31.0	1446.5	0.31	0.11	87	0.0		0.5	13.4	5.0	87	21.5
NOV	-0.3	-10.3	-5.3	17.0	87	-34.0	87	0.0	30.0	20.5	30.0	2111.0	0.13	0.09	87	0.0		0.5	3.4	7.0	87	30.0
DEC	-4.1	-17.9	-11.0	31.0	87	-29.0	87	0.0	31.0	29.0	31.0	2358.0	0.09	0.07	87	0.0		0.0	2.5	5.0	87	31.0
YEAR	AVE 16.5	AVE 3.3	AVE 9.9	REC 70.0		REC -57.0		TOT 1.0	TOT 248.5	TOT 169.0	TOT 289.5	TOT 17756.0	TOT 3.24	REC 0.56		TOT 0.5	TOT	TOT 10.5	TOT 32.1	REC 7.0		TOT 239.0

Precipitation

Precipitation is minimal in the well area. The annual precipitation (including the water content of the snow) and snowfall data for Barrow and Barter Island are provided on Tables 10-1 and 10-2. Mean annual precipitation at these locations is approximately 4 to 6 inches; snowfall averages 28 to 41 inches annually. The record snowfalls in 24 hours at Barrow and Barter Island are 15 and 17 inches, respectively.

Blowing snow is a major phenomenon in the Alaska Arctic during the winter. Freshly fallen snow begins to drift with a wind of approximately 5 mph. When the wind reaches 10 to 15 mph, it is lifted off the ground and becomes airborne. Above 15 mph, the particles are carried to higher altitudes and visibility deteriorates rapidly. Packed snow is less mobile and higher wind speeds are necessary to move it. Storms of blowing snow may last for a day or longer and can seriously affect or even halt air and surface travel (Searby and Hunter, 1971).

Sky Cover and Visibility

The cold air, which occupies most of the Arctic Coast in winter, contains only a small amount of moisture. In winter, cloudiness is at a minimum throughout the area, but when it does occur, it is usually widespread. In summer, cloudiness is more frequent, and winter cloudiness is characteristically at low levels in the form of flat layers. Summer cloudiness is more frequently in the form of cumulus clouds, which build up during the day, forming higher ceilings but extending to great heights. Low, flat cloudiness may also occur in summer, but will be thicker and more dense than similar cloudiness in the colder months. In contrast to most of Alaska, such low, flat cloudiness may lie closer to the ground in summer. The number of cloudy days averages over 200 per year with maximum cloudiness occurring in July through September and the maximum number of clear days in February.

In summer, fog is a fairly common occurrence along the coast. In winter, blowing snow, ice crystals, and steam fog restrict visibility. Summer fog results primarily from the condensation of warm air lying over colder water. Visibilities one-quarter mile or less can be expected on an average of 75 days annually at Barter Island and 65 days annually at Point Barrow (NOAA, 1978). At temperatures below -29.1°C, fog occurs in the form of ice fog. Ice fog increases in frequency with decreasing temperature and is most always present at temperatures of -45.9°C and below.

Wind Speed and Direction

The prevailing wind directions along the Beaufort Sea coast are from the east and the west (Selkregg, 1975). The mean monthly wind speed and direction for Barrow and Barter Island are shown in Table 10-4 and Figure 10-1. Mean annual speeds from these stations are 11.8 and 3.2 mph, respectively.

Some seasonal variation in both wind speed and direction can be noted in the summarized data. Mean monthly wind speeds are generally strongest in the winter months and lowest in the summer. Although wind directions vary somewhat, they are generally from either the east or west. During the summer, the prevailing direction is from the east. Highest winds of record (peak gust) for Barrow and Barter Island are 66 and 75 mph, respectively (Table 10-5). All highest winds were generally from the east or west.

Climate data show that strong correlations exist among wind characteristics measured at widely separated locations along the coast. Thus, data from coastal locations at Barrow and Barter Island should be generally applicable to conditions in the project area.

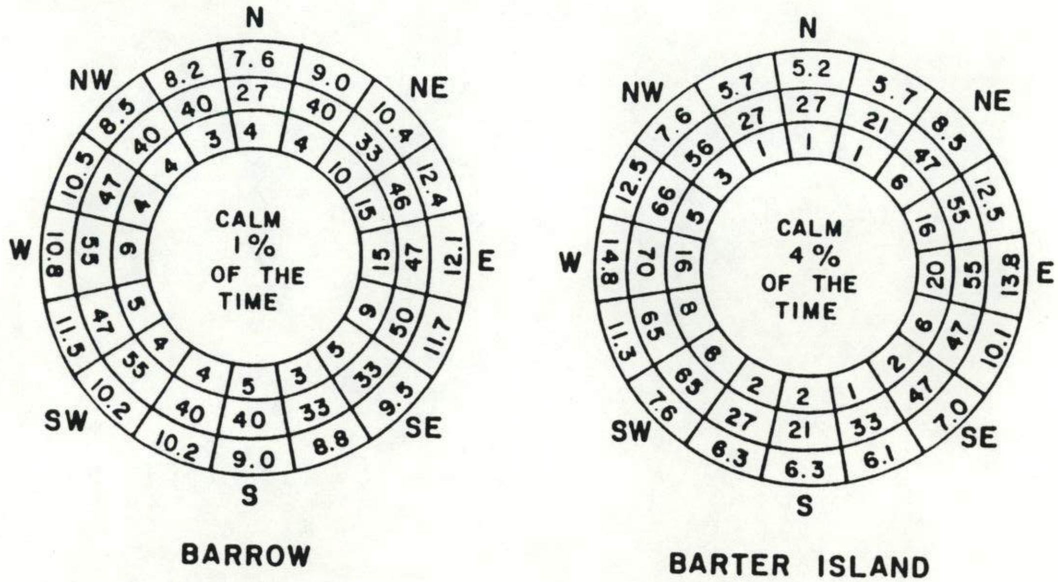
In summer, the diurnally varying land-sea thermal contrast helps generate characteristic sea breezes in the vicinity of the coast. The sea breeze is largely responsible for the increased persistence of onshore surface (northeasterly and easterly) winds in August.

Table 10-4. Mean monthly winds in the Beaufort Sea area.

	Barrow[1]		Barter Island[2]	
Month	Mean Speed (mph)	Prevailing Direction	Mean Speed (mph)	Prevailing Direction
January	11.5	ESE	15.1	W
February	11.0	E	14.4	W
March	11.1	ENE	13.7	W
April	11.4	NE	12.0	W
May	11.7	ENE	12.7	E
June	11.4	E	11.6	ENE
July	11.6	E	10.9	ENE
August	12.3	E	11.8	E
September	13.0	E	13.2	E
October	13.2	E	14.8	E
November	12.4	E	14.9	E
December	11.2	E	13.9	E
Annual	11.8	E	13.2	E

[1] U.S. National Climatic Data Center (1989).

[2] U.S. National Climatic Data Center (1989).



Wind speed in knots

Figure 10-1. Average wind speed (outer band), extreme wind speed (middle band), and percent frequency of occurrence of wind direction (inner band) for various directions at coastal weather stations west (Barrow) and east (Barter Island) of the island site. (Period of record 8 to 20 years) (after Selkregg 1975).

Table 10-5. Maximum winds (peak gusts) in the Beaufort Sea area.

Month	Barrow[1] Speed (mph)	Barrow[1] Direction	Barter Island[2] Speed (mph)	Barter Island[2] Direction
January	58	E	75	W
February	53	W	69	W
March	56	E	66	W
April	47	E	49	E
May	37	E	56	W
June	40	E	53	E
July	40	E	48	W
August	47	SW	58	NW
September	66	SW	58	E
October	48	SW	69	W
November	53	E	61	E
December	60	SW	70	W
Annual	66	SW	75	W

[1] U.S. National Climatic Data Center (1989).

[2] U.S. National Climatic Data Center (1989).

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ATTACHMENT
11

11.0 OCEANOGRAPHY

11.1 General

The Beaufort Sea is a narrow shelf sea bordering the deep Canadian Basin of the Arctic Ocean. The nearshore and inner shelf regions are of primary interest with respect to offshore oil exploration. Oceanographic processes in the shelf regions are influenced by circulation patterns in the Arctic and in turn influence conditions in the deeper Arctic Ocean (Aagaard et al., 1990). Incursions from the south, primarily through the Barrow Arch from the Chukchi Sea, also affect circulation and water chemistry in the Beaufort Sea. A comprehensive treatment of Beaufort Sea circulation is contained in Aagaard et al., 1990.

11.2 Circulation

The inner shelf region is characterized by mean westward water and ice motion primarily driven by the prevailing winds, which are from the east. Strong winds periodically develop from the west causing major flow reversals in the surface current; the response time is rapid. Bottom currents also tend to travel from east to west (see Figure 11-1).

In Harrison Bay, summer current velocities range from 5 to 50 cm/sec (0.09 to 1.0 knots) (EIS, 1987). Nearshore currents are modified by bottom topography, the presence of ice, and the location of offshore barrier islands and shoals. In winter, nearshore currents are generally westerly and less than 5 cm/sec (0.09 knots) and may not exceed 10 cm/sec (0.2 knots) (EIS, 1987).

Seaward of the 50 m (164 ft) isobath, the circulation is dominated by the Beaufort Gyre, which controls surface ice movement and by the Beaufort Undercurrent, which generally runs counter to the predominantly westward ice drift (Aagaard, 1984). The long-term mean speeds of this current are normally in the 5 to 10 cm/sec (0.09 to 0.2 knots) range, although maximum speeds near 75 cm/sec (1.5 knots) have been recorded (Aagaard, 1988). Frequent current reversals have been observed and appear to be due to the long-shore wind component; they may help drive upwelling of warm saline water onto the shelf (Aagaard, 1988). Much of the water flowing northward from the Chukchi Sea is carried by this current and results in a great expanse of warm water extending eastward across the Beaufort Sea, during the summer and fall (Aagaard, 1984).

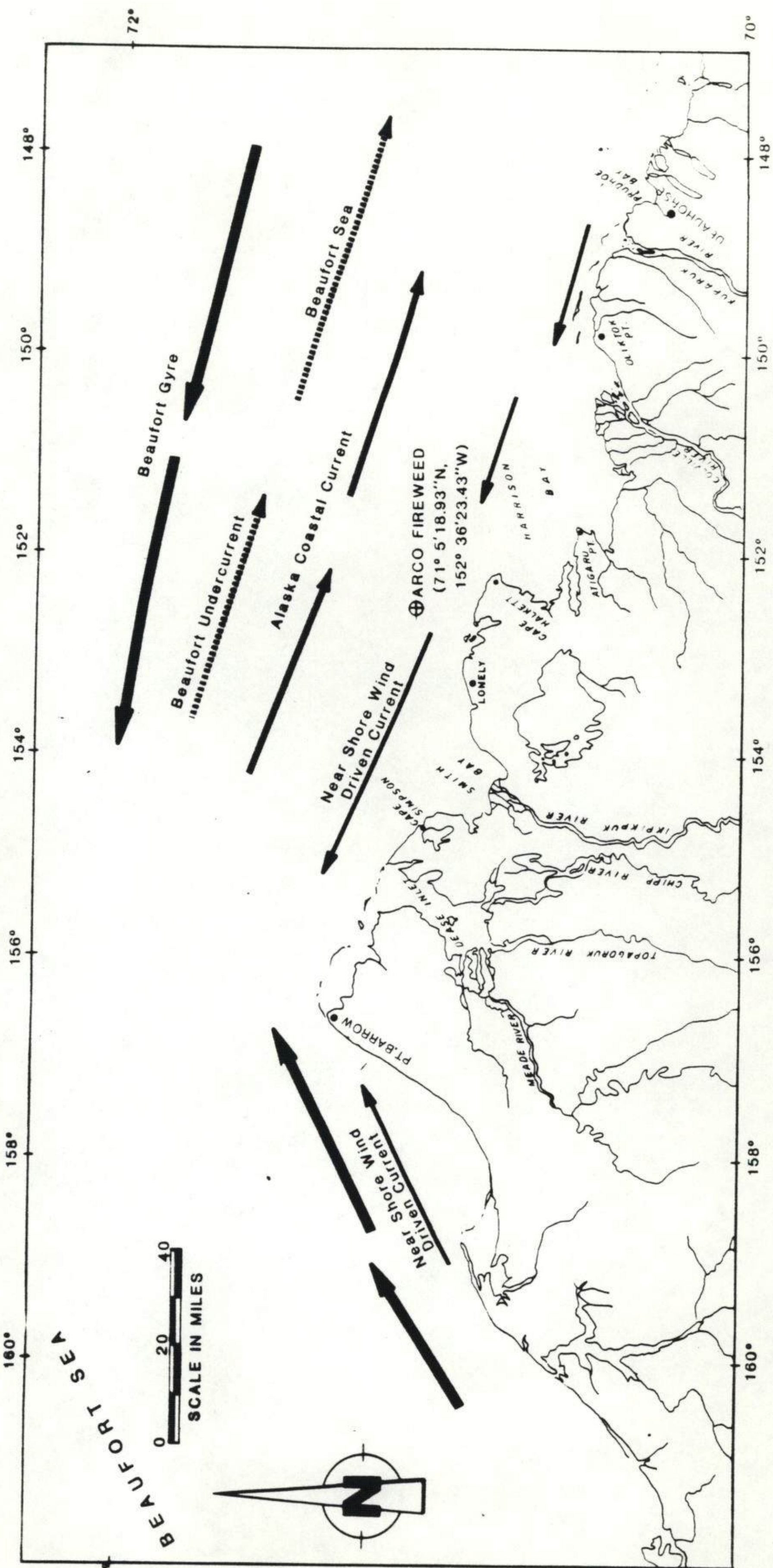

Figure 11-1 Western Beaufort Sea Circulation

11.3 Temperature and Salinity

During the summer, temperatures and salinities of the surface water show very large temporal variations. Maximum surface temperatures of 8°C have been reported (NOAA, 1988). The intrusion of warm water from the eastern Bering Strait is composed of two water masses, the Alaskan coastal water and Bering Sea water (Mountain et al., 1976). These warm eastward flows are restricted to the outer continental shelf and slope. The Alaskan coastal water, which has temperatures west of Barrow as high as 5° to 10°C and salinities less than 31.5 parts per thousand (ppt) mixes rapidly and is not clearly identifiable after about 147° to 148°W (Aagaard, 1984). The Bering Sea water, however, is more dense and is identifiable as far as Barter Island. The transport of this water by the Beaufort undercurrent causes strong stratification in the early summer. Later in the summer and towards the fall, the waters entering the Beaufort Sea from the Chukchi Sea are themselves close to the freezing point and this stratification disappears. In the immediate nearshore zone, the water column may be unstratified due to wind mixing.

11.4 Tides

Tides are classified as mixed and have both diurnal and semi-diurnal components. Beaufort Sea tides are small and the range is generally less than one foot.

11.5 Sea States

Waves in the region are generally from the northeast and the east and are limited to the open water season. The presence of pack ice reduces significant wave height by a factor of four from heights that would otherwise be expected (EIS, 1987). Wave heights greater than 0.5 meters occur in less than 20 percent of observations summarized by Brower et al. (1988). Wave heights greater than 5.5 meters are not reported.

11.6 Ice and Icing Conditions

The position of the summer ice pack varies substantially both temporally and spatially from year to year. In an "average year", the Arctic pack ice in September is typically 20 to 110 kilometers offshore (LaBelle et al., 1983). Frequently, the pack ice remains close inshore in the vicinity of Barrow until August before moving offshore. Winter conditions start with freezeup and by October the edge of the ice pack has moved south of Barrow and the area of the proposed well is ice covered. The winter sea ice may then remain covering the prospect area until about July, although leads and open water may be present earlier. The winter sea-ice types may be divided into a landfast-ice zone, a pack-ice zone, and shear zone (flaw lead zone) between the two. Depending on the particular winter conditions, the prospect area may lie in any of the three zones.

The landfast ice is firmly attached to the shore and may be either bottomfast (to about 2 meters depth) or free floating (to about 20 meters depth). In the Beaufort sea area, the landfast ice may reach 2 meters in thickness.

The shear zone is a dynamic zone characterized by flaw leads and moving ice. Onshore movement of the ice pack causes overriding of the fast ice and the buildup of pressure ridges and broken ice areas. In the Beaufort Sea, the region of most intense ridging occurs in water depths of 15 to 45 meters (Barnes et al., 1984). Ice gouging of the seafloor is most intense in this zone. Gouge densities of more than 100 gouges per square kilometer are found in waters 20 to 40 meters deep (Barnes et al., 1984). The Fireweed Prospect lies within this depth range.

The pack ice zone consists of first year ice, multi-year floes (classified as small to giant, depending on the size), and ice islands. The floating ice may contain ridges and hummocks. Polynyas and leads may be present in the pack ice zone and may persist for long periods of time. Fresh first year ice often forms in these areas of open water. The pack ice in the winter moves relatively small distances, and the net movement is from east to west in response to the Beaufort Gyre.

Sea spray ice is the most common and dangerous form of vessel and equipment icing. It can be caused by heavy sea spray, freezing rain, or fog. It can occur when the air temperature falls below the freezing temperature of sea water (-2°C) and when sea surface temperatures are below 5°C. These conditions can be expected in the Beaufort Sea any time during the open water period (July through September).

11.7 Water Quality

The Beaufort Sea in the vicinity of the Fireweed Prospect is an essentially pristine area free of anthropogenic influences. Significant quantities of suspended material are supplied to the area by runoff along the coast during the summer, particularly from the Colville River. The particulate matter contributes to water turbidity and is a source of trace metals to the marine sediment. Natural hydrocarbon seeps have been documented in the vicinity of the Colville River Delta (Boehm et al., 1987).

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ATTACHMENT

12

12.0 BIOLOGICAL RESOURCES

12.1 General

The following discussions of biological resources are based primarily on data provided in the EIS for Sale Area 97, which encompasses Sale Area 71. The original literature citations are provided here for convenience.

12.2 Pelagic Environment

The pelagic or open-water environment of the Beaufort Sea is inhabited by diverse assemblages of phytoplankton, zooplankton, micronekton, anadromous and marine fishes, and marine mammals. In addition, this environment provides a habitat for many seabird species. The interactions among these species form complex food webs and nutrient cycles. For example, zooplankton consume phytoplankton; fish, marine mammals, and sea birds feed on zooplankton; and sea bird guano is a nutrient source for phytoplankton (see Figure 12-1).

12.2.1 Phytoplankton

Primary production by phytoplankton in the Beaufort Sea is determined by a variety of factors, including ice cover, light, water temperature, and the amount of nutrients present in the water. Ninety-four species and eighteen additional taxonomic categories (e.g., unidentified species and groups of species) of phytoplankton have been identified from the Beaufort Sea (Horner, 1984). The species and species groups were divided by Horner into four major categories: the diatom genus Chaetoceros (including more than 20 species), all other diatoms, dinoflagellates, and flagellates. The most abundant species had broad distributions, but the relative abundance of species groups varied spatially. Near Point Barrow and Pitt Point, flagellates were the most abundant phytoplankton; at the most easterly stations (Harrison Bay, Prudhoe Bay, and Barter Island), Chaetoceros species and dinoflagellates were more abundant. Microflagellates were common in surface waters, whereas diatoms were more numerous in deeper waters. Abundance of phytoplankton appears to be greatest in nearshore waters with decreasing numbers further offshore.

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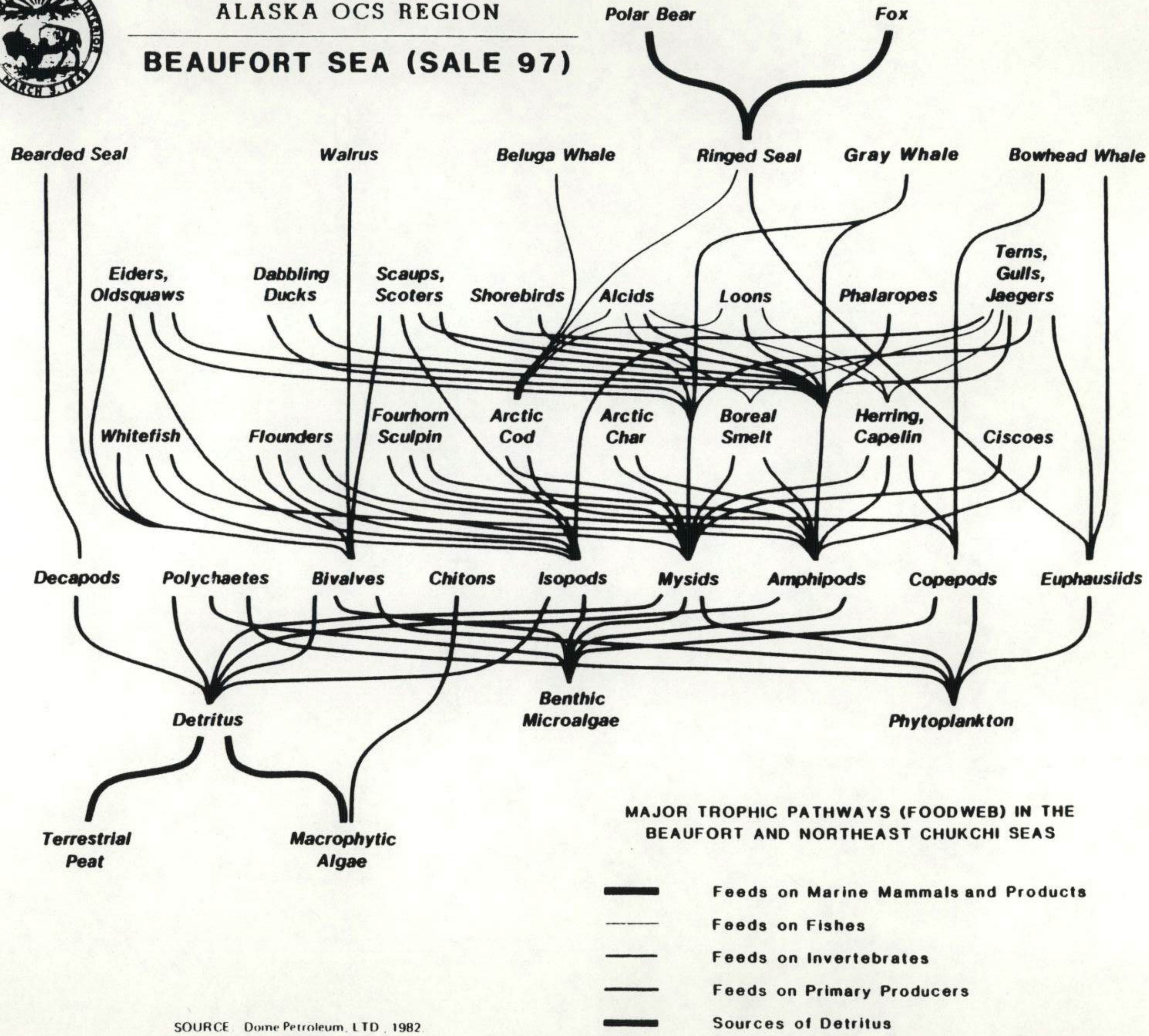
BEAUFORT SEA (SALE 97)



MAJOR TROPHIC PATHWAYS (FOODWEB) IN THE BEAUFORT AND NORTHEAST CHUKCHI SEAS

SOURCE: Dome Petroleum, LTD., 1982

FIGURE 12-1

The highest rates of primary phytoplankton production (30 to 50 grams carbon per meter squared per year ($C/m^2/yr$) occur in the summer in waters between the 20 meter isobath and the permanent ice pack. Lower rates (0.5 to 15 g $C/m^2/yr$) occur shoreward of the isobath. The Beaufort Sea shows a slow seasonal increase in phytoplankton concentration with a gradual depletion of nutrients, rather than the dramatic blooms observed in the Bering Sea.

Productivity generally was highest at depths where Chaetoceros species or other diatoms predominated. A similar pattern in the distribution of species types and productivity was found in earlier studies conducted in the shallow (less than 20 m) depths of Harrison and Prudhoe Bays (Alexander et al., 1974; Horner et al., 1974).

12.2.2 Zooplankton

The greater than 100 species of zooplankton identified from the Beaufort and northeastern Chukchi Seas can be divided into four groups:

1. Species that occur throughout the Arctic Basin;

2. Species that are swept into the Beaufort Sea from the Bering and Chukchi Seas;

3. Species characteristic of nearshore, less saline environments; and

4. Species that are the larval forms of animals that live in the benthos (i.e., meroplankton) (USDOC, NOAA, 1978).

Zooplankton communities found by Johnson (1956) were richer in the Chukchi Sea and the western part of the Beaufort Sea than in the eastern Beaufort (eastward of Barter Island).

12.2.3 Zooplankton/Micronekton

More than 100 species of zooplankton have been identified for the Alaskan Beaufort and northeastern Chukchi Seas. These species can be divided into four groups:

1. Species that occur throughout the Arctic Basin;

2. Species that are swept into the Beaufort Sea to varying extents from the Bering and Chukchi Seas;

3. Species characteristic of nearshore, less saline environments; and

4. Species that are the larval forms of animals that live in the benthos (i.e., meroplankton) (USDOI/MMS, 1987).

Hydrographic conditions can greatly influence the abundance, distribution and diversity of these zooplankton groups. Based on collections made in 1950 and 1951 in the Beaufort Sea, Johnson (1956) has concluded that those animals spending their entire lives in the plankton comprised the most important part of the zooplankton. By contrast, in the Chukchi Sea, the meroplankton were also an important component of the plankton, perhaps reflecting the more shallow, nearshore nature of the water.

Zooplankton may be either primary consumers that graze directly on phytoplankton or secondary consumers that prey on other zooplankton and even their own eggs and larvae. Examples of the first group include copepods and euphausiids, whereas the secondary consumer group includes hyperiid amphipods and arrow worms.

Copepods are the most important components of the zooplankton, both comprising 87 percent of the individual zooplankters and 78 percent in wet-weight zooplankton biomass (Richardson, 1986). All copepodid stages and adults were found (USDOI/MMS, 1984; Norton and Sackinger, 1981). A study performed in the offshore area near Prudhoe Bay showed that the most important genus is Calanus, which comprises 45 to 54 percent of the zooplankton biomass in the upper 4,922 feet (1,500 m) of the Arctic Ocean. Other copepods found in the area include Pseudocalanus minutus, Acartia longiremus, Olithoma spp., Oncaea spp., and several Pacific Ocean expatriates (AINA, 1974).

Other groups that may occasionally contribute significantly to the zooplankton population in the area include hydromedusans (Botrynema and Sminthea), decapods (Hymenodora), chaetognaths (Eukrohnia), amphipods (Parathemisto and Cyclocaris), larvaceans, and radiolarians. Radiolarians occasionally exceed the copepods in numbers. The hydromedusae are the second most diverse group. In addition, the zooplankton characteristically contain larval barnacles, gastropods, lamellibranchs, and fish. The larval barnacles are a major summer constituent of the zooplankton in terms of numbers and biomass (AINA, 1974).

The standing crop of zooplankton in the eastern Beaufort Sea is small compared to communities in the western Alaska Beaufort and Chukchi Seas, primarily because of low primary productivity by phytoplankton and the relative absence of meroplankton. The highest standing crop of zooplankton occurs about one or two weeks after the summer phytoplankton bloom.

The greatest numbers of nauplii (from copepods) occur during October and November. Zooplankton may overwinter in the area by becoming dormant, using detritus as food, or by storing fat (AINA, 1974).

12.3 Fishes

The fishes occurring in the Beaufort Sea fall into three basic categories: (1) freshwater species that make relatively short seaward excursions from coastal rivers, (2) anadromous species that spawn in freshwater and migrate seaward as juveniles and adults, and (3) marine species that complete their entire life cycle in the marine environment. They are typical of the "Inuit fauna" (McAllister, 1962), a fairly distinct assemblage of marine or anadromous fishes that extends from the central Canadian Arctic through the Chukchi Sea and into Siberian coastal waters. Sixty-two fish species have been reported from the Alaskan Beaufort Sea (Craig, 1984a) and 72 from the northeastern Chukchi Sea (Craig, 1984b). By comparison, over 300 fish species occur in the Bering Sea and Gulf of Alaska. The low variety of fish in the region has been attributed to low temperature, low productivity, and harsh ice conditions that preclude extensive use of shoreline habitats during the winter period.

Of the 62 Alaskan Beaufort species reported, 37 were collected in nearshore, brackish waters and 40 in offshore marine waters, indicating that some species occur in both habitats. The areas of greatest species diversity tend to be the delta regions of large rivers draining into the Beaufort Sea.

Some characteristics of the physical environment greatly influence the distribution and abundance, both spatially and temporally, of Beaufort Sea fishes. In particular, the formation of a narrow band of warm, brackish water nearshore affects the movements and activities of anadromous fishes. The formation of this watermass is described in the Sale 87 FEIS (USDOI/MMS, 1984). This warm, brackish water, with its riverine origin, has its greatest extent off the mouths of rivers, with a plume sometimes extending 20 to 25 kilometers offshore (Craig, 1984a). During winter, most of the nearshore water less than 2 meters deep freezes to the bottom.

Aspects of the general biology of freshwater, anadromous, and marine fish species occupying the Alaskan Beaufort Sea follow.

12.3.1 Freshwater Species

Freshwater fishes that venture into the coastal waters are found almost exclusively in association with fresh or brackish waters extending offshore from major river deltas. Their presence in the marine environment is generally sporadic and brief with a peak occurrence probably during or immediately following spring breakup. Such freshwater species include Arctic grayling, round whitefish, and burbot.

12.3.2 Anadromous Species

The anadromous fishes of the Beaufort Sea include Arctic char, Arctic cisco, least cisco, Bering cisco, rainbow smelt, humpback whitefish, and broad whitefish (see Figure 12-2). Pink and chum salmon have been reported from Simpson Lagoon (Craig and Haldorson, 1981) and along the eastern Beaufort (Schmidt et al., 1983), however, their occurrence is thought to be occasional and their abundance relatively low. Other anadromous species recorded from the Alaskan Beaufort include Arctic lamprey, chinook, sockeye, and coho salmon, inconnu, and ninespine and threespine stickleback.

The two largest river drainage systems, the Colville and the MacKenzie, are both east of the Prospect area and support spawning populations of Arctic char, ciscoes, whitefish, and smelt plus small runs of salmon. Several perennial mountain streams, situated between the two rivers, serve as spawning and overwintering grounds for Arctic char (Craig, 1984a).

The nearshore, brackish waters of the Beaufort Sea are used extensively by anadromous fishes. During the three to four month open-water season, these habitats serve as feeding and rearing areas. Anadromous fish prefer the warmer, less saline waters around river deltas as opposed to the cooler, more saline waters further offshore. Within the nearshore, brackish zone, fish tend to be concentrated along the mainland and island shorelines rather than in lagoon centers or offshore. The important human subsistence use of anadromous fishes caught for subsistence in these nearshore waters are Arctic and least cisco and Arctic char. Recent catch statistics also indicate that broad whitefish are an important and preferred species in subsistence harvests (George and Nageak, 1986; Moulton et al., 1986).

12.3.3 Marine Species

Forty-three marine species have been identified in the Alaska Beaufort Sea, with the most important species (i.e., in terms of abundance) being the Arctic cod (Boreogadus saida), saffron cod (Eleginus gracilis), fourhorn sculpin (Myoxocephalus quadricornis), twohorn sculpin (Icelus

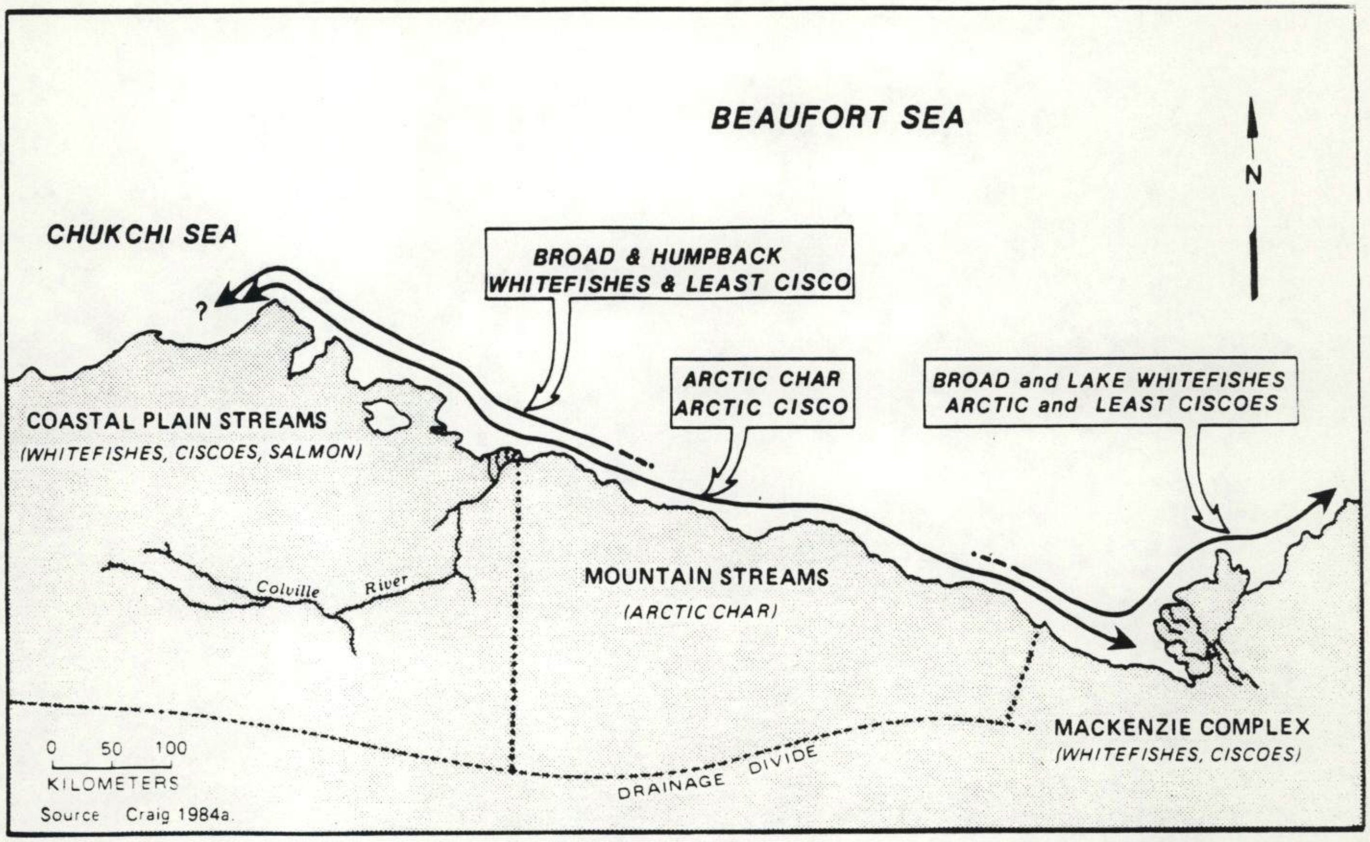


Figure 12-2. Freshwater sources and coastal dispersal patterns of the principal anadromous fishes occurring along the Beaufort Sea coastline.

bicornis), Canadian eelpout (Lycodes sp.), and Arctic flounder (Liopsetta glacialis) (Craig, 1984a). The Arctic cod, Canadian eelpout and twohorn sculpin accounted for 65 percent of the catch, with the Arctic cod described as a "key species in the ecosystem of the Arctic Ocean" due to its widespread distribution, abundance, and importance in the diets of marine mammals, birds, and other fishes (Andriashev, 1954; Quast, 1974; Bain and Sekerak, 1978; Craig et al., 1982; Sekerak, 1982; Craig, 1984a). It has been calculated to be the most important consumer of secondary production in the Alaskan Beaufort Sea (Frost and Lowry, 1983) and may influence the distribution and movements of marine mammals and seabirds (Craig, 1984a, citing Klumov, 1937; Bradstreet, 1980; Davis et al., 1980; and Finley and Gibb, 1982).

Feeding habits of marine species are similar to those of anadromous species in nearshore waters. Almost all of the marine species discussed rely heavily on epibenthic and planktonic crustacea such as amphipods, mysids, isopods, and copepods. Flounders also feed heavily on bivalve mollusks, while fourhorn sculpins supplement their diets with juvenile Arctic cod.

Sport and Commercial Uses

Anadromous fishes, particularly ciscoes, whitefishes, and char are the focal point of several fisheries along the Alaskan Beaufort Sea coastline. Subsistence harvest of fishes is described in Attachment 14.0. Fish are also taken by a commercial fishery operated by the Helmericks family in the Colville Delta.

12.4 Marine Mammals

Species in this group are the pinnipeds (ringed, bearded, and spotted seals and Pacific walrus), the polar bear, and beluga, bowhead, gray, fin, and humpback whales. All marine mammals in United States' waters are protected under the Marine Mammal Protection Act of 1972. Polar bears and their habitats are also protected by the International Agreement on the Conservation of Polar Bears of 1976. Important breeding habitats and migration routes of marine mammals are discussed below.

12.4.1 Ringed Seals

The ringed seal (Phoca hispida) is the most abundant seal in the Beaufort Sea, with a winter population estimated at 40,000 and a summer population that doubles to 80,000 (USDOI/MMS, 1987). Ringed seal densities may depend upon such factors as food availability, proximity to human disturbance, water depth, and ice stability. Although ringed seals do not occur in large herds, aggregations of tens or hundreds of animals may be associated with areas of abundant prey. Ringed seals may feed upon such prey as cod, amphipods, mysids, euphausiids, and small pelagic fishes. Arctic cod are an important source of food during the winter seasons. Pupping occurs in lairs dug into the lee side of irregularities from late March through April. Migration routes are not well delineated, with movement offshore following the recession of the ice (see Figure 12-3). Ringed seals are a major resource for subsistence harvest, with over 14,000 taken each year in northwestern and western Alaska (Moulton and Bowden, 1981).

12.4.2 Bearded Seal

The bearded seal (Erignathus barbatus) is circumpolar in distribution and generally prefers areas of seasonal, broken pack ice in waters less than 200 m deep. Summer concentrations of bearded seals occur along ice remnants between Harrison Bay and Flaxman Island. The bearded seal is primarily restricted to the moving ice of the Beaufort Sea, with the highest population in the summer and lowest in the winter as most of the species seem to migrate out during the solid ice period. Pupping occurs in late March through May. Bearded seal feed primarily on benthic and epibenthic invertebrate prey such as shrimps, crabs, and bivalve mollusks; fish are considered as secondary prey. This seal is relatively important as a subsistence harvest species; more than 6,000 bearded seals are harvested each year (Moulton and Bowden, 1981).

12.4.3 Spotted Seal

Spotted seals (Phoca largha) are seasonal residents of the Beaufort Sea appearing along the coast in July in low numbers (about 1,000). Spotted seals haul out on beaches, barrier islands, and remote sand bars on the river deltas. Traditional haulout and concentration areas include the Colville River Delta, Peard Bay, and Oarlock island in Dease Inlet/Admiralty Bay. These seals have also frequented Smith Bay at the mouth of the Piasuk River. Prey items include pelagic fishes, octopi, and crustaceans. Spotted seals frequently enter estuaries and sometimes ascend rivers, presumably to feed on anadromous fishes. Spotted seals migrate out of the Beaufort Sea in the fall (September to mid-October) as the shorefast ice re-forms and the pack ice advances southward. They spend the winter and spring periods along the ice front throughout the Bering Sea where pupping, breeding, and molting occur. Spotted seals are also an important subsistence resource, with more than 7,000 harvested each year, mostly in the northern Bering Sea (ADF&G, 1981).

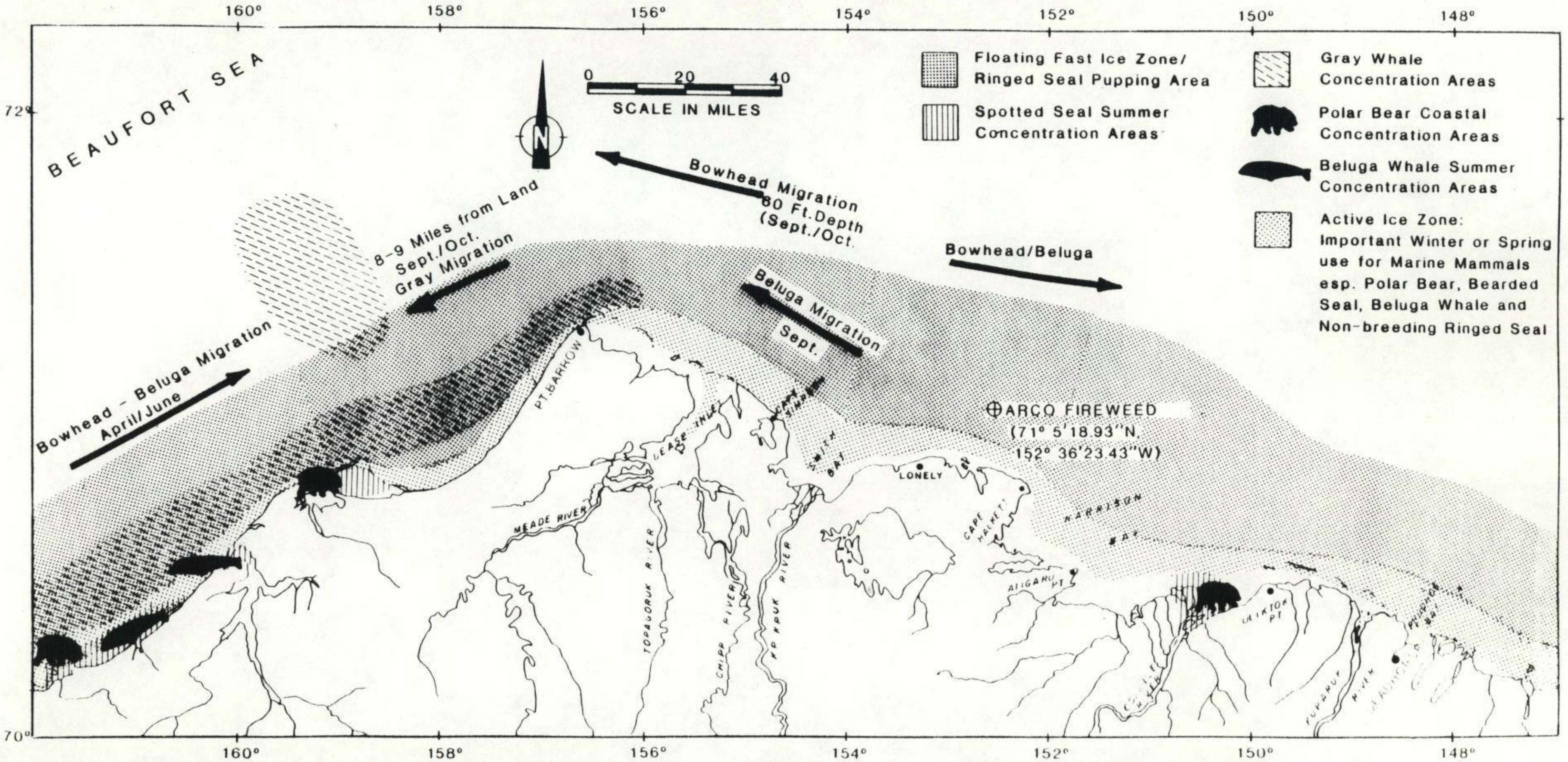


Figure 12-3 Marine Mammal Hab'tats (USDOI/MMS,1987)

12.4.4 Pacific Walrus

The walrus (Odobenus rosmarus) population of the North Pacific is in the range of 170,000 to 250,000 animals, comprising about 80 percent of the world population. In general, most of this population is associated with the moving pack ice year-round. Walrus spend the winter in the Bering Sea, and the majority of the population summer throughout the Chukchi Sea with a small portion moving eastward throughout the Alaskan Beaufort Sea to Canadian waters in the open-water season. Nearly all the adult females with dependent young migrate into the Chukchi Sea during the summer, while a substantial number of adult males remain in the Bering Sea. Spring migration usually begins in April; females with calves comprise most of the early spring migrants. Nearly all of the walrus move through the Bering Strait west to Wrangell Island, the other along the northwest coast of Alaska from Point Hope to Point Barrow. With the southern advance of the pack ice in the Chukchi Sea during the fall (October to December), most of the walrus population migrates south of the Bering Strait. Solitary animals may occasionally overwinter in the Chukchi Sea and in the eastern Beaufort Sea. Walrus are benthic feeders, utilizing bivalve mollusks primarily, and polychaetes, snails, and crustaceans secondarily. Walrus are an important subsistence resource; annual Alaskan harvest yielded about 1,000 to 3,000 animals in the last 15 years (Fay, 1982).

12.4.5 Polar Bear

The total population of polar bears (Ursus maritimus) in Alaska is estimated at 3,000 to 5,000 animals (Amstrup, 1983). Polar bear distribution exhibits substantial annual variation in the Beaufort Sea. Average density appears to be about one bear to every 30 to 50 square miles. Much lower densities occur more than 100 miles offshore (see Figure 12-3). During summer in the Alaskan Beaufort Sea area, few polar bears are found on land, with most found along the edge of the permanent pack ice (Frame, 1972; Moore and Quimby, 1975; Eley and Lowry, 1978). With the advance of the ice sheet in winter, polar bears are common along the shear zone between the landfast ice and drifting pack ice (Lentfer, 1971; Stirling, 1974; Moore and Quimby, 1975; Eley and Lowry, 1978).

Two important natural factors affect polar bear distributions: sea ice and food availability. For instance, the drifting pack ice off the coast of the Beaufort Sea probably supports the greatest number of bears in the area, due to the abundance and availability of subadult seals in this habitat (Smith, 1980). When ice conditions permit, such as when pack ice drifts close to the shore or when shorefast ice forms early in the fall, bears may move onto land. Polar bears off the Alaskan coast feed primarily on ringed seals, bearded seals, walrus, carrion, and human refuse when available.

Pregnant polar bears migrate shoreward seeking denning sites in late October or early November and give birth in December or January (Moore and Quimby, 1975; Eley and Lowry, 1978). Dens usually are constructed in deep accumulations of snow on landfast ice, on moving pack ice, or on land (Lentfer, 1975; Moore and Quimby, 1975; Eley and Lowry, 1978; Benfield, 1979; Amstrup, 1985). Most terrestrial dens are located close to the seacoast, usually not more than 5 to 6.2 miles (8 to 10 km) inland. Insufficient data exist to accurately quantify polar bear denning along the Alaskan Beaufort Sea coast. However, dens appear to be less concentrated than in many denning areas in Canada, on Wrangell Island, and elsewhere in the Arctic (Amstrup, 1985).

Besides being protected by the Marine Mammal Protection Act of 1972, polar bears and their habitats are protected by the International Agreement on the Conservation of Polar Bears of 1976 between Canada, Denmark, Norway, the Union of Soviet Socialist Republics, and the United States. This agreement addresses the protection of "habitat components such as denning, feeding sites, and migration patterns."

Insufficient data exist to accurately quantify polar bear denning activities along the eastern Alaska Beaufort Sea coastline. However, three different parts of the MMS Beaufort Sea Planning Area have been generally delineated as confirmed denning areas (i.e., areas in which polar bear dens and denning activity have been observed during more than one winter) (Amstrup, 1985; USDOI/MMS, 1987). These areas are identified in Figure 12-3.

12.4.6 Beluga Whales

The beluga whale (Delphinapterus leucas) is a sub-Arctic and Arctic species and a summer seasonal visitor throughout offshore habitats of the Alaska portion of the Beaufort Sea. The North American Arctic population is estimated to be at least 30,000, while an estimated 11,500 whales migrate to the eastern Beaufort Sea. Most of the latter population migrate from the Bering Sea into the Beaufort Sea in April or May. However, some whales may pass Point Barrow as early as late March and as late as July (Frost, 1985, personal communication). The spring migration routes through ice leads are similar to those of the bowhead whale. A major portion of the Beaufort Sea population concentrates in the MacKenzie River estuary during July and August. An estimated 3,000 to 4,000 belugas summer in the northwestern Beaufort and Chukchi Seas, with some utilizing coastal areas such as Peard Bay and Kasegaluk Lagoon (Frost, 1985).

Fall migration through the western Beaufort Sea is in September or October (see Figure 12-3). Although small numbers of whales have been observed migrating along the coast (Johnson, 1979), surveys of fall distribution strongly indicate that most belugas migrate offshore along the pack-ice front (Frost, 1985). Beluga whales are an important subsistence resource of Inuit natives in Canada and also are important locally to Inupiat Natives in Alaska (see Attachment 14.0, Use Conflicts).

12.4.7 Bowhead Whales

The bowhead whale (Balaena mysticetus) is one of the largest whales in the world; its enormous head can break ice up to 2 feet thick. The bowhead is a baleen whale that feeds by filtering zooplankton from the water. Prey species of bowhead whales include euphausiids, copepods, and hyperiid and gammarid amphipods (Lowry and Frost, 1984).

At least four stocks of bowhead whales occur in the northern latitudes. The largest of these, the western Arctic stock, is estimated to number at least 7,800 individuals (International Whaling Commission, 1988). Individuals from this stock pass through or near the Prospect area semiannually as they migrate between wintering areas in the Bering Sea and summer-feeding grounds in the Canadian Beaufort Sea. Bowheads can be expected to be present in or near the Prospect area from September through October (USDOI/MMS, 1990).

Bowhead whales probably mate in the late winter, when the population is concentrated in the Bering Sea. Calving season ranges from late March until early August (Nereni et al., 1983), with the peak of calving occurring in May, but their spring migration is far north of the proposed location. Bowhead whales are present in the vicinity of the proposed location only during their fall migration.

The peak breeding period is in late winter, while the bowheads are in the Bering Sea waiting for a break in the pack ice. However, mating behavior has also been reported north of Point Barrow. During their spring migration and stay in the Beaufort Sea, bowheads are calving and lactating. Peak calving probably occurs in May, although calving probably can extend in some years from late March until early August. The breakup initiates the northward spring migration. The gestation period is 12 to 13 months with one calf produced every three to five years. Weaning occurs after five to six months (USDOI/MMS, 1987 and 1990).

Most feeding activity occurs in the Canadian Beaufort Sea. After summer feeding in the Canadian Beaufort Sea, bowheads begin moving westward in August into Alaskan waters in or near the Prospect Area (see Figure 12-3). Generally, however, few bowheads are seen in Alaskan waters until the major portion of the migration occurs, typically between mid-September and mid-October (USDOI/MMS, 1990). Conditions can vary during the fall migration from open water to over 90 percent ice coverage. Bowheads have been observed in waters ranging from several meters to over 2,000 meters in depth. The depth regime over which the greatest number of whales appear to migrate is from 10 to 50 meters (Ljungblad et al., 1984a). During migration, endangered bowhead whales passing through the Alaskan Beaufort Sea stop to feed opportunistically. The rate, time, and character of the fall migration across the Alaskan Beaufort Sea appears to be related to the extent of ice coverage and its effect on prey productivity and resultant feeding opportunities (Ljungblad et al., 1986; Richardson, 1986).

Data on the bowheads' fall migration through the Chukchi Sea is limited. It appears that before bowheads migrate south into the Bering Sea, most move through the Chukchi Sea in a broad front from Point Barrow to the Chukotsk Peninsula's northern coast (USDOI/MMS, 1990).

The bowhead spring migration to the north appears to be timed with ice breakup, usually beginning in April. In the Chukchi Sea, bowheads follow leads in the flaw zone from outer Kotzebue Sound to Barrow. After passing Barrow from April through mid-June, they continue to move through offshore leads in an easterly direction. East of Barrow, bowheads continue their migration in lead systems that vary in location and extent from year to year. Bowheads typically arrive on their summer-feeding grounds about late May to June in the vicinity of Banks Island and Amundsen Gulf (Fraker, 1979; USDOI/MMS, 1990).

Ice coverage will limit primary and therefore, secondary productivity (i.e., whale food) by deflecting and diffusing incident light (Schell et al., 1982). The trend, for five years of data, was for migrations in light-ice years to be longer and to consist of more feeding whales than migrations in heavy ice years (Ljungblad et al., 1984b).

Bowheads appear to feed throughout the water column and have been observed feeding in or near the project location during their fall migration. Food items most commonly include euphausiids, mysids, copepods and amphipods. Areas to the east of Barter Island appear to be used by many bowheads for feeding as they migrate westward across the Beaufort (Thomson and Richardson, 1987). In some years, groups of bowheads have been observed feeding east of Point Barrow near the Plover Islands. Carbon isotope analysis of bowhead baleen has indicated that a significant amount of feeding may also occur in wintering areas (Scheel et al., 1987). In 1985 and 1986, bowheads were seen feeding in the vicinity of Point Barrow during the spring. These varied observations indicate that bowheads will opportunistically feed wherever food is available (USDOI/MMS, 1990).

Bowhead whales were once abundant in Arctic waters. Extensive commercial whaling greatly reduced their numbers. Now, no longer commercially hunted since the early part of the 20th century, bowheads are considered an endangered species. They are fully protected and hunted only for subsistence (i.e., regulated; see Attachment 14.0, Use Conflicts). Modern bowhead hunting occurs in the spring from the villages of Barrow, Point Hope, Wainwright, Gambell, Savoonga, and Kivalina. The villages of Nuiqsut and Kaktovik conduct only fall whale hunts. Around 30 bowhead are harvested annually by Natives (Gusey, 1983).

There have been no clear trends as to whether the bowhead population is increasing, stable, or decreasing. In recent years, population estimates have risen dramatically, however this increase may more likely be due to better censusing techniques than rapidly increasing numbers. The current bowhead population is estimated at about 40 percent of the historic population level prior to commercial harvesting. There presently appears to be more bowheads than at the close of the commercial whaling period, just after the turn of the century, when it was estimated that there were about 1,000 bowhead remaining (USDOI/MMS, 1990).

12.4.8 Gray Whales

Gray whales present near the Prospect area are primarily engaged in feeding. Gray whales are known to feed mainly on infaunal benthic amphipods, particularly Ampelisca macrocephala, in relatively shallow waters and these feeding grounds usually contain extensive amphipod communities. The area between St. Lawrence Island and the Bering Strait is probably the most important feeding habitat for the eastern gray whale population (Lewbel, 1983). Gray whales are harvested by Soviets in the southwest Chukchi Sea and are occasionally harvested by Alaskans from Hope Basin, Wales, and Little Diomede.

The current eastern North Pacific stock of gray whales is estimated at 17,000 individuals (Rugh, 1984). The northern boundary of the migration route of the gray whale extends to Point Barrow, with some occasionally found in the Beaufort Sea east of Barrow. A limited number probably pass through and feed in the Prospect area during summer and fall. This eastern population calves while wintering along the west coast of Baja, California and the southern Gulf of California. Young whales are dependent on their mothers for approximately one year before being weaned (Morris, 1988, personal communication). Another western population, which once wintered near the coast of Korea, is now thought to be extinct (Lewbel, 1983). From late February to May, the gray whales migrate north and spend the summer feeding in the shallow waters of the northern Bering Sea and Chukchi Sea. They enter through the Bering Strait as the pack ice breaks. Twenty-five to sixty percent of the migratory whales reach the Chukchi Sea by June (USDOI/MMS, 1987). As many as 200 whales have been reported in one sighting, in the vicinity of Point Belcher during the summer. From 1982 to 1984 during July through October, 323 gray whales were seen feeding between Wainwright and Point Barrow generally within 8.5 miles of shore. The farthest offshore sighting was of three feeding gray whales approximately 105 miles northwest of Barrow in August. Although the distribution may vary from year to year, most gray whale sightings in the Chukchi Sea occur along the coast of the

Chukchi Peninsula (Lewbel, 1983). Gray whales seen in or near Sale Area 97 from August to mid-October 1984 seemed to alternate feeding and migrating to the southwest (Ljungblad et al., 1985). Late migrants probably leave Sale Area 97 in the latter portion of October.

12.5 Birds

Several million birds, composed of about 150 species of seabirds, waterfowl, shorebirds, passerines and raptors, including the threatened peregrine falcon, inhabit the Arctic coastal plain landward of the Prospect area (USDOI/MMS, 1987). Most of these species visit seasonally in the Arctic from May through September. The most abundant of these include the red phalarope, oldsquaw, black-legged kittiwake, glaucous gull, common eider, Arctic tern, Ross' gull, Pacific brant, northern pintail, semipalmated sandpiper, pectoral sandpiper, and dunlin. Gyrfalcons, ravens, and snowy owls are also common along the coastal plain.

The majority of birds in the area are migratory, with only six species present in the area from September to May. These overwintering species are the rock ptarmigan, willow ptarmigan snowy owl, common raven, gyrfalcon, and black guillemot (USDOI/BLM, 1979).

Offshore-feeding marine birds, including Arctic terns, murres, guillemots, kittiwakes, and some gulls prey mostly upon fish, and to a lesser extent, pelagic crustaceans. Nearshore feeders prey on various invertebrate fauna or graze on emergent vegetation. During nesting season, waterfowl and shorebirds feed in coastal salt marshes and tundra ponds.

In the vicinity of the Prospect area, major concentrations of birds occur nearshore (in waters less than 20 m in depth) and in coastal areas such as the Plover Islands to Barrow Spit, Pitt Point to Cape Halkett, Fish Creek Delta, Colville River Delta, and Simpson Lagoon. In the far western part of the proposed sale area (Point Barrow area), high densities of birds occur offshore, apparently due to increased productivity caused by nutrient intrusion from the Bering Sea. Areas such as Elson Lagoon to the Plover Islands, Pitt Point to Cape Halkett, and Simpson Lagoon support 50 to 100 birds per square kilometer (birds/km^2) in August, with feeding flocks of thousands of birds/km^2 occurring when abundant food sources are available. However, pelagic areas (waters deeper than 20 m and out to the shelf break) offshore of Point Barrow to the Plover Islands in the western Beaufort Sea support high average densities (38.1 birds/km^2) of predominant species during the open-water season (USDOI/MMS, 1987).

Shortly after spring migration, most shorebirds and waterfowl populations disperse to nesting grounds primarily on moist tundra and marshlands of the Arctic slope. The Teshekpuk Lake area, Colville River Delta, MacKenzie River Delta, Canning River Delta, and Herschel Island are very important nesting areas for waterfowl such as Pacific brants, yellow billed loons, and snow geese, respectively. Other species such as common eiders, Arctic terns, glaucous gulls, and black guillemots nest on barrier islands (see Figure 12-4) (USDOI/MMS, 1987).

Timing of breakup of ice surrounding a barrier island is critical for determining the island's importance as a nesting site for marine birds. For this reason, islands near large river deltas such as Thetis and Herschel Islands receive the heaviest use (USDOI/MMS, 1987).

Other barrier island nesting sites shown in Figure 12-4 vary in their importance to nesting birds. In the Plover Islands, islands such as Cooper and Deadman Islands (in the western Beaufort Sea) are important for nesting black guillemots (USDOI/MMS, 1987).

Beginning in mid-July, large concentrations of 10,000 or more oldsquaw and eider occur in coastal waters inshore of islands such as those in Simpson Lagoon where birds intensively feed and rest before fall migration (Gill et al., 1985). In late July, large numbers of phalaropes and other shorebird species begin to concentrate along the coast. They feed intensively at coastal beach habitats of barrier island sand spits such as Barrow Spit to the Plover Islands and along lagoon coastlines, marshlands, and mudflats. Use of lagoons and other coastal habitats peaks in August to late September before and during fall migration. During migration, tens of thousands of birds may use a local habitat area while passing through. In addition to the above habitats, coastal tundra lakes, ponds, and river deltas are very important for waterfowl and shorebird molting and staging before and during fall migration. Major areas are Teshekpuk Lake, Fish Creek Delta, Colville River Delta, Hulahula River Delta, and coastal tundra areas (for snow geese and tundra swans) on the Arctic National Wildlife Refuge (USDOI/MMS, 1987).

One threatened bird species, the Arctic peregrine falcon, inhabits the region in and adjacent to the Prospect area. Although the birds utilize the Prospect area and adjacent coastal region, there is no known active nesting sites along the Alaskan Beaufort Sea coastline; nest sites or possible nesting sites closest to the coast include those of the Colville River at Ocean Point (25 miles inland), at Franklin Bluff on the Sagavanirktok River (25 miles inland), and at Red Hill on the Canning River (40 miles inland). Coastal sightings are most common from mid-August to mid-September east of the Colville River.

Most peregrines in coastal northern Alaska occur east of the mouth of the Colville River, which empties into the western Beaufort Sea east of the Prospect area. Peregrines in this area feed mostly on seabirds and shorebirds.

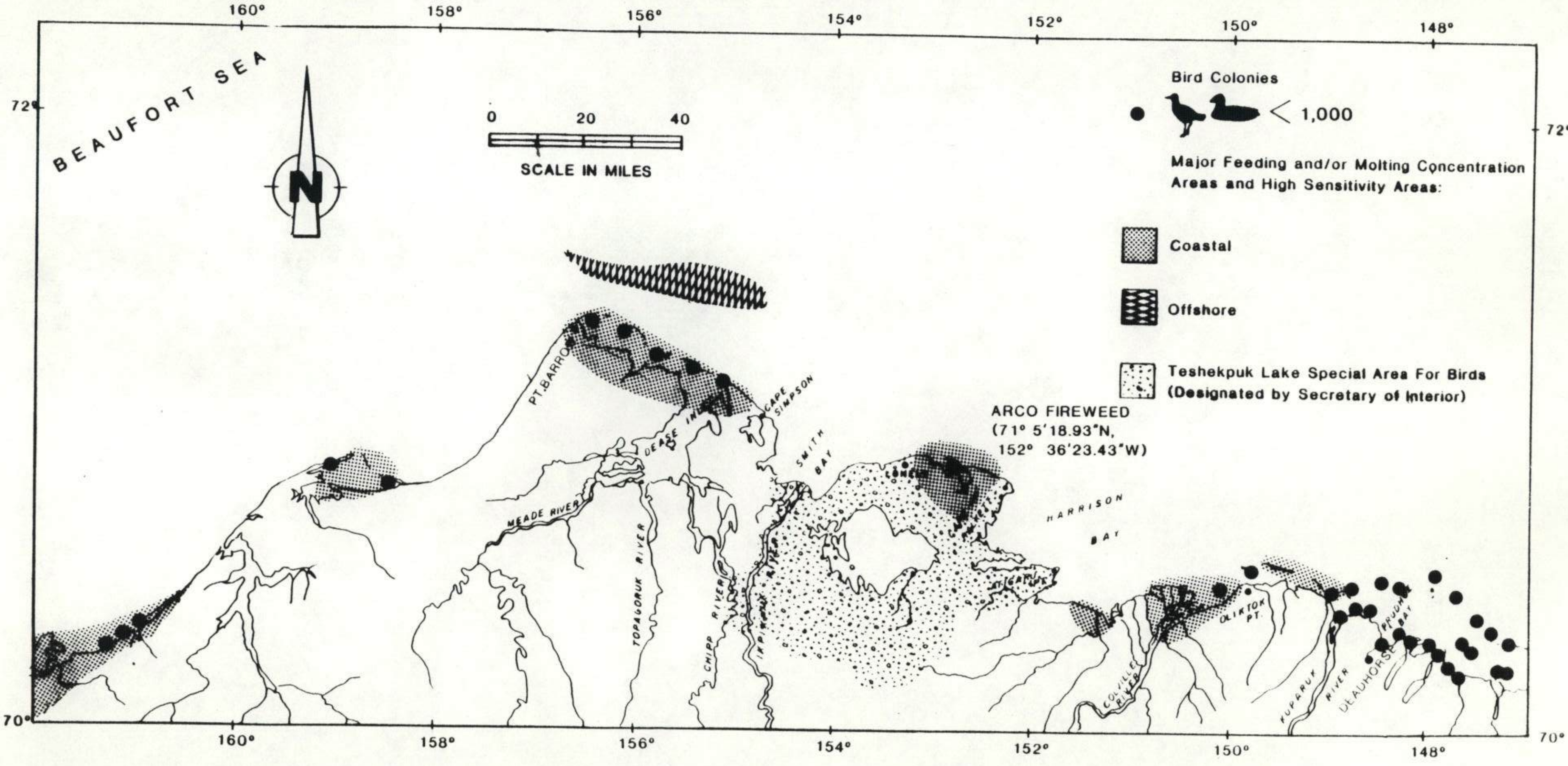


Figure 12-4 Marine and Coastal Bird Habitat (MMS, 1987)

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ATTACHMENT
13

13.0 ENVIRONMENTALLY SENSITIVE AREAS

13.1 General

Environmentally sensitive areas are categorized into two sections: 1) identified preserves set aside by statute and 2) sensitive areas recognized by areawide studies not segregated by statute. Both areas are discussed below.

13.2 Statute Mandated Areas

The only officially designated federal special area along the Alaska Beaufort Sea is that coastline now held in the Arctic National Wildlife Refuge. This area, which is administered by the U.S. Fish and Wildlife Service, covers the land area between the Canning River and the Canadian border.

Eight areas along the Alaska Beaufort Sea coastline are presently under consideration as federally-designated natural landmarks intended to preserve unique natural areas or resources (Koranda and Evan, 1975). At the present time, all of these areas have been deferred and their status and boundaries are uncertain (ACS, 1983).

Ten areas have been considered for potential ecological reserves along the Alaska Beaufort Sea coastline (Underwood, 1977). In most cases, these areas are without well-defined boundaries and are not presently being evaluated for official recognition (ACS, 1983).

The North Slope Borough has identified Areas Meriting Special Attention (AMSA) in its Coastal Management Program. The AMSA designations, which are designed to address special coastal areas where unique ecological, recreational, cultural, geologic, or developmental values exist, include Cape Thompson and Kaseguluk Lagoon/Barrier Island System. Both of these areas are located on the Chukchi Sea and are highly unlikely to be impacted by operations at the Fireweed Prospect.

13.3 Area-Wide Study Areas

These areas are characterized by observed biological activity occurring over relatively undefined geographic boundaries. Examples include:

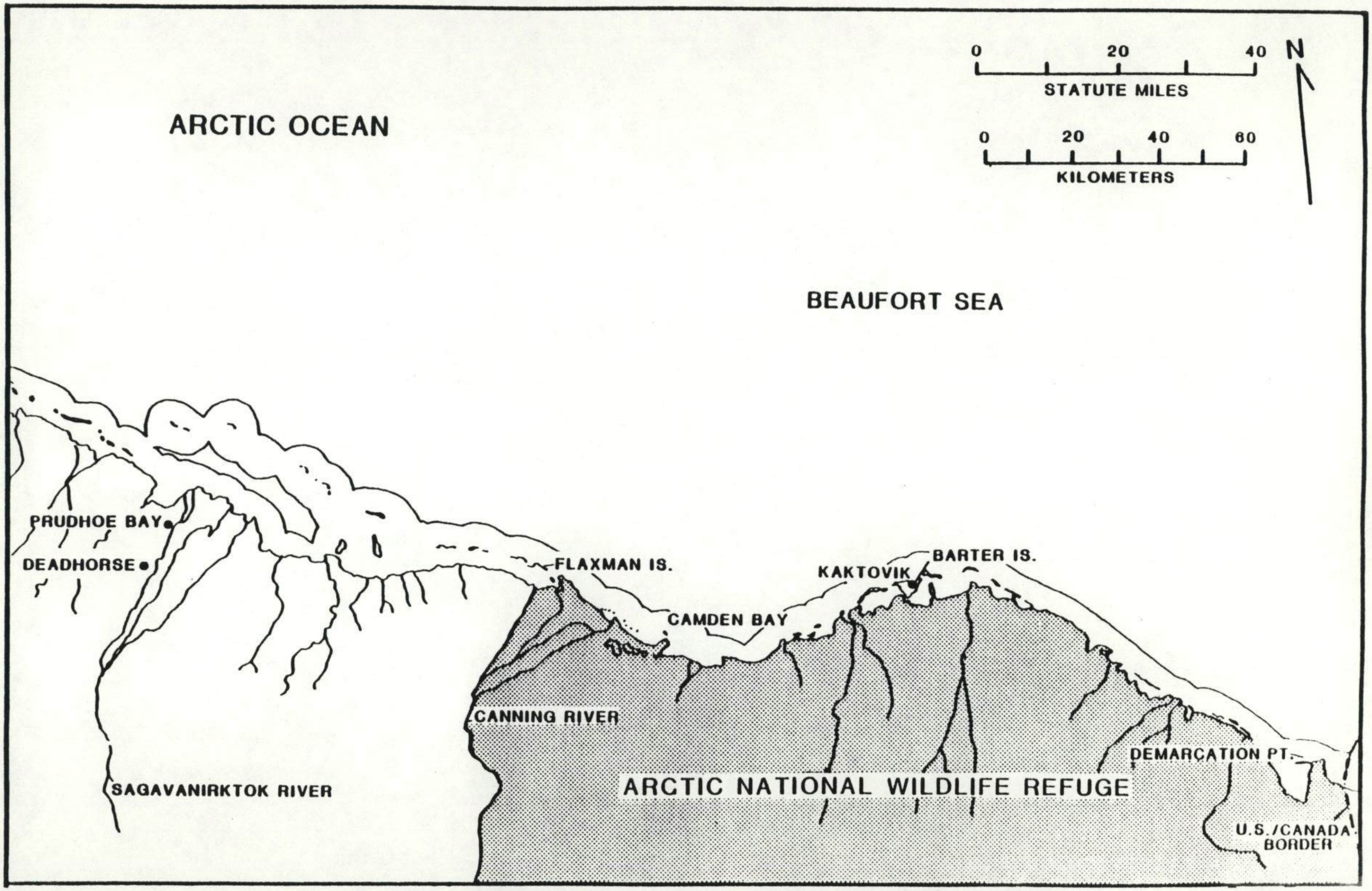

FIGURE 13-1 ARCTIC NATIONAL WILDLIFE REFUGE

- Bowhead whale migration routes;
- Gray whale migration and feeding grounds;
- Beluga whale migration, feeding, and calving areas;
- Seal, walrus, and polar bear migration areas; and
- Migratory bird nesting areas.

Less defined environmentally sensitive areas include the barrier island groups and wetland areas.

The proposed ARCO offshore and onshore exploration activities are expected to have a minimal impact on these less geographically defined environmentally sensitive areas. A detailed discussion of these areas is presented under Section 12 and in the Environmental Impact Statement prepared by the Minerals Management Service for the OCS Lease Sale Area 97, Beaufort Sea, Alaska.

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ATTACHMENT
14

14.0 USE CONFLICTS

14.1 Subsistence Use

This section describes the subsistence harvest patterns of the Inupiat (Eskimo) communities closest to the exploration activities areas--Wainwright, Barrow, Atqasuk, Nuiqsut, and Kaktovik. The residents of North Slope communities that might be affected by Fireweed Prospect exploration activities participate in a subsistence way of life. Alaskan and Federal statutes define "subsistence uses" as those customary and traditional uses in Alaska of fish, wildlife, and vegetation for direct personal, family, and community needs (AS Sec. 16.05.940). Residents of the North Slope often refer to hunting as their "lifestyle," and this assertion is echoed by social scientists familiar with the area. For example, a typical assessment states, "subsistence activities are unquestionably assigned the highest cultural value by North Slope Inupiat." They remain "a focus for maintaining a sense of identity" as well as an important economic activity (Nelson, 1969). Subsistence activities also provide a major source of food and other products in communities characterized by low and unstable household incomes.

The possible effect of offshore oil development on subsistence is a major scoping concern. This concern combines past experiences of onshore oil development and industrial accidents with secondary information on the subject, usually gleaned from the media; and it appears within a framework of a long history of use and knowledge of the Arctic environment, of the wildlife species that inhabit this environment, and of its ocean and ice conditions. The local Inupiat view biological effects on wildlife species and habitats as, inevitably, causing subsistence effects as well. Analysis of public hearing testimony (Kruse et al., 1983) indicates that Inupiat concerns may be divided into five categories:

1. Direct damage to subsistence resources and habitat.
2. Migratory disruptions of subsistence species.
3. Disruption of access to subsistence areas.
4. Harm to cultural-resource landmarks.
5. Loss of Native food.

Subsistence is a system of production and consumption, a fact that complicates the analysis of subsistence effects. For example, a species might be temporarily eliminated from a village's subsistence spectrum. If that loss could not be offset by increased harvests of other resources, subsistence consumption would decline. However, effects on consumption could be serious even if the net quantity of available food did not decline. For example, some species are important for the role they have in the yearly cycle of subsistence resource harvest. Waterfowl arrive in early spring before other species become available and at a time when stored subsistence foods are low. During this time, birds may provide the most important source of meat. If, as is often the case, caribou are scarce in the winter, ringed seal may provide a more reliable source of fresh meat. In addition, some harvestable subsistence species fill nutritional roles in the diet or are especially preferred and sought after. For example, throughout the study area, seal oil is invariably served with frozen fish or meat (kwak). Especially preferred foods include, among others, waterfowl, bowhead and whale products, polar bear, and smelt. Thus, important subsistence consumption patterns may be significantly affected without comparable effects on total consumption.

Harvestable subsistence resources also provide such materials for personal and family use as furs and skins for clothing, bone for tools, and bearded seal hides for boats. The sharing of harvestable subsistence resources helps maintain traditional family organization (Heinrich, 1960; Burch, 1975; Worl and Smythe, 1986); for example, a boy's semi-ritualistic gift of this first harvest to an elder reinforces ties between generations (Luton, 1985).

Subsistence provides special foods for religious and social occasions. Bowhead whaling gives rise to the nalukataq, a traditional North Slope religious ceremony sponsored by successful whaling captains. In addition, bowhead whaling strengthens the family and community ties and the sense of a common Inupiat heritage, culture, and way of life. Therefore, whaling activities provide strength, purpose, and a sense of unity in a modern and changing world (USDOI/MMS, 1990).

Throughout the area, households serve waterfowl for special social occasions such as Thanksgiving and Fourth of July feasts. The sharing, trading, and bartering of harvestable subsistence resources structures relations among communities within the study area, while the giving of such foods helps maintain ties with family members elsewhere in Alaska (Worl et al., 1980; ACI-Braund, 1983). In these traditional sharing and exchange networks, preferred and special foods play an especially important role (Luton, 1985).

Finally, subsistence provides a link to the market economy. Households within the region earn income from crafting ivory, baleen, and furs and from the sale of furs.

These are examples of possible effects on consumption; the productive side of the subsistence system may also be affected. For example, the temporary elimination of a species from a community's subsistence spectrum may impair the overall productivity of hunting without substantially affecting the diet. Many important species, such as bearded seal and polar bear, are normally taken as "targets of opportunity" by hunters in pursuit of other game (Nelson, 1969, 1982; Luton, 1985). If such opportunities were significantly curtailed, overall harvest efficiency might decline. People might have to work harder, hunt longer, travel farther, or spend more money for an equivalent harvest.

14.2 Exploration Effects on Subsistence Use

Exploration activities may impact the environment potentially decreasing the subsistence success. The following is an abbreviated discussion of some of the subsistence uses which could be affected by exploration activities. A more thorough discussion can be found in the FEIS for Lease Area 97 (USDOI/MMS, 1987) and the DEIS for Lease Sale 124 (USDOI/MMS, 1990).

Subsistence use areas for Wainwright, Barrow, Atqasuk, Nuiqsut, Kaktovik, the North Slope communities adjacent to the Prospect area, have been described in the FEIS's for Sales 71, 87, and 97 and the DEIS for Sale 124. Figure 14-1 summarizes and incorporates by reference this community-level, subsistence-use-area information. This figure presents the broad, current-use areas of these villages. These boundaries are dynamic, and they expand and contract according to the availability of game (Pedersen, 1979). Figures 14-2 and 14-3 present these broad, current-use areas in terms of species harvested. Figure 14-2 indicates where Wainwright, Barrow, Atqasuk, Nuiqsut, and Kaktovik harvest bowhead and beluga whales; Figure 14-3 indicates where these communities harvest seals and walruses. In all, the subsistence-use areas of the five North Slope communities total 84,436 square miles, although these areas overlap (Pedersen, 1979). Under certain conditions, harvest activities may occur anywhere in this wide expanse, but they tend to be concentrated along rivers and ocean coastlines, near villages, and at particularly productive sites. The size of the area used by each village is as shown in Figure 14-1.

For all five communities, the subsistence resources that might be affected by exploration activities of the Fireweed Prospect include bowhead whales, beluga whales, seals, walruses, polar bears, caribou, fishes, and marine and coastal birds.

One of the greatest concerns that the residents of these communities have is for the possible effects of the proposed action on whales and whaling. Whaling remains a primary subsistence activity for the communities of Barrow, Wainwright, Nuiqsut, and Kaktovik. "Whales are not only an important subsistence issue; they are the singlemost important animal to the North Slope sociocultural system, which also has roots in prehistory" (USDOI/MMS, 1990). Barrow is the only community within the area that harvests whales in both the spring and the fall. Wainwright residents hunt bowhead only during the spring; Nuiqsut and Kaktovik residents hunt only during the fall. The DEIS for Sale 124 (USDOI/MMS, 1990) describes in detail the whaling activities of these communities and the potential effects from exploratory activities. These topics are summarized below.

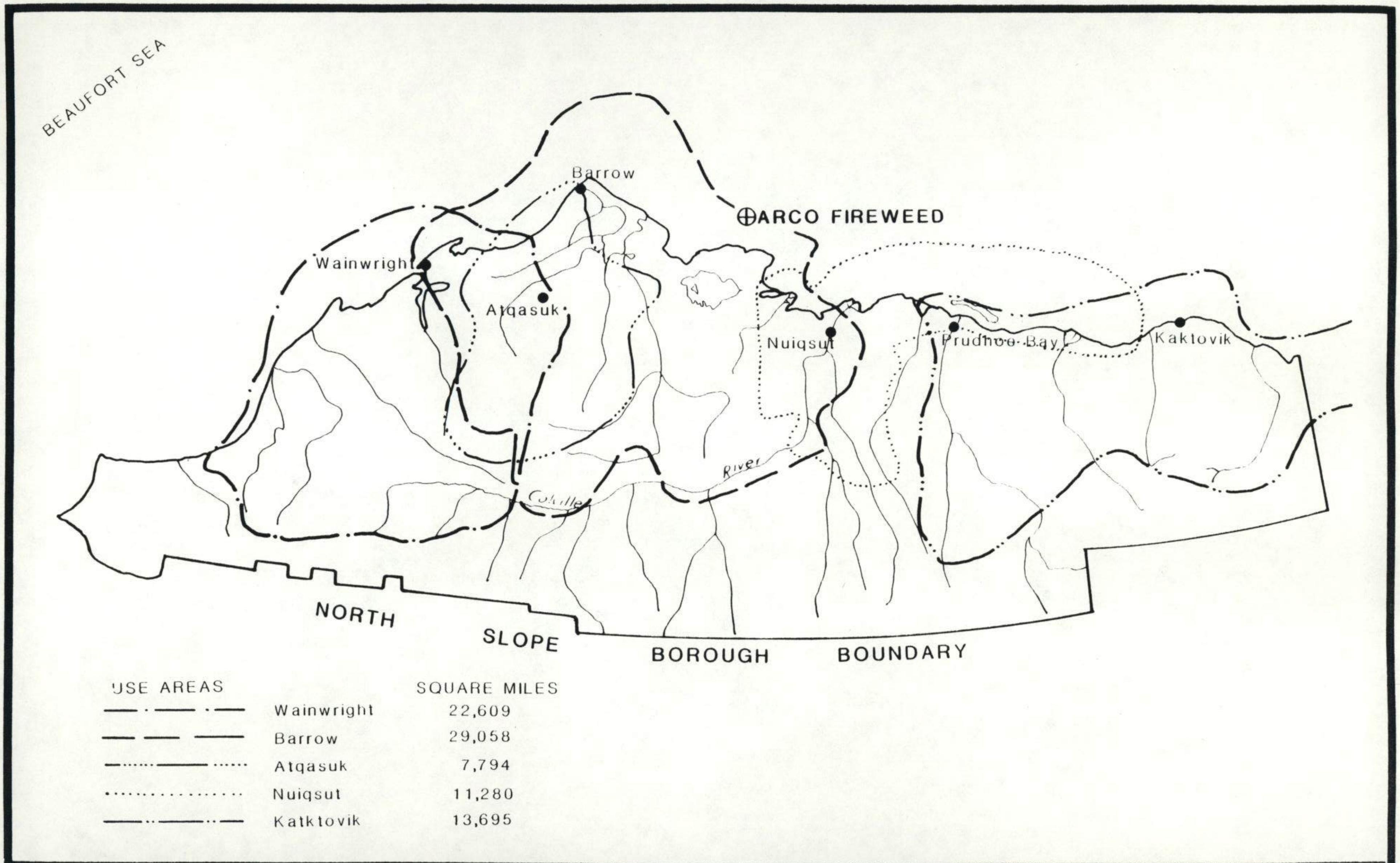
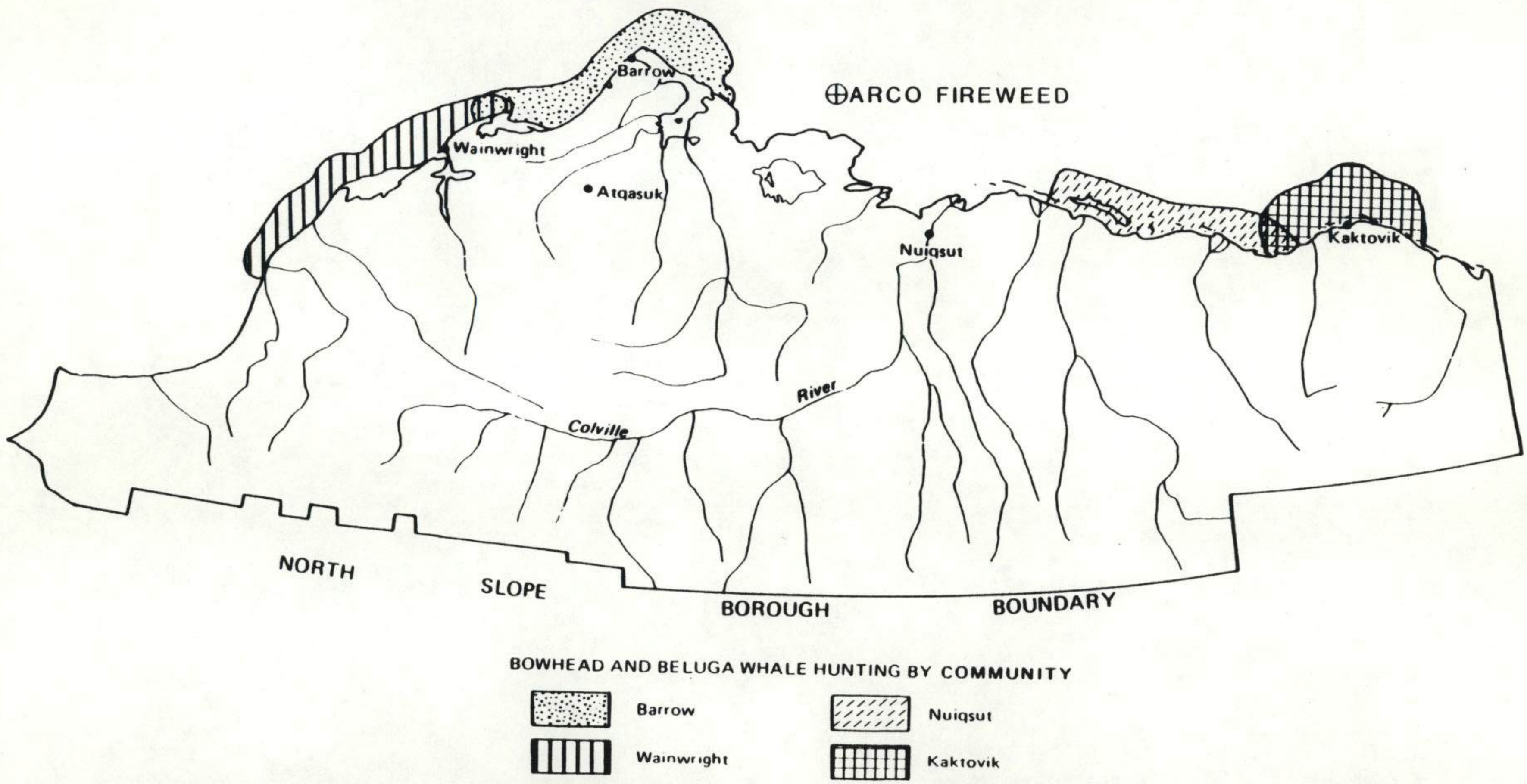
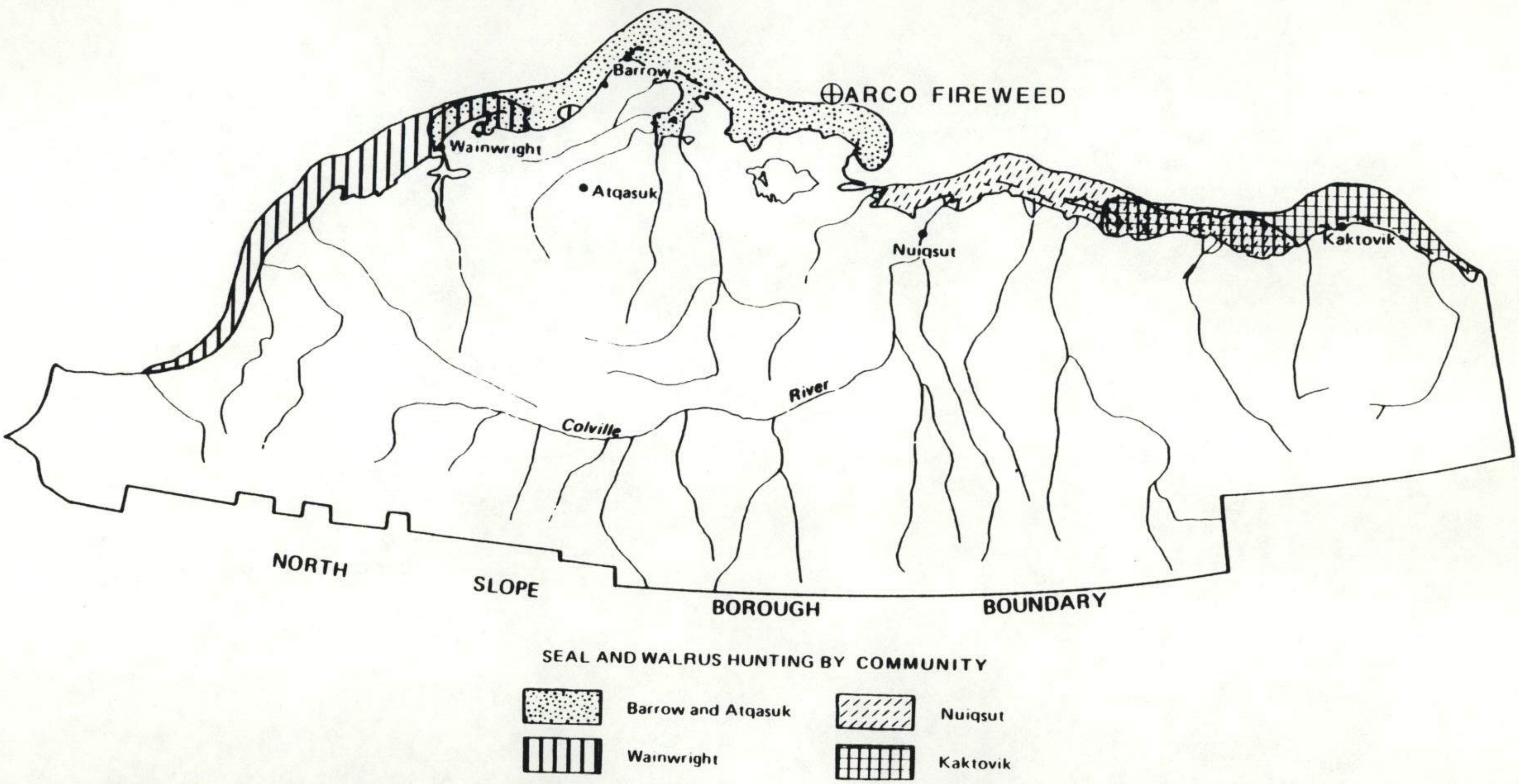


Figure 14-1. Village Subsistence Use Areas (Pederson 1978, 1979)



Sources. Original files compiled by Alaska Department of Fish and Game, Division of Subsistence, Arctic Region, North Slope Office, Fairbanks, AK. Map based on North Slope Borough Geographic Information System, December 1985.

FIGURE 14-2 NORTH SLOPE BOROUGH SUBSISTENCE-USE AREAS – BOWHEAD AND BELUGA WHALE HUNTING



Sources Original files compiled by Alaska Department of Fish and Game, Division of Subsistence, Arctic Region, North Slope Office, Fairbanks, AK. Map based on North Slope Borough Geographic Information System, December 1985.

FIGURE 14-3 NORTH SLOPE BOROUGH SUBSISTENCE-USE AREAS – SEAL AND WALRUS HUNTING

14.2.1 Whaling Activities

Barrow: Residents hunt the bowhead whale during both the spring and fall migrations (Figure 14-4). The spring whale hunt is the major whaling season. No other marine mammal is harvested with the intensity that is expended on obtaining the bowhead (Table 14-1).

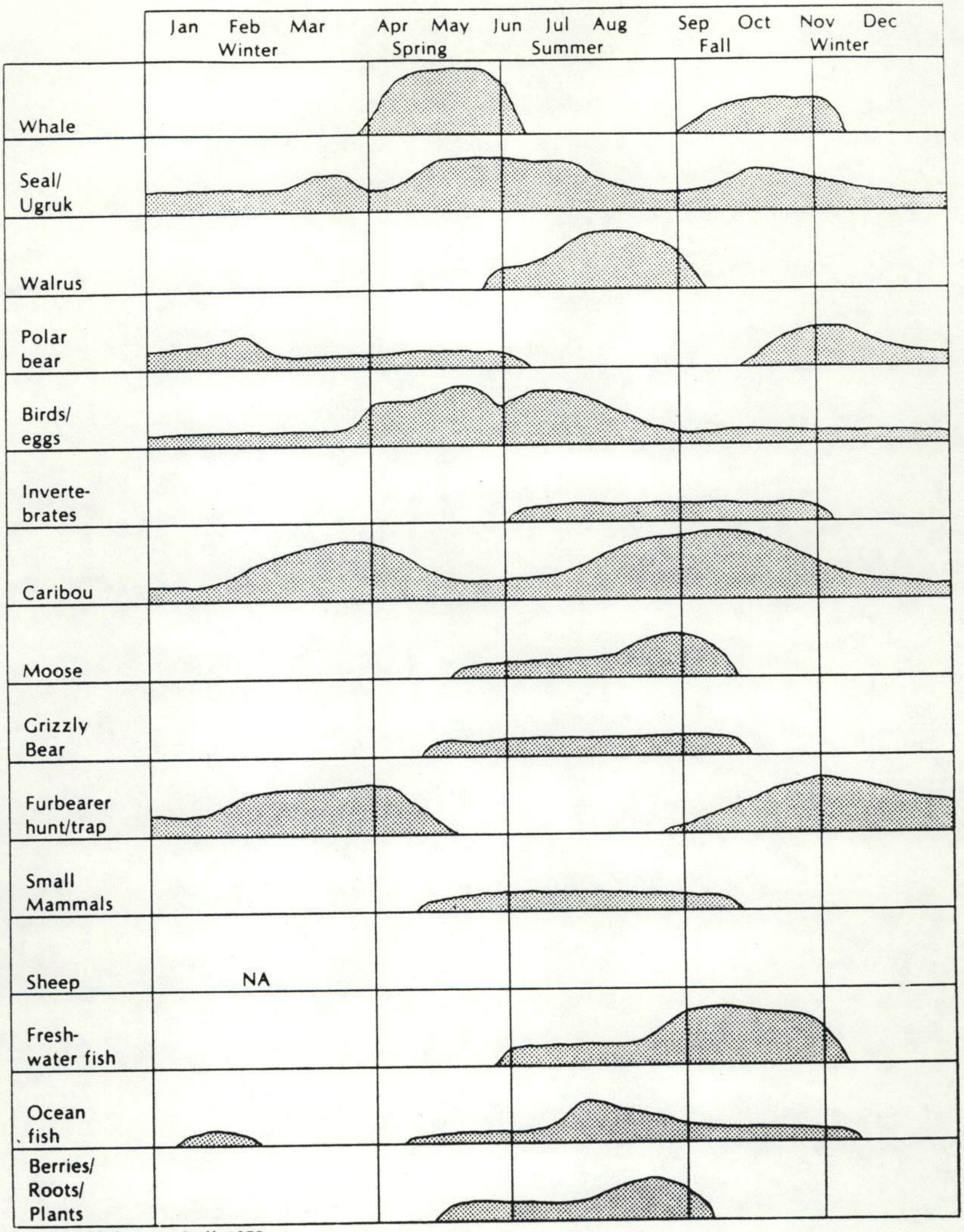
The International Whaling Commission (IWC) establishes a quota for subsistence hunting of the bowhead whale for each community. Barrow whalers only hunt in the fall if they are unable to obtain their quota during the previous spring hunt. There are approximately 30 Barrow whaling camps along the landfast ice edge. The location of the camps depends on ice conditions and currents. Strong currents and many leads near Point Barrow prevent crews from camping near the point. Therefore, most whaling camps are located south of Barrow.

In the spring from early April until the first week of June, bowheads are hunted from leads that open when pack ice conditions deteriorate. Whales are harvested along the coast from Point Barrow to the Skull Cliff area. The location of the leads varies from year to year. The leads are usually parallel and close to shore, but they occasionally break directly from Point Barrow to Point Franklin, forcing whalers to travel offshore over the ice as much as 16 km to reach open leads. A lead is normally open from Point Barrow to the coast, allowing whaling 2 to 5 km from shore. Spring whaling is conducted almost entirely with skin boats due to narrow leads. These ice conditions prevent the use of aluminum skiffs which are difficult to maneuver.

In the fall, whaling occurs east of Point Barrow from the Barrow vicinity to Cape Simpson. Fall whaling is conducted with aluminum skiffs and outboard motors in open water as much as 48 km offshore.

Wainwright: Bowhead whales are the most important marine resource beginning in late April. Wainwright is not as ideally situated for whaling and therefore not as successful as is Barrow (Table 14-1). Ice leads often break far from shore and are often wider than those near Barrow; multiple leads are common. Skin boats are used early in the season, when the leads are narrower. As leads widen later in the season, Wainwright whalers use aluminum boats to pursue bowheads farther offshore. Each year, there are approximately eight whaling camps along the landfast ice edge; in some years, these camps are 16 to 24 km offshore (Figure 14-2). Harvest areas necessarily vary from year to year, depending on where the open leads occur.

Nuiqsut and Kaktovik: Nuiqsut hunters sometimes harvest bowhead whales with Kaktovik hunters. Bowhead whaling usually occurs between late August and early October, depending on ice and weather conditions. Unlike spring-whaling communities which hunt from the edge of ice leads, the fall whalers hunt bowheads in aluminum skiffs in open water. They usually hunt within 16 km of shore but can travel as much as 32 km or more offshore. Bowheads are commonly harvested off of Cross Island but the entire coastal area from Nuiqsut to Kaktovik



Source: NSB Contract Staff, 1979.

Figure 14-4. Typical yearly subsistence cycle.[1]

[1] Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, season needs, and desirability.

Table 14-1. Annual subsistence-resource harvests averaged for the period 1962 through 1982[a].

Source	Wainwright	Barrow	Nuiqsut	Kaktovik
Bowhead Whales	1.50 13,350 8.2%	10.10 89,890 21.3%	0.30 2,670 8.6%	1.00 8,900 27.5%
Caribou	1,200.00 84,000 51.6%	3,500.00 245,000 58.2%	400.00 28,000 90.2%	75.00 5,250 16.2%
Walrus	86.0 30,205 18.5%	55.00 19.260 4.6%	b b b	±3.00 1,050 3.2%
Bearded Seals	250.00 20,000 12.3%	150.00 12,000 2.9%	b b b	30.00 2,400 7.4%
Hair Seals	375.00 7,125 4.4%	955.00 18,145 4.3%	b b b	70.00 1,330 4.1%
Beluga Whales	11.00 4,400 2.7%	5.00 2,000 0.5%	b b b	5.00 2,000 6.2%
Polar Bears	7.00 1,575 1.0%	7.00 1,575 0.4%	1.00 225 0.1%	4.00 900 2.8%
Moose	2.00 450 0.3%	5.00 1,125 0.3%	b b b	5.00 1,125 3.5%
Dall Sheep	0.00 0 0.0%	0.00 0 0.0%	b b b	27.00 1,227 3.8%
Small Game	b b b	c 455 0.1%	b b b	c 136 0.4%
Birds	c 545 0.3%	c 3,636 0.9%	b b b	c 1,045 3.2%
Fishes	c 1,273 0.8%	c 27,955 6.6%	b b b	c 7,045 21.7%
Vegetation	b b b	b b b	b b b	b b b
Total Harvest (kilograms)	169,923	421,031	b	32,408
Per Capita	439	245	b	219

Source: Stoker, 1983, as cited in ACI-Braund, 1983 in USDOI/MMS, 1987.

[a] For each resource listed under the "Source" column, results are expressed as follows:
line 1: number of animals landed
line 2: utilizable weight (kg)
line 3: contribution to total village harvest (%)
Note that these results are averaged for the years 1962-1982.
Because of missing data and underestimates of some harvests, the actual per capita harvests may be somewhat higher.

[b] No data.

[c] Data expressed only as utilizable weight (kg) rather than number of animals landed.

is also utilized (Figure 14-2). Bowhead whales are a major subsistence meat source for Kaktovik residents. Although bowheads are not a major subsistence food for Nuiqsut residents (Table 14-1), they are culturally important to Nuiqsut residents, as with all of these communities, since the harvested bowhead is shared extensively with other North Slope and Alaskan communities. Its baleen is bartered in traditional networks and is used in the manufacture of traditional arts and crafts.

14.2.2 Potential Effects

At the project location, there should be no adverse effects from major oil spills as a result of exploration operations and it is expected that any associated fuel spills would likely be insignificant. There could be a number of minor alterations in bowhead habitat in the project location since a bottom-founded drilling unit will cover small areas of benthic habitat. Muds and cutting from drilling could also bury small portions of the seafloor that support benthic invertebrates ultimately used for food by bowheads. However, these effects are expected to be minimal because bowheads feed primarily on pelagic zooplankton and the seafloor area affected would be very small in relation to the total available habitat.

The major effect on bowhead whales from exploration activities would be the noise and disturbance resulting from such activities. Noise-producing activities most likely to affect bowhead whales would include aircraft traffic, vessel traffic, geophysical/seismic surveys, and exploratory drilling. Bowheads are unlikely to react significantly to occasional single passes by helicopters ferrying personnel and equipment to offshore operations from Prudhoe Bay/Deadhorse. If bowheads are overflown, some probably would dive in response to the aircraft noise. However, aircraft noise is generally audible for only a brief period of time (less than 90 seconds) and the whales should, within minutes, resume their normal activities.

Bowheads do react to the approach of vessels at greater distances than they react to most other exploration activities. In the Canadian Beaufort Sea, bowheads observed in vessel-disturbance experiments began to orient away from an oncoming vessel at a range of up to 4 km and to move away at increased speeds when approached closer than 2 km. Under experimental conditions, as a vessel approached, it caused a temporary disruption of activities and sometimes disrupted groups of whales. Fleeing from a vessel generally stopped within minutes after the vessel passed, but scattering of the whale group persisted for a longer period of time.

Vessel traffic associated with this project would be limited to an approximate one-week period in August 1990 when three support vessels would be used to bring in and situate the bottom-founded drilling unit on location and another one-week period in 1991 at the end of the winter drilling season (after ice breakup) when the vessels would remove the drilling unit from the project location. Additional vessel and barge traffic may also be present in August and

September if additional fueling of the SSDC is required. Bowhead whales could encounter the vessels during their fall migration or while feeding in the eastern Alaskan Beaufort Sea. In this case, bowheads probably would adjust their individual swimming paths to avoid approaching within several kilometers of vessels and probably would move away from vessels that approached within a few kilometers. Due to the extremely short duration for vessel activities in 1990 and 1991, the adverse effects associated with vessel traffic are expected to be minimal.

Sound from seismic exploration is another potential source of noise disturbance to bowhead whales. Bowheads appear to display normal behavior in the presence of high resolution seismic surveys at distances greater than 4.5 km but orient away from nearby seismic operations. Because of the small amount of shallow-hazards seismic surveys that would be conducted for exploration sites, these activities are not likely to have significant effects on bowhead whales. Seismic surveys are not proposed as part of this Exploration Plan.

Another source of noise would be from the drilling unit. Stationary sources of offshore noise appear less disruptive to bowhead whales than moving sound sources such as vessels. Bowhead whales exhibiting normal behavior while on their summer-feeding ground have been observed on several occasions within a few kilometers of operating drillships, well within the zone where drillship noise is clearly detectable. In playback experiments, some bowheads showed a weak tendency to move away from a sound source comparable to that which would be present several kilometers from an operating drillship. In general, bowhead avoidance has been observed in the Canadian Beaufort Sea to be greater around a drilling structure attended by supply vessels than by an unattended structure (as in this project).

Exploratory drilling is proposed to begin in late September or early October of 1990 and end in April of 1991. Fall-migrating bowheads could be exposed to drilling noise from the drilling structure. Bowheads in the vicinity of the SSDC would be expected to respond to noise from the drilling unit by slightly changing their migration speed and swimming direction to avoid closely approaching this noise source.

Concerns have also been raised in regards to the effects of noise from bottom-founded drilling operations in the spring-lead system and the potential for this noise to delay or block the bowhead spring migration (not applicable for the Fireweed location). The DEIS for Sale 124 notes that one factor to consider in assessing the possible effects of exploration noise in the lead system is that drilling platforms are stationary, whereas the lead system is not. Consequently, a platform that is present within or near a lead one day may be well outside the lead the next. High ambient noise levels have been measured at the boundary between open water and pack ice; consequently, ambient noise could be high in the area of the spring lead. If this is the case, ambient noise would tend to mask distant exploration noise and consequently be less disturbing to the bowheads. Gray whales, which appear to react to noise disturbance at levels fairly similar to bowheads, show little avoidance of production or drilling platform noise.

Experimental evidence using playback noise indicated that 50 percent of migrating gray whales would avoid drilling platform noise at 40 m. Consequently, if migrating bowheads in the Beaufort Sea react to platforms in a similar manner as gray whales, there should be little avoidance of platforms or drilling units.

14.2.3 Summary

A summary of all subsistence resources harvested shows the type, number, utilizable weight, and percent contribution to the total village harvest of the animals harvested by each native group (see Table 14-1). Barrow and Atqasuk data are combined as hunting areas and efforts for the two villages area are often combined. Generally, caribou and bowhead whales represent the largest utilizable percentages of the harvest, with fish also being a major part of the Nuiqsut and Kaktovik diet. Discussion of individual characteristics and habitats of each of the above-mentioned animals can be found in Section 12.0.

Exploration activities in the Prospect area are not expected to have any major impact on traditional Inupiat subsistence hunting and fishing activities. In general, these impacts would include actual or perceived conflicts with traditional use areas for marine mammal hunting and area usage.

Traditional harvest periods for most groups of marine mammals and migratory waterfowl (see Figure 14-4) occur during late June through early November and these activities could overlap with some of the exploration activities. It is important to consider that marine mammal and waterfowl harvest, although a very strong traditional/cultural feature as well as a subsistence necessity, is secondary to the harvesting of caribou as a primary source of meat.

14.3 Other Uses

Some of the other uses of the area include the following: commercial fishing, shipping, military use, recreation, mariculture, cultural resources, refuges, preserves and marine sanctuaries, pipelines and cables, other mineral resources and ocean dumping. Commercial fishing is restricted to one family operation, discussed in Attachment 12.3. Cultural resources and archaeology are discussed in Attachment 15.0. Refuge, preserves and marine sanctuaries are covered in Attachment 13.0.

14.3.1 Shipping

There are no deepwater ports along the Alaskan Beaufort Sea coastline. Generally, ships must anchor from approximately 0.5 to 1.1 miles (0.8 to 1.8 kilometers) offshore and cargo must be lightered ashore. Barges operated by Pacific Alaska Lines deliver approximately 2,000 tons of freight annually to the North Slope. Arctic Lighterage and Bowhead Transport provide supplemental barge service to North Slope communities out of Kotzebue. Cape Lisburne and the various Distant Early Warning System (DEW-line) sites on the North Slope are presently served by a contract carrier of the U.S. Air Force (Alaska Puget United Transportation Company). Deliveries are limited to ice-free months. Barges transport most heavy and bulk cargo associated with petroleum-related activities in the Borough (Maynard, Partch/Woodward Clyde Consultants, 1983). Prudhoe Bay has three barge docks - one at the east dock and two at the west dock. The east dock can accommodate vessel drafts of 4 feet (1 meter), and the west docks can accommodate vessel drafts of 6 to 10 feet (2 to 3 meters). The end of the west dock has been expanded to accommodate deeper draft barges as part of the Prudhoe Bay Unit Waterflood Project (USDOI/MMS, 1984).

Barge traffic in support of continued development on the North Slope of Alaska has ranged from a low of 2 barges in 1979 to a high of 26 in 1983 and 1986. Typically, 10 to 15 barges per year have been in the sealift (USDOI/MMS, 1987).

Peak years of goods movement by the marine mode have been 1970 (187,000 tons), 1975 (153,000 tons), and 1983 (estimated to be 126,100 tons). These years correspond with the Prudhoe Bay Unit construction, Trans-Alaska Pipeline System (TAPS) construction, and the Prudhoe Bay Unit Waterflood Project, respectively. In comparison, 1981 sealift traffic to Prudhoe Bay was estimated to be 70,000 tons (USDOI/MMS, 1984).

14.3.2 Military Use

Two military-related activities have taken place in the vicinity of the Alaskan Beaufort Sea. These are oil and gas exploration in the National Petroleum Reserve-Alaska (NPR-A) by the U.S. Navy and construction and maintenance of the Oliktok DEW station by the U.S. Air Force (LGL, 1983).

NPR-A (formerly Petroleum Reserve 4) is no longer under Navy jurisdiction. Even when it was, there was no military activity in the usual sense. The Barter Island and Oliktok DEW stations are radar surveillance bases located well away from the proposed operations (LGL, 1983). Consequently, there is no potential for interference from military operations in the vicinity of the Fireweed Prospect.

14.3.3 Recreation

The recreational qualities offered by the eastern Alaska Beaufort Sea area include the seasonal changeability of the natural land/seascape, the solitude, the challenge of the environment, the special nature of the area, and the area's visual qualities. The Native communities of Barrow, Nuiqsuit, and Kaktovik, and the adjacent land and ocean areas are visited most frequently by tourists because of their intrinsic cultural and recreational qualities and because they are accessible by air. Excursions from Barrow and entry points at Nuiqsut and Kaktovik involve: backpacking, cross-country skiing, float trips, observing wildlife, and other recreational activities. In addition, wilderness areas are used for the qualities they possess, including: remoteness, exceptional wildlife species, exceptional terrain, and other wilderness qualities that are not found in more populated areas (ADNR, 1976 and 1983; USDOI/MMS, 1987).

An Alaska Travelers Survey and Visitor Industry Analysis reported that, of all surveyed visitors to Alaska, about two percent visited the Barrow and adjacent surrounding area. Therefore, of the approximate 645,960 visitors to Alaska from October 1982 to September 1983, a substantial number visited the area at least once (i.e., approximately 3,900). The report states that an average of 500 people in the Barrow/North Slope area were employed as a result of these visitors and that the visitors brought in about $19.5 million in total wages to the area. According to recent figures, the trend from 1983 to the present has been toward $25 million in tourist trade for the area (ADNR, 1983; USDOI/MMS, 1987).

14.3.4 Mariculture

No mariculture activities occur on or in the vicinity of the Fireweed Prospect.

14.3.5 Pipelines and Cables

Hydrocarbon production from the North Slope is transported south through the Trans-Alaska Pipeline System (TAPS) which begins about 90 miles (145 kilometers) southeast of the Prospect (USDOI/MMS, 1984). The TAPS carries crude oil to Valdez where the oil is loaded onto tankers for shipment to refineries in the more southern portions of the United States. It is operated by the Alyeska Pipeline Service Company, a consortium of eight major oil companies (Lynch et al., 1985). The TAPS has a nominal capacity of 1.5 million barrels of oil per day delivery (USDOI/MMS, 1984). In 1983, the pipeline carried 601 million barrels of oil south from Prudhoe Bay, an average of more than 50 million barrels per month (Alaska Oil and Gas Conservation Commission, 1984). Spur oil pipelines have been constructed to connect the Kuparuk, Milne Point, and Endicott fields to the TAPS.

14.3.6 Other Mineral Resources

Gravel and coarse sand are one of the Arctic's most important resources because these scarce aggregates are required to construct roads, airstrips, work pads, foundations, causeways and, in the event of offshore drilling, artificial soil islands. Quantitative and qualitative data on North Slope and Alaskan Beaufort Sea gravel and sand resources are limited. Most of the major rivers and streams contain sand and gravel. In addition, coastal gravel and sand resources are available in beaches and spits east of the Colville River and on barrier islands. Significant gravel deposits occur in a series of coalesced alluvial fans along the flanks of the Brooks Range east of the Canning River (Dames and Moore, 1978).

Few data are available on offshore seafloor and subsurface gravel and sand deposits. Data on these resources have generally been collected incidentally as part of investigations on such issues as coastal processes, subsea permafrost, and sediment transport rather than as specific resource evaluations (Dames and Moore, 1978).

14.3.7 Ocean Dumping

There are no known military or domestic dumps or dumping activities taking place in the vicinity of the Fireweed Prospect.

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ATTACHMENT
15

15.0 ARCHAEOLOGICAL AND CULTURAL RESOURCES

15.1 Archaeological Resources

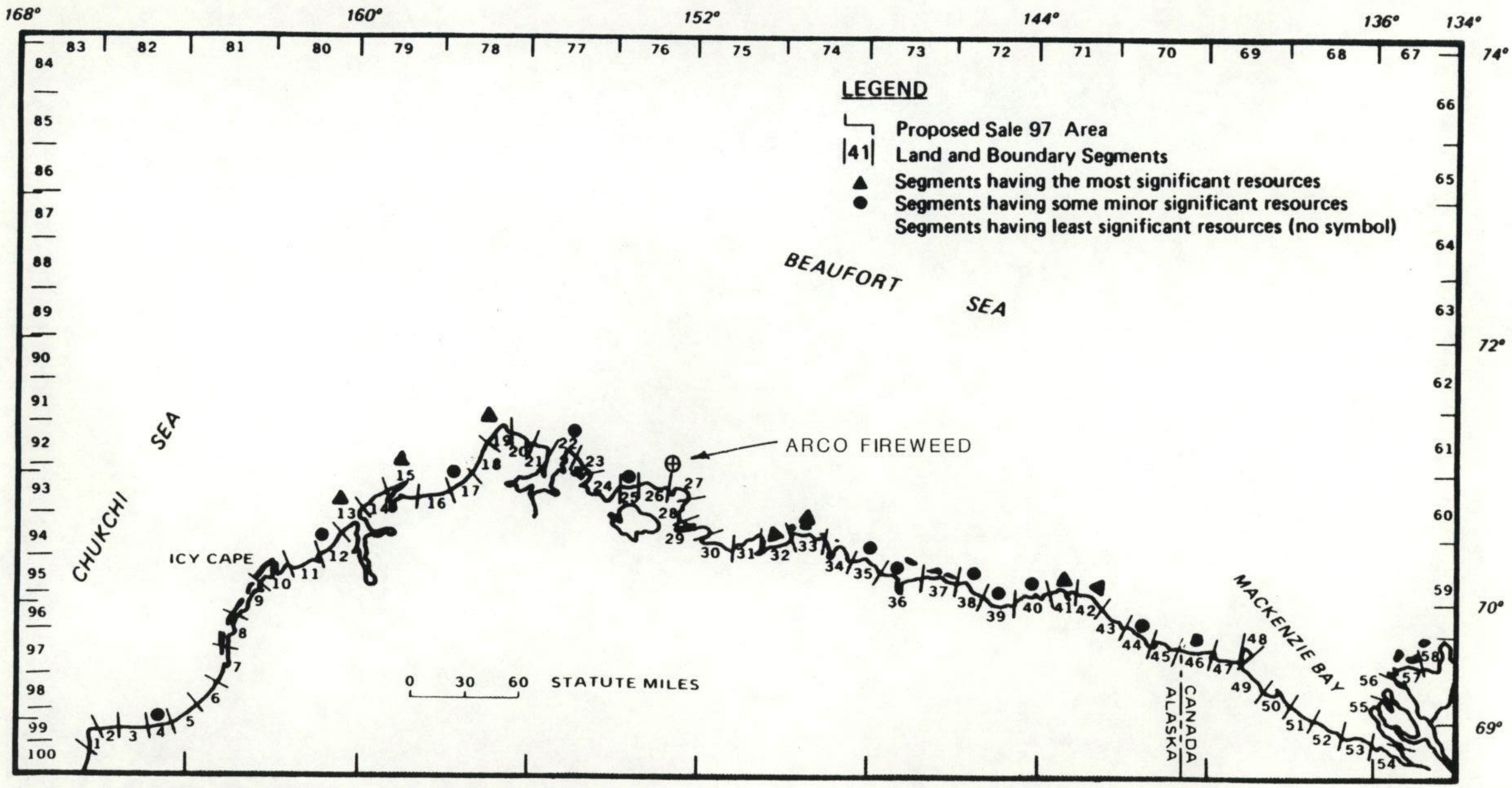
Archaeological resources on the North Slope include objects or artifacts generally man-made or modified by human activity. They are usually over 50 years old and classified as either historic or prehistoric.

Offshore, within the Prospect area itself, archaeological sites are relatively few and widely scattered. Visual archaeological resources could include: shipwrecks, abandoned whaling-era equipment, and possibly Eskimo artifacts. A review of the available side scan sonar records shows no feature suggestive of resources such a shipwrecks or other artifacts. However, side scan sonar records from future drilling sites will be reviewed as exploration continues.

Onshore, adjacent to the Prospect area, archaeological sites are more numerous. They occur along coastal areas, inland along rivers and at selected upland areas. The proposed onshore support operations, however, will be stationed at existing camp facilities and, as such, will not impact local identified archaeological sites.

A number of historic and archaeological sites have been identified in the vicinity of the Alaska Beaufort Sea; however, the significance of many of these sites has not been established. Of known sites whose significance has been assessed, two are registered National Historic Sites and three have been approved but are not yet entered in the National Register. The former are the Ernest de Koven Leffingwell's camp on Flaxman Island and the archaeological site at Birnirk near Barrow. The latter three are at Cross Island, Tigvariak Island, and Flaxman Island-Brownlow Point (ACS, 1983). In addition, there was a recent discovery of an Eskimo family preserved for two to three centuries in their house on the eroding edge of the Beaufort Sea near Barrow (USDOI/MMS, 1987). These historic sites (i.e., with the exception of Birnirk and the most recent discovery), potential natural landmarks, and known archaeological sites are identified in Figure 15-1.

Recent studies have attempted to place a value on the potential for the occurrence of prehistoric archaeologic sites on the Outer Continental Shelf. Value judgements have been derived by comparing past environmental and geographic conditions with the conditions required for settlement of the area by northern hunters and gatherers. Based on these values, only two areas on the Alaska Beaufort Sea Outer Continental Shelf have been described as having a



Source: MMS, Alaska OCS Region Computer File (Tornfelt, 1986).

Figure 15-1. Shipwrecks and archaeological, recreational, and tourism resources.

significantly enhanced resource potential. One lies just offshore from Barter Island and the other lies in the far western Beaufort Sea, offshore from the present location of Point Barrow. The relatively steep, seaward-facing slopes of this area might have been attractive to terrestrial grazers seeking fall range, and would have provided viewpoints for hunters of both terrestrial and, later on, marine mammals. In addition, topographic evidence indicates that this area might have been the recipient of one or more rivers during submergence, hosting seasonal runs of anadromous fish (Dixon et al., 1986)

Early man has occupied the Beaufort Sea Continental Shelf during the past 18,000 years, but there is little chance that any of his habitation sites would have survived the tremendous amount of ice gouging that has occurred. In addition, surviving sites could not be detected by seismic-reflection methods, due to the fact that sub-surface sediments are jumbled and homogenized (USDOI/MMS, 1987).

15.2 Cultural Resources

Cultural resources involve the Inupiat Eskimo's relationship with natural resources (particularly game animals), their nuclear and extended families, and spiritual beliefs (particularly in animal spirits). The cultural resources comprise a tightly woven interdependency among the people, the land, the sea, and the animal life.

Impacts to cultural resources can be geographically centralized to the major areas of operation:

- Offshore drilling.
- Onshore support.
- Support transportation, both aerial and marine.

Much concern has been raised over the years regarding the possible adverse impacts of offshore oil and gas exploration on the traditional cultural resources of the area. The largest single concern regards the impact to subsistence whaling activities. Secondly, concerns may also include impacts to fisheries, cultural land use areas, and land mammal migrations.

Minimal impact to seasonal whale migration and feeding zones is anticipated as a direct result of exploratory drilling activities (USEPA, 1988). Consequently, the cultural impacts, particularly those related to subsistence whaling, are considered to be minimal. However, ARCO has taken further steps to reduce even minimal adverse impacts. These steps include:

- Deadhorse's existing facilities will be used for all primary air logistics support.
- Barrow and Lonely will be utilized as secondary air logistics support bases.
- Air and marine transportation routes will be selected to minimize adverse effects on subsistence resources and activities.
- Drilling activities will be conducted from September/October through April. This will complete rig operation before the spring bowhead migration.
- The drilling support vessels will employ state-of-the-art ice management procedures.
- A lifesaving capability will exist through the availability of the medic on the drilling unit and helicopter support.
- Offering native residents from the major villages training and employment opportunities.

ARCO Alaska, Inc. recognizes the critical importance of local cultural resources and has taken early steps to identify key local cultural resource concerns. ARCO has prepared exploration plans with strong considerations for North Slope residents concerns.

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ATTACHMENT
16

16.0 ENVIRONMENTAL DATA MONITORING

ARCO will monitor and report data on meteorological, oceanographic, and vessel response as specified in the Notice to Lessors (NTL). These monitoring activities, as outlined in Table 16-1, will be conducted at no greater than 3-hour intervals, with the exception of ice condition and current. Ice conditions will be reported daily. Current speed and direction will, at a minimum, be monitored hourly for a 12-hour period during each month of operation. Trained observers and calibrated instrumentation will be used.

Any weather, sea conditions, or ice conditions, exerting severe or unusual impact on performance parameters, as well as those aspects of performance affected, will be reported.

Logs, such as illustrated on Figure 16-1 (Minerals Management Service reporting form) and Figure 16-2 (National Weather Service Form MF1-10C), and data printouts will be submitted to the Regional Supervisor, Field Operations (RSFO) on a weekly basis. Practical performance data and other data, which are considered confidential, will be submitted separately.

A summary report, containing all meteorological, oceanographic, and performance information, will be submitted to the RSFO within 30 days following completion of the well.

Table 16-1. Summary of parameters for environmental monitoring.

Type of Parameter	Parameters	Units	Measurement Interval
Meteorology	Wind direction	°True	3 hr
	Average wind speed	knots	3 hr
	Maximum wind gust	knots	3 hr
	Barometric pressure	mb, in	3 hr
	Wet bulb temperature	°F	3 hr
	Dry bulb temperature	°F	3 hr
	Dewpoint	°F	3 hr
	Relative humidity	%	3 hr
	Precipitation type	-	3 hr
	Precipitation amount	inch	3 hr
	Percent cloud cover and type	%	3 hr
	Ceiling elevation	ft	3 hr
	Visibility range	mi	3 hr
	Visibility obstructions	-	3 hr
Oceanography	Significant wave height	ft	3 hr
	Maximum wave height	ft	3 hr
	Wave period	sec	3 hr
	Sea direction	°True	3 hr
	Current speed	knots	Monthly
	Current direction	°True	Monthly
	Ice type	-	Daily
	Percent ice coverage	%	Daily
	Ice thickness	ft	Daily
	Ice pressures	psi	Daily
	Ice movement direction	°True	Daily
	Ice movement speed	knots	Daily
Vessel Performance	Vessel draft	ft	3 hr
	Vessel heading	°True	3 hr

SUGGESTED METEOROLOGICAL, OCEANOGRAPHIC & VESSEL PERFORMANCE DATA FORM

(24 HOURS)

Operator ARCO Alaska, Inc.

Location ______

Lease & Well No. ______

Rig SSDC

Date ______

Vessel Heading ______

	BAR PRES	AIR TEMP	WIND			CLOUD COVER	SURF VIS	SEA SURF TEMP	PRECIP	WAVES				SWELL			ICE COND	VESSEL MOTION					ANCHOR TENSIONS								BALLAST DEPTH	KG
			SPD	DIR	GUST					SIG	MAX	DIR	PER	HT	DIR	PER		HEAVE	PITCH	ROLL	% OFF-SET	RISER ANG	1 Av/Max	2 Av/Max	3 Av/Max	4 Av/Max	5 Av/Max	6 Av/Max	7 Av/Max	8 Av/Max		
	*	*	*	*	*	*	*	*				*	*	*	*	*		**	**	**	**	**	**	**	**	**	**	**	**	**		
0300																																
0600																																
0900																																
1200																																
1500																																
1800																																
2100																																
2400																																
	IN HG	°F	MPH	COMP HEAD	MPH	0-10	MILES	°F	IN	FT	FT	COM HD	SEC	FT	COM HD	SEC	DESCR	FT	DEG	DEG	% OF WATER DEPTH	DEG	KIPS									

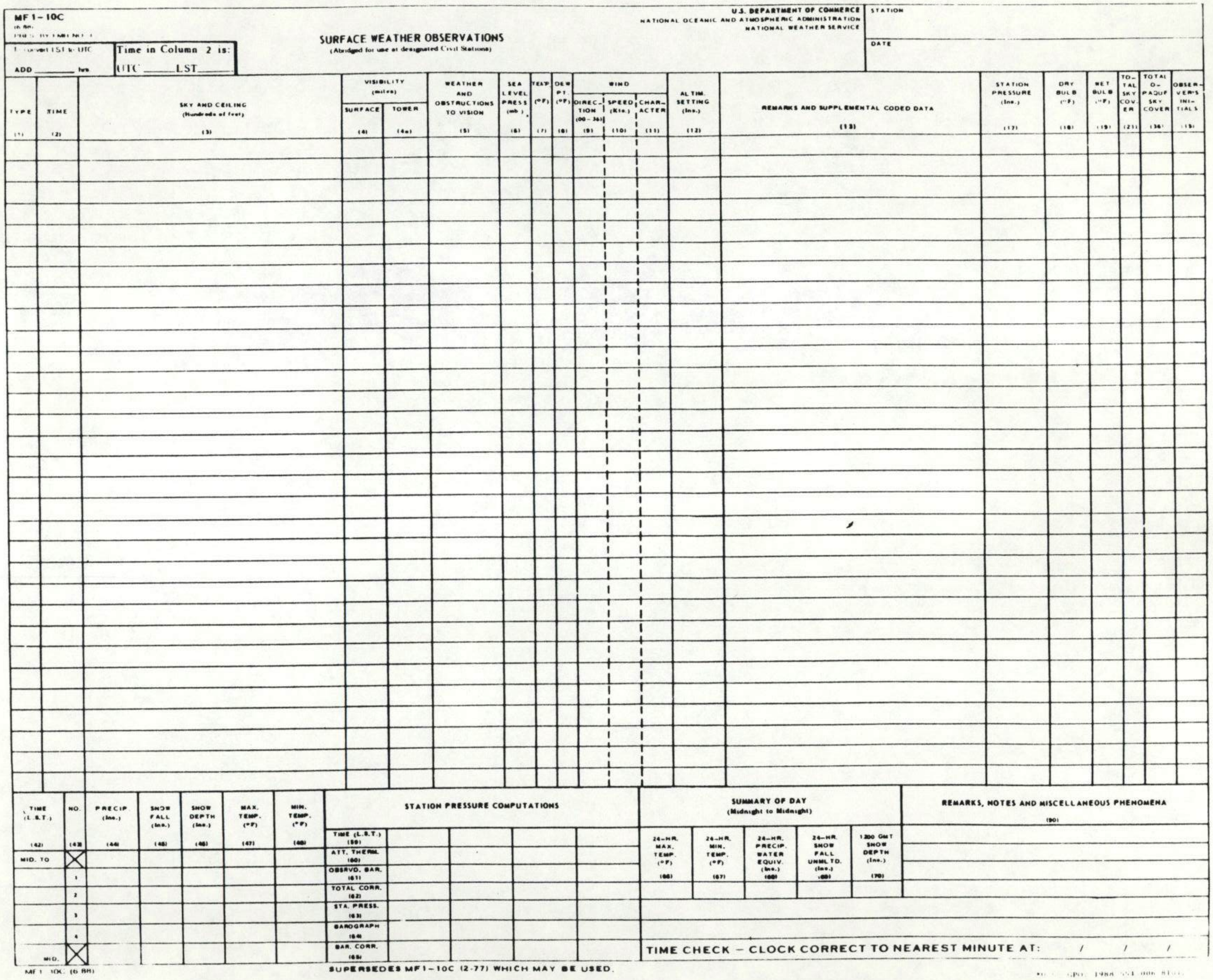
Instantaneous Maximum for One Minute *

Record Maxima and Three-Hour Average **

Remarks ______

Anchor Pattern Sketch :

Figure 16-1. Minerals Management Service Data Reporting Form.



MF 1–10C

Time in Column 2 is: UTC ____ LST ____

ADD ____ hrs

SURFACE WEATHER OBSERVATIONS
(Abridged for use at designated Civil Stations)

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

STATION

DATE

TYPE (1)	TIME (2)	SKY AND CEILING (Hundreds of feet) (3)	VISIBILITY (miles) SURFACE (4)	TOWER (4a)	WEATHER AND OBSTRUCTIONS TO VISION (5)	SEA LEVEL PRESS (mb) (6)	TEMP (°F) (7)	DEW PT (°F) (8)	WIND DIREC-TION (00–36) (9)	SPEED (Kts.) (10)	CHAR-ACTER (11)	ALTIM. SETTING (Ins.) (12)	REMARKS AND SUPPLEMENTAL CODED DATA (13)	STATION PRESSURE (Ins.) (17)	DRY BULB (°F) (18)	WET BULB (°F) (19)	TOTAL SKY COVER (21)	TOTAL OPAQUE SKY COVER (36)	OBSERVERS INITIALS (15)

TIME (L.S.T.) (42)	NO. (43)	PRECIP (Ins.) (44)	SNOW FALL (Ins.) (45)	SNOW DEPTH (Ins.) (46)	MAX. TEMP. (°F) (47)	MIN. TEMP. (°F) (48)
MID. TO	X					
	1					
	2					
	3					
	4					
MID.	X					

STATION PRESSURE COMPUTATIONS

TIME (L.S.T.) (59)				
ATT. THERM. (60)				
OBSERVD. BAR. (61)				
TOTAL CORR. (62)				
STA. PRESS. (63)				
BAROGRAPH (64)				
BAR. CORR. (65)				

SUMMARY OF DAY
(Midnight to Midnight)

24-HR. MAX. TEMP. (°F) (66)	24-HR. MIN. TEMP. (°F) (67)	24-HR. PRECIP. WATER EQUIV. (Ins.) (68)	24-HR. SNOW FALL UNML TD. (Ins.) (69)	1200 GMT SNOW DEPTH (Ins.) (70)

REMARKS, NOTES AND MISCELLANEOUS PHENOMENA (90)

TIME CHECK – CLOCK CORRECT TO NEAREST MINUTE AT: / / /

MF1–10C (6-88)

SUPERSEDES MF1–10C (2-77) WHICH MAY BE USED.

Figure 16-2. National Weather Service Data Reporting Form.

ATTACHMENT
17

17.0 DIRECT AND CUMULATIVE IMPACTS

17.1 General

This section describes direct and cumulative impacts form ARCO proposed drilling activities at the Fireweed Prospect. Definitions used in the effects assessment follow those outlined in the Lease Sale 124 Draft EIS (USDOI/MMS, 1990) which encompasses the Lease Sale 71 area.

In the assessment of cumulative impacts, the following concurrent activities were assumed:

1. ARCO exploration drilling activities at the Fireweed Prospect (September 1990 to April 1991).

2. Shell Western E&P Inc. exploration drilling activities in the Chukchi Sea (July to October, 1990 and 1991).

3. Sealift activities for the Prudhoe Bay/Kuparuk River developments (August 1990).

4. BeauDril rig move through the Alaskan Beaufort Sea (August 1990) and Chevron/Texaco exploration drilling activities in the Chukchi Sea (June to November 1991).

5. Possible exploration drilling activities from a bottom-founded drilling unit (CIDS) in the eastern Beaufort Sea (1990?).

6. Possible exploration drilling activities from a floating drilling unit (Explorer II) in the eastern Beaufort Sea (1990?).

7. Possible geophysical surveys in the Beaufort Sea (1990-1991?).

The first four of these activities appear to be fairly certain of occurring, while the remaining activities are speculative. The cumulative assessment does not present the possible effects of the entire lease area(s) development including oil and gas production; these impacts are presented in detail in the EIS's for Lease Sales 71, 97, and 124.

The following sections provide a summary of the impact assessment for individual resource categories. Table 17-1 provides a summary of the assessment. Table 17-2 provides definitions of effect levels used in the assessment.

17.2 Lower-Trophic Level Organisms

Benthic habitat may be locally affected by placement of the SSDC/MAT and by solids deposition from drilling effluent discharges. These impacts will be local, short-term, and unavoidable but not irreversible. Impacts of bottom deposition are described in the ODCE for the Beaufort Sea (USEPA, 1988). These effects are classified as LOW.

Since impacts from various Beaufort Sea operations are all fairly local and widely separated, cumulative effects are classified as LOW.

17.3 Fishes

Fishes present in the area are discussed in Attachment 12. Fishes, primarily marine species, may be locally affected by drilling effluent discharges during the late fall and may locally lose some food sources from disturbed benthic habitat. These effects are short-term, local, and classified as VERY LOW.

Since impacts are local and widely separated, cumulative effects are classified as VERY LOW.

17.4 Marine and Coastal Birds

Marine and coastal birds present in the area are discussed in Attachment 12. Short-term effects may result primarily as a result of noise and other disturbances from helicopter and/or marine vessel traffic. Frequent use of helicopter routes (1-2 times per day) in the late fall have the potential to disturb thousands of feeding or molting birds. Mitigative measures such as avoiding sensitive areas and maintaining vertical separation will be employed. Overall, these effects are classified as LOW.

Helicopter and/or marine vessel traffic will likely occur during at least part of the summer over the entire Beaufort Sea coast. Except for support activities for exploration drilling, traffic will generally be widely spaced, intermittent, not overlap with ARCO use patterns, and produce only short-term effects. Cumulative impacts are therefore classified as LOW.

Table 17-1. Summary of direct and cumulative impacts.

Resource Category	Direct Impacts*	Cumulative Impacts**
Lower-Trophic-Level Organisms	Low	Low
Fishes	Very Low	Very Low
Marine and Coastal Birds	Low	Low
Pinnipeds, Polar Bears, and Beluga Whales	Low	Low
Endangered and Threatened Species		
Bowhead Whales	Low	Low
Gray Whales	Very Low	Low
Arctic Peregrine Falcons	Very Low	Very Low
Caribou	Low	Low
Population	Very Low	Low
North Slope Sociocultural Systems	Low	Low
Subsistence - Harvest Patterns		
Overall (Regional)	Low	Low
Wainwright	Very Low	Low
Barrow	Low	Low
Kaktovik	Very Low	Low
Nuiqsut	Low	Low
Economy of the North Slope Borough	Very Low	Low
Land Use Plans and CZM	Low	Low
Archaeological Resources	Very Low	Very Low
Recreation and Tourism Resources	Very Low	Very Low
Water Quality	Low	Low
Air Quality	Low	Low

* Possible impacts from activities described in this exploration plan.

** Possible cumulative impacts for seven items listed in Section 17.1.

Table 17-2. Definitions used in effects assessment (after USDOI/MMS, 1990).

Resource Category	VERY LOW	LOW	MODERATE	HIGH	VERY HIGH
	Effect-Level Definitions				
Water Quality[1/]	No regulated contaminant is discharged into the water column, or some amount is discharged, but the resulting concentration of contaminant does not exceed the acute or chronic State standards or EPA criterion.	A regulated contaminant is discharged into the water column and resulting concentration of contaminant occasionally exceeds but does not increase the average beyond the chronic State standard or EPA criterion. Turbidity only occasionally exceeds State standards or EPA criterion. Acute State standards or EPA criteria are not exceeded.	A regulated contaminant is discharged into the water column and the resulting concentration of contaminant averages more than the chronic State standard or EPA criterion but does not exceed acute (toxic) State standards or EPA criterion. Average water turbidity exceeds State standards or EPA criterion but does not exceed 7,500 ppm suspended solid concentration. Acute State standards or EPA criteria are not exceeded.	A regulated contaminant is discharged into the water column and the resulting concentration of contaminant is above the acute (toxic) State standard or EPA criterion more than once in a 3-year period. Or, turbidity exceeds 7,500 ppm suspended-solid concentration more than once in a 3-year period.	A regulated contaminant is discharged into the water column and the resulting concentration of contaminant is above the acute (toxic) State standard or EPA criterion more than once in a 3-year period and averages more than the chronic State standard or EPA criterion. Or, turbidity exceeds 7,500 ppm suspended-solid concentration more than once in a 3-year period and averages more than chronic State standards or EPA criteria.
Biological Resources	Individuals in a population experience sublethal effects that do not change population abundance or distribution.	A population or portion of a population changes in abundance and/or distribution in a localized area and/or for a short time period.	A population or portion of a population changes in abundance and/or distribution but would recover to its former status within one generation.	A population changes in abundance and/or distribution requiring one or two generations to recover to its former status.	A population changes in abundance and/or distribution requiring three or more generations to recover to its former status.
Endangered and Threatened Species	No discernible population decline (no lethal effects), but a number of individuals experience sublethal effects and would recover to preactivity conditions within 1 year.	No discernible population decline (no lethal effects), but a number of individuals experience sublethal effects and would recover to pre-activity conditions within 1 to 3 years. Distribution changes affecting a low number of individuals in a small local area would last no longer than the project.	A population decline (including lethal effects to a low number of individuals), resulting in a minor change in the distribution and/or abundance of the species. The expected duration of the effects on the population is 3 to 6 years.	A population decline resulting in a change in the distribution and/or abundance of the species with recovery in less than one generation or 6 to 10 years.	A substantial population decline that results in a change in the distribution and/or abundance of the species with recovery in more than one generation or more than 10 years.
Economy of the North Slope Borough	Economic effects which will not have a measurable effect on the economic well-being of the residents of the area. Local employment is increased by less than 20 percent.	Economic effects which may marginally affect the economic well-being of residents of the area. Local employment is increased by 10 to 19 percent for less than 5 years.	Economic effects which will immediately affect the economic well-being of residents of the area. Local employment is increased 10 to 19 percent for at least 5 years.	Economic effects which will significantly affect the economic well-being of residents of the area. Local employment is increased by 20 percent or more for less than 5 years.	Economic effects which will cause important and sweeping changes in the economic well-being of residents of the area. Local employment is increased by 20 percent or more for at least 5 years.

Table 17-2. Definitions used in effects assessment (after USDOI/MMS, 1990) (Cont'd).

Resource Category	Effect-Level Definitions: VERY LOW	LOW	MODERATE	HIGH	VERY HIGH
Sociocultural Systems	Periodic disruption of sociocultural systems occurs without the displacement of existing institutions.	Disruption of sociocultural systems occurs for a period of less than 1 year without a tendency toward the displacement of existing institutions.	Chronic disruption of sociocultural systems occurs for a period of 1 to 2 years without a tendency toward the displacement of existing institutions.	Chronic disruption of sociocultural systems occurs for a period of 2 to 5 years with a tendency toward the displacement of existing institutions.	Continuous disruption of sociocultural systems occurs for a period of more than 5 years with a tendency toward the displacement of existing institutions.
Subsistence-Harvest Patterns	Subsistence resources could be periodically affected, but with no apparent effects on subsistence harvests.	Subsistence resources would be affected for a period not exceeding 1 year, but no resource would be unavailable, undesirable for use, or greatly reduced in number.	One or more important subsistence resources would become unavailable, undesirable for use, or available only in greatly reduced numbers for a period not exceeding 1 year.	One or more important subsistence resources would become unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 1 to 2 years.	One or more important subsistence resources would become unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 2 to 5 years.
Air Quality[2/]	Emissions would not exceed USDOI exemption criteria for regulated air pollutants and no measurable environmental effects that are not addressed by air-quality standards would occur onshore.	Emissions would exceed USDOI exemption criteria for regulated air pollutants but not exceed the significance criteria at the shoreline, other than for VOC, nor approach health-based National Ambient Air Quality Standards (NAAQS) or Prevention of Significant Deterioration (PSD) safeguards for high air quality (including visibility) and/or local, short-term effects not addressed by air-quality standards would occur onshore.	Emissions would exceed USDOI regulatory air-quality significance-increment criteria, other than for VOC at the shoreline, but would not exceed health-based NAAQS or PSD safeguards for high air quality (including visibility) and/or regional, short-term effects not addressed by air-quality standards would occur onshore.	Emissions would result in violation of health-based NAAQS and/or PSD safeguards for existing high air quality (including visibility) at the shoreline for an existing air-quality-attainment area and/or local, long-term environmental effects not addressed by air-quality standards would occur onshore. Human health could be adversely affected. The USDOI exemption criteria would be exceeded.	Emissions would result in violation of health-based NAAQS at the shoreline for an existing air-quality-nonattainment area and/or regional, longterm environmental effects not addressed by air-quality standards would occur onshore. Human health could be adversely affected. The USDOI exemption criteria would be exceeded.
Archaeological Resources	Little damaging interaction between an effect-producing factor and an archaeological site occurs.	An interaction between an archaeological site and an effect-producing factor occurs, but effects are temporary and reversible.	An interaction between an archaeological site and an effect-producing factor occurs and results in the loss of archaeological data that are not significant.	An interaction between an archaeological site and an effect-producing factor occurs and results in the loss of significant, but not unique, archaeological information.	An interaction between an archaeological site and an effect-producing factor occurs and results in the loss of unique archaeological information.

Table 17-2. Definitions used in effects assessment (after USDOI/MMS, 1990) (Cont'd).

	Effect-Level Definitions			
VERY LOW	LOW	MODERATE	HIGH	VERY HIGH
Resource Category				
Land Use Plans and Coastal Management Programs				
Activities generally conform with existing land use and with policies of local, State, and Federal coastal management programs and land use plans.	Activities infringe on proposed land use, or they conflict with one policy of local, State, or Federal coastal management programs and land use plans.	Activities infringe on existing land use, or they conflict with two policies of local, State or Federal coastal management programs and land use plans.	Activities alter a preferred land use, or they conflict with three policies of local, State, or Federal coastal management programs and land use plans.	Activities are incompatible and displace a preferred land use, or they conflict with four or more policies of local, State, or Federal coastal-management programs and land use plans.

Source: USDOI, MMS, Alaska OCS Region.

1/ LOCAL--Changes in water quality from one or more sources, extending beyond the edge of a mixing zone (100-m radius), but affecting less than 1,000 km^2 about each discharge. REGIONAL--Changes in water quality over an area of at least 1,000 km^2 or larger about a discharge source.

2/ National Ambient Air Quality Standards are based on the protection of human health. Numerical standards for each pollutant are given in Table III-A-1. Regional refers to effects on areas that are as large as, or larger than, about one-half the area of the North Slope of Alaska. Local refers to effects limited to tens of miles near the shoreline. Short term refers to hours, days, or weeks; and long term refers to seasons or years.

17.5 Pinnipeds, Polar Bears, and Beluga Whales

Pinnipeds, polar bears and beluga whales are discussed in Attachment 12. Short-term, local and unavoidable impacts may result from helicopter and/or marine vessel operations. Polar bears may also be directly and/or indirectly attracted to winter drilling operations, which could result in conflicts. Noise from drilling operations could also locally effect pinnipeds and beluga whales. Mitigative measures such as maintaining vertical separation will be employed. Overall, these effects are classified as LOW.

Since impacts from various Beaufort Sea operations are all fairly local and short-term, cumulative impacts are also considered to be LOW.

17.6 Bowhead Whales

Bowhead whales are discussed in detail in Attachments 12 and 14. It is proposed that drilling operations occur during part of the fall bowhead whale migration period (generally September 1 to October 31). A monitoring program (outlined in Section 3.0) is proposed to detect the presence of bowheads in the vicinity of the Fireweed Prospect and to monitor responses of bowheads to noises from the drilling operations. As such, if impacts are detected, appropriate mitigative measures can be employed at the direction of MMS and/or other appropriate government agencies. Resulting effects are therefore considered to be LOW at the Fireweed Prospect.

There appears to be a relatively higher level of industrial activity in the Beaufort Sea than has occurred in at least the past few years. Most activity will be widely separated from the Fireweed Prospect, be of short duration, and in part occur prior to the fall bowhead migration period. As such, cumulative effects are also considered to be LOW.

17.7 Gray Whales

Gray whales are discussed in Attachment 12. Drilling operations could occur when gray whales are present in the area, and short-term unavoidable impacts could result from noises from helicopters, marine vessels, and/or drilling operations. Since gray whales use the Beaufort Sea in the vicinity of the Fireweed Prospect area on a very limited basis, effects are expected to be VERY LOW.

Other activities, principally those in the Chukchi Sea, are expected to more directly affect gray whales than those proposed at the Fireweed Prospect. Cumulative effects of all operations are still expected to be LOW.

17.8 Arctic Peregrine Falcons

Exploration drilling and support activities should not overlap with the Arctic peregrine falcon habitat. USDOI/MMS (1990) indicates all known nests are located at least 25 miles inland from the coast. The most frequent sightings of Arctic peregrine falcons along the Beaufort Sea coast have occurred east of the mouth of the Colville River where it is believed immature birds use the area on a transient basis from mid-August to mid-September. Mitigative measures to avoid possible conflicts involve maintaining vertical separation for helicopter support operations. Effects, if they occur, are likely to be classified as VERY LOW.

Since impacts from other Beaufort Sea operations are all fairly local, widely-separated and short term, cumulative effects are also classified as VERY LOW.

17.9 Caribou

Caribou in the area are discussed in Attachment 12 and in detail by USDOI/MMS (1990). The Teshekpuk Lake herd uses the onshore area south of the Fireweed Prospect for calving and overwintering (USDOI/MMS, 1990). Disturbances to caribou will primarily be associated with helicopter support traffic (1 or 2 flights per day) and are expected to be brief, lasting for a few minutes to one hour. Mitigative measures, including vertical separation for helicopters, will be employed and effects are expected to be LOW.

Helicopter operations are likely to occur across the entire North Slope for a variety of projects. Since most operations will be short-term and widely separated, cumulative impacts on caribou are expected to be LOW.

17.10 Population

The population of the North Slope Borough is described in detail by the USDOI/MMS (1990). Activities associated with the Fireweed Prospect will be concentrated either at the drilling location or at existing oil and related facilities in the Deadhorse/Prudhoe Bay area. ARCO activities may, however, provide short-term direct and indirect employment opportunities. Direct effects are considered to be VERY LOW.

Various operations in the Beaufort Sea coincident with those at the Fireweed Prospect will likely provide a number of short-term, direct and indirect employment opportunities for many North Slope villages. Cumulative effects are considered to be LOW.

17.11 North Slope Sociocultural Systems

Exploration activities will use existing support facilities in the Deadhorse/Prudhoe Bay area and possibly at Lonely, which will limit the interaction between Native and non-Native groups. Impacts, if they occur, should be local and of a short duration. As a mitigative measure, ARCO will avoid interaction with Native communities where appropriate. Direct impacts are expected to be LOW.

Various operations will require some interaction with local villages, primarily to obtain local hires and to obtain local consultation on various projects. Such interaction should be minimal and cumulative impacts should be LOW.

Subsistence use areas are described in Attachment 14. The Fireweed Prospect generally avoids most subsistence use areas. It is possible that some overlap may occur for use areas for Barrow (vessel operations) and Nuiqsut (helicopter operations). Impacts, if they occur, will be short-term and local. There is potential for positive impacts in that ARCO could support search and rescue operations in their normal operations. Direct impacts are considered to be LOW for Barrow and Nuiqsut use areas and VERY LOW for other villages.

Geographically, other projects are planned to occur in subsistence use areas for most villages; however, cumulative effects will generally be short-term and are considered to be LOW.

17.13 Economy of the North Slope Borough

The economy of the North Slope Borough is discussed in detail by the USDOI/MMS (1990). ARCO's exploration drilling activities may employ a few Native residents from the North Slope Borough either directly or indirectly. Employment will be short-term and will have a VERY LOW effect on governmental policies, planning, budgeting or general economic well-being of North Slope Borough Native residents.

Generally, increased oil and gas related activities on the North Slope may provide short-term employment opportunities for Native residents. The cumulative effect of all activities will likely be LOW.

17.14 Land Use Plans and Coastal Zone Management Programs

Proposed drilling operations generally conform with existing land use and coastal zone management programs with the exception that drilling activities are proposed to occur, in part, concurrently with the fall bowhead whale migration. A monitoring program, as outlined in

Section 3.0, is proposed to detect the presence of bowheads in the vicinity of the Fireweed Prospect and to monitor responses of bowheads to noises from drilling operations. Resulting effects are therefore considered to be LOW.

Since impacts from various Beaufort Sea operations are all fairly local and short-term, cumulative effects are also considered to be LOW.

17.15 Archaeological Resources

There are no known archaeological resources which will be impacted by ARCO's proposed program (see Attachment 15). Most activities will be conducted using existing facilities. Side scan sonar records from the drilling site will be reviewed to ensure potential marine sites are identified and avoided. Direct impacts are therefore considered to be VERY LOW.

All known concurrent oil and gas activities on the North Slope will take precautions to avoid disturbances to known archaeological sites. Cumulative effects are also considered to be VERY LOW.

17.16 Recreation and Tourism Resources

The area in the vicinity of the proposed Fireweed drilling location is not known to be of high potential for recreation and tourism resources. As such, direct impacts will be VERY LOW.

Various Beaufort Sea operations are generally fairly short-term and will not occur in areas of high traditional recreation and tourism use. Cumulative effects of all operations are therefore considered to also be VERY LOW.

17.17 Water Quality

Short-term, unavoidable and measurable degradation of water quality may occur locally as a result of drilling effluent discharges. These discharges are identified in Attachments 4 and 9, and water quality impacts are described in the ODCE for the Beaufort Sea (USEPA, 1988). Direct impacts are considered to be LOW.

Since impacts from various Beaufort Sea operations are all fairly local and widely separated, cumulative effects are classified as LOW.

17.18 Air Quality

Air emissions from exploration activities will result in short-term and unavoidable degradation of air quality. As described in Attachment 19, pollutant concentrations at the shoreline do not exceed maximum levels permitted by federal standards for ambient and/or incremental air quality. Direct effects are considered to be LOW.

Since impacts form various Beaufort Sea operations are all fairly local and widely separated, cumulative effects are also classified as LOW.

REFERENCES

U.S. Department of the Interior/Minerals Management Service (USDOI/MMS). 1987. Alaska Outer Continental Shelf Beaufort Sea Sale 109. Final Environmental Impact Statement Alaska OCS Region. Vol. 1 and 2.

USDOI/MMS. 1990. Alaska Outer Continental Shelf Beaufort Sea Planning Area, Oil and Gas Lease Sale 125. Draft Environmental Impact Statement. Vol. 1 and 2.

USEPA, 1988. Ocean Discharge Criteria Evaluation for Beaufort OCS Oil and Gas Lease Offering 97; Final. U.S. Environmental Protection Agency, Region X; Seattle, Washington, August 1988.

ATTACHMENT

18

Coastal Project Questionnaire and Certification Statement

Please answer all questions. Include maps or plan drawings with your packet. An incomplete questionnaire may be returned and will delay the review of your packet.

APPLICANT INFORMATION

1. ARCO Alaska, Inc.
Name of Applicant
P.O. Box 100360
Address
Anchorage, Alaska 99510-0360
City **State** **Zip Code**
(907)276-1215
Daytime Phone

2. Mr. J. Green
Contact Person
same
Address
same
City **State** **Zip Code**
(907)265-6239
Daytime Phone

PROJECT INFORMATION

1. Provide a brief description of your project and ALL associated facilities (caretaker facilities, etc.):

Conduct petroleum exploration drilling activities an offshore prospects in the Beaufort Sea Lease Sale 71 area. Helicopter base operations at Deadhorse, Alaska.

Starting Date for Project July 1990 Ending Date for Project August 1991

PROJECT LOCATION

1. Please give location of project. (Include nearest community or identifiable body of land or water.)

Beaufort Sea Lease Area 71 Latitude 71°5' 18.93"N Longitude 152° 36' 23.43"W

Township ____ Range ____ Meridian ____ Section ____ Aliquot Parts ____ USGS Map ____

2. Is the project on: *(please mark with ✓)*

State Land ____ Federal Land XXX Private Land ____ Municipal Land ____

3. Project is located in which region of the state (see attached map):

Northern XXX Southcentral ____ Southeast ____

CURRENT APPROVALS

1. Do you currently have any State or federal approvals for this project? If yes, please list below. (Note: *approval* means permit or any other form of authorization.) List state review ID#, if any. Yes ☐ No ☒ (XXX)

Approval Type	Approval #	Expiration Date	State ID#

FEDERAL APPROVALS

1. Will you be placing structures or fills in any of the following: tidal waters, streams, lakes, or wetlands*? Yes ☐ No ☒ (XXX)

** If you are uncertain whether your proposed project area is in a wetland, contact the U.S. Corps of Engineers, Regulatory Branch at (907) 753-2720 for a wetlands determination. If you are outside the Anchorage area, call toll free 1-800-478-2712.*

If yes, have you applied for or do you intend to apply for a U.S. Army Corps of Engineers (COE) permit? Please indicate at right and give date of submittal ________. Yes ☐ No ☒ (XXX)

2. Have you applied for or do you intend to apply for a U.S. Environmental Protection Agency National Pollution Discharge Elimination System (NPDES) permit? Please indicate at right and give date of submittal ______ . (Note: For information regarding the need for a NPDES permit, contact EPA at 271-5083.) — Yes [XX] No [ ]

3. Have you applied for or do you intend to apply for permits from any other federal agency? If yes, please list below. — Yes [XX] No [ ]

Agency	Approval Type	Date submitted (or intend to submit)
USEPA	NPDES, General Permit - Beaufort	January 1990
MMS	Permit to Drill	April 1990

DEPARTMENT OF NATURAL RESOURCES APPROVALS

1. Is the proposed project on state-owned land or will you need to cross state lands for access? — Yes [XX] No [ ]
Note: In addition to state owned uplands, the state has jurisdiction over most land below the ordinary high water line of streams, rivers, lakes, and mean hightide line seaward for three miles.

2. Is any portion of your project placed below the ordinary high water line of a stream, river, lake, or mean high water line of a saltwater body? — Yes [ ] No [XX]

3. Will you be dredging? If yes, location of dredging is: — Yes [ ] No [XX]
Township ______ Range ______ Meridian ______ Section ______
- Location of disposal site for dredged materials (describe): ______
Township ______ Range ______ Meridian ______ Section ______

4. Will you be filling with rock, sand or gravel? If yes, amount? ______ — Yes [ ] No [XX]
- Location of source: Township ______ Range ______ Meridian ______ Section ______
- Location of fill site: Township ______ Range ______ Meridian ______ Section ______

5. Do you plan to use any of the following state-owned resources?

Timber
- Will you be harvesting timber from 10 or more acres? If yes, amount? ______ — Yes [ ] No [XX]
- Location of source: Township ______ Range ______ Meridian ______ Section ______

Other Materials — Yes [ ] No [XX]
- If yes, what material? ______
(peat, building stone, silt, overburden, etc.)
- Location of source: Township ______ Range ______ Meridian ______ Section ______

6. Are you planning to use any fresh water? — Yes [XX] No [ ]
- If yes, amount (gallons per day)? 500
- Source? Prudhoe Bay Area

7. Will you be building or altering a dam? — Yes [ ] No [XX]

8. Do you plan to drill a geothermal well? — Yes [ ] No [XX]

9. Will you be exploring for or extracting coal? — Yes [ ] No [XX]

10. Will you be exploring for or extracting minerals on state-owned land? — Yes [ ] No [XX]

11. Will you be exploring for or extracting oil and gas on state-owned land? — Yes [ ] No [XX]

12. Will you be investigating or removing historical or archaeological resources on state-owned land? Yes [ ] No [XX]

13. Will the project be located in a unit of the Alaska State Park System? Yes [ ] No [XX]

If you answered NO to all questions in this section, you do not need an approval from the Alaska Department of Natural Resources (DNR). Continue to the next section.

If you answered YES to ANY questions in this section, contact DNR to identify and obtain necessary application forms.

Based on your discussion with DNR, please list (below) the approval type needed and date submitted.

Approval Type	Date Submitted (or intend to submit)
Existing Permits	

Have you paid the filing fees required for the DNR permits? Yes [XX] No [ ]

If you are not applying for DNR permits, indicate reason below:

___ a. ______________ (DNR contact) told me on ________ (date) that no DNR approvals or permits were required on this project.

___ b. Other: ______________

DEPARTMENT OF FISH AND GAME APPROVALS

1. Will you be working in a stream, river, or lake? (This includes work in running water or on ice, within the active floodplain, on islands, the face of the banks, or the stream tidelands down to mean low tide.) Yes [ ] No [XX]

Name of stream or river: ______________ Name of lake: ______________

Will you be doing any of the following:

	Yes	No
a) Building a dam, river training structure or instream impoundment?	[ ]	[XXX]
b) Using the water?	[ ]	[XXX]
c) Diverting or altering the natural channel stream?	[ ]	[XXX]
d) Blocking or damming the stream, (temporarily or permanently)?	[ ]	[XXX]
e) Changing the water flow or the water channel?	[ ]	[XXX]
f) Pumping water out of the stream or lake?	[ ]	[XX]
g) Introducing silt, gravel, rock, petroleum products, debris, chemicals or wastes of any type into the water?	[ ]	[XX]
h) Using the stream as a road (even when frozen), or crossing the stream with tracked or wheeled vehicles, log-dragging or excavation equipment (backhoes, bulldozers, etc.)?	[ ]	[XX]
i) Altering or stabilizing the banks?	[ ]	[XX]
j) Mining or digging in the beds or banks?	[ ]	[XX]
k) Using explosives?	[ ]	[XX]
l) Building a bridge (including an ice bridge)?	[ ]	[XX]
m) Installing a culvert or other drainage structure?	[ ]	[XX]

n) Constructing a weir? — Yes [ ] No [XX]

o) Other in-stream structure not mentioned above? — Yes [ ] No [XX]

2. Is your project located in a designated State Game Refuge, Critical Habitat Area, or State Game Sanctuary? — Yes [ ] No [XX]

3. Does your project include the construction and operation of a salmon hatchery? — Yes [ ] No [XX]

4. Does your project affect or is it related to a previously permitted salmon hatchery? — Yes [ ] No [XX]

5. Does your project include the construction of a shellfish or sea vegetable farm? — Yes [ ] No [XX]

If you answered NO to all questions in this section, you do not need an approval from the Alaska Department of Fish and Game (DFG). Continue to the next section.

If you answered YES to any of the questions under 1 or 2, contact the Regional DFG Habitat Division Office for information and application forms.

If you answered YES to questions 3, 4 or 5, contact the DFG Private Nonprofit Hatchery Office at the F.R.E.D. division headquarters for information and application forms.

Based on your discussion with DFG, please list (below) the approval type needed and date submitted.

Approval Type	Date Submitted (or intend to submit)
______________	______________
______________	______________
______________	______________

If you are not applying for permits, indicate reason below:

___ a. ______________ (DFG contact) told me on ________ (date) that no DFG approvals or permits were required on this project.

___ b. Other: ______________

DEPARTMENT OF ENVIRONMENTAL CONSERVATION APPROVALS

1. Will a discharge of wastewater from industrial or commercial operations occur? (See #2 in "Federal Approvals" section) — Yes [XX] No [ ]

2. Do you intend to construct/install or modify any part of a wastewater (sewage or greywater) disposal system? — Yes [XX] No [ ]

3. If yes, will the discharge be 500 gpd or greater? — Yes [XX] No [ ]

4. Do you expect to request a mixing zone for your proposed project? — Yes [ ] No [XX]
   If your wastewater discharge will exceed Alaska water quality standards, you may apply for a mixing zone. If so, please contact DEC to discuss information required under 18 AAC 70.032.

5. Will the project result in dredging or disposal of fill in wetlands or placement of a structure in waterways? (Note: your application for this activity to the Corps of Engineers will also serve as your application to DEC.) — Yes [ ] No [XX]

6. Will your project result in the development of a currently unpermitted facility for the disposal of domestic or industrial solid waste? — Yes [ ] No [XX]

7. Will your project require the application of oil or pesticides to the surface of the land? — Yes [ ] No [XX]

8. Will your project generate air emissions from the following:

	Yes	No
a) Diesel generators totaling more than 10,000 hp?	XX	
b) Other fossil fuel-fired electric generator, furnace, or boiler totaling greater than 10,000 hp, or 9,000 kWh, or 100,000,000 btu/hr?		XX
c) Asphalt plant?		XX
d) Incinerator burning more than 1000 lbs. per hour?		XXX
e) Industrial process?		XXX
9. Will you be altering a public water system?		XXX
10. Will your project require offshore drilling or vessel transport of oil, or other petroleum products as cargo, or include onshore facilities with an effective storage capacity of greater than 10,000 barrels of such products?	XXX	
11. Will you be subdividing lands into two or more lots (parcels)?		XX

If you answered NO to all questions in this section, you do not need a permit or approval from the Alaska Department of Environmental Conservation (DEC). Please continue to the next section.

If you answered YES to any of these questions (see #5 Note), contact the DEC Regional Office for information and application forms.

Based on your discussion with DEC, please list (below) the approval type needed and date submitted.

Approval Type	Date Submitted (or intend to submit)
Not Applicable	

If you are not applying for permits, indicate reason below:

___ a. ________________ (DEC contact) told me on ______ (date) that no DEC approvals or permits were required on this project.

___ b. Other: ________________________

Certification Statement

The information contained herein is true and complete to the best of my knowledge. I certify that the proposed activity complies with, and will be conducted in a manner consistent with, the Alaska Coastal Management Program.

________________________ ________________

Signature of Applicant or Agent　　　　Date

Note: This certification statement is a requirement for federal permit applicants. Federal agencies conducting an activity that will directly affect the coastal zone are required to submit a federal consistency determination per 15 CFR 930, Subpart C.

To complete your packet, please attach your state permit applications and copies of your federal permit applications to this questionnaire.

Revised 3/89

ATTACHMENT 19

19.0 AIR QUALITY

ARCO has proposed to use CANMAR's SSDC with only limited support from CANMAR ice breaking vessels M/V Kigoriak, M/V Supplier, and M/V Supplier II (or equivalent) during mobilization and demobilization of the SSDC. The onboard prime mover power systems for the SSDC are expected to produce the largest air emissions and Table 19-1 provides engine specifications for the SSDC. All major sources will use diesel fuel and their specifications are provided in Table 19-2.

The SSDC and support vessels are expected to produce carbon monoxide (CO), nitrogen oxide (NO_x), sulphur dioxide (SO_2), volatile organic compounds (VOC), and total suspended particulates (TSP). Formal determination of air emissions from the proposed exploration activity was performed in accordance with MMS guidelines, emission factors published in the USEPA AP-42 (USEPA, 1986), and design information received from CANMAR. Predicted emissions from the major components are indicated in Table 19-3, as are the calculated USDOI exemption levels for shoreline air quality. Since the ice breaking vessels will only be on-site for the mobilization and demobilization activities (10 days or less), their emissions have only been estimated based on a review of emissions from similar types of CANMAR vessels.

Short period air emissions may also be produced from gas flaring associated with testing of exploration wells. Although flaring of produced fluids (including oil) is not anticipated, emissions from this source have been determined and are summarized on Table 19-4.

Based on this information, calculated air emissions from operations (including flaring) will not exceed the USDOI calculated exemption levels. Thus, additional air quality monitoring and/or controls are not expected.

Table 19-1. Engine specifications for the SSDC.

Main Engines (5)	
Make:	Caterpillar
Model:	D-399 JWAC
Bore:	6.25 inch
Stroke:	8 inch
No. of Cylinders:	16 ea
RPM:	1200
BHP:	1,000 ea
Converted by:	Five (5) AC KATO 6P5-3150 rated at 1,500 KW each
Emergency Generator (1)	
Make:	Caterpillar
Model:	D-399 JWAC
Power:	746 KW
Usage:	Emergency use only

Table 19-2. Fuel specifications.

Grade:	Gulf diesel fuel 20X
Gravity:	37 API
Specific Gravity	.8398
Flash Point	76°C
Sulphur	0.14%
Cloud Point	-12°C
Pour Point	-15°C
Ash	0.02%
Crane Index	52.0
BTU Gross/Pound	19,650
BTU Net/Pound	18,430
BTU Gross/Gallon	165,000
BTU Net/Gallon	154,800

Table 19-3. Estimated vessel emissions and USDOI exemption levels.

	Pollutant (tons per year)*				
	CO	NO_x	TSP	SO_2	VOC
CANMAR SSDC	112	427	43	51	11
M/V Kigoriak	11	45	4	5	2
M/V Supplier	6	23	2	3	1
M/V Supplier II	6	23	2	3	1
Helicopters	4	3	<1	<1	1
Exemption Levels**	19,750	466	466	466	466

* NO_x = Nitrogen Oxides
TSP = Total Suspended Particulates
SO_2 = Sulfur Dioxide
CO = Carbon Monoxide
VOC = Volatile Organic Compounds (excluding nonreactive compounds such as methane and ethane). SSDC loading assumes 120 days of operation and 240 days of standby; standby rates are assumed to be at 30 percent of the operating rates. Support vessels loadings are estimated for 10 days of operations (mobilization and demobilization only).

** Calculated per 250.45(d) assuming a minimum distance of 14 statute miles to the coastline.

NOTE: Each vessel is considered as a separate point source for air emission calculations. Cumulative totals are not considered in accordance with USDOI/MMS.

Table 19-4. Estimated emissions from flaring.

Source**	Pollutant (tons per year)*				
	CO	NO_x	TSP	SO_2	VOC
Natural Gas Flaring	.2	.6	.2	<.1	.1
Crude Oil Flaring	188	8	298	198	1

* NO_x = Nitrogen Oxides
TSP = Total Suspended Particulates
SO_2 = Sulfur Dioxide
CO = Carbon Monoxide
VOC = Volatile Organic Compounds (excluding nonreactive compounds such as methane and ethane). Loading assumes 100 hours total duration.

** Assumed rate is 2,500,000 ft^3/day of natural gas and 5,000 barrels per day of crude oil. Pollutant loadings derived from values provided for blowout emissions as presented in the EIS (USDOI/MMS, 1987).

NOTE: Each vessel is considered as a separate point source for air emission calculations. Cumulative totals are not considered in accordance with USDOI/MMS guidelines.

REFERENCES

USEPA, 1986. Compilation of Air Pollutant Emission Factors. Volume 1. Stationary Point and Area Sources. AP-42. 4th Edition. Office of Air and Radiation, Office of Air Quality Planning and Standards, Research Triangle Park, N. Carolina. NTIS Publ. #PB87-150959.

ATTACHMENT

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20.0 ARCO CONTACTS

The primary contact for ARCO Alaska, Inc. is:

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ATTACHMENT
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21.0 OTHER INFORMATION

No other information has been requested by the MMS Regional Supervisor.