EXPLORATION PLAN

OCS LEASE SALE 71: DIAPIR FIELD BEAUFORT SEA, ALASKA

AMOCO PRODUCTION COMPANY

OCS-Y 0302

EXPLORATION PLAN
OCS LEASE SALE 71: DIAPIR FIELD
BEAUFORT SEA, ALASKA

AMOCO PRODUCTION COMPANY
Operator for Amoco, Shell and Unocal, Koch Industries

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

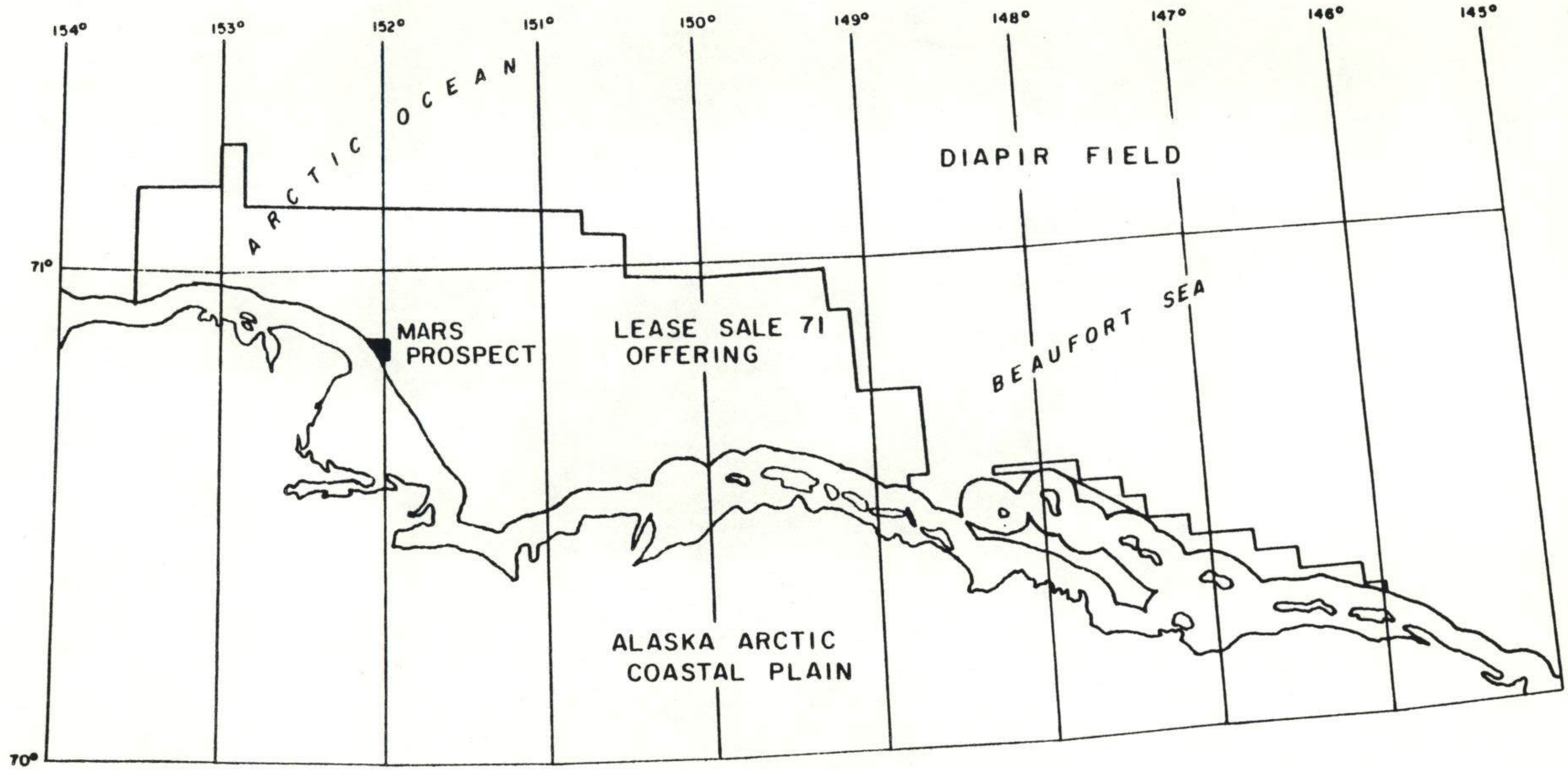
(1) INTRODUCTION

Amoco Production Company hereby submits its Exploration Plan for drilling one exploratory well (Mars Prospect) in the OCS Sale No. 71 area. An Environmental Report is submitted as a separate document with this Exploration Plan. Amoco has conducted or participated in extensive geophysical surveys and geological studies in the area. Amoco's interpretation of data collected in these surveys suggests that significant accumulations of hydrocarbons may exist under this lease. Amoco proposes to drill one exploratory well to evaluate this prospect, according to the procedures outlined in this Exploration Plan.

The Exploration Plan is composed of three separate documents. The main part of the plan is included in this document. In addition to this document, two separate appendices have been submitted. Appendix 1 includes proprietary and confidential geological information; Appendix 2 is the Amoco Oil Spill Contingency Plan for the project.

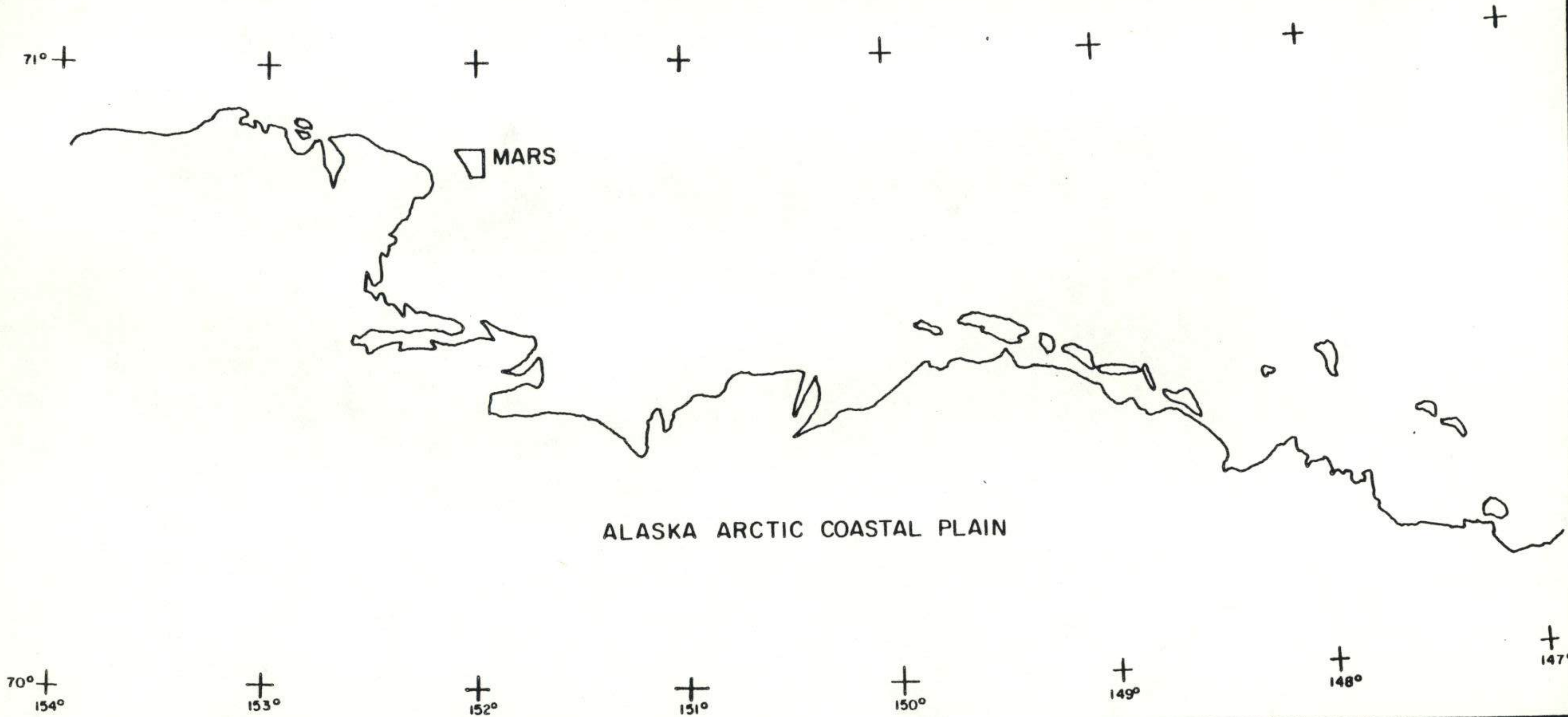
(2) LOCATION OF DRILLING ACTIVITY

The Mars Prospect is located in Lease OCS-Y-0302, Block 140, Tract 138, Protraction Diagram NR5-4. The specific location of the well site is latitude 70.84309°N, longitude 152.07180°W, and Grid System UTM Zone No. 5, (N = 7859981.111, E = 534000.717). This location is approximately 7.8 km (4.9 mi.) northeast of the eastern end of Cape Halkett, Alaska, located along the Beaufort Sea coastline. The well location is approximately 155 km (97 mi.) west-northwest of Prudhoe Bay, Alaska. Figure 1 shows the location of the Diapir Field Lease Sale area, September 1982 lease offering and the Mars Prospect. Figure 2 shows the specific location of the Mars Prospect in the Cape Halkett area and Figure 3 shows the specific locations of the lease block and exploratory well.



LOCATION OF DIAPIR FIELD LEASE SALE AREA, LEASE SALE 71 OFFERING AND THE MARS PROSPECT

Woodward-Clyde Consultants | FIGURE 1



0 10 20 30
SCALE IN MILES

AMOCO MARS PROSPECT LOCATION
EASTERN BEAUFORT SEA

Woodward-Clyde Consultants | FIGURE 2

(3) PROPRIETARY DATA

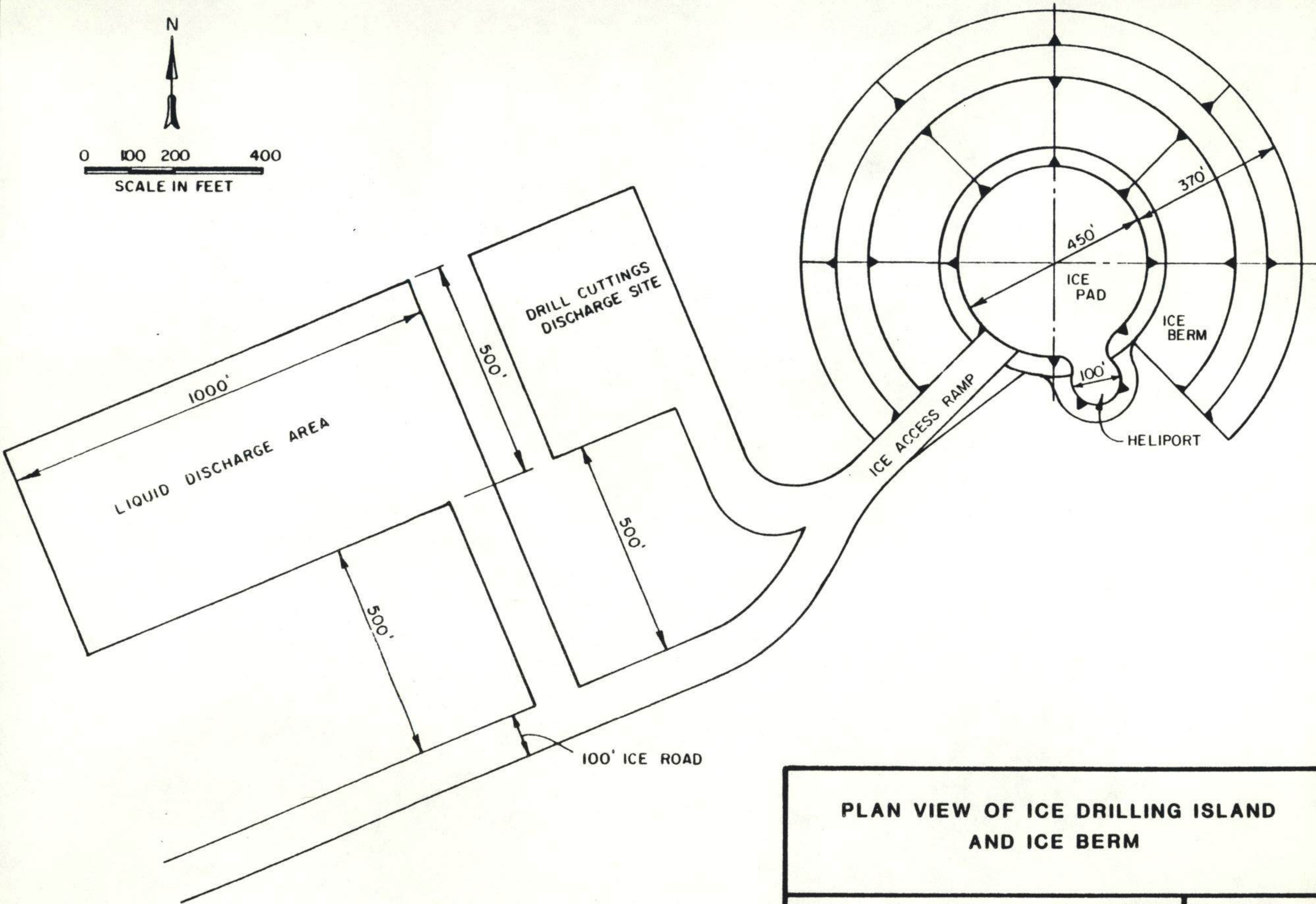
All proprietary data in the Exploration Plan have been included in Appendix 1, which is a separate volume. These data are provided for the exclusive use of MMS. Included in Appendix 1 is a brief geologic description of the prospect with regard to structural and stratigraphic elements, a structure map, based on seismic data; and two schematic cross-sections. Also included is a tentative drilling prognosis for the prospect. Geophysical sections will be included with the Application for Permit to Drill (APD) for the project.

(4) DESCRIPTION AND SCHEDULE OF PROPOSED ACTIVITY

(a) DESCRIPTION

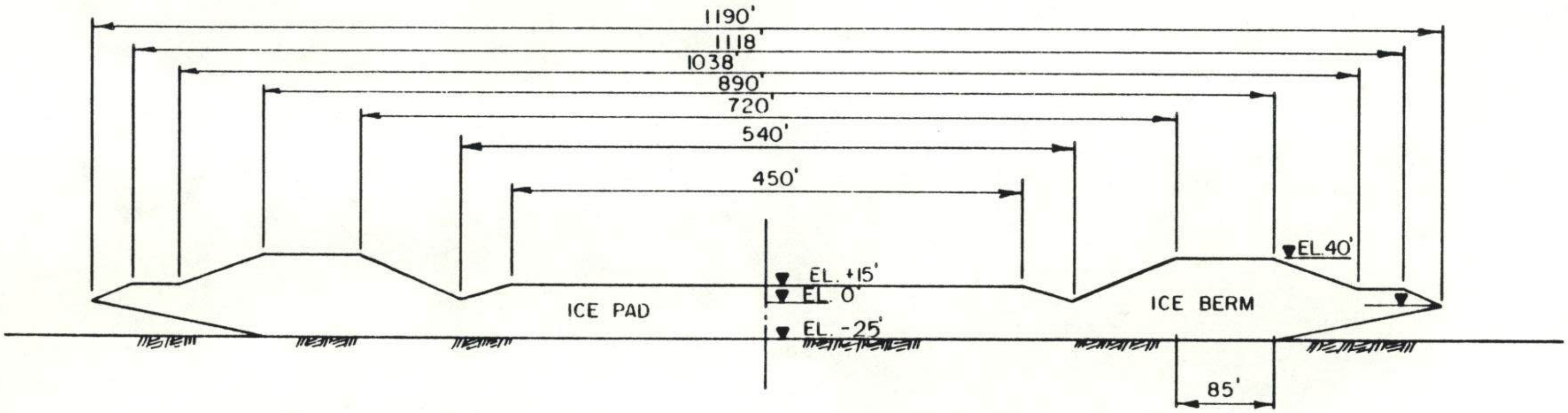
Amoco proposes to drill, evaluate, test and abandon one exploratory well for the Mars Prospect. The proposed well will be vertically drilled to a depth of 2424 m (8000 ft.) using a conventional diesel engine-powered rotary drilling rig. The well will be drilled from a spray ice island constructed in approximately 7.6 m (25 ft.) of water. The ice island working surface will be approximately 136 m (450 ft.) in diameter, generally circular in shape, and surrounded by a protective ice berm. The island will be grounded and will extend approximately 4.5 m (15 ft.) above the water (ice) surface. The ocean floor at the drill site consists primarily of clay. The drill site is located in an area of late winter floating landfast ice. A plan view and cross-section view of the ice island are presented in Figures 4 and 5, respectively.

The proposed spray ice island, including the ice berm, is a new technology that has been recently developed and tested. Spray ice islands have not been previously utilized for drilling of exploratory wells. However, Sohio Petroleum Company designed, constructed, tested and monitored a grounded



PLAN VIEW OF ICE DRILLING ISLAND AND ICE BERM

Woodward-Clyde Consultants FIGURE 4



CROSS-SECTION VIEW OF
ICE DRILLING ISLAND AND ICE BERM

Woodward-Clyde Consultants | FIGURE 5

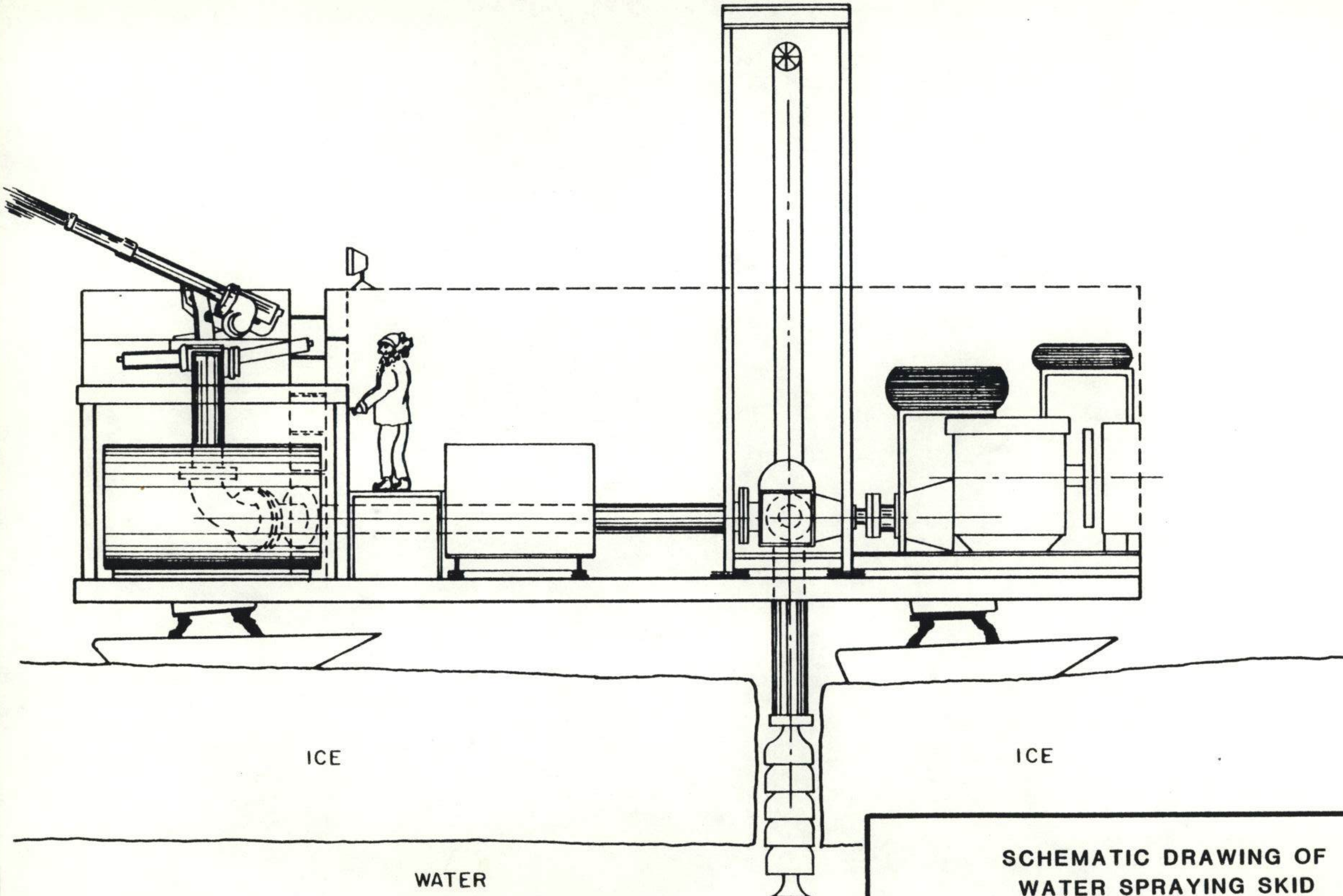
spray ice structure located near Prudhoe Bay in the Alaskan Beaufort Sea region in the winter of 1984-1985. The island was 106 m (350 ft.) in diameter and was situated in approximately 9 m (30 ft.) of water. The specific objective of the program was to obtain additional engineering information regarding spraying techniques and spray ice properties for the design and construction of working grounded spray ice structures. Information collected in this program was used in the design of the Amoco Mars Prospect ice island.

In addition to the Sohio program, Amoco has completed detailed preliminary engineering feasibility studies concerning spray ice islands and is currently completing detailed design studies for the Mars Prospect. Final ice island design will be reviewed by MMS during the Platform Verification Process.

No additional new or unusual technology will be utilized for the project.

The spray ice construction technique involves pumping sea water from the immediate area through nozzles which spray the water into the water. The water drops freeze in the air and form ice crystals which fall to the sea ice surface. The addition of sprayed ice crystals continues until the ice mass sinks to the ocean floor and is grounded. A diagram of the spray equipment is presented in Figure 6.

An arc-shaped, grounded ice berm will be constructed around the offshore-facing section of the ice island to prevent potential movement caused by contact with moving sea ice. The berm would be constructed using the same technique as would be used to construct the ice island. Plan and cross-section views of the ice berm are presented in Figures 4 and 5, respectively. The ice berm would be a maximum of 21 m (70 ft.) above the ocean floor, approximately 7.9 m (26 ft.) higher than the ice island.



SCHEMATIC DRAWING OF
WATER SPRAYING SKID

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FIGURE 6

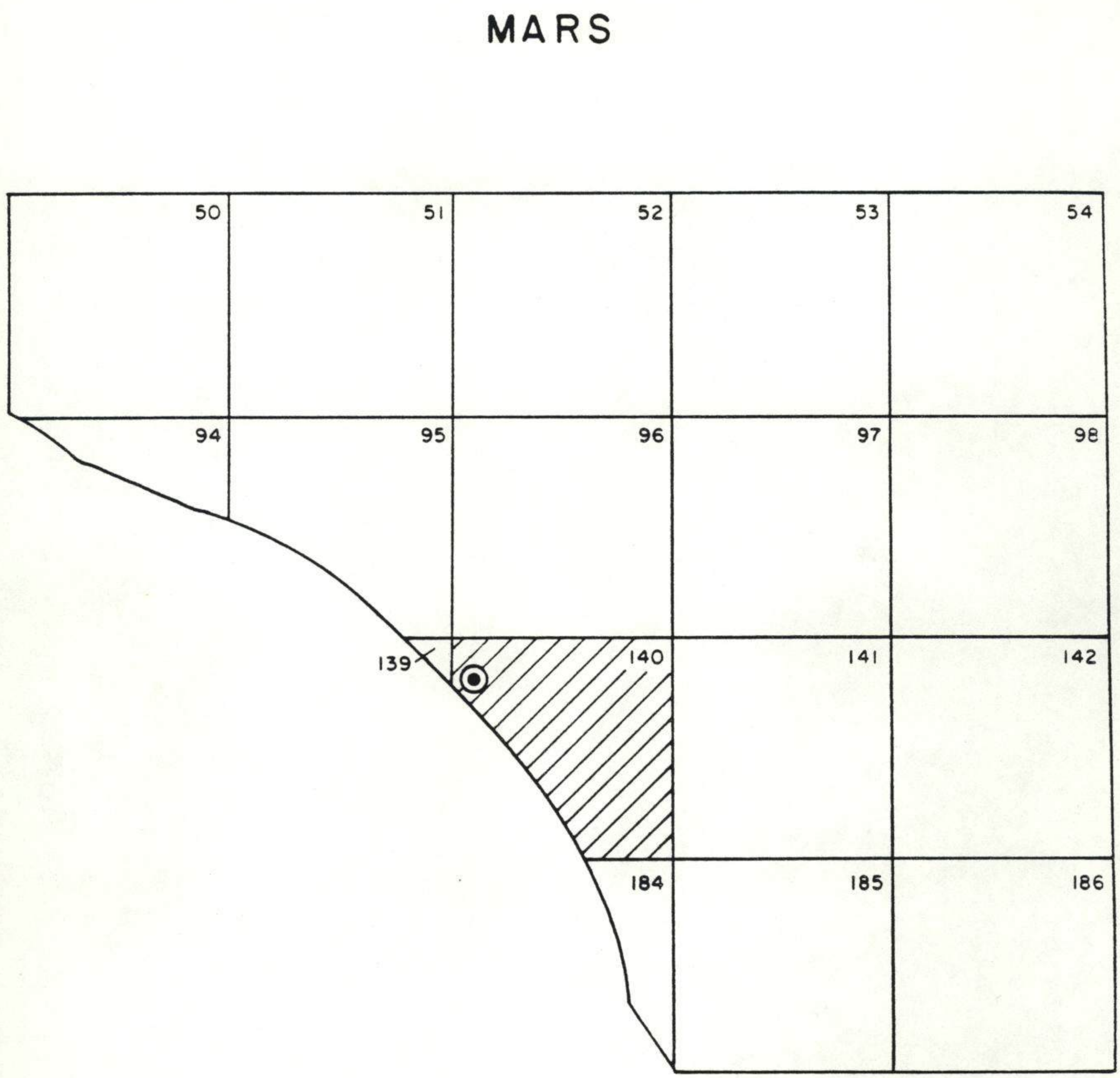
The logistical support system for the project will consist of the following facilities:

- o Airplane landing strip,
- o Onshore support base, and
- o Ice access road.

An ice airplane landing strip will be constructed by flooding a dry lake bed or using an existing lake in the Cape Halkett area. The location of the lake is shown in Figure 7. Construction will be conducted by transporting fresh water from adjacent lakes and discharging the water on to the dry lake bed. This water will freeze and form the landing strip. The landing strip will be approximately 45 m (150 ft.)-wide and 1667 m (5,500 ft.)-long, with an area of approximately 8 hectares (ha) (20 ac.).

The landing strip will be utilized by large cargo airplanes and other fixed wind aircraft to transport equipment, material and supplies between the onshore support base and Prudhoe Bay/Deadhorse and other locations. In addition to the airplane landing strip, a helicopter landing pad will be provided.

An onshore support base will be constructed adjacent to the Cape Halkett airstrip in the dry lake bed (Figure 7). The support base will be utilized throughout project construction, operation and abandonment for the following purposes: (1) housing of project workers, (2) storage of certain equipment and supplies, (3) fuel storage, (4) vehicle parking, (5) establishment of a shop and (6) air traffic control and communications. The support base will be constructed on an ice pad using the same technique utilized to construct the ice landing strip. The support base will be approximately 213 m (700 ft.)-wide and 213 m (700 ft.)-long, covering an area of approximately 4.5 ha (11 ac.).



MARS LEASE BLOCK AND WELL LOCATION

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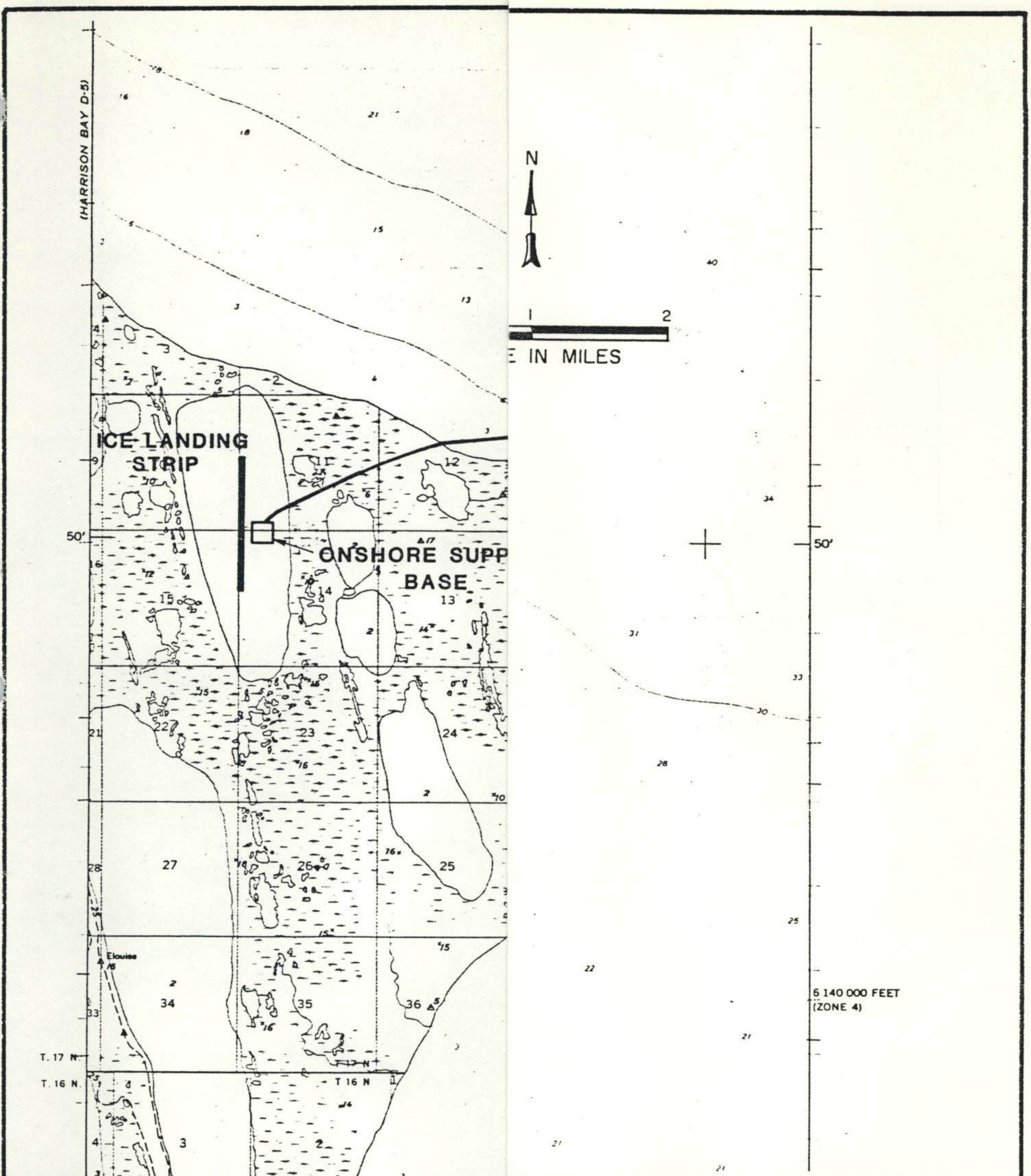
FIGURE 3



SPECIFIC LOCATION OF PROJECT FACILITIES

oodward-Clyde Consultants | FIGURE 7

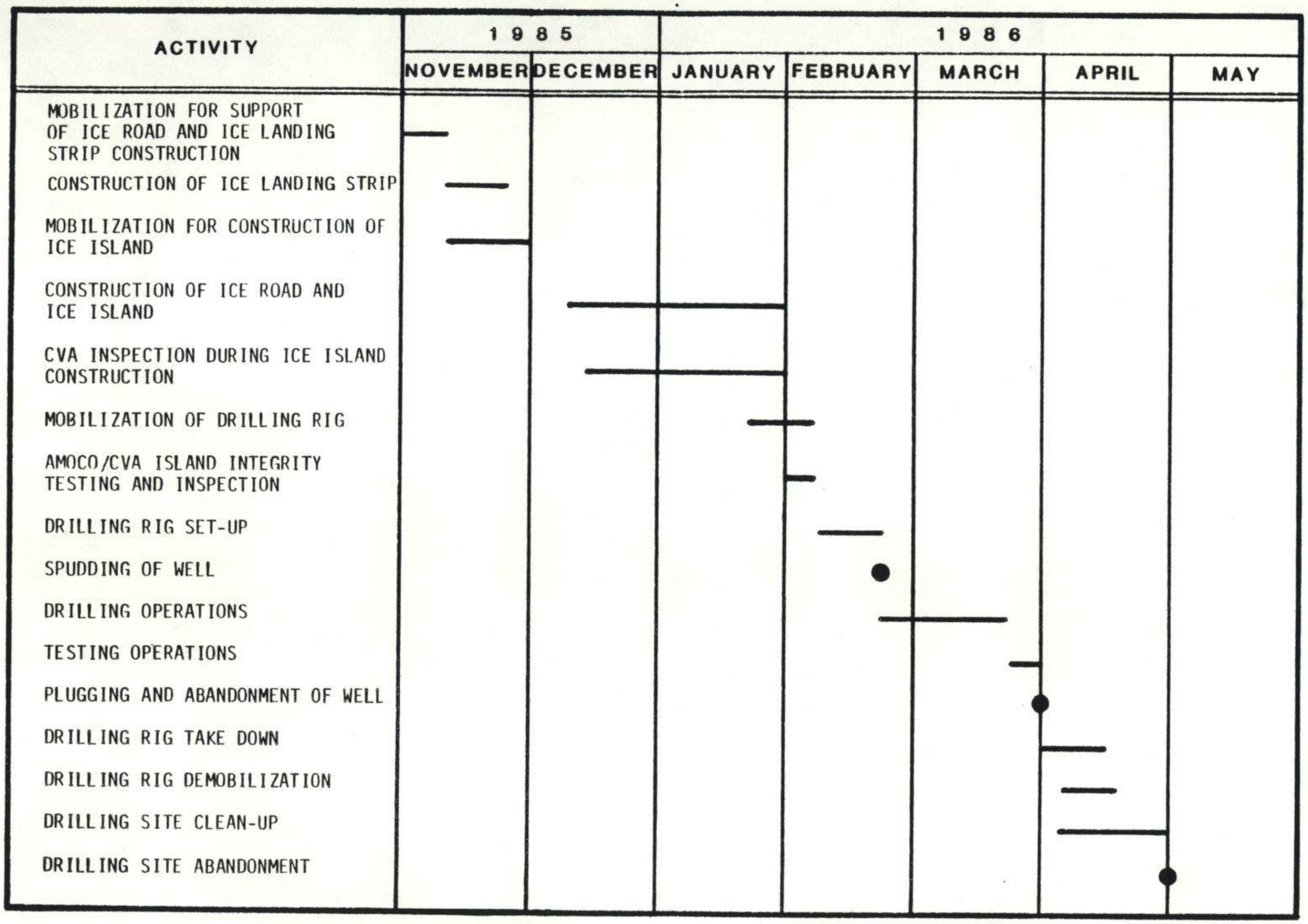
In addition to the onshore support base, a rig camp for drillers and other rig personnel will be located on the ice drilling island. This camp will include all living facilities required by workers directly associated with the drilling rig.

An ice access road will be constructed between the onshore support base and the ice island well pad to facilitate movement of equipment and supplies. The access road will be approximately 45 m (150 ft.)-wide and 10.2 km (6.4 mi.)-long, covering an area of approximately 46 ha (116 ac.). The road will be constructed by flooding the natural ice sheet with sea water pumped from below the ice. The offshore section will be approximately 1.4 m (4.5 ft.)-thick and will be grounded where water depths are less than 1.4 m (4.5 ft.).

Ground access will also be required between Prudhoe Bay/Deadhorse and the onshore support base at Cape Halkett. In order to establish the Cape Halkett airstrip, All Terrain Vehicles will transport the necessary equipment to the construction site. No road will be constructed; All Terrain Vehicles will travel over frozen tundra and other substrates following freeze-up (after 1 November, 1985). Some snow and ice clearing and substrate improvement in certain areas may be required for travel along this route. The crossing point of the Colville River will be located near the village of Nuiqsut.

(b) SCHEDULE

The proposed project schedule is presented in Figure 8. The project will be completed in the approximate period 1 November, 1985 to 1 May, 1986. Mobilization for construction of the ice roads, ice airstrip and ice island will be initiated in early November, 1985. Initial project activities will



PROPOSED PROJECT SCHEDULE

Woodward-Clyde Consultants | FIGURE 8

include the transport of equipment and supplies required for construction of the initial Cape Halkett onshore support base by All Terrain Vehicles travelling to the base site from Prudhoe Bay/Deadhorse. The initial support base will be completed by approximately 15 November, 1985. Following completion of the landing strip by approximately 22 November, 1985, equipment and supplies for the support base and ice island construction will be moved by large cargo airplanes to Cape Halkett. Construction of the ice road and ice island will occur in December, 1985 and January, 1986, and will be completed by 1 February, 1986. Ice island integrity testing and inspection will be completed in the first week of February, 1986. The drilling rig will be mobilized, transported to the ice island, and set up in mid-February. The well will be spudded on approximately 21 February. Drilling operations will occur through the third week in March and testing will occur in the last week in March. The well will be plugged and abandoned by 31 March. Rig take-down and demobilization will occur in the first two weeks of April. The drilling site will be cleaned-up and abandoned by 1 May, 1986.

(5) ICE ISLAND AND DRILLING RIG DESCRIPTION

(a) ICE ISLAND

A general description of the ice island is presented in Section (4)(a). The ice berm is designed to remain stable under the design ice loading. The ice island (drilling rig pad) is also designed to remain stable under the design ice loading without the presence of the protective berm. Thus, the system is redundant to provide maximum ability to withstand sea ice forces.

Sea bottom soils in the area of the drill site appear to be comprised of clay; the clay layer on the bottom is approximately 30 m (100 ft.)-thick. Areas of bonded permafrost are generally present within approximately 3 to 5 m (10 to 15 ft.) of the ocean floor. Permafrost of this magnitude is not significant to the proposed construction designs. The undrained shear strength of clay soils present at the drilling site ranges from 750 to 4500 psf, with an average of approximately 1000 psf. Ice gouging occurs in the drill site area and is accounted for by reducing the contact area of the grounded portions of the island.

The spray ice is not as dense as the natural ice and varies between .7 and .95 specific gravity. Thus, weight on the sea bed is established by increasing the free board of the island and berm (15 ft. and 41 ft. respectively). Resistance to movement is dependent on the area of contact with the sea bed and the friction generated by assumed ice or soil properties. A friction angle of 30 degrees between the natural ice sheet and the sea bed or an undrained shear strenght of 1000 psf will be used, depending on which strength is critical.

The spray ice island/berm will be surrounded by landfast ice. Although late winter movements of landfast ice are not common, severe late winter storms could generate significant ice sheet movements. The strength of the spray ice is less than the strength of sea ice. Therefore, sea ice movement would result in penetration of the sea ice into the spray ice berms. As the sea ice advanced further into the spray ice berm, rubble building would be initiated at the contact point.

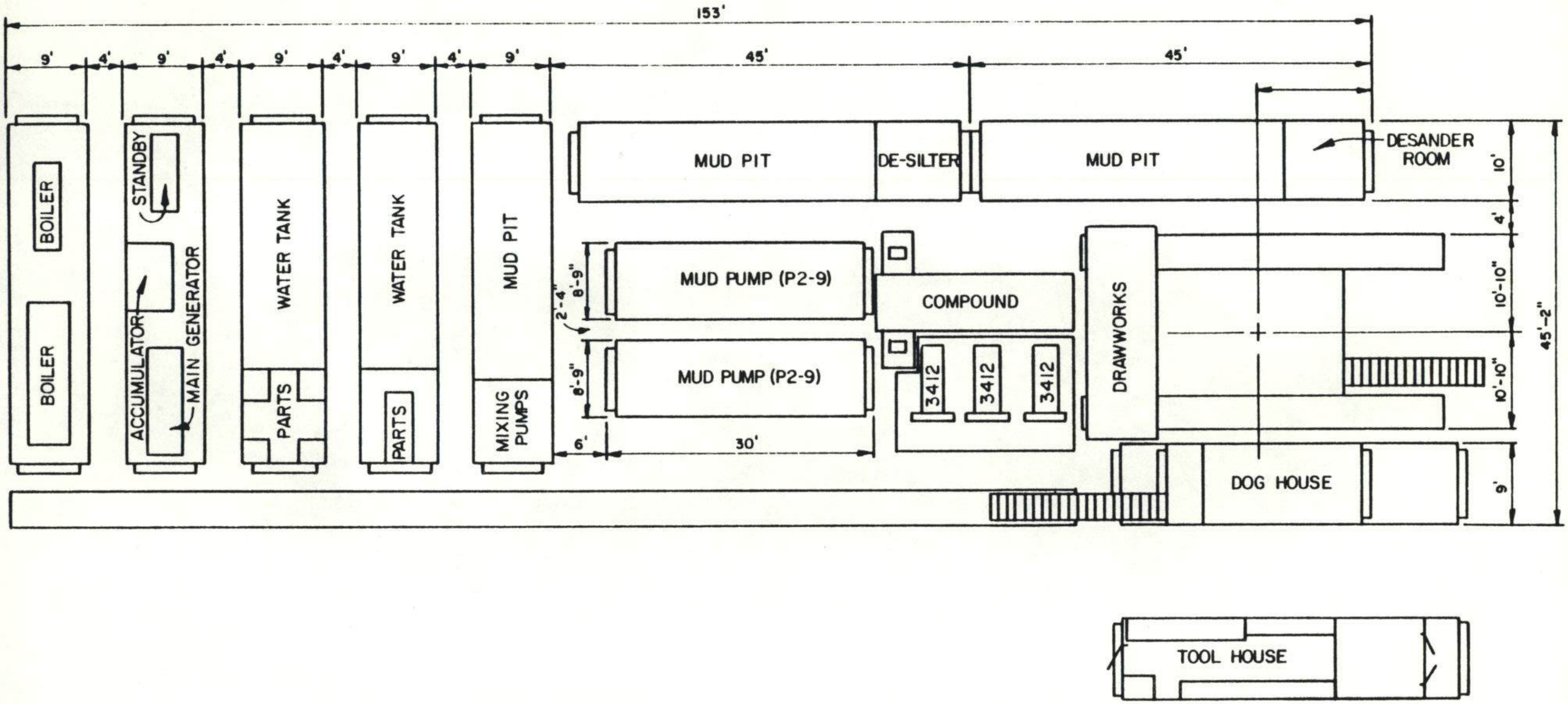
The ice pad and berm must develop sufficient reaction at the sea floor to the maximum forces developed by interaction of the two masses. The ice berm is designed to ensure that rubble building occurs, limiting loads to an acceptable level on the ice drilling pad.

(b) DRILLING RIG

A conventional diesel engine-powered, mechanical rotary drilling rig will be utilized for the project. It is expected that Parker Drilling Company

Rig 123 or similar rig will be utilized. A plan view of Rig 123 is presented in Figure 9. General descriptions of Rig 123 components are presented below. More specific information will be presented in the APD, if necessary.

Component	Description
Drawworks	OIME SL 1500
Engines	4-Caterpillar D-3412, 570 horsepower each (2200 total horsepower)
Compound	OIME 3 Engine
Substructure	21'
Mud Pits	1,700 BBL
Traveling Equipment	350 Ton
Rotary Table	National 275, 27.5" Inside Diameter
Drill Pipe	4.5"
Drill Collars	8", 6.75"
Mud Pumps	2 Gardner Denver 1000 Horsepower P2-9
Maximum Drilling Depth	15,000'
Total Number of Loads of Movable Components (Rig and Camp)	88 C-130 Hercules Loads, 73 Truck loads
Fire-Fighting and Safety Equipment	2-150 lbs. Ansul Dry Chemical Units, 22-30 lbs. Ansul Dry Chemical Units; 4 Scott Air Pack Breathing Units (30 minutes, 45 cubic feet capacity)
Fresh Drilling Water Storage	400 BBL
Fuel Oil Storage	400 BBL
Fuel Oil Day Tank Capacity	100 gal.
AC Generators	Caterpillar SR-4 520 KVA 440 KW, 440-120-208 V (driven by D-3412 diesel engines)
Emergency Power	Caterpillar SR-4



PLAN VIEW OF DRILLING RIG

Woodward-Clyde Consultants

FIGURE 9

Component	Description
Derrick	136' Cantilever Model No. 27415; nominal capacity = 1,025,000 lbs; Static hook load capacity with 10 lines=670,000 lbs.
Drawworks	OIME TBA-2000 Horsepower
Inside BOP's	5000 PSI WP for 4.5' drill pipe; make = TIW HRL-0 with 4.5" XH box pin connection
BOP and Control Equipment	BOPE Stacks and (choke manifold(s) designed to meet State of Alaska Requirements; 13 5/8" BOPE Stack with Bell nipple and riser
Rig Camp	48-man capacity; Generators and Support Units to allow Independent Operation
Estimated Average Daily Fuel Consumption	4500 gallons/day
Miscellaneous Equipment	Drilling Recorder Volcano Boilers Tioga Air Heater Wire Line Unit Crownomatic Forklift Camp Sewage Treatment Plant Water Treatment Plant Shop Crew-Cab Pickup

(6) POLLUTION PREVENTION AND CONTROL EQUIPMENT PROCEDURES

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 and at onshore support facilities in order to minimize or prevent pollution. Good housekeeping practices are emphasized and clean-up equipment is provided at all sites. The equipment and procedures for responding to potential oil spills associated with the project are described in the Oil Spill Contingency Plan which is a part of this Exploration Plan (see Appendix 2, separate document).

(7) FRESH WATER SOURCE, TREATMENT OF SEWAGE, AND OTHER DISCHARGES

Fresh water will be required on the ice drilling island for domestic consumption and drillwater. Approximately 4,500 gallons per day (GPD) (315,000 gallons for the duration of the project) will be required for domestic consumption. Approximately 15,000 GPD (675,000 gallons for the duration of the project) will be required for drillwater. Fresh water will be obtained from a tundra lake located near the onshore support base and trucked out to the ice drilling island or generated using a desalinization plant which would process sea water.

Fresh water will be required at the onshore support base for domestic consumption. Approximately 3,400 GPD (510,000 gallons for the duration of the project) will be required. Fresh water will be obtained from a tundra lake located near the onshore support base or generated using a desalinization plant which would process sea water.

Construction of the ice airstrip and onshore support base may require approximately 4.1 million gallons of fresh water, assuming that no snow is present for use. Construction of the onshore section of the ice access road from the support base to the ice island will require approximately 3 million gallons of fresh water. Fresh water will be obtained from a tundra lake located near the onshore support base.

Estimated discharges resulting from drilling of the Mars Prospect are summarized in Table 1. These categories cover overall possible discharges either offshore on the drilling pad, or onshore at the Cape Halkett base camp. Drill mud, well completion fluids, drill cuttings and wash water, and BOP fluid discharges will be discharged onto the sea ice in the vicinity of the ice island (Figure 4). The Environmental Protection Agency

Table 1 Estimated discharges for drilling of the proposed Mars exploratory well.

Discharge		Estimated Volume Per Day	Estimated Volume Total	
Drill mud		6,576 gallons	197,270 gallons	
Well completion fluids (1 time)		40,550 gallons,	40,550 gallons	
Drill cuttings and wash water		5,765 gallons	172,950 gallons	
Sanitary and domestic waste water				
ice island camp		4,500 gallons	315,000 gallons	(70 days)
man onshore base		3,400 gallons	510,000 gallons	(150 days)
		Total	825,000 gallons	
Blowout prevention (BOP) fluid discharge		50 gallons	2,500 gallons	
Desalinization plant	- ice island	13,500 gallons	945,000 gallons	(70 days)
blowdown*	- onshore base	10,200 gallons	1,530,000 gallons	(150 days)
		Total	2,475,000 gallons	
Trash (burnable kitchen	- ice island	550 pounds	39,500 pounds	
waste, boxes, cartons,	- onshore base	300 pounds	45,000 pounds	
paper, wood, etc.)		Total	84,500 pounds	
Refuse (non-burnable	- ice island	750 pounds	52,500 pounds	
material, including	- onshore base	400 pounds	60,000 pounds	
iron, drums, steel,		Total	112,000 pounds	
used equipment, etc.				

* volume estimates based on a 75 percent blowdown percentage of a 100 percent daily and total fresh water requirement to be supplied by desalinization plant.

(EPA) National Pollutant Discharge Elimination System (NPDES) General Permit for the Beaufort Sea will cover all discharges onto the ice. The respective volumes were estimated based on a 70 day overall drilling pad operation including 30 actual drilling days. The Cape Halkett Camp will be operational for approximately 150 days.

Sanitary and domestic waste water at the drilling ice pad site will be processed through a Met-Pro Chemical Sewage Unit which purifies liquid content and separates solid components for incineration and final ash deposit on the ice. Liquids will also be deposited on the ice. Sewage generated at the onshore support base will be treated similarly. Ash generated at the onshore support base will be transported to an approved disposal site or the sea ice disposal area, in accordance with applicable regulatory requirements. Liquids will also be disposed of at the sea ice disposal area in accordance with applicable regulatory requirements. Combustable trash from the ice drilling island and onshore support base will be burned at the onshore support base. Non-burnable junk from the two locations will be transported to an approved disposal site.

(8) TRAINING AND DRILLS

(a) DRILLING PERSONNEL TRAINING

As required by OCS Order 2, Amoco and contractor personnel involved directly in drilling operations will be trained in well control methods and detection of abnormal pressures. Such training will be completed in approved Amoco or industry schools before drilling is commenced. A list of personnel and their completed training will be maintained on the drilling rig and will be available on request. Blowout prevention drills will be conducted as required under current OCS Orders. Drills will also be conducted to familiarize project personnel with specific elements of the ice drilling island evacuation and lifesaving plan.

(b) FIRE DRILLS

Procedures for emergencies such as fires will be identified in a Station Bill and, together with the specific emergency responsibilities for crew members, will be posted at appropriate conspicuous places on the drilling rig. Fire drills will be conducted on a regular basis for all crew members.

(c) SAFETY MEASURES

Safety meetings will be conducted periodically to make crews aware of safety procedures and to review potential sources of accidents, and the means of preventing them. Post-accident causes and corrective measures to be taken to prevent recurrence will be reviewed in the event of accidents.

(9) MUD SYSTEMS

Sea water will be the base of the mud used to spud and for drilling prior to the setting point of the first two casing strings. Fresh water/saltwater gel mud will be used for drilling the hole for surface casing. Below surface casing, a lime-potassium mud will be used. Components for these will all be EPA-approved for discharge. Specific mud programs will be provided at the time the APD is submitted to the MMS for approval.

Quantities of basic mud materials maintained at the drill site will meet or exceed the minimum quantitites required by Alaska OCS Order No. 2. The NPDES General Permit for the Beaufort Sea allows the discharge of mud and cuttings. All discharges will comply with the conditions of the General Permit. Amoco will request permission to operate under the General Permit for all drilling in this area.

Mud testing and monitoring will be completed as required by OCS Order No. 2. A description of the mud logging and monitoring system to be used in the drilling operations will be submitted with the APD.

(10) FORMATION SAMPLING PROGRAM

Formation cutting samples will be collected during drilling operations and cores will be taken at selected depths in the well. Descriptions of sample intervals and planned core intervals will be described in the APD filed for the well.

(11) ENVIRONMENTAL TRAINING

An Environmental Training Program (ETP) has been developed by Sohio in cooperation with other potential operators in the Beaufort Sea area and has been approved by MMS. The program is designed to comply with OCS Sale 71 stipulations and will be given to all personnel directly involved in the exploratory activity covered by this plan. The purpose of the program is to provide Amoco managers, supervisors, and employees, together with their partners, agents, contractors, and subcontractors, an awareness of and sensitivity to the Beaufort Sea - North Slope area environmental, cultural, and sociological systems. A videotape presentation will be prepared for viewing by all personnel who will be working on or visiting the drilling operation.

(12) COASTAL ZONE MANAGEMENT CONSISTENCY

The activities proposed in this Exploration Plan are consistent with Alaska's Coastal Zone Management Program and will be conducted in a manner consistent with the purposes of that program. A copy of the certification of consistency is contained in the Environmental Report which accompanies this document.

(13) EMERGENCY SITUATION PROVISIONS

Plans for dealing with emergency situations involving oil spills are presented in Appendix 2, Beaufort Sea Oil Spill Contingency Plan. A plan covering hydrogen sulfide hazards will be included in the APD filed for the well. Other emergency situations are discussed in the following sections. The factors that will result in the potential curtailment of drilling operations on location in the Beaufort Sea Sale 71 area will be wind and ice.

(a) WIND FACTOR

Any drilling operation will be critical when the wind speed exceeds limits expressed below. Critical operations include: drilling, coring, running and cementing casing or riser, cutting and recovering casing, logging, or other wireline operations, and drill stem testing. As a general rule, no operation will commence or be conducted when the wind speed exceeds 70 mph. Specific curtailment limits for each of these critical operations will be included with a more detailed curtailment plan to be submitted with the APD.

(b) OTHER CONDITIONS

No drilling operations will commence or be conducted when any of the following conditions exist:

(1) When there is an insufficient supply of drilling fluid materials on site to control the well.

(2) When sufficient emergency containment and cleanup equipment is not on location or is not maintained in good working order.

(3) When the manpower required to safely conduct the drilling operation is not available.

(4) When any critical machinery needed to assure a normally safe operation is not operative.

IMPORTANT: The above list is only a guideline. The decisions concerning actions to implement during a given emergency, no matter what the cause, must be based on the judgment of the Amoco Drilling Foreman and the Contract Tool Pusher. The Amoco person in charge of the overall drilling operation is:

W. G. Smith
Anchorage District Manager
Amoco Production Company
P.O. Box 100779
Anchorage, Alasaka 99510
(907) 272-8471

(c) RELIEF WELL PLAN

In the event of a well blowout, all equipment necessary for constructing a relief well pad would be immediately mobilized from Prudhoe Bay to the drill site location. The specific equipment that would be utilized would depend upon the specific time of year and the availability of logistics support equipment. The ABSORB Manual includes comprehensive lists of construction companies located at Prudhoe Bay.

A drilling rig would also be located at this time and planned for mobilization as soon as the pad is available. The relief well drilling rig could be any industry rig in current Arctic service. If all adequate rigs are under contract and in use at the time of a spill, oil industry practice is that any operator would release a rig if a rig is required for relief well service. In addition, if necessary, a rig that could be transported in a C-130 Hercules aircraft could be flown into Deadhorse from another area.

Depending on the time of year that the blowout occurred, it may be necessary to obtain a helicopter-transportable rig. Supplies and equipment required for drilling the relief well would be obtained and moved to a staging area at Deadhorse to permit rapid transportation to the locations as soon as the relief well pad was completed. Gravel for the relief well pad would probably be obtained from a local gravel source or from existing Prudhoe Bay sources. It is anticipated that most rig and supply movement would take place over existing ice roads or by tug and barge during the open water season. During the periods of breakup and freezeup, all transportation would be by airplane, helicopter, tug and barge or possibly air cushion vehicle.

The optimum location for a relief well pad is dependent upon several factors existing at the time of the blowout, including blowout well depth, and current and projected wind and current conditions at the location. In the Mars project area, currents are strongly influenced by wind direction. An attempt would be made to place the drill pad in an area with a minimum water depth at a distance from the blowout well. In all cases, the relief well pad would be placed a sufficient distance from the blowout well to ensure personnel and equipment safety for the duration of the anticipated relief well drilling program. It is anticipated that, in most cases, the relief well pad would be located in areas with water depth similar to the original pad.

During periods of ice presence after freezeup, a gravel island sufficiently large to accommodate the drilling rig and kill equipment would be constructed using appropriate construction techniques. Holes would be cut in the ice and gravel dumped through the holes until the gravel had built up to the water surface. The ice would be cut away from around the emerging gravel pad and more gravel dumped to expand the island. All available equipment that could be used efficiently would be utilized to construct the gravel island. As soon as the pad was large enough to support the drilling rig and associated drilling support equipment, the rig and equipment would be mobilized to the pad over ice roads, as appropriate on the basis of ice conditions. The pad could then be expanded as necessary to accommodate the kill equipment and fluids, which would not be required until the relief well is drilled to total depth. Depending on specific timing, the kill equipment could be brought to the location on barges after breakup.

During the open water periods, a relief well gravel island would be constructed using the proven technique of barges and tugs to transport the gravel from Prudhoe Bay (West Dock) to the location.

During breakup and freezeup periods, pad construction would not be attempted until such time as conditions were safe for personnel and equipment to operate. In this case, all supplies, equipment, and material required for construction would be assembled at the nearest staging point so that construction could begin immediately.

Based on the previous discussion, time requirements for gravel island construction and relief well drilling are dependent upon a number of factors. Based on variables such as hole deviations, depth of objectives, pressure gradient and formation conditions anticipated at the Mars Prospect, the following time requirements are estimated for regaining control of a blowout well:

o	Gravel island construction (winter or summer)	40 days
o	Rig up and prepare to spud	7 days
o	Drill relief well	35 days
o	Kill well	10 days
	Total	92 days

During periods of broken ice (breakup and freezeup), an additional 75 days may be required to allow for gravel transport by either barge or truck to the relief well drillsite.

(d) LOSS OR DISABLEMENT OF THE DRILLING UNIT

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

(1) Personnel safety and evacuation, if required.

(2) Prevention of pollution from well in progress.

(3) Minimize property and rig damage.

(4) Regulatory agency and Amoco management notification.

All contingency plans are developed with these priority objectives in mind. If the drilling unit is damaged to the point where it cannot be repaired on the location, after evacuation of personnel (if necessary) and securing or plugging the well in progress, the rig would be moved to the nearest suitable facility for repairs. This facility would probably be located at Prudhoe Bay-Deadhorse. If the rig is damaged beyond repair, a new rig could be brought in as soon as possible to continue drilling or to plug and abandon the well in progress. Re-entering a well in this fashion is a routine procedure as long as the wellhead is not severely damaged by the first rig. If there was significant damage to the wellhead or shallow casing strings, the well would be re-entered and plugged, to the extent possible, to prevent pollution or underground flow. Debris would be removed from the seafloor in accordance with USCG regulations and other agency requirements.

(e) LOSS OR DAMAGE TO SUPPORT CRAFT

Support craft will not be required for the project because the drilling operation will be primarily completed during the winter when open water conditions do not exist. All helicopters, all-terrain vehicles, and trucks used for support will be removed from the Cape Halkett area. Any downed or damaged equipment will not be left in the ice offshore.

(f) ENVIRONMENTAL HAZARDS UNIQUE TO THE SITE OF THE DRILLING OPERATIONS

The significant environmental hazards associated with the proposed exploratory drilling program include sea ice movement and structure icing. Sea ice movements could affect the structural integrity of the ice drilling island and ice road connecting the onshore support base and the ice drilling island. As previously described, the ice drilling island is designed to withstand structural forces imposed by moving sea ice. An ice island and road observation and monitoring program will be implemented to detect potential problems involving ice island and road integrity.

The ice island and road observation program will include visual observations by three full-time observers to locate potential cracks and other types of problem areas. One observer will be on duty for an 8 hour period; continuous, 24 hour observations will be provided by successive watches of the three observers. Mechanical ice movement stations will be established to collect ice movement data; these data will be transmitted to a monitoring station on the ice island through a wiring system or a telemetry system. Inclinometers will be utilized to measure potential changes in the axis of the ice island. Sondex tubes will be utilized to detect potential settling of the island. Thermistors will be utilized to measure ice island temperatures.

A program will also be developed to complete potentially required ice modifications in potentially hazardous situations. This program will include visual observations of the adjacent ice sheet, slotting of ice to promote specific ice responses and construction of grounded ice piles to reduce potential ice movements. Ice building equipment will be available to construct and modify ice, as necessary.

An operations curtailment plan will be developed to ensure safe drilling operations; this plan will be described in detail in the APD for the project. Meteorological data for the project area indicate that moderate to heavy structure icing can occur during the months of September and October. The occurrence of icing conditions is dependent upon air temperature, surface water temperature and wind speed. The drilling rig will be instrumented with meteorological and oceanographic monitoring systems that will accurately monitor wind speed, air temperature and water temperature. Meteorological and oceanographic forecasts will be made on a routine basis. Conditions at the drill site will be monitored and recorded, and information disseminated to supervisory personnel on a routine basis. By utilization of recorded data and forecasts, impending structure icing conditions can be predicted.

APPENDIX 1

GEOLOGICAL DATA

(Proprietary and Confidential)

Appendix 1 will be submitted with the APD and contains the following information for the Mars Prospect: (1) a brief geologic description of the prospect with regard to structural and stratigraphic elements; (2) a structural map, based on seismic data; (3) two schematic cross-sections; and (4) a drilling prognosis. Geophysical sections will also be included with the APD.

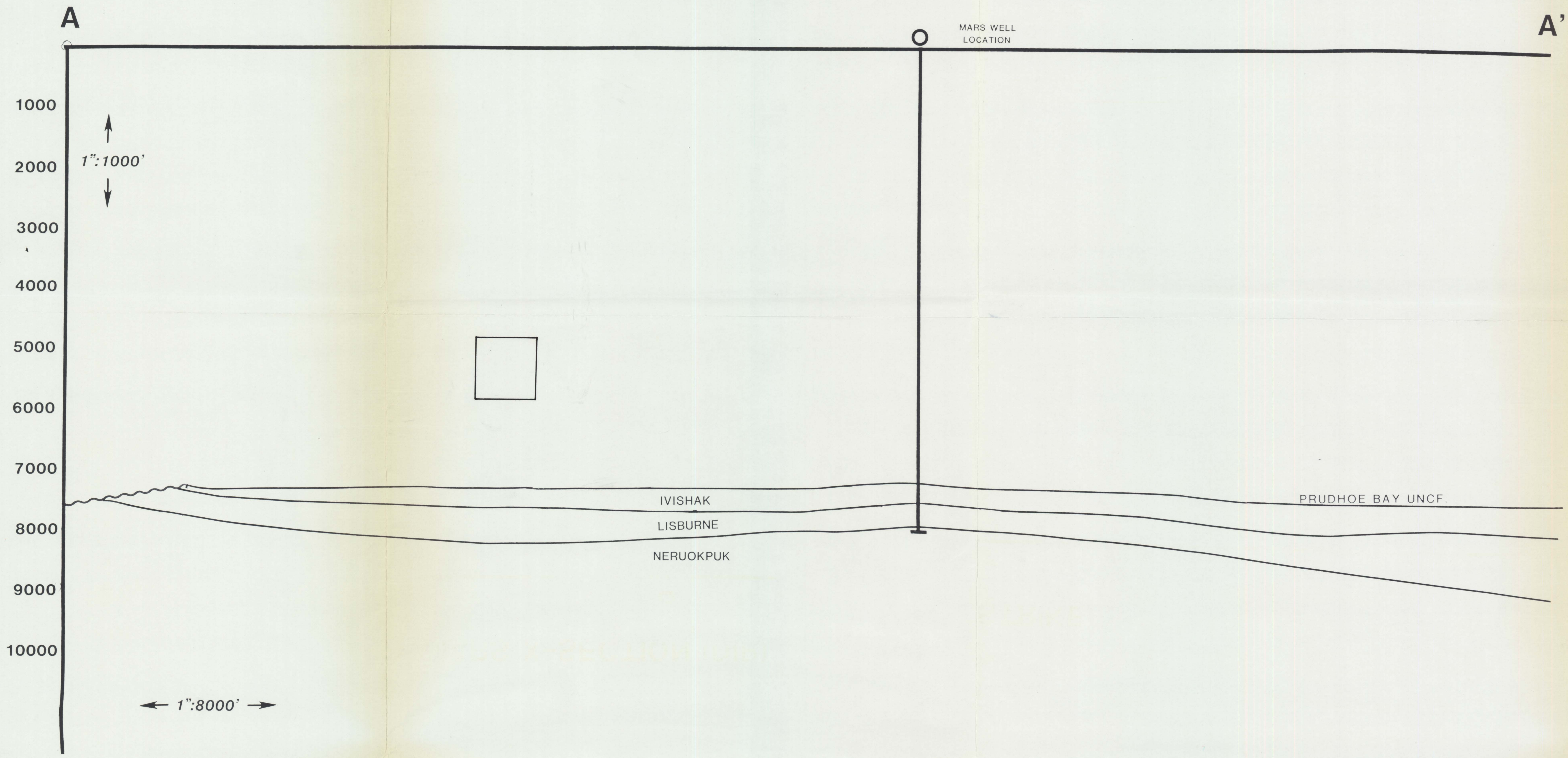
Prop info included from 10 day EP. Whatever is missing will be included in APD.

11/13/85

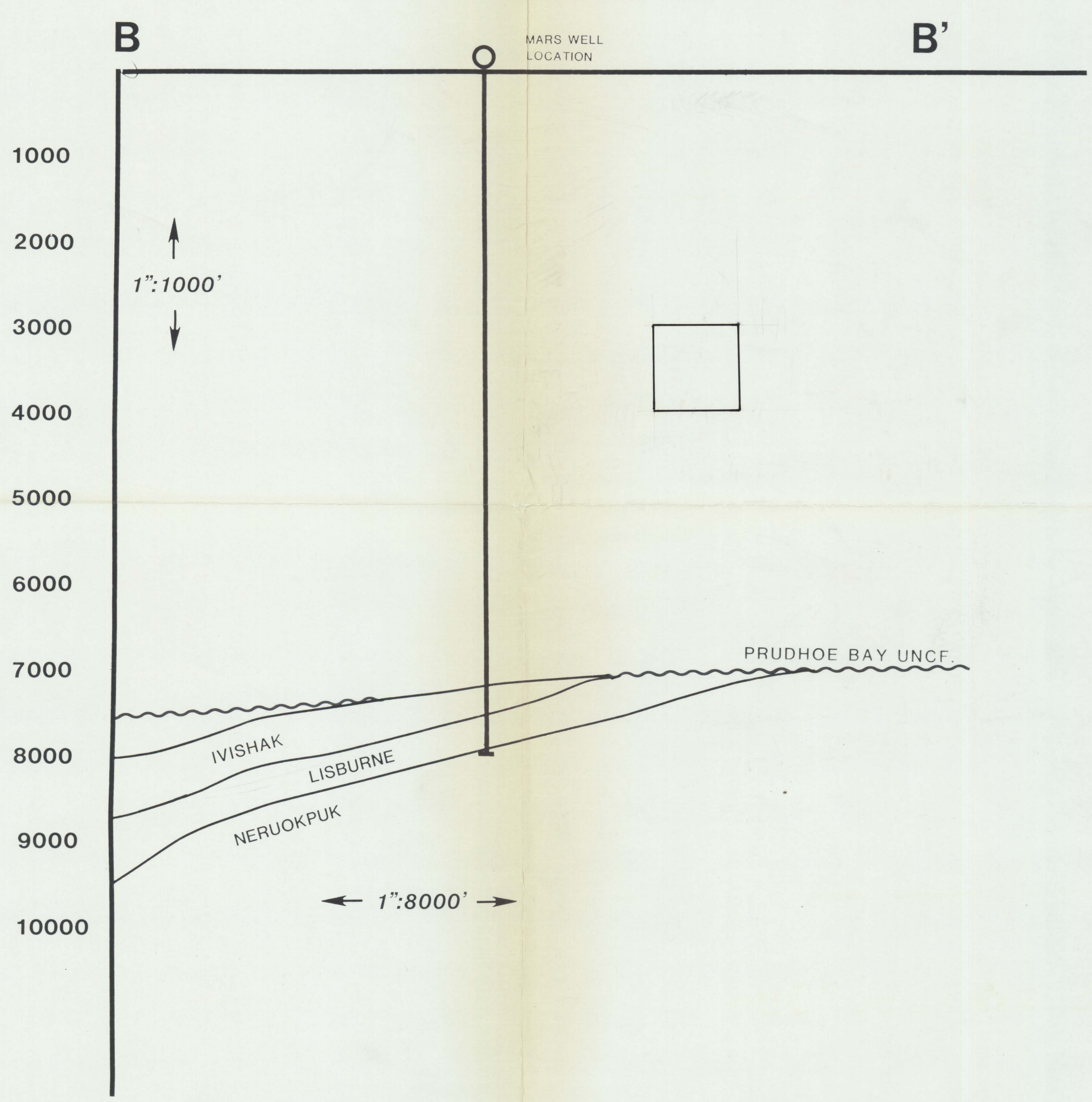
per Pat Hallin


PROSPECT MARS
TOP IVISHAK
ACREAGE AND STRUCTURE
C.I. = VARIABLE
(B) = PROTRACTION BLOCK NO.
(T) = SALE 71 TRACT NO.
1" = 8000'
A
A'
B
B'
1(B) 233(T)
2(B) 234(T)
3(B) 80(T)
4(B) 81(T)
235(T) 47(B)
46(B) 235(T)
43-11
43-13
43-14
49(B) 101(T)
50(B) 102(T)
94(B) 120(T)
95(B)
96(B) 122(T)
121(T)
43-15
43-16
43-17
43-18
43-19
43-20
43-22
43-23
IVISHAK TRUNCATION
MARS LOCATION
140(B) 138(T)
141(B) 139(T)
142(B) 140(T)
143(B) 141(T)
184(B) 154(T)
185(B) 155(T)
186(B) 156(T)
187(B) 157(T)
188(B) 158(T)
231(B) 172(T)
-7300
-7550
X D856323
CONFIDENTIAL
CLASS I MATER
Released to public file
Name: Date: NOV 1 2018
Amoco Production Company
Denver Region
PROSPECT MARS
TOP IVISHAK DEPTH MAP
By:
Scale:
Date:
Encl. No.

PROSPECT MARS X-SECTION (STRIKE)



PROSPECT MARS X-SECTION (DIP)



Amoco Production Company
Denver Region

PROSPECT MARS

X-SECTIONS
HARRISON BAY
BEAUFORT SEA, ALASKA

By: Date:
Scale: Encl. No.

PROSPECT MARS

STRATIGRAPHIC AND STRUCTURAL ELEMENTS

The Mars anomaly is a large northwest southeast trending stratigraphic trap on the south flank of the Barrow "Arch". It is defined on its northern limits by truncation of the Ivishak sandstone and Lisburne formation. West closure is delineated by intersecting structural contours with the Ivishak pinchout and eastern closure by the "structural" saddle between Mars and the Mukluk (Venus) structure. The saddle is believed to be a topographic low and developed by erosion on the Ivishak sandstone. As with Prudhoe Bay, Mars is an early trap combining structure and truncation and sealed by the Neocomian Pebble Shale and Upper Cretaceous pro-delta shales.

PROSPECTS MARS

DRILLING PROGNOSIS

Base Delta	-4000
Pebble Shale	-6990
Ivishak	-7200
Lisburne	-7500
Neruokpuk	-7900
TD	-8000

Depth in Feet

APPENDIX 2

OIL SPILL CONTINGENCY PLAN

(Separate, stand-alone volume; 3-ring binder)

ENVIRONMENTAL REPORT

OCS LEASE SALE 71: DIAPIR FIELD
BEAUFORT SEA, ALASKA

AMOCO PRODUCTION COMPANY

ENVIRONMENTAL REPORT (EXPLORATION)
OCS LEASE SALE 71: DIAPIR FIELD
BEAUFORT SEA, ALASKA

AMOCO PRODUCTION COMPANY
Operator for Amoco, Shell and Unocal, Koch Industries

Prepared By: Woodward-Clyde Consultants
701 Sesame Street
Anchorage, Alaska 99503

AUGUST 1985

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
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TABLE OF CONTENTS
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TABLE OF CONTENTS
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TABLE OF CONTENTS
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TABLE OF CONTENTS
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TABLE OF CONTENTS
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Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

ENVIRONMENTAL REPORT (EXPLORATION)
OCS LEASE SALE 71
DIAPIR FIELD, BEAUFORT SEA, ALASKA

August 1985

LEASE AND BLOCK NUMBERS

Lease	Block	Protraction Diagram
OCS-Y-0302	140	NR 5-4

LESSEES
Amoco Production Company; Shell Oil Co.; Unocal, Koch Industries, Inc.

OPERATOR
Amoco Production Company

CONTACT
Ms. Cheryl Winkler
Amoco Production Company
P.O. Box 100779
Anchorage, Alaska 99510
(907) 272-8471

RELATED ENVIRONMENTAL DOCUMENTS

U.S. Army Corps of Engineers. 1980. Final Environmental Impact Statement, Prudhoe Bay Oil Field Waterflood Project.

U.S. Department of the Interior, Bureau of Land Management, Alaska OCS Office. 1982. Final Environmental Impact Statement. Diapir Field, Proposed Oil and Gas Lease Sale 71.

U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region. 1984. Final Environmental Impact Statement, Proposed Diapir Field Lease Offering (June 1984, Sale 87).

Continental Shelf Associates, Inc. 1983. Environmental Report (Plan of Exploration): Beaufort Sea, Diapir Field OCS Sale No. 71 Area. Prepared for Exxon Company, USA.

LGL Alaska Research Associates, Inc. 1983. Environmental Report (Exploration): Mukluk Project. Prepared for Sohio Alaska Petroleum Company.

The Earth Technology Corporation. 1985. Environmental Report (Exploration): Harrison Bay, Alaska. Prepared for Tenneco Oil Company.

Texaco USA. 1983. Environmental Report (Exploration): Fur Seal Island, Harrison Bay, Alaska.

(2) DESCRIPTION OF PROPOSED ACTION

(a) LESSEE AND/OR OPERATOR

The lessees are Amoco Production Company (Amoco), Shell Oil Company, Unocal and Koch Industries, Inc. Amoco is the operator for the project.

(b) LEASE NUMBERS AND LOCATIONS

The Mars Prospect is located in the OCS Lease Sale 71 area, Lease OCS-Y-0302, Block 140, Protection Diagram NR5-4. The specific location of the well site is latitude 70.84309°N, longitude 152.07180°W and Grid System UTM Zone No. 5(N = 7859981.111, E = 534000.717). This location is approximately 7.8 km (4.9 mi.) northeast of the eastern end of Cape Halkett, Alaska, located along the Beaufort Sea coastline approximately 155 km (97 mi.) west-northwest of Prudhoe Bay, Alaska. Figures 2-1 through 2-3 show the location of the project area.

(c) OBJECTIVES OF THE PROPOSED ACTIVITIES

The objective of the proposed activities is to evaluate the hydrocarbon potential of the lease block.

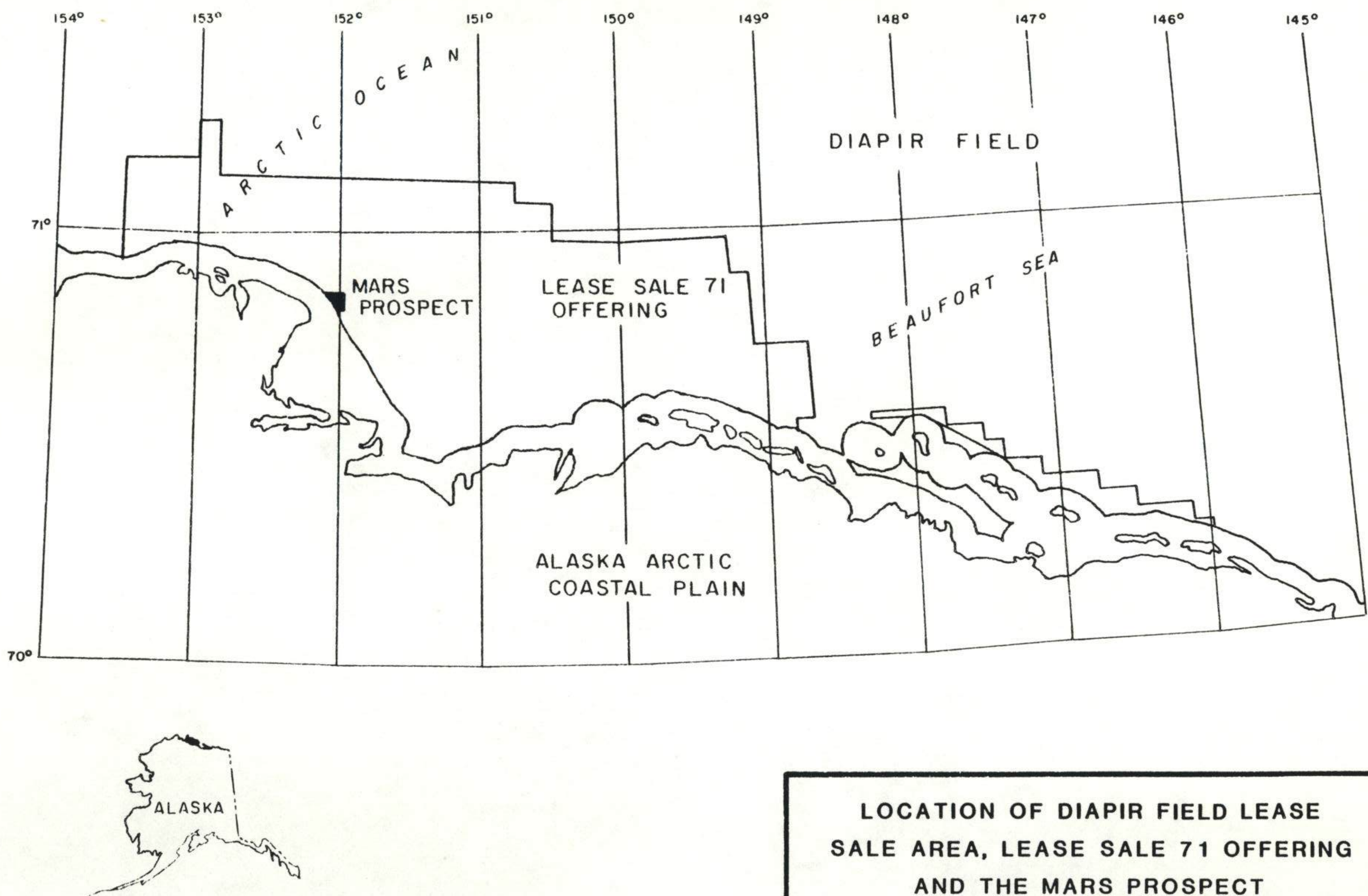
(d) DESCRIPTION AND LOCATION OF EXISTING AND/OR PROPOSED ACTIVITIES

A detailed description of the proposed exploratory drilling program is presented in the Exploration Plan for the project. Amoco proposes to drill, evaluate, test and abandon one exploratory well for the Mars Prospect. The proposed well will be vertically drilled to a depth of 8000 feet using a conventional diesel engine-powered rotary drilling rig. The well will be drilled from a spray ice island constructed in approximately 7.6 m (25 ft.) of water. The ice island working surface will be approximately 136 m (450 ft.) in diameter, generally circular in shape, and surrounded by protective ice berm. The island will be grounded and will extend approximately 4.5 m (15 ft.) above the water (ice) surface. The ocean floor at the drill site consists primarily of clay. The drill site is located in an area of late winter floating landfast ice. The location of the project area is shown in Figures 2-1 through 2-3.

(e) APPROXIMATE TIME FRAMES FOR CONDUCTING INDIVIDUAL ACTIVITIES

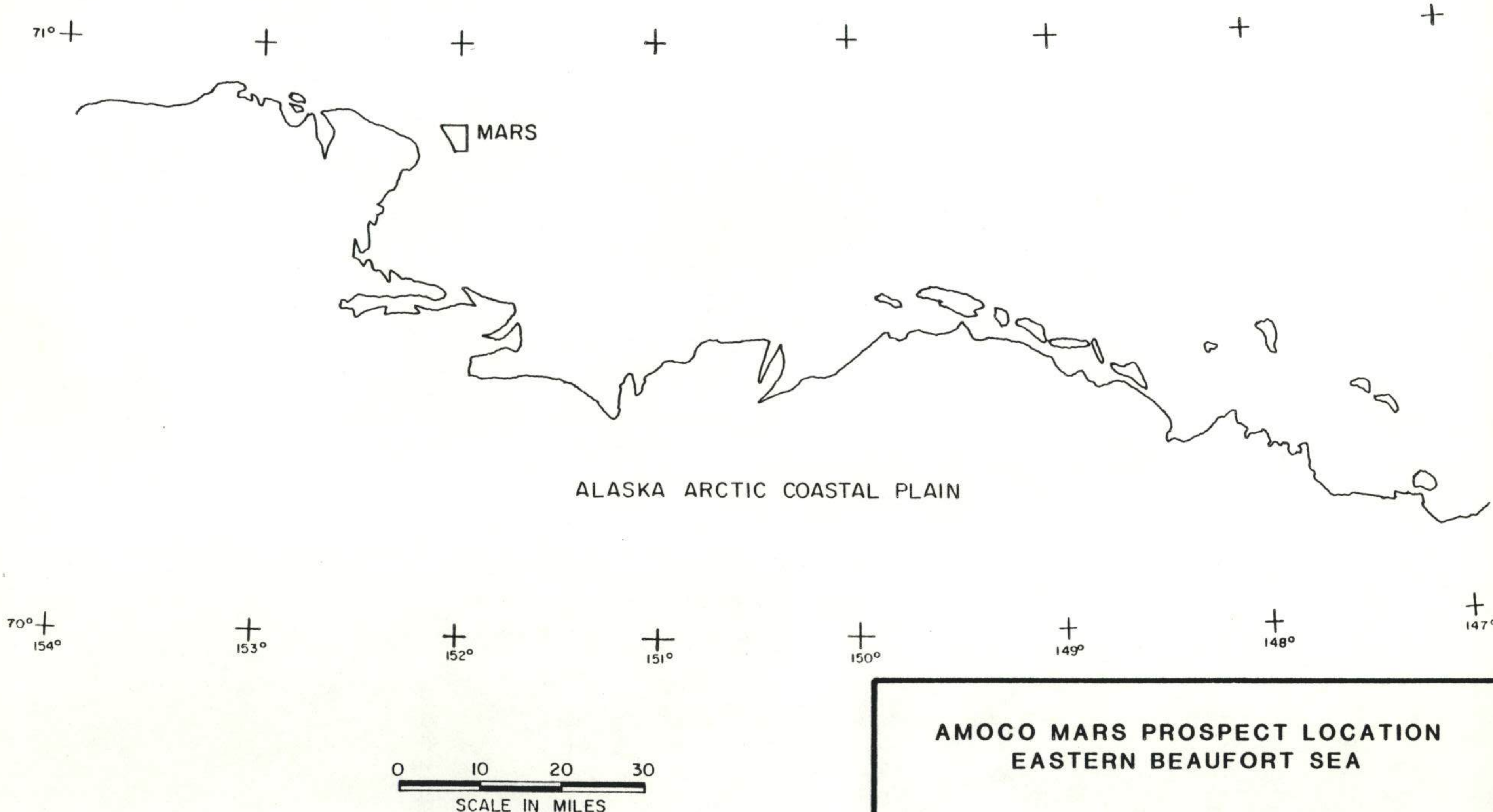
The proposed project schedule is presented in Figure 2-4. The project will be completed in the approximate period 1 November, 1985 to 1 May, 1986. Mobilization for construction of the ice roads, ice airstrip and ice island will be initiated in early November, 1985. Initial project activities will include the transport of equipment and supplies required for construction of the initial Cape Halkett onshore support base by approximately 15 All Terrain Vehicles from Prudhoe Bay/Deadhorse (see page 2-15 for the general route). The initial support base will be completed by approximately 15 November, 1985. Following completion of the landing strip by approximately 22 November, 1985, equipment and supplies for the support base and ice island construction will be moved by large cargo airplanes to Cape Halkett.

Construction of the ice road and ice island will occur in December, 1985 and January, 1986, and will be completed by 1 February, 1986. Ice island integrity testing and inspection will be completed in the first week of February, 1986. Following this evaluation, the drilling rig will be mobilized and transported to the ice island and set-up in mid-February. The well will be spudded on approximately 21 February. Drilling operations will occur through the third week in March and testing will occur in the last week in March. The well will be plugged and abandoned by 31 March. Rig take-down and demobilization will occur in the first two weeks of April. The drilling site will be cleaned-up throughout April and abandoned by 1 May, 1986.



LOCATION OF DIAPIR FIELD LEASE SALE AREA, LEASE SALE 71 OFFERING AND THE MARS PROSPECT

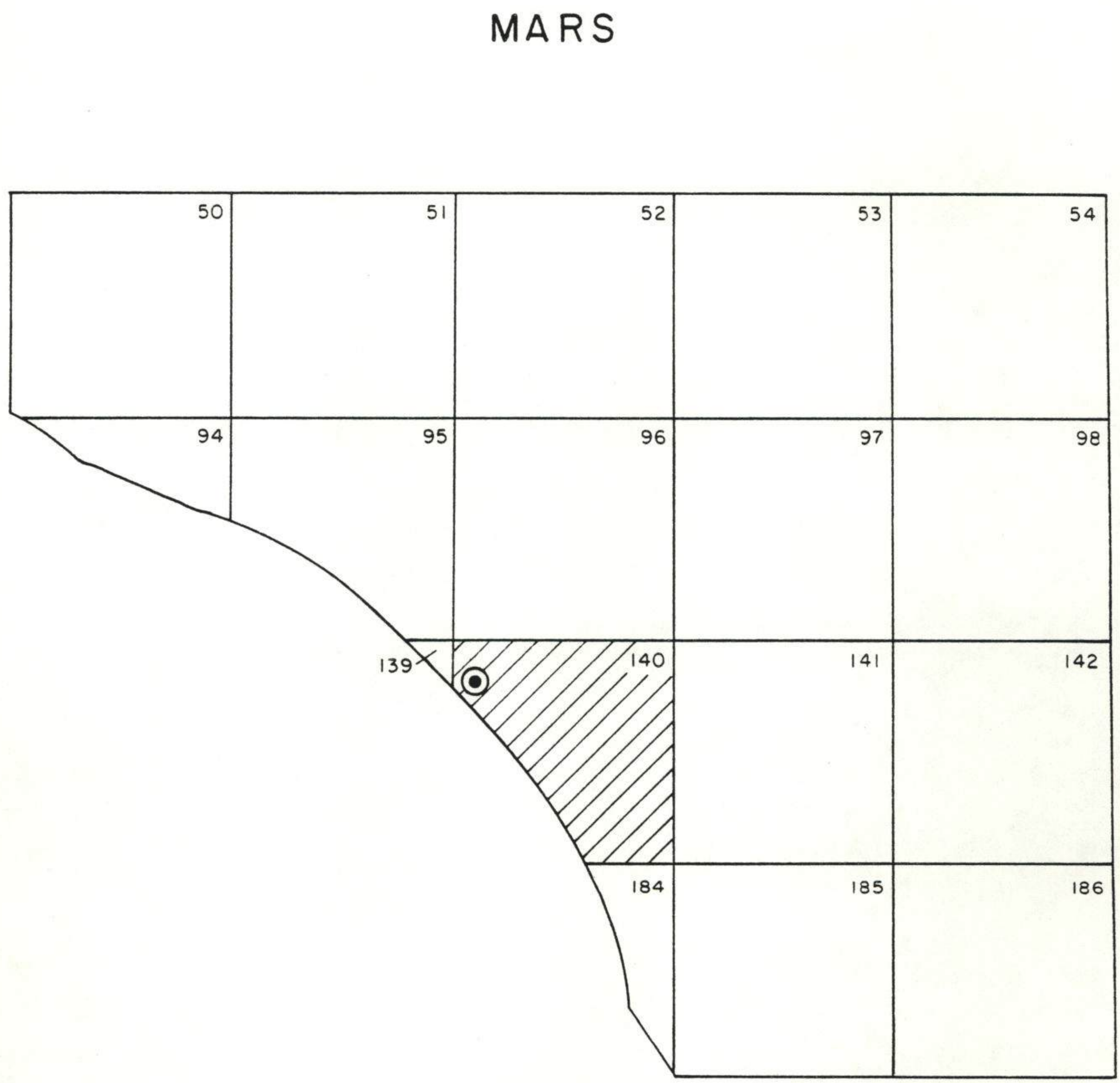
Woodward-Clyde Consultants | FIGURE 2-1



AMOCO MARS PROSPECT LOCATION
EASTERN BEAUFORT SEA

Woodward-Clyde Consultants

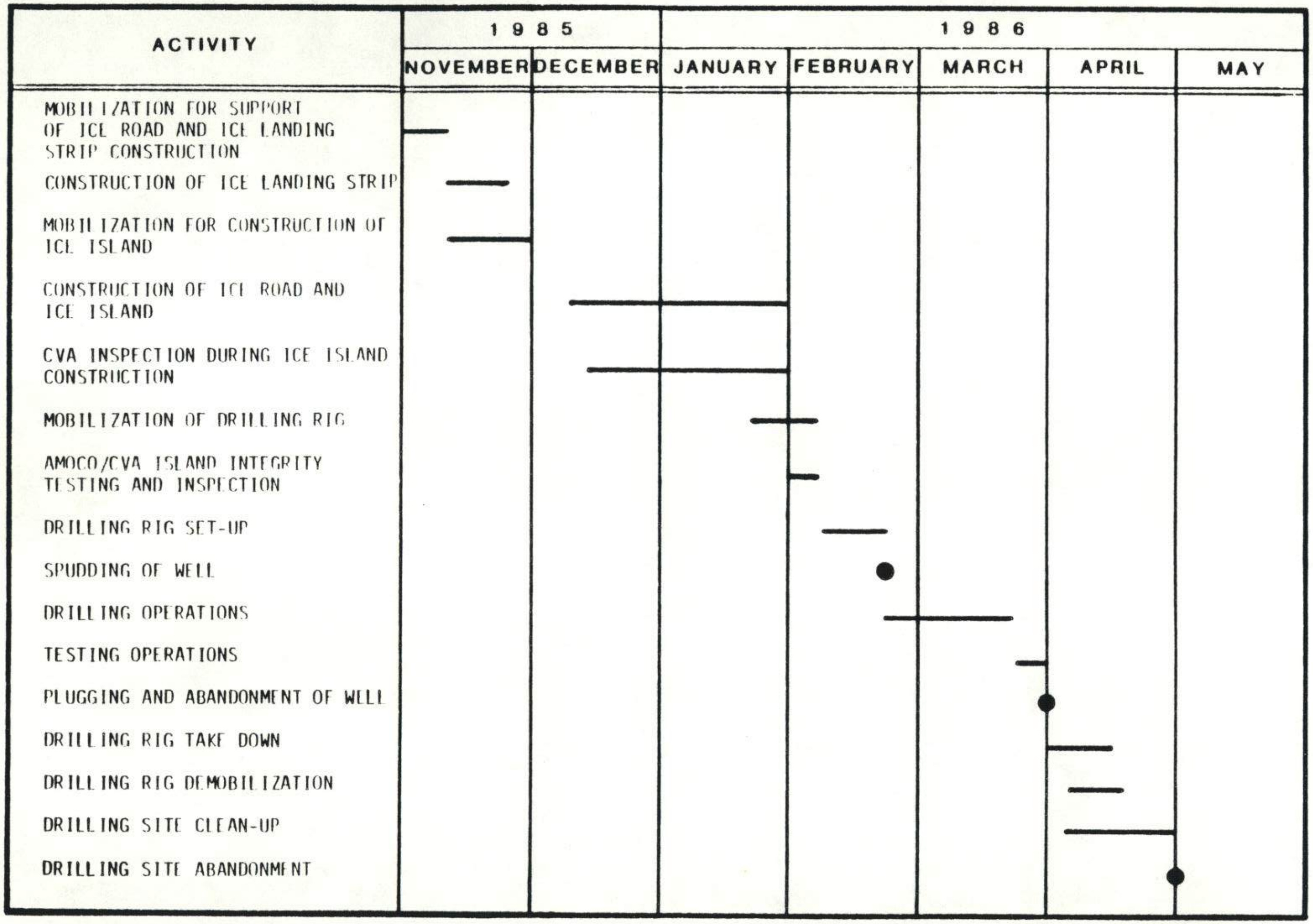
FIGURE 2-2



MARS LEASE BLOCK AND WELL LOCATION

Woodward-Clyde Consultants

FIGURE 2-3



PROPOSED PROJECT SCHEDULE

Woodward-Clyde Consultants | FIGURE 2-4

(f) DESCRIPTION OF PROPOSED TRAVEL MODES, ROUTES AND FREQUENCIES

The logistical support system for the project includes transport of equipment and supplies by airplane (large cargo airplanes and other fixed wing aircraft), All Terrain Vehicles, conventional truck and helicopter. The following large cargo airplane trips will be completed between Prudhoe Bay/Deadhorse and other areas and the ice landing strip at Cape Halkett in the approximate period 1 November, 1985-1 May, 1986:

Project Phase	Number of Trips	Cargo
Construction Mobilization	10	Fuel
	10	Pumps
	15	Onshore Camp
	15	General
Operations Mobilization	25	Mud, casing, similar equipment
	100	Drilling rig, drilling camp
	10	Drilling rig fuel
Operations (Drilling)	20	Fuel
	15	General
Demobilization	100	Drilling rig, drilling camp
	5	Testing materials
	5	Casing, similar equipment
	10	Pumps
	5	Fuel
	15	Onshore camp
Total	360	

The large cargo airplane flights will follow the most direct route between Prudhoe Bay/Deadhorse and the onshore support base.

In addition to these large cargo airplane flights, approximately two fixed wing aircraft flights per week to carry food and other general supplies between Prudhoe Bay/Deadhorse and the onshore support base during the operational (drilling) phase of the project will be completed.

Approximately two helicopter trips per week between Prudhoe Bay/Deadhorse and the ice island will be completed to transport required materials. The fixed wing aircraft and helicopter flights will follow the most direct route between Prudhoe Bay/Deadhorse and the project area. All aircraft will maintain a minimum flight altitude of 455 m (1,500 ft.) above and 1.6 km (1 mi.) from observed wildlife concentration areas, as specified in the Lease Sale 71 stipulations.

Mobilization of equipment and supplies to the onshore support base will require the use of approximately 15 All Terrain Vehicles. Approximately 10 of these vehicles will return to Prudhoe Bay/Deadhorse after delivering material. Demobilization will require approximately five All Terrain Vehicles. The All Terrain Vehicles will generally travel over the tundra between Prudhoe Bay/Deadhorse and the onshore support base. These vehicles will cross the Colville River near Nuiqsut. Approximately 10-20 trips per day of All Terrain Vehicles, conventional trucks and other vehicles will occur on the ice access road between the onshore support base and the ice drilling island throughout the duration of the project.

In addition to the previously described fixed wing aircraft flights, approximately 1-2 flights per week of this aircraft between Prudhoe Bay/Deadhorse and Cape Halkett will be completed for crew changes.

(g) PERSONNEL REQUIRED

(i) Offshore

The work crew present on the ice island, primarily including drilling supervisors, engineers, geologists, rig superintendent, drillers, loggers, tool pushers and related personnel, construction and maintenance workers, and cooks and similar personnel, will be comprised of approximately 50 individuals. This crew will be present for approximately 90 days

(February-April). Approximately 50 percent of the total crew will change-out each week.

(ii) Onshore

The total number of employees present at the onshore support base will be comprised of approximately 40 workers for 60 days and 15 workers for 90 days. This crew will be comprised of aircraft support staff, construction and maintenance workers, equipment operators, mechanics, and cooks and similar personnel. In addition, approximately two materials expeditors for the project will be based on Prudhoe Bay/Deadhorse. These workers will utilize existing facilities. Additional workers associated with the project include relatively low numbers of airplane and helicopter pilots.

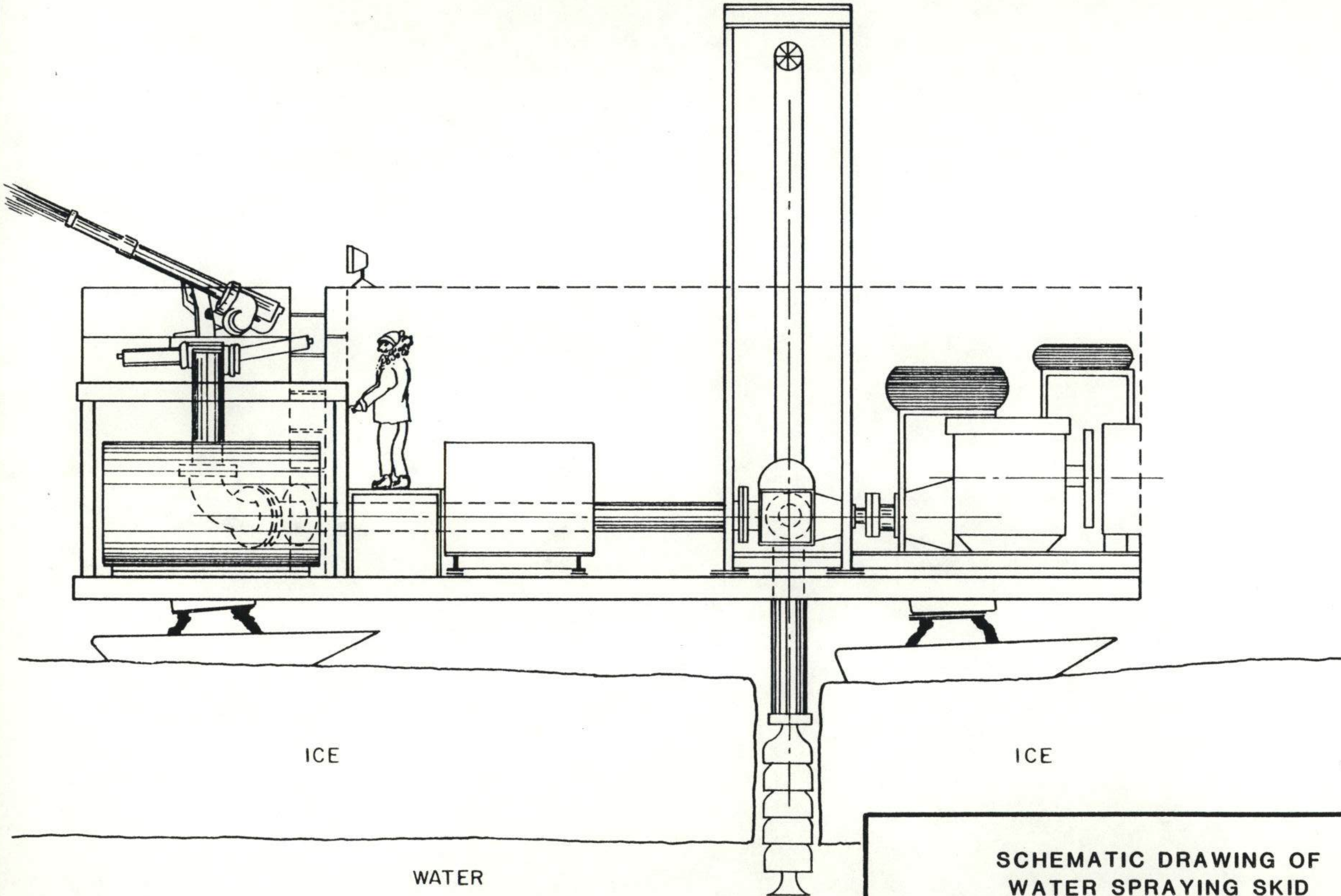
(h) EQUIPMENT AND GENERAL LAYOUT, SAFETY SYSTEMS, MONITORING SYSTEMS AND ONSHORE SUPPORT SYSTEMS

(i) Equipment and General Layout

(a) Ice Island

The ice island will be constructed using a spray technique. This technique involves pumping sea water from the immediate area of the drill site through nozzles which spray the water into the air. The water drops freeze in the cold air and form ice crystals which fall to the sea ice surface. The addition of ice crystals continues until the ice mass sinks to the ocean floor and is grounded. A diagram of the spray equipment is presented in Figure 2-5.

An arc-shaped, grounded ice berm will be constructed around the offshore-facing section of the ice island to prevent potential movement caused by contact with moving sea ice. The berm will be constructed using the same



SCHEMATIC DRAWING OF
WATER SPRAYING SKID

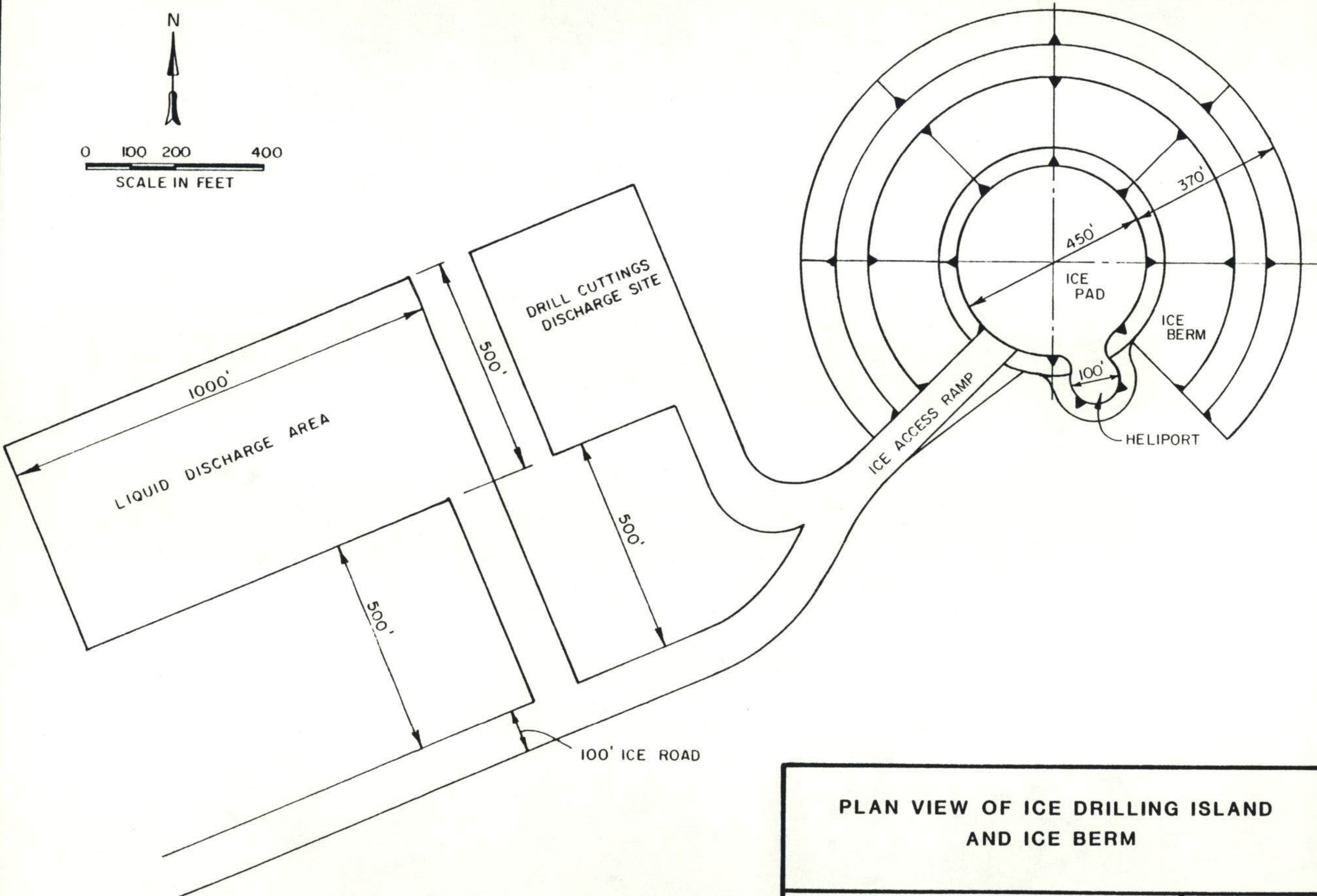
Woodward-Clyde Consultants FIGURE 2-5

technique as will be used to construct the ice island. Plan and cross-section views of the ice berm are presented in Figures 2-6 and 2-7, respectively. The ice berm will be a maximum of 21 m (70 ft.) above the ocean floor, approximately 7.9 m (26 ft.) higher than the ice island. The berm will be located adjacent to the ice island. The ice berm is designed to remain stable under the design ice loading. The ice island (drilling rig pad) is also designed to remain stable under the design ice loading without the presence of the protective berm. Thus, the system is redundant to provide maximum ability to withstand sea ice forces.

Sea bottom soils in the area of the drill site appear to be comprised of clay; the clay layer on the bottom is approximately 30.3 m (100 ft.)-thick. Areas of bonded permafrost are generally present within approximately 3-4.5 m (10-15 ft.) of the ocean floor. Permafrost of this magnitude is not significant to the proposed construction designs. The undrained shear strength of clay soils present at the drilling site ranges from 750 to 4500 pounds per square foot (psf), with an average of approximately 1000 psf. Ice gouging occurs in the drill site area and is accounted for by reducing the contact area of the grounded portions of the island.

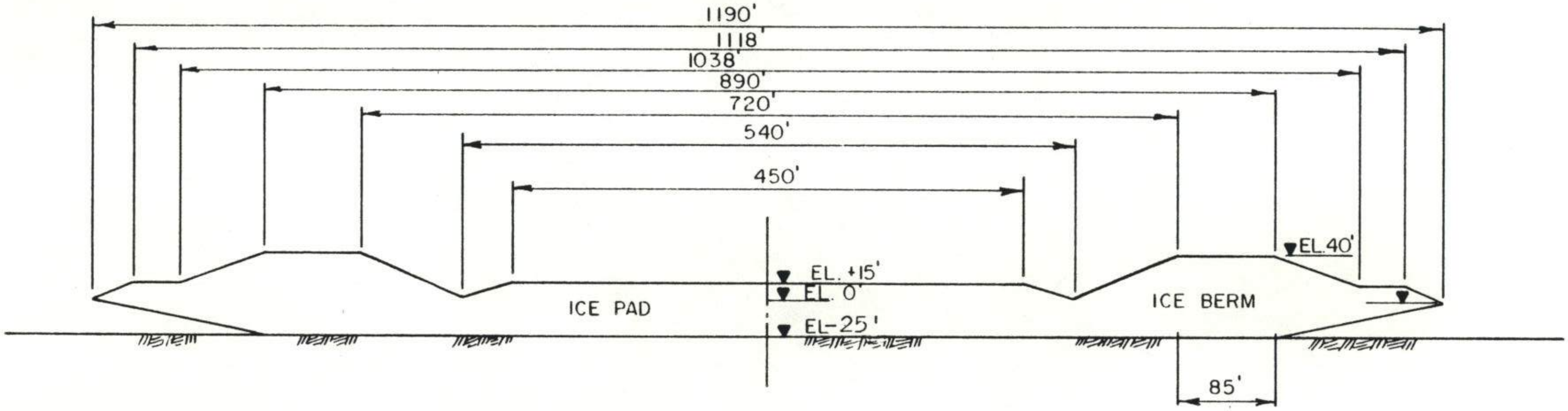
The spray ice island/berm will be surrounded by landfast ice. Although late winter movements of landfast ice are not common, severe late winter storms could generate significant ice sheet movements. The strength of the spray ice is less than the strength of sea ice. Therefore, sea ice movement would result in penetration of the sea ice into the spray ice berm. As the sea ice would advance further into the spray ice berm, rubble building would be initiated at the contact point.

The ice pad and berm must develop sufficient reaction at the sea floor to the maximum forces developed by interaction of the two masses. The ice



PLAN VIEW OF ICE DRILLING ISLAND AND ICE BERM

Woodward-Clyde Consultants | FIGURE **2-6**



CROSS-SECTION VIEW OF
ICE DRILLING ISLAND AND ICE BERM

Woodward-Clyde Consultants

FIGURE 2-7

berm is designed to ensure that rubble building occurs, limiting loads to an acceptable level on the ice drilling pad.

(b) Logistical Support System

The logistical support system for the project will consist of the following facilities:

- o Airplane landing strip,
- o Onshore support base, and
- o Ice access road.

The ice airplane landing strip will be constructed by flooding a dry lake bed or using an existing lake in the Cape Halkett area. The location of the lake is shown in Figure 2-8. Construction of the ice landing strip will be conducted by transporting fresh water from adjacent lakes into the dry lake bed. The discharged water will freeze and form the landing strip. The landing strip will be approximately 45.5 m (150 ft.)-wide and 1515 m (5500 ft.)-long, with an area of approximately 8 hectares (ha) (20 ac.).

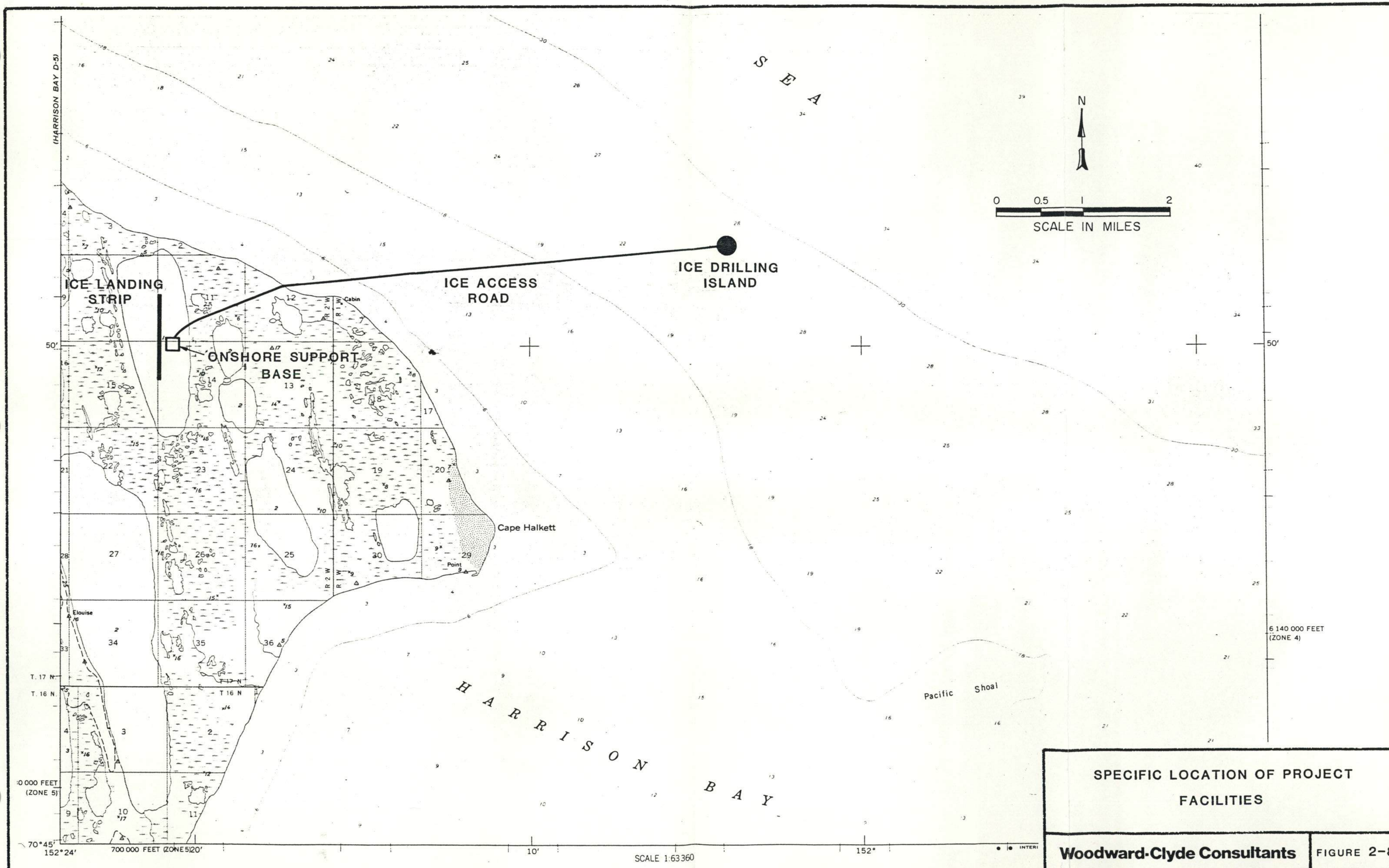
The landing strip will be utilized by large cargo airplanes and other fixed wing aircraft to transport equipment, material and supplies between the onshore support base and Prudhoe Bay/Deadhorse and other locations. In addition to the airplane landing strip, a helicopter landing pad will be provided.

An onshore support base will also be constructed adjacent to the ice airstrip in the dry lake bed in the Cape Halkett area (Figure 2-8). The support base will be utilized throughout project construction, operation and abandonment for the following purposes (1) housing of project workers, (2) storage of certain equipment and supplies, (3) fuel storage, (4) vehicle parking, (5) establishment of a shop and (6) communications. The support base will be constructed on an ice pad that will be established using the same technique utilized to construct the ice landing strip. The support base will be approximately 121 m (400 ft.)-wide and 121 m (400 ft.) long, covering an area of approximately 2 ha (5 ac.).

In addition to the onshore support base, a worker camp for drilling and other rig personnel will be present on the ice drilling island. This camp will include all living facilities required by workers directly associated with the drilling rig.

An ice access road will be constructed between the onshore support base and the ice island well pad to provide for the movement of equipment and supplies. The access road will be approximately 45 m (150 ft.)-wide and 10 km (6.4 mi.)-long, covering an area of approximately 46 ha (116 ac.). The road will be constructed by flooding the natural ice sheet with sea water pumped from below the ice. The offshore section will be approximately 1.4 m (4.5 ft.)-thick and will be grounded in inshore areas with water depths less than 1.4 m (4.5 ft.).

Access will also be required between Prudhoe Bay/Deadhorse and the onshore support base at Cape Halkett. All Terrain Vehicles will travel between these two points along a route generally located along the Beaufort Sea coastline. No road will be constructed; All Terrain Vehicles will travel over frozen tundra and other substrates following freeze-up (following 1 November, 1985). Some snow and ice clearing and substrate improvement in certain areas may be required for travel along this route. The crossing point of the Colville River will be located near the village of Nuiqsut. It is expected that the vehicles will not have an effect on the inhabitants of Nuiqsut.



SPECIFIC LOCATION OF PROJECT FACILITIES

Woodward-Clyde Consultants

FIGURE 2-8

(c) Drilling Rig

A conventional diesel engine-powered, mechanical rotary drilling rig will be utilized for the project. It is expected that Parker Drilling Company Rig 123 or similar rig will be utilized. A general description of Rig 123 is presented below. Additional, more specific information will be presented in the APD, if necessary.

Component	Description
Drawworks	OIME SL 1500
Engines	4-Caterpillar D-3412, 570 horsepower each (2280 total horsepower)
Compound	OIME 3 engine
Substructure	21'
Mud pits	1,700 BBL
Traveling equipment	350 ton
Rotary Table	National 275, 27.5" inside diameter
Drill pipe	4.5"
Drill collars	8", 6.75"
Mud pumps	2 Gardner Denver 1000 horsepower P2-9
Maximum drilling depth	15,000'
Total number of loads of moveable components (rig and camp)	88 C-130 Hercules loads, 73 truck loads
Fire-fighting and safety equipment	2-150 lbs. Ansul Dry Chemical Units, 22-30 lbs. Ansul Dry Chemical Units, 4 Scott Air Pack Breathing Units (30 minutes, 45 cubic feet capacity)
Fresh drilling water storage	440 BBL
Fuel oil storage	440 BBL
Fuel oil day tank capacity	100 gallons

Component	Description
AC generators	Caterpillar SR-4 520 KVA 440 KW, 440-120-208 V (driven by D-3412 diesel engines)
Emergency power	Caterpillar SR-4 prime mover
Derrick	136' Cantilever Model No. 27415; nominal capacity = 1,025,000 lbs; static hook load capacity with 10 lines=670,000 lbs.
Drawworks	OIME TBA-2000 horsepower
Inside BOP's	5000 PSI WP for 4.5' drill pipe; make = TIW HRL-O with 4.5" XH box pin connection
BOP and control equipment	BOPE stacks and [choke manifold(s)] designed to meet State of Alaska and MMS requirements; 13 5/8" BOPE stack with Bell nipple and riser
Rig camp	48-man capacity; generators and support units to allow independent operation
Estimated average daily fuel consumption	4500 gallons/day
Miscellaneous equipment	Drilling recorder Volcano boilers Tioga air heater Wire line unit Crownomatic Forklift Camp Sewage treatment plant Water treatment plant Shop Crew-cab pickup

A plan view of Rig 123 is presented in Figure 2-9.

(ii) Safety Systems

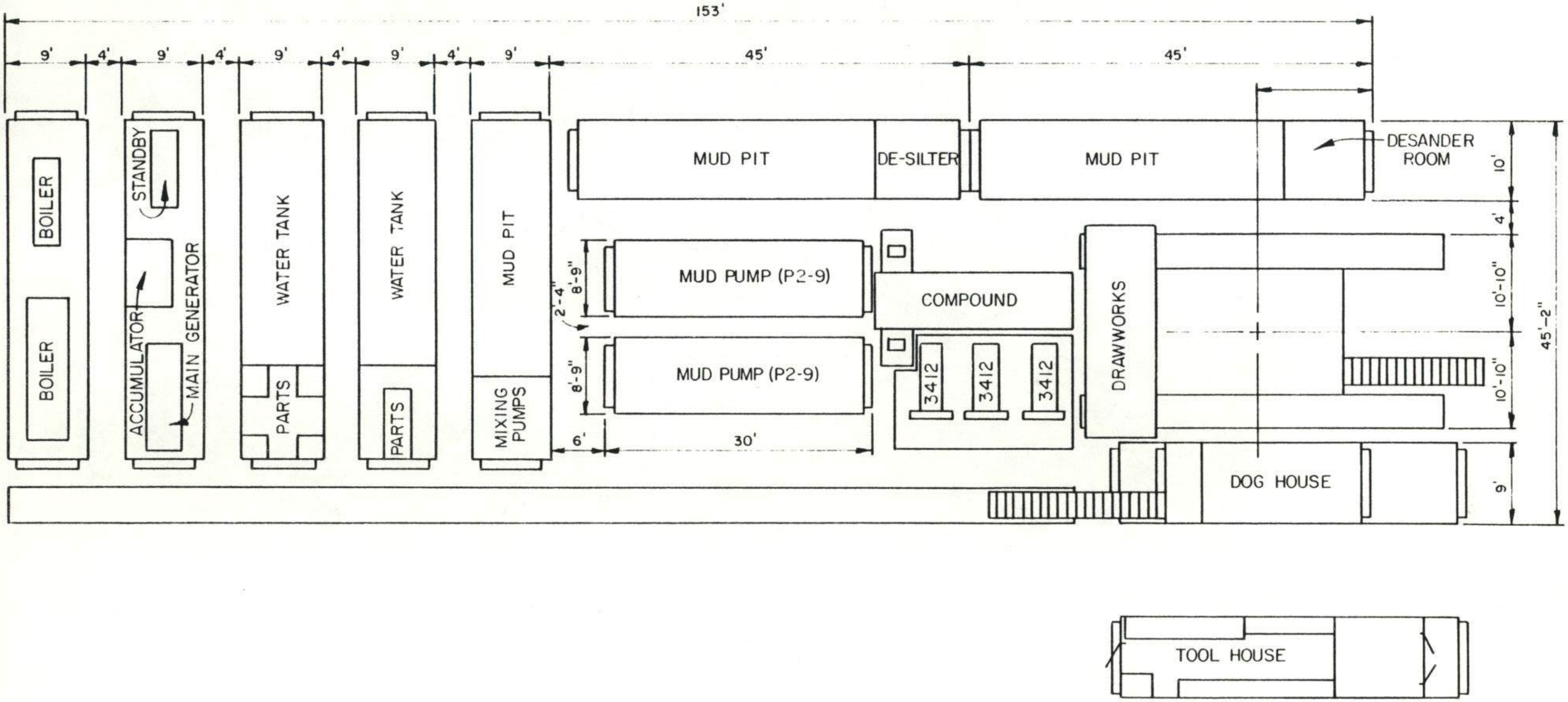
Project safety systems include drilling hazard, blowout prevention, fire-fighting, personnel evacuation and lifesaving, aircraft navigation and warning, and communications systems. The principal safety measures to be implemented to ensure worker safety include maintaining the integrity of the ice island and protecting the environment relative to the assessment of potential shallow drilling hazards, hydrogen sulfide contingency planning, and the preparation of a Critical Operations and Curtailment Plan. In addition, implementation of regular equipment testing and performance monitoring, and personnel training programs will help minimize the potential for accidents and promote knowledge of safety equipment and its use. Following are more specific descriptions of important safety systems.

(a) Drilling Hazards

All required geophysical work completed prior to initiating the exploratory drilling operation on the lease covered by this report will be completed and submitted to MMS for review prior to submittal of the APD for the proposed well. High resolution geophysical data, seismic common depth point (CDP) data, velocity data and structural interpretations will be examined and all potential shallow drilling hazards will be assessed. Appropriate measures will be developed on the basis of this evaluation and incorporated into the detailed drilling program.

(b) Blowout Prevention

The drilling rig will be adequately equipped with the necessary diverter and BOP equipment to maintain complete well control. The blowout prevention equipment is rated at 10,000 pounds per square inch (psi) and will be installed and tested as required by Alaska Region OCS Order No. 2, and the testing results will be recorded in the driller's report. Regular inspection and maintenance will be performed on the equipment. Drilling personnel will be trained and qualified in accordance with the provisions of the MMS OCS standard "Training and Qualifications of Personnel in Well-Control Equipment and Techniques for Drilling on Offshore Locations" before



PLAN VIEW OF DRILLING RIG

Woodward-Clyde Consultants

FIGURE 2-9

initiating work on the well. Blowout prevention drills will be conducted as required by MMS and recorded in the driller's report. A description of the blowout prevention equipment to be included on the drilling rig will be provided in the APD.

The proposed drilling mud, casing and cementing programs will be designed to ensure that the well is drilled in a safe manner. These programs will be described in the APD for the proposed well. Company representatives will provide on-site supervision of drilling operations on a 24-hour basis. In addition, a member of the drilling crew or the tool pusher will continuously maintain rig-floor surveillance, unless the well is safely secured.

(c) Curtailment of Drilling Operations

A detailed Critical Operations and Curtailment Plan will be submitted with the APD and will apply to all subsequent drilling operations in the Beaufort Sea OCS area. This plan will be on file with MMS and will be on the drilling rig.

(d) Hydrogen Sulfide

A Hydrogen Sulfide Contingency Plan will be submitted with the APD and will apply to all potential subsequent drilling operations in the Sale 71 area. A copy of the plan will be on file with MMS and will be present on the drilling rig. The drilling rig will be equipped with adequate hydrogen sulfide detectors, alarms and protective equipment. A list of the hydrogen sulfide detection and protection equipment will be referenced in the Hydrogen Sulfide Contingency Plan.

(e) Firefighting

The drilling rig will be equipped with a U.S. Coast Guard-approved fire-fighting system. Fire stations will be located at strategic points on the drilling rig. Drills will be conducted to familiarize personnel with the location and use of the fire-fighting equipment.

(f) Evacuation and Lifesaving

All required evacuation and lifesaving equipment will be present on the ice drilling island. Cold-water survival suits, lifeboats, lifecapsules or lifecrafts will not be required because project operations will not be completed under open water conditions. An evacuation and lifesaving plan will be developed to cover potential emergencies associated with use of the ice island. Drills will be conducted to familiarize project personnel with specific elements of the evacuation and lifesaving plan.

(iii) Monitoring Systems

A state-of-the-art design mud logging and monitoring system will be used during the drilling operations. A mud logging unit will continuously monitor the drilling mud for hydrocarbon gases. Hydrogen sulfide gas also will be monitored. The mud pit room will be equipped with hydrogen sulfide and methane gas monitors. The liquid level in the mud pits and the well flow rate also will be monitored. The logging system, core sampling and formation cutting programs will be submitted with the APD.

Consistent with OCS Order No. 2 and MMS published guidelines, equipment required to collect oceanographic and meteorological data will be installed on the drilling rig. Amoco will collect the following meteorological, oceanographic and performance data:

- ° <u>Meteorological</u>
  - wind speed and direction (mph - average, maximum)
  - barometric pressure (in Hg)
  - air temperature (°F)
    - dew point
    - relative humidity
  - precipitation (type, amount)
  - visibility, ceiling, cloud over and type
  - other weather conditions
- ° <u>Oceanographic</u>
  - ice conditions (type, thickness, coverage)
- ° <u>Performance</u> (ice island and access road)
  - ice island and road cracking and other potential problems
  - regional ice movement
  - ice island axis
  - ice island settling
  - ice island temperature

In order to comply with Lease Stipulation No. 8 - Protection of Biological Resources, Amoco understands that the company may be required to conduct biological surveys to determine the extent and composition of biological populations or habitats which might require additional protective measures. The results of such monitoring could be utilized to design and implement adverse impact mitigation measures.

Amoco also understands that the MMS regional Supervisor, Field Operations (RSFO) will receive recommendations from the Beaufort Sea Biological Task Force concerning the enforcement of Stipulation No. 8 - Protection of biological Resources.

(iv) Onshore Support Systems

Onshore support systems required for the project are described in detail in Section (2) (h)(i)(b) (pages 2-14).

(i) NEW OR UNUSUAL TECHNOLOGY

Several ice islands or ice berms have been constructed in the Alaskan Beaufort Sea during the past decade. The Canadians have also artificially thickened ice for use as a floating drilling pad in the Arctic offshore. In the winter of 1976/77 Union Oil Company of California successfully constructed a 300' by 500' ice island for exploratory drilling near Oliktok Point in 9 feet of water using a water flooding technique. In 1978/79 Exxon USA constructed an exploratory ice island in approximately 18 feet of water north of Prudhoe Bay using a center-pivot sprinkler system.

The proposed spray ice island, including the ice berm, is a new technology that has been recently developed and tested. Spray ice islands have not been previously utilized for drilling of exploratory wells. However, Sohio Petroleum Company designed, constructed, tested and monitored a grounded spray ice structure located in the Alaskan Beaufort Sea in the Prudhoe Bay region in the winter of 1984-85. The island was 106 m (350 ft.) in diameter and was located in an area with a 9 m (30 ft.) water depth. The specific objective of the program was to obtain additional engineering information regarding spraying techniques using high pressure pumps, and the design and construction of working grounded spray ice structures. Information collected in this program was utilized in the design of the proposed ice island for the Amoco Mars Prospect.

In addition to the Sohio program, Amoco has completed detailed preliminary engineering feasibility studies concerning spray ice islands and is currently completing detailed design studies for the Mars Prospect. Final ice island design will be reviewed by MMS during the Certified Verification Agent (CVA) review project.

No additional new or unusual technology will be utilized for the project.

(j) DISCUSSION OF OIL SPILL CONTINGENCY PLAN

(i) Description of Oil Pollution Prevention Procedures

It is the policy of Amoco to protect the environment by employing the best control mechanisms, procedures and processes that have proven to be technically sound. Amoco will take all proper and appropriate actions to avoid the discharge of and to assure the containment, cleanup and disposal of oil and oily debris. Appropriate state-of-the-art equipment will be used by Amoco and its contractors, and all activities will be conducted in a carefully planned and orderly fashion to prevent the discharge of pollutants.

Spill prevention during exploratory drilling activities will be maximized by Amoco and its drilling contractor with strict adherence to all applicable laws and regulations. Alaska OCS Orders No. 2 and 7 include specific requirements with respect to oil spill and pollution prevention. Order No. 2 establishes casing and casing-cement requirements, blowout prevention equipment specifications, mud program testing and control requirements, and a mandatory program for the supervision and surveillance of activities and the training of personnel. Order No. 7 establishes requirements for liquid and solid waste disposal, personnel training and drills for the pollution prevention, and pollution inspections and reports.

The principal methods used to prevent blowouts which may cause oil pollution are a mud program, proper casing design and the diverter blowout prevention system. All geologic horizons which contain oil, gas or fresh water will be fully protected by casing and/or cement. Equipment which meets or exceeds the standard established in OCS Order No. 2 will be used.

A comprehensive Oil Spill Contingency Plan for the Amoco exploratory drilling operation has been submitted to MMS as part of Amoco's Exploration Plan. The Oil Spill Contingency Plan is designed to assist Amoco personnel and contractors in responding rapidly and effectively to oil spills that may result from the exploratory drilling operation. The plan includes a list of the manpower, equipment and materials maintained by or available to Amoco for use in the event of a spill incident. The principal sections of the plan are described below.

(ii) Personnel Involved in Implementation of the Contingency Plan

(a) Personnel Training

All Amoco Drilling Foremen, and other key personnel as required, will complete all well control and other requirements established by MMS OCS Standard No. T-1 (MMSS-OCS-T-1).

A description of the oil spill training program for Amoco personnel and the contract drilling crew is included in the Amoco Oil Spill Contingency Plan. The appropriate personnel will receive training in the deployment, operation and maintenance of the containment and cleanup equipment applicable to their function. Training drills will be conducted periodically to familiarize Amoco and other project personnel with the onsite equipment, proper deployment techniques and equipment maintenance.

Sufficient advance notice will be given to allow MMS to witness the drill. Drills will be recorded and the records will be available to MMS personnel.

(b) Personnel Involved in Activating Key Phases of the Contingency Plan

A list of the Amoco personnel to be involved in implementation of the contingency plan is included in the spill response organization section of the Amoco Oil Spill Contingency Plan. The individual who detects the oil spill will notify the Amoco Drilling Foreman, who will make an initial assessment of the spill and report it to the Spill Response Coordinator (SRC). The SRC will notify the Amoco District Manager in Anchorage and all appropriate agency personnel, including representatives from MMS, EPA, Alaska Dept. of Environmental Conservation (ADEC) and U.S. Coast Guard to initiate the appropriate control actions.

If necessary, the Amoco Major Spill Response Team will be activated by the District Manager. For details concerning these procedures, including emergency phone lists, see appropriate sections of the Oil Spill Contingency Plan.

(c) Oil Spill Cooperatives

If an oil spill occurs which is beyond the means of onsite personnel and equipment to control, Amoco will activate its Major Spill Response Team. Additional equipment may be obtained from Alaska Clean Seas, oil spill cleanup contractors in Alaska [e.g., ABSORB, Crowley Maritime, Alaska Offshore, Cook Inlet Response Organization (CIRO)] or from oil spill cooperatives outside of Alaska (see the Oil Spill Contingency Plan).

(iii) Description of Cleanup Activities, Response Time, Capacity and Location of Equipment

A detailed description of the equipment, techniques and capacity of containment and cleanup if included in the Amoco Oil Spill Contingency Plan.

(a) Cleanup Activities

The response organization section of the Amoco Oil Spill Contingency Plan describes how Amoco is organized to respond to oil spill situations. Two related response teams, the Immediate Response Team and the Major Spill Response Team, are described. In the appropriate section of the plan, the oil spill response actions are explained.

(b) Response Time

The logistics and response times for the deployment of oil spill containment and cleanup equipment are described in the Amoco Oil Spill Contingency Plan.

The equipment onboard the drilling unit can be deployed for immediate response. Response times for offsite equipment would vary considerably depending on storage location, staging area, weather conditions and other factors. A detailed discussion of logistics and the time requirements to move equipment to the drilling site is included in the Amoco Oil Spill Contingency Plan. Equipment stored at other sites in Alaska would be moved to a staging area at Deadhorse by cargo plane. From these areas, equipment would be moved to the spill site by helicopter or vehicle. Response time estimates are included in the Oil Spill Contingency Plan.

(c) Description, Location, and Capability of Equipment

Oil spill containment and cleanup equipment is described in the appropriate section of the Amoco Oil Spill Contingency Plan. Equipment present at the drill site is adequate to respond to minor operational spills. For larger spills, this equipment would be deployed as a first response effort to control the spill until additional equipment and manpower arrives.

(iv) Relationship to the National and Regional Oil Spill Contingency Plans

The National Oil and Hazardous Substances Contingency Plan, established pursuant to the Clean Water Act, is the basis for federal action to minimize pollution damage from discharges of oil or hazardous substances. The National Plan is a master plan comprised of various regional plans. In case of an oil spill, a representative of the U.S. Coast Guard becomes the Federal On Scene Coordinator (OSC). The OSC has a Regional Response Team (RRT) comprised of federal and state agencies for immediate call-up.

Any spill of oil, regardless of size, would be reported to the U.S. Coast Guard and the MMS District Supervisor. In the event of a major spill, the RRT may be activated by the OSC. However, the purpose of the federal response team is not to unilaterally step in and take over containment and cleanup activities. When the discharger is financially capable, and takes appropriate remedial actions voluntarily, the principal purpose of the federal activities would be to observe and monitor progress and to provide assistance.

(k) WASTE MATERIALS

Two general types of waste materials will be generated as a result of project implementation: gaseous pollutants, and solid and liquid wastes.

(i) Gaseous Pollutants

Air emissions that will result from the proposed exploratory drilling operations include nitrogen oxides and small quantities of sulfur oxides, carbon monoxide, suspended particulates and hydrocarbons. Information on the nature and quantity of these emissions and the characteristics and operating frequency of significant emission sources are summarized in Section 4 (Environmental Consequences) and are described in detail in Appendix B.

The air pollutants generated as a result of the proposed drilling program are minor in nature and of short duration. Because the emmissions produced by the drilling and testing of the proposed exploratory well described in this report are much less than the exemption amounts "E" described by MMS, no further analysis of their impact on onshore areas is required. The emissions generated by support vehicles and airplanes also are very low and will probably result in no adverse onshore impacts.

(ii) Solid and Liquid Wastes

In compliance with the provisions of the Federal Water Pollution Control Act as amended (33 USC 1251 et. seq.), the U.S. Environmental Protection Agency (EPA) regulates the discharge of liquid and solid wastes into OCS waters.

Sewage generated at the worker camp on the ice drilling island will be processed through Met-Pro Chemical Sewage Unit which purifies liquid content and separates solid components for incineration before the ash is deposited upon the ice. Sewage generated at the onshore support base will be treated in a similar unit.

Estimated discharges resulting from drilling of the Mars Prospect are summarized in Table 2-1. Drill mud, well completion fluids, drill cuttings and wash water, and BOP fluid discharges will be disposed of on the natural ice surface in the area of the ice island. The Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES)

General Permit for the Beaufort Sea wil cover all discharges placed on the ice surface.

Combustable trash from the ice drilling island and onshore support base will be incinerated. Non-burnable refuse from the two locations will be transported to an approved disposal site.

(l) <u>SUITABLE MAPS AND DIAGRAMS SHOWING DETAILS OF THE PROPOSED PROJECT</u>

Figures 2-1 through 2-3 show the location of the project area.

(m) <u>CERTIFICATION OF COASTAL ZONE CONSISTENCY</u>

The proposed activities comply with the State of Alaska's approved Coastal Zone Management (CZM) Program and will be conducted in an manner consistent with this program. A CZM consistency evaluation is presented in Appendix C.

(n) <u>A DESCRIPTION OF MEASURES PROPOSED TO COMPLY WITH OCS ORDERS AND OTHER PERTINENT REGULATIONS</u>

Amoco's proposed drilling activities satisfy all requirements of current applicable MMS OCS Orders and Notices to Lessees (NTLs). This will ensure complete compliance with all MMS standards, criteria and requirements for overall well control (including the casing design and mud and cement programs, and the installation and testing of BOP equipment), personnel training, monitoring, surveillance and reporting, well surveys, hydrogen sulfide detection and safety measures.

Amoco's activities will also satisfy all requirements imposed by specific lease stipulations and information to lessees appearing in the Lease Sale

Table 2-1. Estimated discharges for drilling of the proposed Mars exploratory well.

Discharge		Estimated Volume Per Day	Estimated Volume Total	
Drill mud		6,576 gallons	197,270 gallons	
Well completion fluids (1 time)		40,550 gallons,	40,550 gallons	
Drill cuttings and wash water		5,765 gallons	172,950 gallons	
Sanitary and domestic waste water				
ice island camp		4,500 gallons	315,000 gallons	(70 days)
man onshore base		3,400 gallons	510,000 gallons	(150 days)
		Total	825,000 gallons	
Blowout prevention (BOP) fluid discharge		50 gallons	2,500 gallons	
Desalinization plant blowdown*	- ice island	13,500 gallons	945,000 gallons	(70 days)
	- onshore base	10,200 gallons	1,530,000 gallons	(150 days)
		Total	2,475,000 gallons	
Trash (burnable kitchen waste, boxes, cartons, paper, wood, etc.)	- ice island	550 pounds	39,500 pounds	
	- onshore base	300 pounds	45,000 pounds	
		Total	84,500 pounds	
Refuse (non-burnable material, including iron, drums, steel, used equipment, etc.	- ice island	750 pounds	52,500 pounds	
	- onshore base	400 pounds	60,000 pounds	
		Total	112,000 pounds	

* volume estimates based on a 75 percent blowdown percentage of a 100 percent daily and total fresh water requirement to be supplied by desalinization plant.

No. 71 contract. Cultural resource surveys and preservation will be implemented if such resources are expected or found as required by Stipulation No. 2. Since the area containing the Amoco lease block lies on submerged lands that were probably never inhabited, terrestrial cultural resources are not expected to be found. The Environmental Training Program required by Lease Stipulation No. 3 will be presented to all personnel involved in the lease operations, including all contractors and subcontractors. This program and a continuing technical environmental briefing program for managerial and supervisory personnel will be approved by MMS prior to the commencement of operations. Protection of biological populations and habitats during the proposed exploratory drilling activities will be implemented as required by Stipulation No. 4.

(o) NEARBY PENDING ACTIONS

Other drilling operations may be conducted within the Lease Sale 71 area concurrently with the proposed Amoco operations. Exxon, Tenneco, and Shell have approved Exploration Plans which propose drilling during the 1985-86 drilling season in the vicinity of the Mars Prospect. In addition, drilling operations will be conducted in the Endicott and Lisburne development areas of Prudhoe Bay.

(p) MEANS FOR TRANSPORTING OIL AND GAS TO SHORE

Because the proposed drilling activities are exploratory in nature, transportation of produced oil and gas will not be required. If well tests are conducted during the proposed drilling program, liquid hydrocarbons may be recovered. These will be flared, stored or transported to shore for appropriate disposal or reclamation.

(q) EXISTING OR PLANNED MONITORING SYSTEMS

All monitoring systems (hydrogen sulfide, mud, oil pollution, oceanographic, meteorological and performance) will be in full operation throughout the drilling program.

(r) OTHER ENVIRONMENTAL PROTECTION MEASURES

The discussions in other sections of this report and in the Exploration Plan accurately document the environmental protection measures which will be taken to ensure that Amoco's drilling operations are conducted in a prudent, safe and skillful manner.

The Environmental Training Program will be presented to all personnel involved in the lease operations, including all contractors and subcontractors. Supervisors and all other project personnel will be required to attend seminar-type training sessions that will present in-depth information on the resources of the Beaufort Sea, the location of the sensitive areas, the time of year when areas are most sensitive, and likely responses of fish and wildlife to exploration activities.

(3) DESCRIPTION OF THE AFFECTED ENVIRONMENT

(a) GEOLOGY

(i) Bathymetry

The Amoco Mars Prospect is located approximately 7.8 km (4.9 mi.) northeast of Cape Halkett, Alaska in approximately 7.6 m (25 ft.) of water in an area where the bathymetry is generally uncomplicated (USDI, 1984). The seafloor gradient inside of the 60 m (198 ft.) isobath (shelf break) is approximately 0.06° (1 m/km). This gently sloping seafloor configuration is due to the occurrence of 10-200 m (33-656 ft.) of fine grained sediments deposited in the past 10,000 years (USDI, 1982). The thickness of these Holocene deposits generally increases with water depth. The physical characteristics, low deposition rate and shallow inner shelf gradients indicate that the sediments may be relatively stable.

The upper 1-2 m (3-6 ft.) of the sediments that are present within the 2 to 15 m isobaths (6-50 ft.) are reworked by ice gouging, strudel and current scouring, and by wave action. These forces disturb the seabed and cause local depressions of 1 to 4 m (3-13 ft). The depressions range laterally for hundreds of meters and are generally oriented parallel to the shoreline. Isolated depressions of 1-2 m (3-6 ft.)-deep are present intermittently on the inner shelf and are probably the result of current scouring and sediment erosion around grounded ice features (NRC, 1982).

(ii) General Geologic Description

The Amoco Mars prospect is located in the Arctic Platform Province on the inner portion of the Beaufort Sea Continental Shelf (USDI, 1984). Most of the province is prospective for petroleum; thermal history calculations indicate that the Cretaceous rocks present in the area have been exposed to a temperature regime that is favorable for the formation of oil and gas.

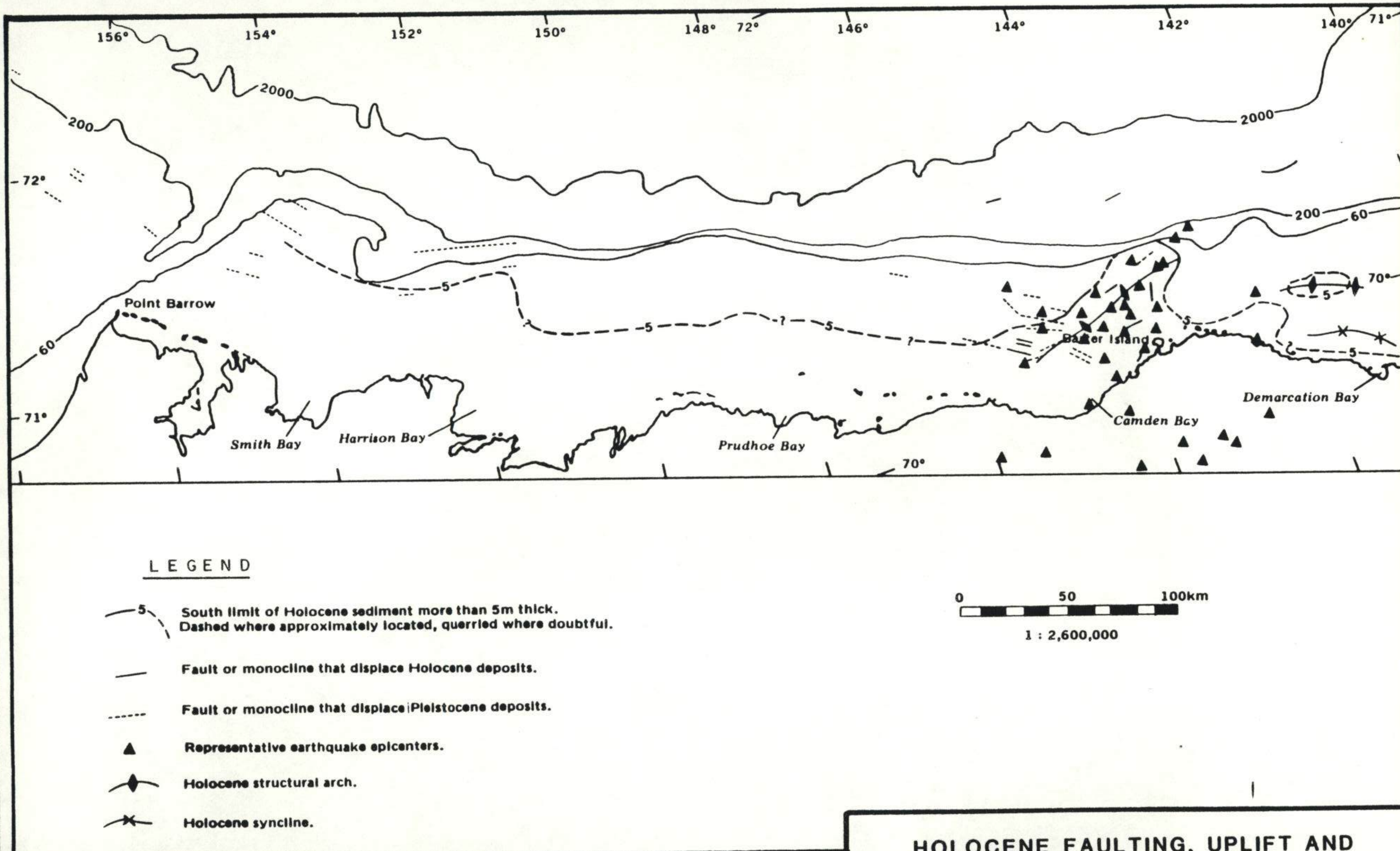
The surficial seafloor sediments in the project region consist of muddy sands derived from materials discharged onto the shelf by rivers and streams that flow across the Arctic Coastal Plain. Coastal erosion and ice rafting result in deposition of additional material. Sediments that were deposited during the Pleistocene Epoch form the relict surficial sand and gravel deposits and underly the Holocene sediments. These deposits may be up to 100 m (330 ft.)-thick, and are comprised of peaty muds and alluvial gravels.

A series of islands that resemble barrier chains extends in an east-west direction along much of the Beaufort Sea coast. However, deeply-embayed coastal segments, primarily Harrison Bay (near the proposed Mars Prospect) and Smith Bay, lack protective island chains (USDC, 1978). Where offshore islands are present, they provide only minimal wave shelter to the coast, because the islands enclose wide, shallow lagoons that allow considerable fetch. However, the presence of the islands does result in protection from ice push on mainland coasts. The coarse-grained sediments of these islands are dynamic, and tend to migrate westward and landward at a rapid rate (USDC, 1978).

(iii) Submarine Geologic Hazards

(a) Faulting and Seismicity

There is no historical evidence of earthquake activity in the Harrison Bay area. However, seismic surveys indicate the presence of faults located northwest of this area (Figure 3-1; Grantz et al., 1980). It appears that there has been no movement along the faults underlying Harrison Bay since



SOURCE: GRANTZ et al. (1980)

HOLOCENE FAULTING, UPLIFT AND SUBSIDENCE, AND EARTHQUAKE EPICENTERS ON THE BEAUFORT SHELF NORTH OF ALASKA

Woodward-Clyde Consultants

FIGURE 3-1

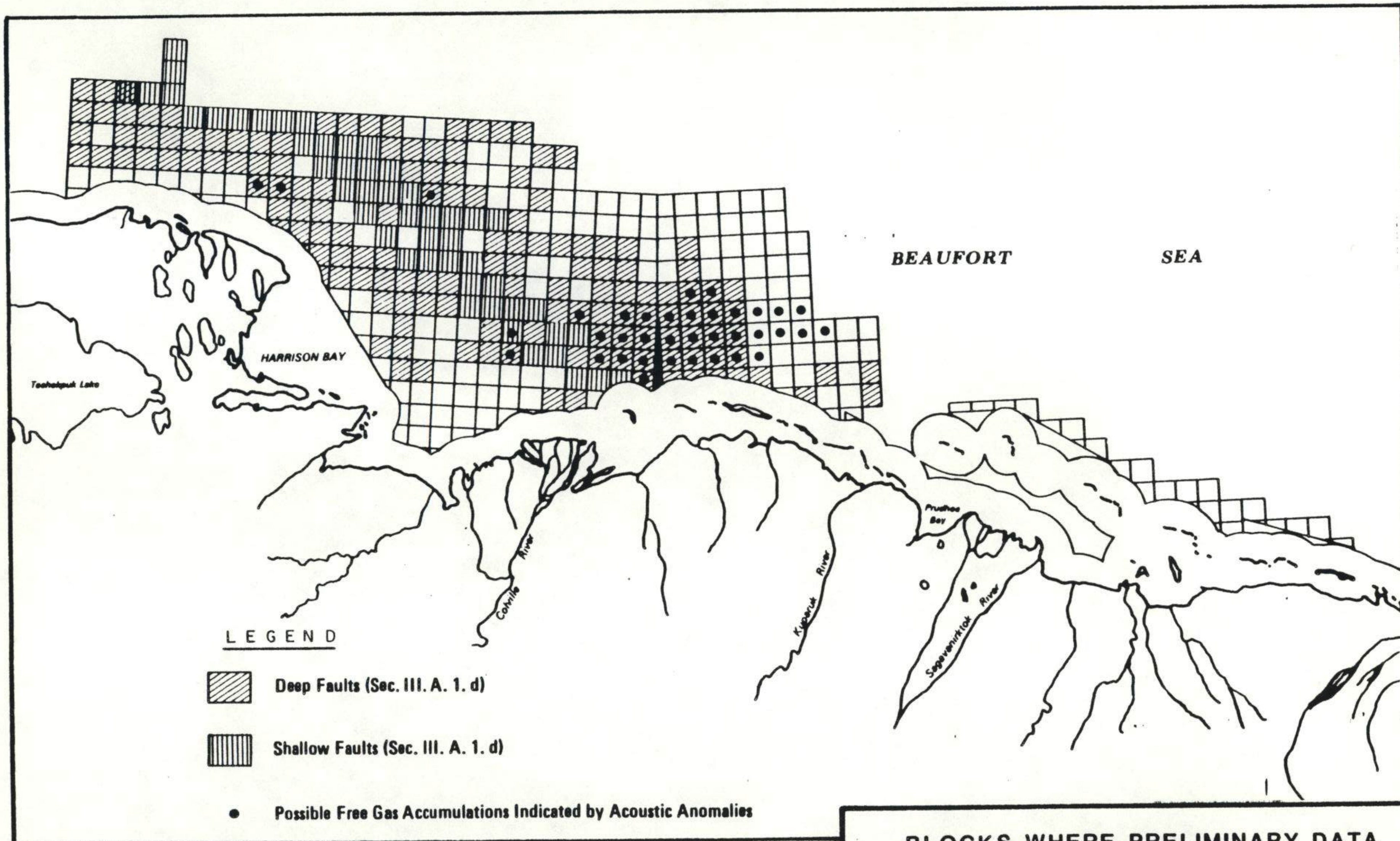
the Pleistocene Period. In addition, the absence of recent seismic activity in the western portion of the Beaufort Sea indicates that displacement along any of the faults is not expected. The faults may provide migration routes for gas from the lower Cretaceous beds or could create traps for gas at shallow depths.

(b) Shallow Gas

Shallow gas accumulations on the Alaskan Beaufort Sea continental shelf may be located in the following areas: 1) isolated pockets within and beneath shallow permafrost, 2) scattered concentrations (probably biogenic) within loosely consolidated Pleistocene and Holocene sediments, and 3) sedimentary or structural traps (probably thermogenic) located adjacent to faults. In the eastern part of Harrison Bay, acoustic anomolies of seismic reflection profiles indicate that shallow gas may be present in regions where numerous faults are located (Craig and Thrasher, 1982). Based on work by Craig and Barnes (1982), areas on the continental shelf where shallow gas may be concentrated in the sediments are shown in Figure 3-2. The Amoco Mars Prospect exhibits deep faults, but no acoustic anomalies. However, some of the blocks located adjacent to the shoreward boundary of the lease sale area (including block 140) may be underlain by permafrost with associated free gas (Figure 3-3). Natural gas hydrates, which tend to cement sediments together, can trap free gas in a zone of reduced permeability at the base of the sediments. Gas hydrates are widespread in the Diapir Field area, but are probably not present at the Prospect since they do not usually occur inside of the 60 m (198 ft.) isobath (Grantz et al., 1982).

(c) Permafrost

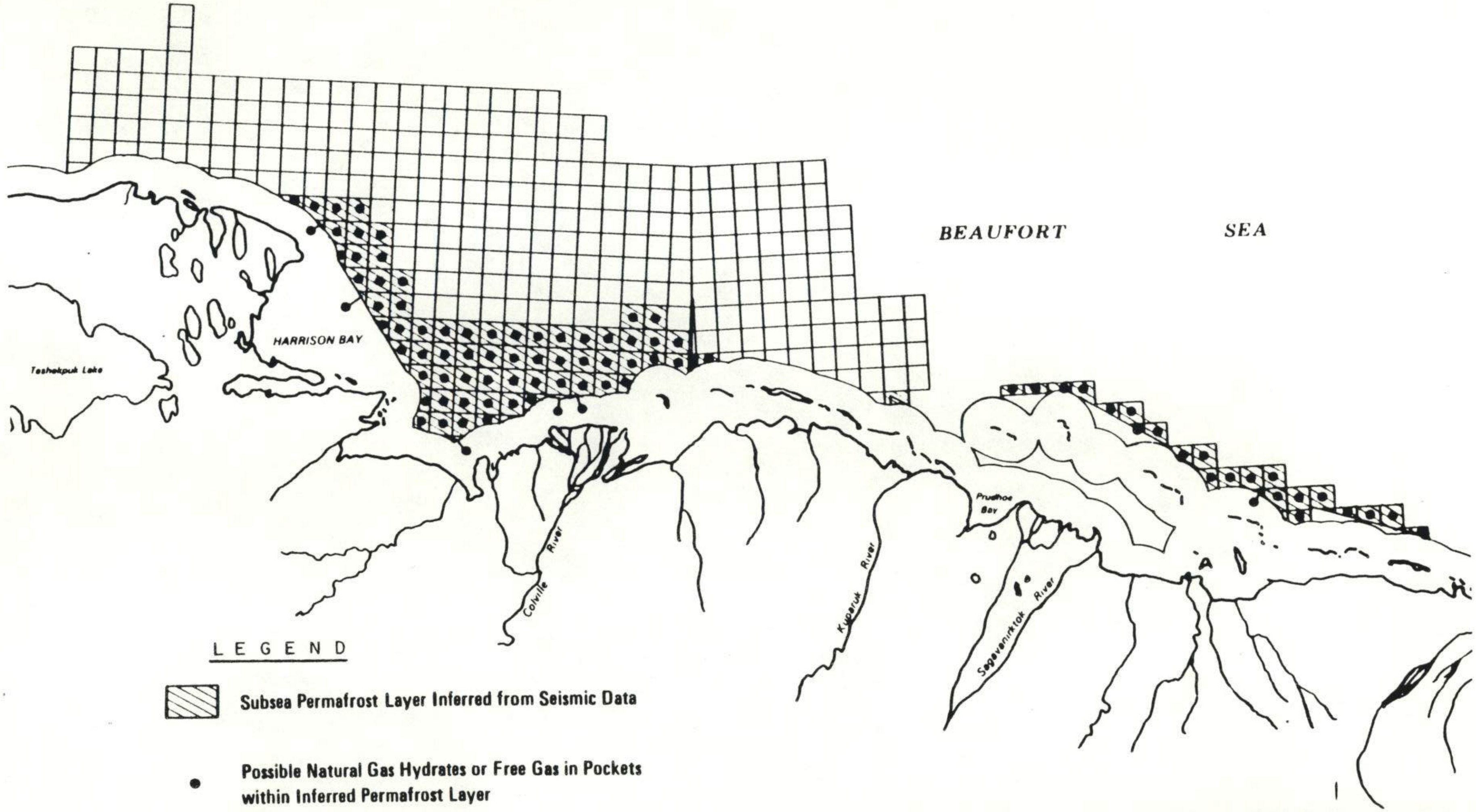
Permafrost, a relict feature, underlies much of the Beaufort Sea located shoreward of the 90 m (295 ft.) isobath. As shown in Figure 3-3, seismic



SOURCE: CRAIG AND BARNES (1982)

BLOCKS WHERE PRELIMINARY DATA INDICATES THE PRESENCE OF DEEP AND SHALLOW FAULTS AND POSSIBLE FREE GAS ACCUMULATIONS

Woodward-Clyde Consultants FIGURE 3-2



BLOCKS WHERE PRELIMINARY DATA WAS USED TO INFER THE PRESENCE OF SUBSEA PERMAFROST LAYERS AND NATURAL GAS HYDRATES OR FREE GAS POCKETS

Woodward-Clyde Consultants FIGURE 3-3

SOURCE: CRAIG AND BARNES (1982)

data indicate that ice-bonded permafrost may be found within 3 to 5 m (10-15 ft.) of the ocean floor in Harrison Bay (Craig and Thrasher, 1982). The permafrost was formed when the currently submerged Beaufort Sea continental shelf was exposed to subfreezing temperatures during periods of glaciation. The newly formed permafrost became insulated from temperature extremes as glacial melting caused a rise in sea level. A 1 m (3 ft.)-thick lens of bonded soil was present at a soil depth of 1 m (3 ft.) in one borehole completed for the project.

The stability of subsea permafrost is dependent on soil composition. Fine-grained sediments inhibit the flow of interstitial water and soluble salts, preserving the permafrost. Coarse-grained soils permit pore water to flow freely and allow thermal degradation to occur. As a result, permafrost in some areas may exist as discontinuous ice lenses or layers, due to the occurence of different soil types.

(d) Landslides, Submarine Slumps and Soil Liquefaction

Seabed slides and slumping are unlikely to occur in the project area since the mechanisms for initiating underwater landslides (high surface gradients and/or ground motions) are absent. The sediments at the proposed drillsite are considered to be relatively stable (USDI, 1982). However, due to their unconsolidated nature, the sediments may undergo liquefaction during an earthquake.

(e) Ice Gouging

Gouging of the seafloor by moving submerged ice occurs in water depths of 1 to 60 m (3 to 197 ft.); gouging is most substantial in areas between the 15 and 40 m (49 and 131 ft.) isobaths. This area is known as the Stamukhi zone and is present at the interface of landfast and pack ice. Ice ridges are formed in this area when mobile pack ice or floes collide with the stationary landfast ice. The ridges may develop keels that extend to the seafloor (Figure 3-4). Gouges present in the Stamukhi zone are typically 1-4 m (3-13 ft.)-deep, 1-50 m (3-164 ft.)-wide and may be hundreds of meters long. The trenches are usually oriented parallel to the bathymetric contours. The Mars Prospect is located inside of the Stamukhi zone, and the area may be affected by ice ridges and gouging.

(f) Other Geologic Hazards

Other geologic hazards are not known to exist at or near the proposed drillsite.

(iv) Mineral Deposits

(a) Oil and Gas

Low, mean and high resource estimates for the Lease Sale 71 area are 0.5, 2.4 and 4.7 billion barrels of oil, and 0.37, 1.8 and 3.6 trillion cubic feet of gas, respectively (USDI, 1982).

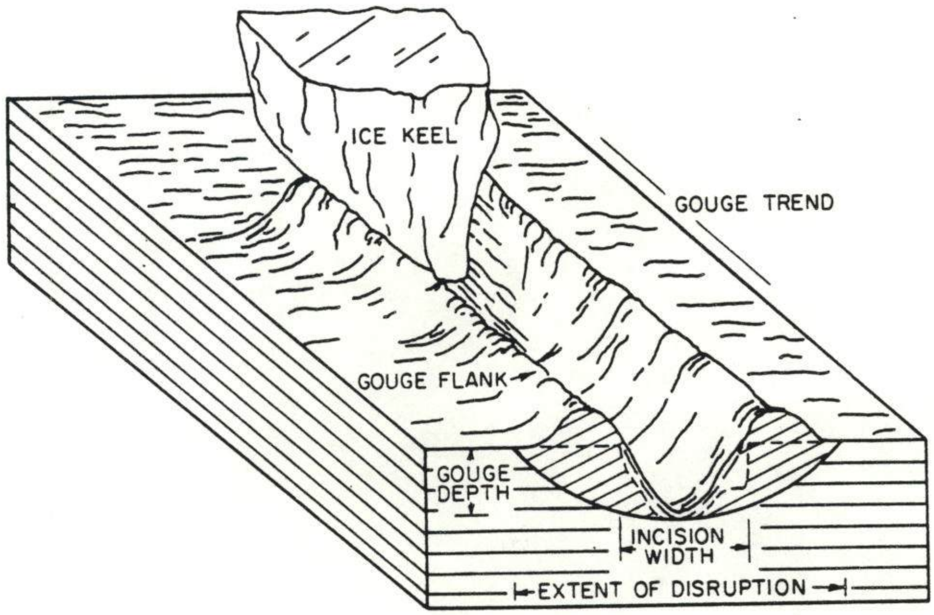
(b) Metallic Minerals

Only negligible quantities of metallic minerals are known to exist on the Arctic Coastal Plain, including the Beaufort Sea continental shelf.

(c) Non-metallic Minerals

1) Gravel and Sand

Substantial sources of gravel and sand are present along the Beaufort Sea coastline east of the Colville River (USDI, 1982). Frozen gravel is



SOURCE: BARNES, et al. (1977a)

ICE GOUGE PROCESS - IDEALIZED ICE GOUGE AND TERMINOLOGY

Woodward-Clyde Consultants

FIGURE 3-4

essentially present at depths less than 5 m (16.5 ft.). Gravel for support of oil exploration, development and production operations is presently mined at onshore pits located near the Sagavanirktok, Putuligayuk, Kuparuk, Ugnavarik and Shaviovik Rivers (Figure 3-5).

In offshore areas, paleovalleys are a potential source of sand and gravel. Gravel in the Sagavanirktok Paleovalley is unfrozen and present under 10 m (33 ft.) of unconsolidated marine clay, silt and fine sand. There are indications that a paleovalley is present off of the Colville River in eastern Harrison Bay (USDI, 1982).

(2) Coal

It is not presently known if coal beds extend beneath the continental shelf (AINA, 1974). Coal has been discovered in areas located onshore from Cape Lisburne to areas located west of Prudhoe Bay. However, this resource is not presently commercially mined.

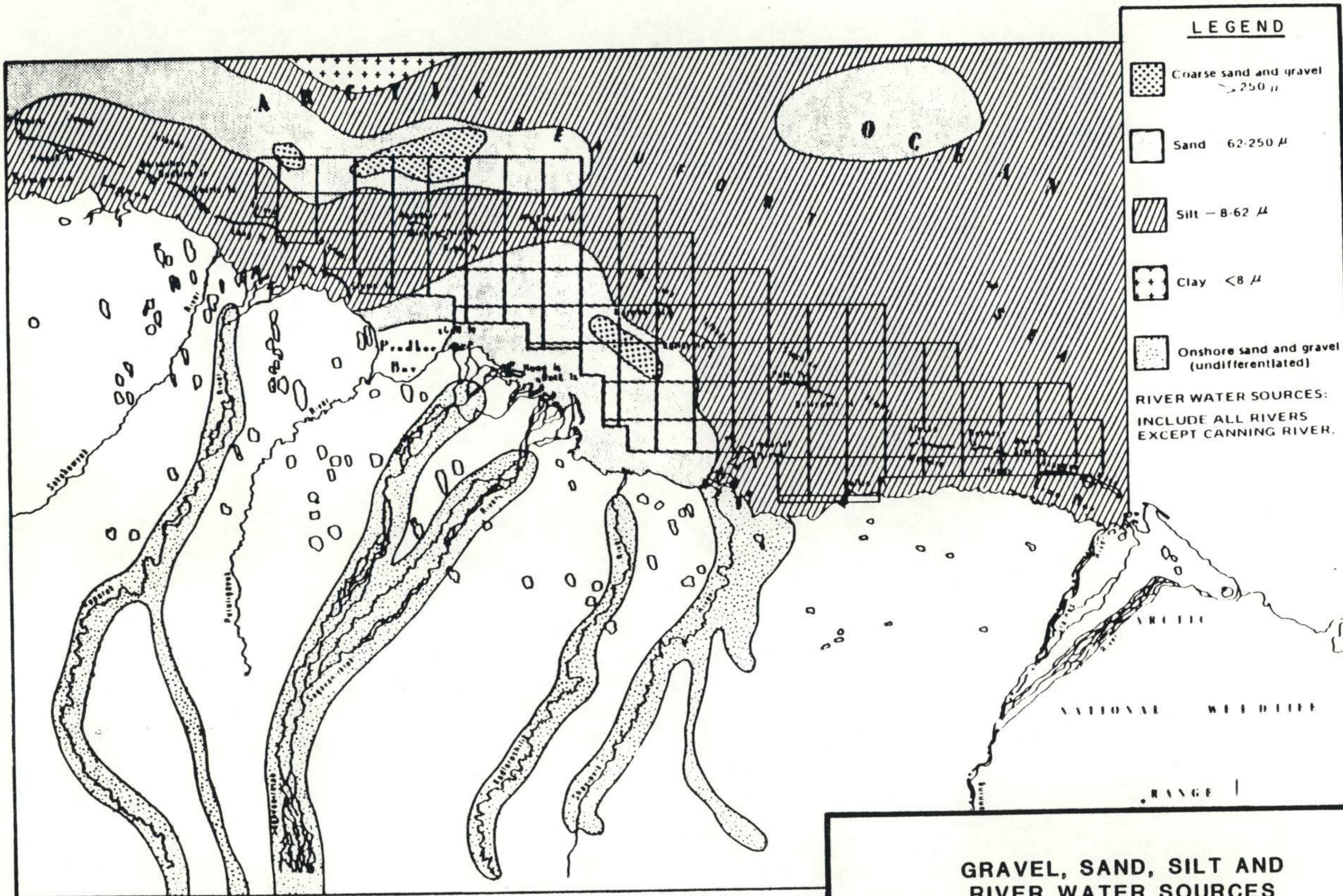
(v) Aquifers

Aquifers are not known to exist in the project area.

(b) METEOROLOGY

(i) General Weather Patterns

The Lease Sale 71 area is located in the Arctic climate zone that extends from the Brooks Range north to the Arctic Ocean. This zone is characterized by long, extremely cold winters and short summers that are moderate in



SOURCE: USDI (1979)

GRAVEL, SAND, SILT AND RIVER WATER SOURCES

Woodward-Clyde Consultants | FIGURE 3-5

temperature. Other characteristics of the climate are generally low generally low precipitation rates and persistent winds. Official National Weather Service weather stations are located near Barrow and Barter Island. These stations provide year-round historical weather data that are generally applicable to much of the eastern Alaskan Beaufort Sea coast.

(a) Temperatures

Mean annual air temperature in the Arctic climate zone is approximately -12.2°C (10°F) and ranges from approximately 9°C (40°F) to -29°C (-20°F). Temperature data from the Barter Island weather station are presented below (Continental Shelf Associates, 1983).

	Month				
Temperature Parameter	January	April	July	October	Annual
Average Daily Maximum (°C)	-22.5	-13.2	7.5	-5.8	-9.0
Average Daily Minimum (°C)	-29.9	-22.3	1.4	-11.6	-15.4
Monthly Mean (°C)	-26.2	-17.7	4.4	-8.7	-12.2
Highest (°C)	3.9	6.1	25.6	7.8	25.6
Lowest (°C)	-47.8	-38.9	-4.4	-30.6	-50.6
Number Days Minimum <0°C	31	30	9	31	311
Number Days Minimum <-17.8°C (0°F)	28	23	0	6	166

(b) Sky Cover and Visibility

Table 3-1 provides a comparison the monthly percentage of time that visibility at Barrow and Barter Island is obstructed. Sky cover at Barrow

Table 3-1 Summary of Vision Obstruction in the Project Area.[a]

Month	Fog		Blowing Snow		Smoke and/or Haze		Total Percentage Observations with Obstructions to Vision	
	Barter Island	Barrow	Barter Island	Barrow	Barter Island	Barrow	Barter Island	Barrow
January	6.9	12.5	20.2	13.7	0.1	0.5	26.6	24.7
February	8.0	13.1	22.3	12.6	0.1	0.3	29.2	25.3
March	9.7	7.9	16.8	10.0	0.1	0.2	24.9	17.3
April	11.8	9.3	11.5	7.8	0.2	0.2	22.7	16.7
May	25.1	17.4	3.3	4.0	0.0	0.0	27.5	21.0
June	26.6	26.4	0.1	0.5	0.1	0.0	26.7	26.9
July	25.3	25.9	0.0	0.0	0.0	0.0	25.3	25.9
August	31.5	25.5	0.0	0.0	0.1	0.0	31.6	25.5
September	26.6	17.7	1.9	0.7	0.0	0.0	28.3	18.2
October	13.5	13.0	10.4	7.7	0.2	0.0	22.6	20.9
November	9.8	10.5	17.6	16.3	0.1	0.0	25.0	26.0
December	8.0	10.4	16.6	13.5	0.1	0.1	23.7	22.5
Year	17.0	15.8	9.9	7.2	0.1	0.1	26.1	22.6

Source: Selkregg (1976).

a Values are percents of total time that vision obstructions occured. To qualify as an obstruction to vision, visibility must be reduced to 6 miles or less.

varies on a monthly basis between 0 and 8.6 tenths. Cloudy weather prevails along the Beaufort Sea coast from February through October. Visibility in the period May-September is frequently reduced by fog, which can severely hamper flight operations.

(c) Wind Speed and Direction

Winds in the Arctic Coastal Plain region are fairly consistent in terms of direction and speed. Winds in this area have an important influence on nearshore and continental shelf circulation patterns. At Barrow, mean monthly wind speed varies between 17.8 km/hr (11.1 mph) and 21.9 km/h (13.6 mph), with a mean annual speed of 19.3 km/hr (12 mph) (USDI, 1979). The most frequent wind direction recorded at Pt. Barrow is from the east-northeast during all seasons. At Barter Island, where the mean annual wind speed is 20.7 km/hr. (12.9 mph), the annual prevailing wind direction is from the east; however, westerly winds are common from January through April. Figure 3-6 provides a comparison of wind characteristics at Barrow and Barter Island.

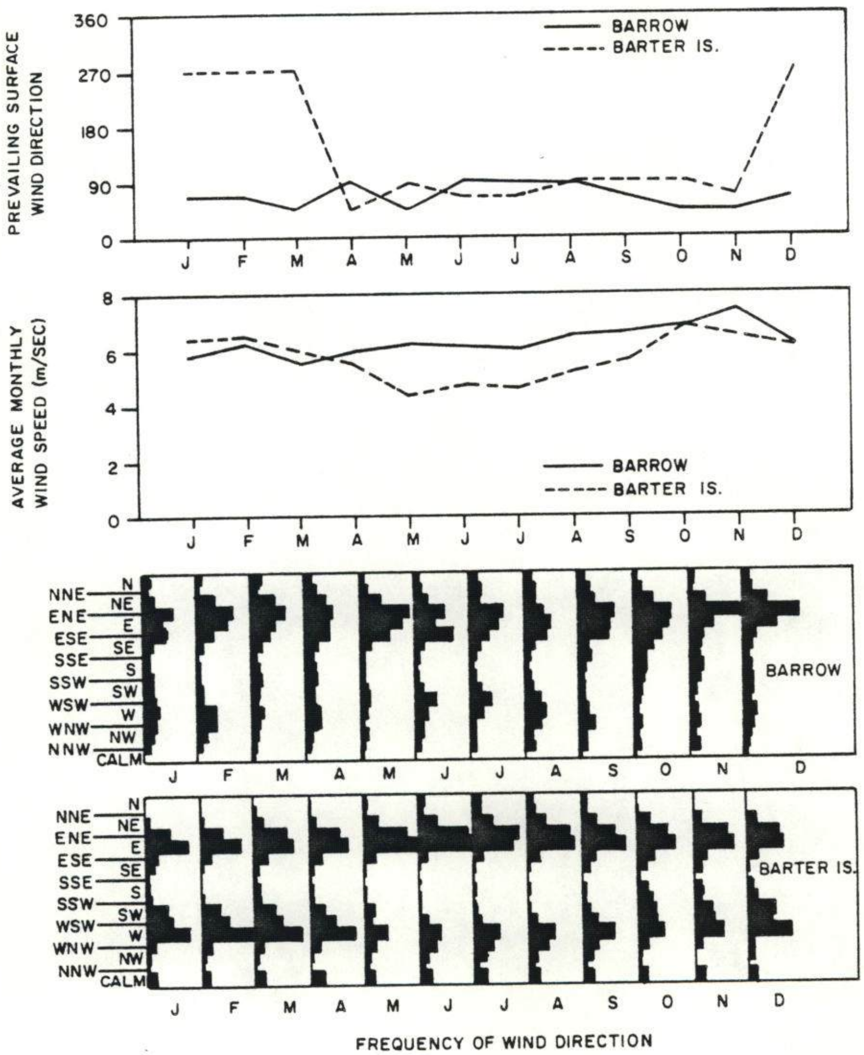
(d) Severe Weather

1) Inversions

In the winter months a strong and persistent, 1200-1500 m (3960-4950 ft.)-thick, inversion layer typically occurs in the project area (Continental Shelf Associates, 1983).

2) Storms

Storm systems that affect the Beaufort Sea coast generally move under the influence of Siberian and Alaskan high pressure systems (USDI, 1979). The



SOURCE: USDC (1978)

CHARACTERISTICS OF THE WIND AT BARROW AND BARTER ISLAND, ALASKA

Woodward-Clyde Consultants

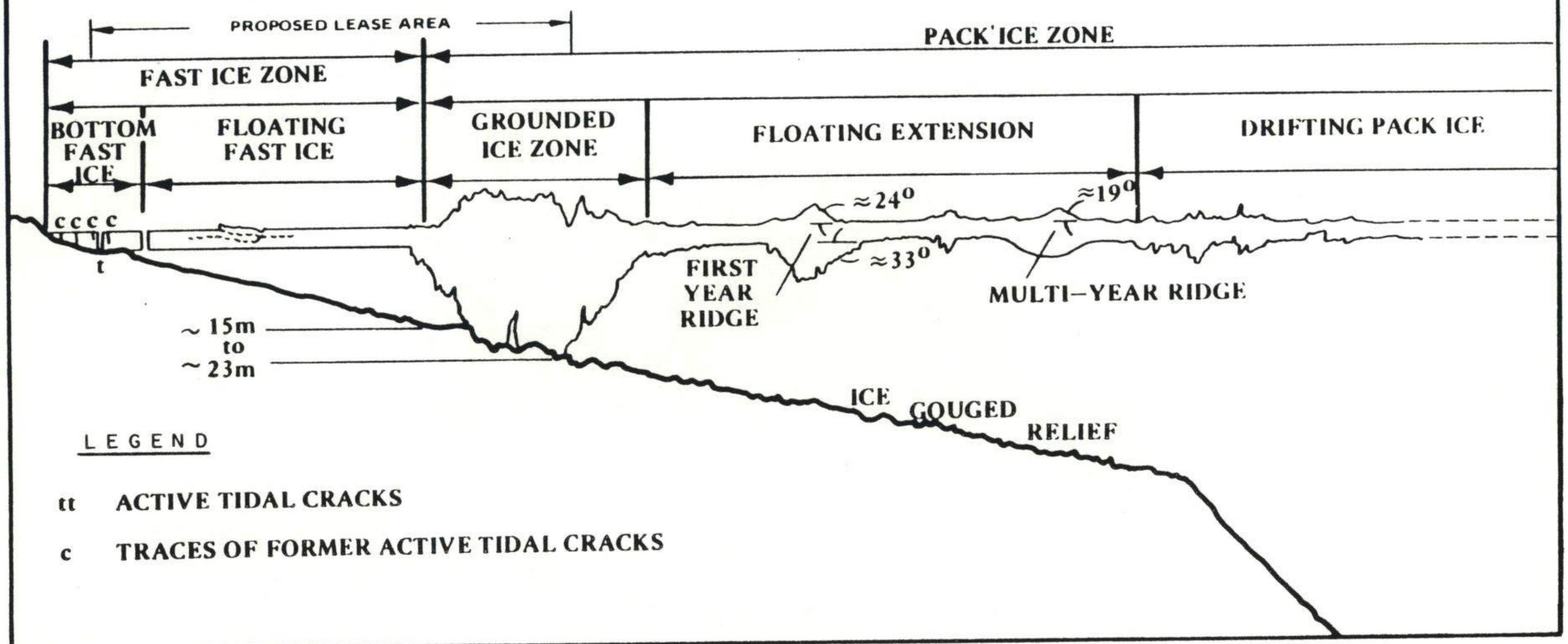
FIGURE 3-6

storms originate near the Aleutian Island chain and pass through the Bering Strait. Occasionally, storms generated near the Siberian Shelf move eastward into the Beaufort Sea region. Once in this region, the storms track north of the Alaskan coastline and continue to move eastward. Storm conditions at specific locations are usually brief due to the rapid movement of the systems.

Surges generated by storms can significantly increase or decrease sea level, and, in the Beaufort Sea, these surges cause the most important variations in sea level. The greatest fluctuations occur in September and October when fetch is increased by long stretches of open water. For example, westerly gale-force winds have resulted in maximum recorded surges of 3.7 m (12 ft.) at Barrow (USDI, 1979). Winter surges of lower magnitude are also known to occur, including periods of occurence when nearly complete ice cover is present (Henry, 1975). Negative surges, caused by easterly winds along the coast, appear to occur more frequently in the winter.

3) Ice Movement

Sea ice cover in the Beaufort Sea nearshore area is divided into two zones: landfast (bottomfast and free floating) and pack ice (grounded ice and floating extention) (Figure 3-7). Bottomfast ice is the portion of the landfast zone that is in continous contact with the seafloor and shoreline. The extent of bottomfast ice in the winter reaches to about the 2 m (6 ft.) isobath. Throughout most of the year, movements of bottomfast ice are minor; large movements are only possible during fall freezeup or spring breakup (USDI, 1979). Bottomfast ice extends through much of Harrison Bay located south of the Mars Prospect.



SOURCE: USDC (1978)

LATE WINTER ICE ZONATION OF THE BEAUFORT SEA COAST

Woodward-Clyde Consultants

FIGURE 3-7

Floating fast ice is the portion of the landfast ice zone that generally occupies the area from the 2 m (6 ft.) to the 15 m (45 ft.) isobath, in the region present immediately inside of the grounded zone of pack ice. Ice movements in this zone most often occur during freezeup and breakup; during the remainder of the year movements are generally only a few tens of meters (Weeks and Kovacs, 1977).

The zone of grounded ice ridges occurs where free-floating pack ice contacts the more stable landfast ice forming the complex shear and pressure ridges that characterize the zone. The rubble buildup occasionally results in ice keels that extend to the seafloor; movements of the keels cause seafloor gouging [see Section (3)(a)(iii)(e)]. The area of extensive ice gouging is generally present between the 15 and 40 m (49-131 ft.) isobaths (USDI, 1984). However, in Harrison Bay, an additional grounded ridge zone develops at approximately the 10 m (33 ft.) isobath in early winter (Pritchard and Stringer, 1981). Thus, the Mars Prospect, located near Harrison Bay in approximately 9 m (30 ft.) of water, may be expected to experience some ice ridge buildup.

4) Snow

Barrow receives an annual average water equivalent of approximately 76.2 cm (30 in.) of precipitation in the form of snow. Barter Island, located to the east along the Beaufort Sea coastline, receives approximately 115.5 cm (45.3 in) of snow in a year (USDI, 1979). Snow precipitation increases in September and usually remains on the ground from October through June. Single storms producing up to 43 cm (17 in.) of snow in 24 hours have occurred (USACOE, 1980). Windblown snow often limits visibility at Barrow and Barter Island.

5) Spray Icing

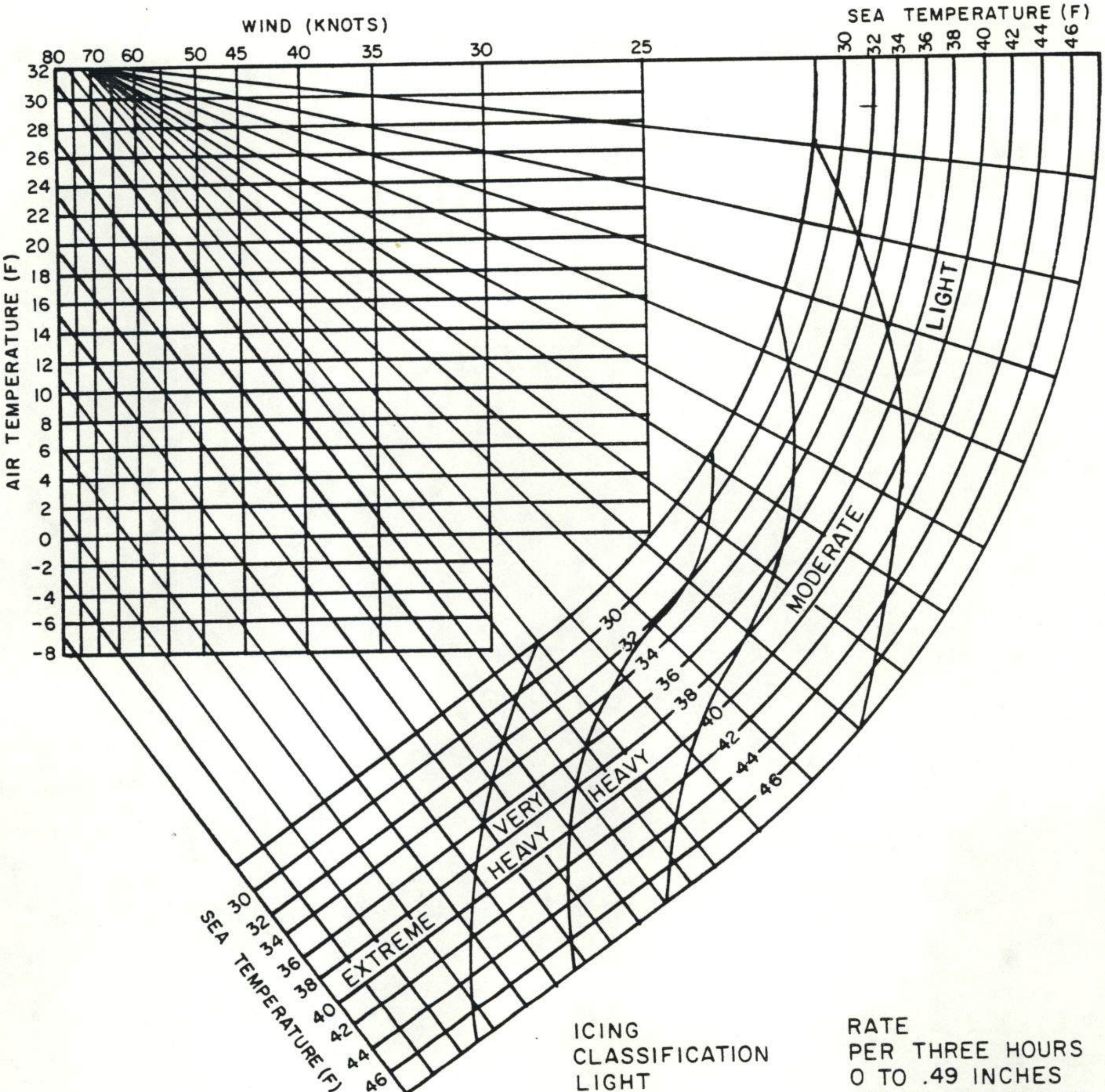
The operation proposed by Amoco is not expected to be affected by spray ice conditions. Strong winds with low air temperatures and high waves can result in sea spray icing (see Fig. 3-8). However, exposure to open water and spray icing conditions should not be a problem since drilling is to be conducted in the winter.

6) Freezing Conditions

Air temperatures below 0°C (32°F) are most common from September to June, but may occur at any time of year in the Beaufort Sea area. Freezing air temperatures occur continuously from October through May, and the lowest temperatures are generally recorded from December through March. Section (3)(b)(i)(a) provides average minimum-maximum temperatures recorded at Barter Island, located east of the Mars Prospect.

(3) Precipitation

The Beaufort Sea coast is classified as a desert in terms of precipitation. Mean annual precipitation ranges from 12.6 cm (4.8 inc.) to the west (Pt. Barrow) to 17.8 cm (7.05 in.) in the east at Barter Island (USDI, 1982). Most precipitation occurs as summer rain.



ICING CLASSIFICATION	RATE PER THREE HOURS
LIGHT	0 TO .49 INCHES
MODERATE	.50 TO .99 INCHES
HEAVY	1.00 TO 1.49 INCHES
VERY HEAVY	1.50 TO 2.49 INCHES
EXTREME	2.50 + INCHES

INSTRUCTIONS: SAY THAT YOU ESTIMATE THAT THE AIR TEMPERATURE IS 14°F, WIND VELOCITY IS 30 KNOTS, AND THE SEA TEMPERATURE IS 32°F. ENTER THE NOMOGRAPH ON THE 14°F LINE. FOLLOW THIS LINE TO THE 30 KNOT WIND VELOCITY LINE. FROM THE INTERSECTION OF THE TWO LINES, FOLLOW THE DIAGONAL LINE TO THE APPROPRIATE WATER TEMPERATURE LINE. AT THE INTERSECTION READ OFF THE ICING CATEGORY-IN THIS CASE, HEAVY ICING.

SOURCE: COMISKEY (1976)

ESTIMATING ICE SEVERITY

Woodward-Clyde Consultants FIGURE 3-8

(ii) Air Quality

(a) Onshore

Although it has not been extensively monitored at any location, air quality along the Beaufort Sea coast is generally considered to be very good. Even in areas located downwind of the industrial emission sources at the Prudhoe Bay and Kuparuk oil fields, air quality has always been much higher than that required to meet Federal standards (USDI, 1982; 1984). In the winter and spring, long-distance transport of pollutants from industrial centers in Europe and Asia causes an aerosol haze of hydrocarbon compounds to form over much of the Arctic Coastal Plain, resulting in considerable increases in pollutant concentrations over basic gounds levels. However, regional air quality at these times is still substantially above Federal standards.

(b) Offshore

Ambient air quality conditions at the Mars Prospect are expected to be as good as, or better than, onshore conditions.

(c) PHYSICAL OCEANOGRAPHY

(i) Sea Temperature and Salinity

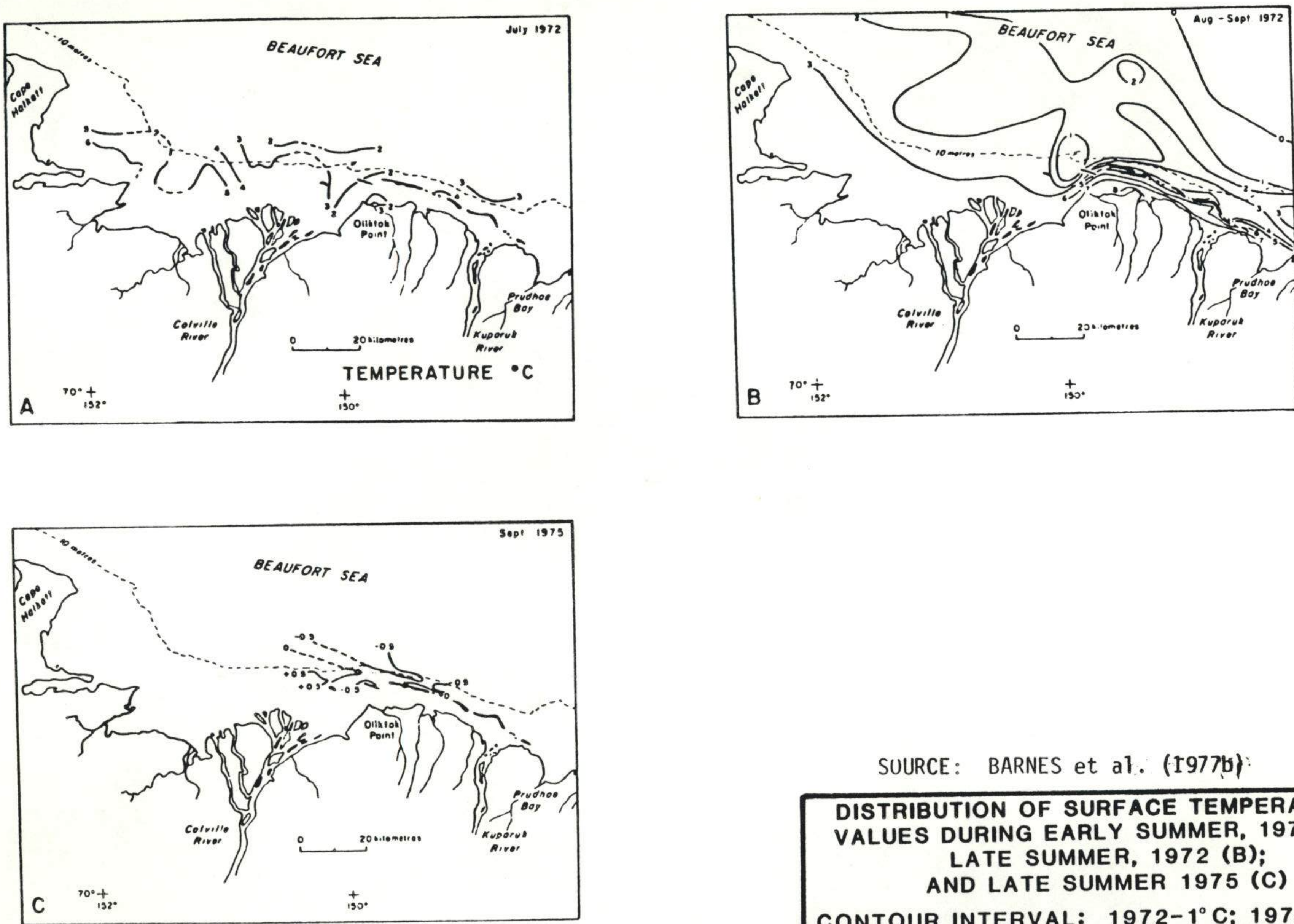
Sea water temperature and salinity distribution patterns in Harrison Bay vary seasonally, locally and vertically in the water column. The patterns are predominantly influenced by spring flooding of the Colville River and by the winter formation of sea ice. In addition, sea temperatures are influenced by solar radiation, air temperatures and surface winds.

From September through May, the formation of about 2 m (6 ft.) of ice has a substantial effect on inshore temperature and salinity conditions. Water temperatures under ice cover are generally -2 to -1°C (28-30°F) in well-circulated areas. Approximately 80-85 percent of the solutes in seawater are excluded during freezing; thus, the salinity of the adjacent water is increased (Barnes et al., 1977b). This effect is more pronounced in small bays where winter salinities are often substantially above 35°/oo. The thermal and saline stratification of the under-ice water column is homogeneous since there is little input from river discharge, surface runoff and/or solar radiation.

In the early spring months, river flow starts before the fast ice begins to melt and breakup. The freshwater flows over bottomfast ice and drains through the floating fast ice, forming a freshwater layer under the ice (Walker, 1974). As melting continues, much of the freshwater influx is kept on the surface by the receding ice front.

From June to early September, the warmer [1-11°C (34-54°F)] brackish (0-10°/oo) river water is distinguishable in the inshore region. The initial river floods, which also cause most of sediment discharge, occur in the period late May-early June, predominantly over a 2 week period prior to breakup. This initial flood water mixes with the brine remaining from the sea ice freezing processes. Figures 3-9 and 3-10 show surface temperature and salinity values for the project area in mid-summer and late summmer.

Vertical temperature profiles taken in August and September of 1972 show a 2-6 m (6-18 ft.) thick surface layer of 0.5 to 2.5°C (32.9-36.5°F) water in central and western Harrison Bay (Barnes et al., 1977b). Salinity profiles also taken in August and September, 1972 show a thin [2 m (6 ft.) thick] layer of low salinity (16°/oo) surface water present off of the Colville

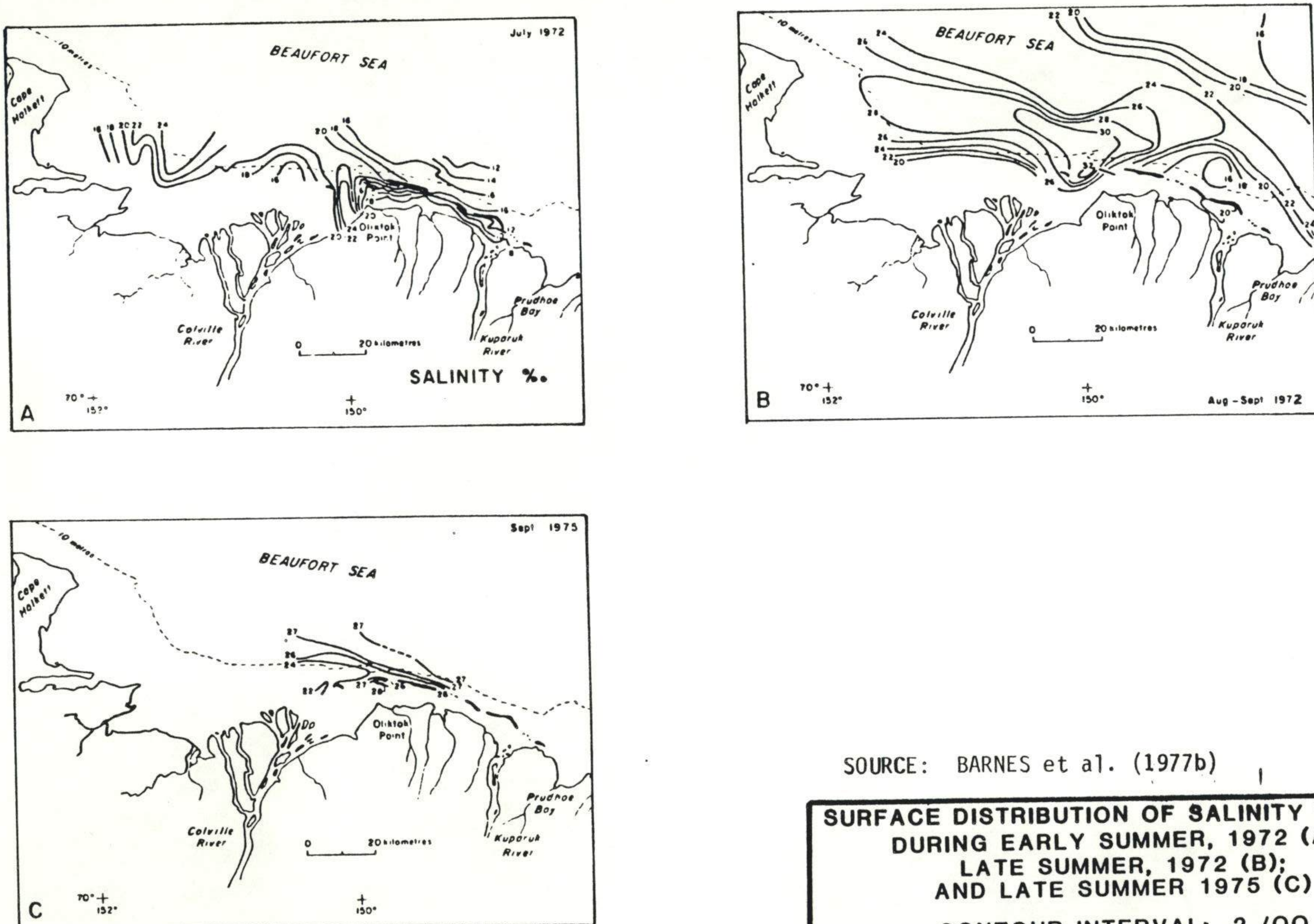


SOURCE: BARNES et al. (1977b)

DISTRIBUTION OF SURFACE TEMPERATURE VALUES DURING EARLY SUMMER, 1972 (A); LATE SUMMER, 1972 (B); AND LATE SUMMER 1975 (C)

CONTOUR INTERVAL: 1972–1° C; 1975–0.5°C

Woodward-Clyde Consultants | FIGURE 3-9



SOURCE: BARNES et al. (1977b)

SURFACE DISTRIBUTION OF SALINITY VALUES DURING EARLY SUMMER, 1972 (A); LATE SUMMER, 1972 (B); AND LATE SUMMER 1975 (C)

CONTOUR INTERVAL: 2 /OO

Woodward-Clyde Consultants | FIGURE 3-10

River Delta (Barnes et al., 1977b). At other locations in the project region, the low salinity surface layer is thicker. A well developed layer of highly saline water is located under the brackish surface layer in central Harrison Bay.

Substantially below the summer surface layers, a cold [-1.5 to -1.1°C (29-30°F)], saline (30.1-32.2°/oo) layer that is 5-10 m (10-15 ft.)-thick may be present at depths of about 15-40 m (49.5-132 ft.) (Barnes et al., 1977b). This cold water is probably the remains of the winter convective processes due to the greater intensity of winter cooling and convection compared to summer heating and mixing.

The growth of sea ice begins near the shoreline usually in late September. Frazil (slush) ice is initially formed on the surface at the coastline and extends in a seaward direction. The forming ice sheet is continually shattered by wind-induced movement and refrozen. From November through February, the ice thickens, and becomes stable and landfast inside the 14 m (45 ft.) isobath. By May, the ice sheet is generally stable inside of the 18 m (60 ft.) isobath (Barry, 1977).

In the Alaskan Beaufort Sea, most landfast ice shoreward of the grounded ridges is present into July (USDI, 1982). In the Colville River Delta region of Harrison Bay, the brief June influx of freshwater from the river overflows 500-700 km^2 (190-270 mi^2) of sea ice and tends to accelerate the melting process and reduces early summer persistence of ice cover (Schell and Horner, 1981).

Further offshore the pack ice, usually present within 200 km (125 mi.) of the coast all year, breaks up at the edges. Floes are released which move with the wind throughout the open water season. Rapid movement of the floes may cause hazards to shipping.

During the summer, open water usually lasts for 24-30 days in the northern Harrison Bay region (USDI, 1984). In southern Harrison Bay, a longer period of open water, on the average from 36-66 days, often occurs.

(ii) Currents

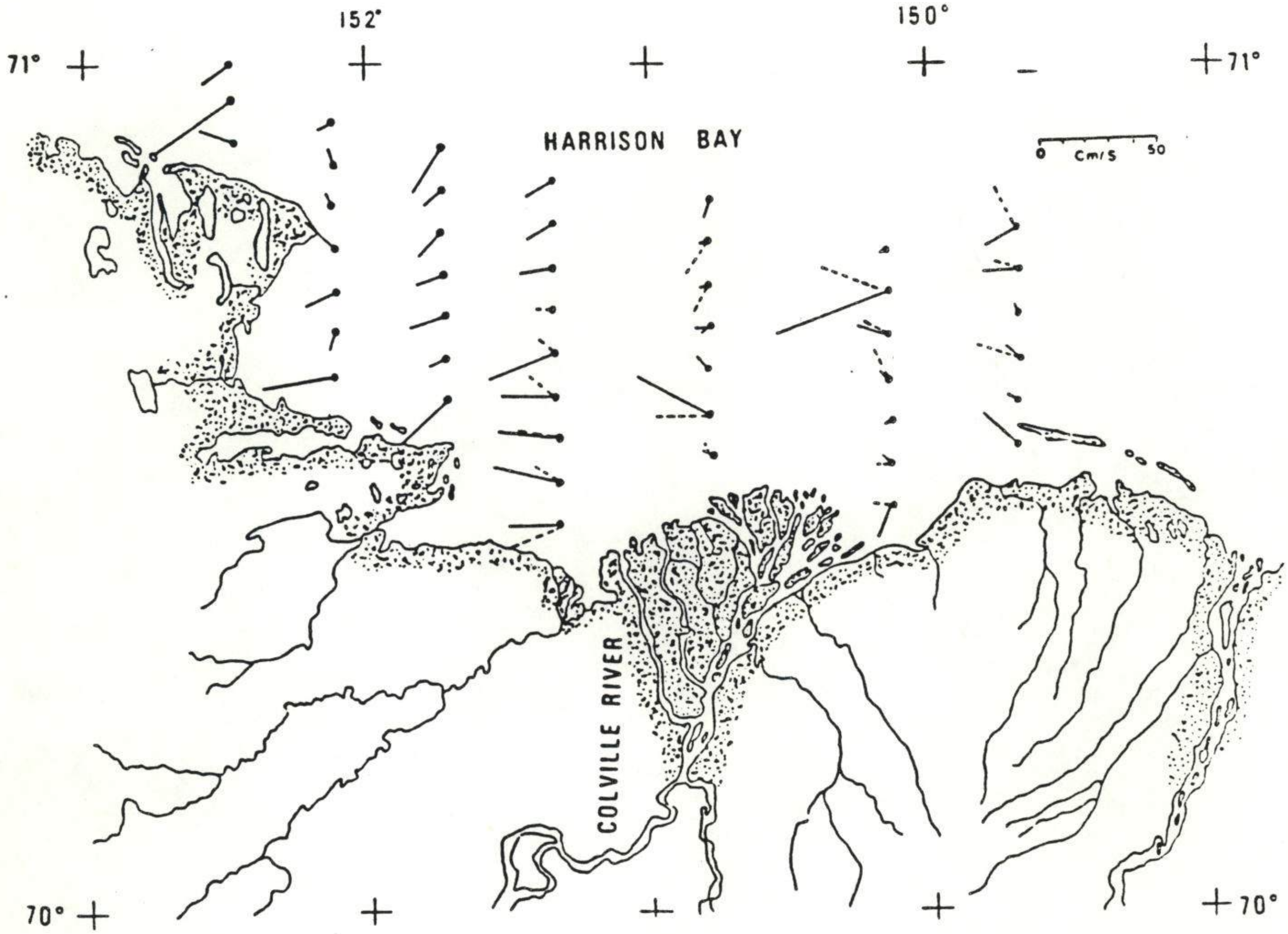
Circulation in the Harrison Bay area appears to be primarily wind-driven (Hufford et al., 1977). Figure 3-11 shows surface currents in the Harrison Bay area on August 14, 1977. Mean current speeds are typically 3 percent of the wind speed. Thus, current speeds generally range from 0 to 20m/sec (0-0.7 ft./sec), although, if high surface winds occur, current velocities can reach 50 cm/sec (1.6 ft./sec). Prevailing current direction is to the west-northwest, driven by prevailing northeasterly winds (USDC, 1978). Rapid reversals of current direction occur in response to changing wind direction.

Under-ice currents are minimal since they are not affected by winds. Generally, under-ice currents are related to tidal fluctuation and thermohaline convection. Inner shelf winter current speeds are generally less than 5 cm/sec (0.2 ft./sec) for water depths of 40 m (132 ft.) or less (Aagaard, 1977).

(iii) Tides

Astronomical tides in the Beaufort Sea are mixed semi-diurnal and small in range [< 0.6 m (2 ft.)]. Ranges are usually lower at the edge of the continental shelf than in shallow waters and constricted coastal bays.

Propagation is northward through the Bering Strait. The tidal waves join those from the Siberian Shelf in the Chukchi Sea, and move past



LEGEND

----- 14 AUGUST 1977

——— 15 AUGUST 1977

SOURCE: HUFFORD et al. (1977)

SURFACE MOVEMENT OF WATER ON 14 AUGUST 1977 AND 15 AUGUST 1977

Woodward-Clyde Consultants | FIGURE 3-11

Pt. Barrow into the Beaufort Sea. From this point to the east, tides approach the coastline from the north.

In Harrison Bay, the maximum tidal range is approximately 0.2 m (0.8 ft.) (USDI, 1984). This relatively small amplitude is further decreased by the effects of winter ice cover, including a limit to tidal response due to loss of volume and a loss of tidal energy due to friction against the ice cover.

In addition to astronomical tides, a build-up of water along the Beaufort Sea coast occurs during periods of strong westerly winds. This southerly (onshore) mass transport of coastal waters, an important component of Harrison Bay tidal circulation, occurs due to the Coriolis Effect on along-shore winds.

(iv) Sea State

The Beaufort Sea coastline is a low energy wave environment. Wave build-up is minimal, even in open-water conditions, due to the permanent pack ice which limits fetch to a relatively narrow coastline corridor. In general, wave heights in the region range from 0.5 to 2 m (1.6-6.6 ft.), with periods ranging from 0.5 to 7 seconds. In Harrison Bay, wind fetch is not reduced by the presence of barrier islands, resulting in waves with slightly higher crests than in adjacent areas.

(v) Water Quality

In general, the waters of the Alaskan Beaufort Sea are considered to be relatively clean, since there is relatively little or no industrial activity in the region. Potential sources of pollution in the area include barges, tugs and freighters that service the North Slope. The Arctic Coastal Plain rivers that drain into the Beaufort Sea are also relatively free of pollution.

Sediments of the Beaufort Sea coastal area were analyzed for trace metal and hydrocarbon content by Boehm et al. (1985). Sediments at all stations sampled contained significant quantities of fossil hydrocarbons. However, they are probably related to the nature of sediment source material which contains organic peat. Evidence for inputs from oil and gas activities was not detected. The highest trace metal concentrations were associated with fine-grained sediments located near major river discharges. The Mars Prospect is not located in such an area.

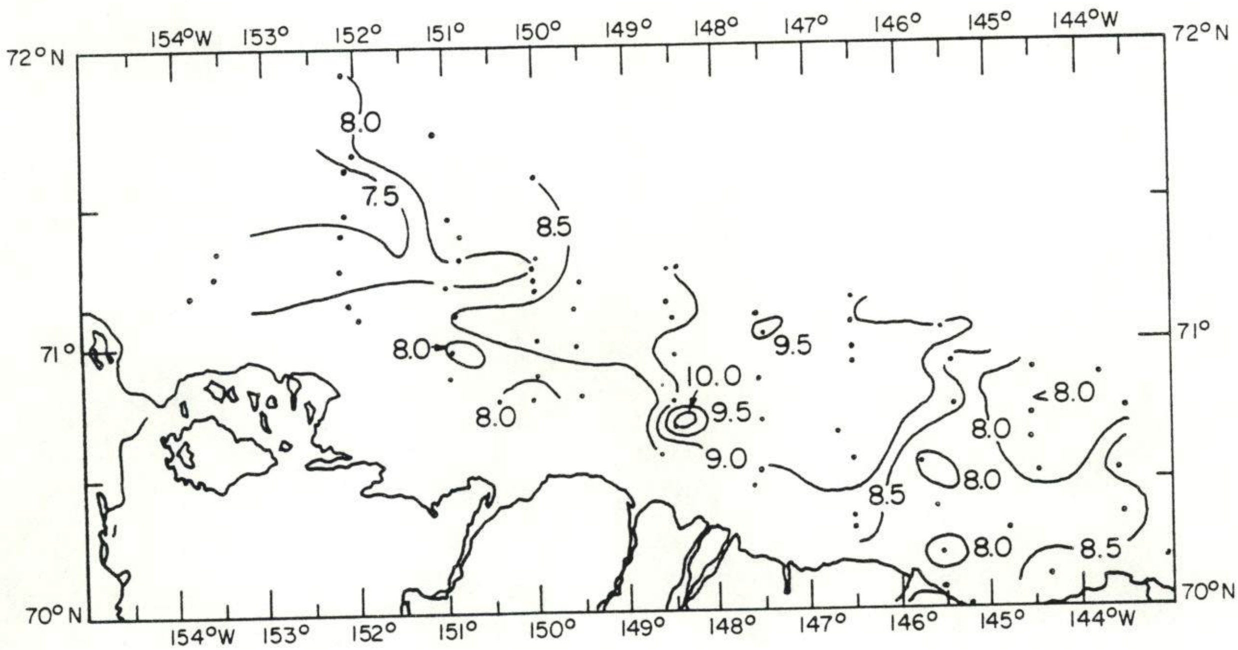
(a) Dissolved Oxygen

During the openwater season, dissolved oxygen levels in the Beaufort Sea are high; Hufford (1974) recorded dissolved oxygen levels of approximately 8 ml/l in surface waters present immediately north of Harrison Bay (Figure 3-12). In the winter, ice cover isolates oxygen dissolved in the water from atmospheric oxygen. In areas of high respiration and little circulation, dissolved oxygen levels can drop to anoxic levels preceding spring breakup (Schell, 1975). However, dissolved oxygen levels do not usually drop below 6 ml/l.

(b) Turbidity

Shallow [<20 m (66 ft.)] inshore waters of the Beaufort Sea tend to exhibit high levels (commonly greater than 50 mg/l) of suspended solids. This is particularly true in the period mid-June through early July, when river runoff adds tons of sediment to coastal waters. For example, the Colville River carries approximately 6 x 10^6 metric tons of sediment into Harrison Bay during the flooding period (Arnborg et al., 1967). These high turbidity levels partially block solar radiation into the water masses and measurably reduce primary productivity inshore of the 13 m (43 ft.) isobath (Lowry and Frost, 1981). During the open season, wave action from winds and storms typically resuspends sediments, and keeps turbidity levels uniform with depth in nearshore areas.

As ice begins to form in the fall, wave disturbance decreases, allowing suspended sediments to settle, and reducing turbidity values to between 2 and 10 mg/l in shallow and deep waters (USACOE, 1980).



SOURCE: HUFFORD (1974).

HORIZONTAL DISTRIBUTION OF DISSOLVED OXYGEN (ml PER LITER) IN THE SURFACE WATERS DURING SUMMER 1972

Woodward-Clyde Consultants

FIGURE 3-12

(c) Nutrients

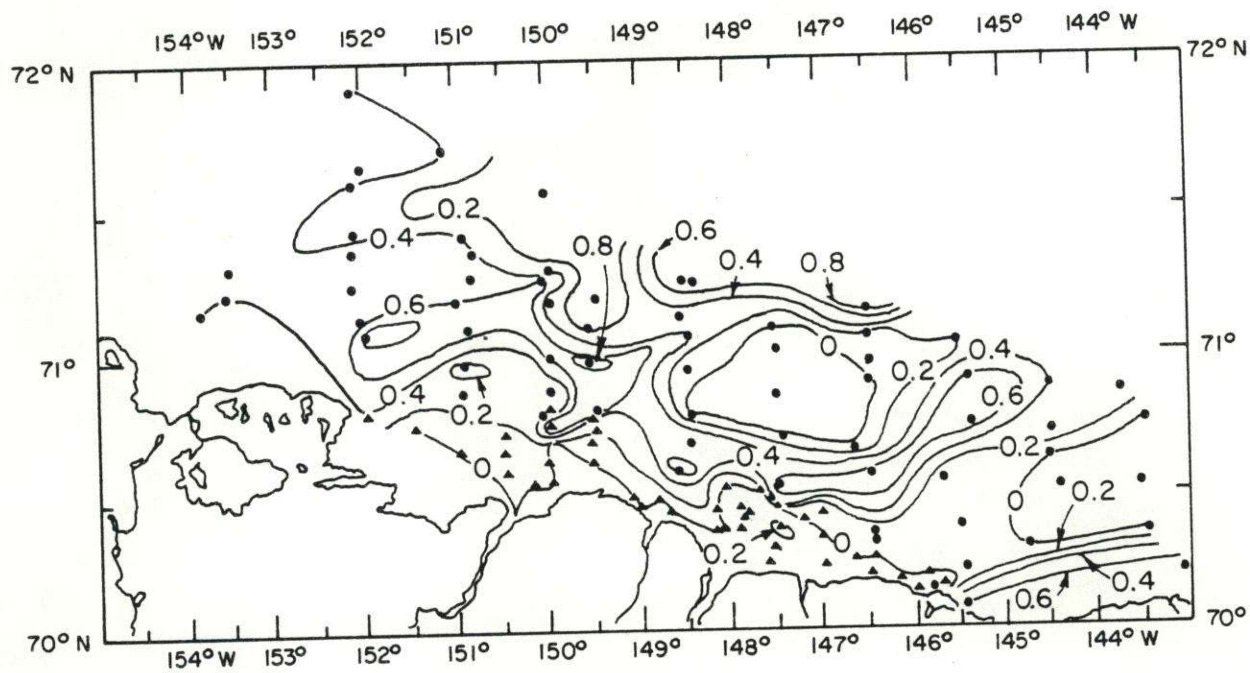
Nutrients that are important in terms of limiting Beaufort Sea primary production are nitrogen and phosphorus. Silicon is probably not an important nutrient in the Beaufort Sea system. Nitrogen and phosphorus in the coastal Beaufort Sea region are land-derived from river input and coastal peat erosion. Productivity in the freshwater rivers and delta regions of the Arctic Coastal plain is limited by phosphorus, while coastal marine waters are nitrogen limited (Schell, 1975).

In the spring, river discharges contribute nitrogen to coastal waters. As production increases, nitrogen values decline throughout the summer, reaching the point of being limiting by summer.

In August-September of 1971 and 1972, Hufford (1974) recorded surface phosphate and nitrate concentrations to vary regionally and to range between undetectable and 0.8 mg-at/l in 1971, and undetectable and 2.2 mg-at/l in 1972 (Figures 3-13 and 3-14). Over the winter, bacterial degredation replaces some of the nutrients utilized in productivity; however, the most significant amounts are provided during spring flooding.

(d) Hydrocarbons

Background hydrocarbon levels in Beaufort Sea waters are low, usually less than 1 ppb, and appear to be of biogenic origin. Abiotic aromatic hydrocarbons have been recorded in Beaufort Sea sediments; they appear to be from a variety of nonindustrial sources.

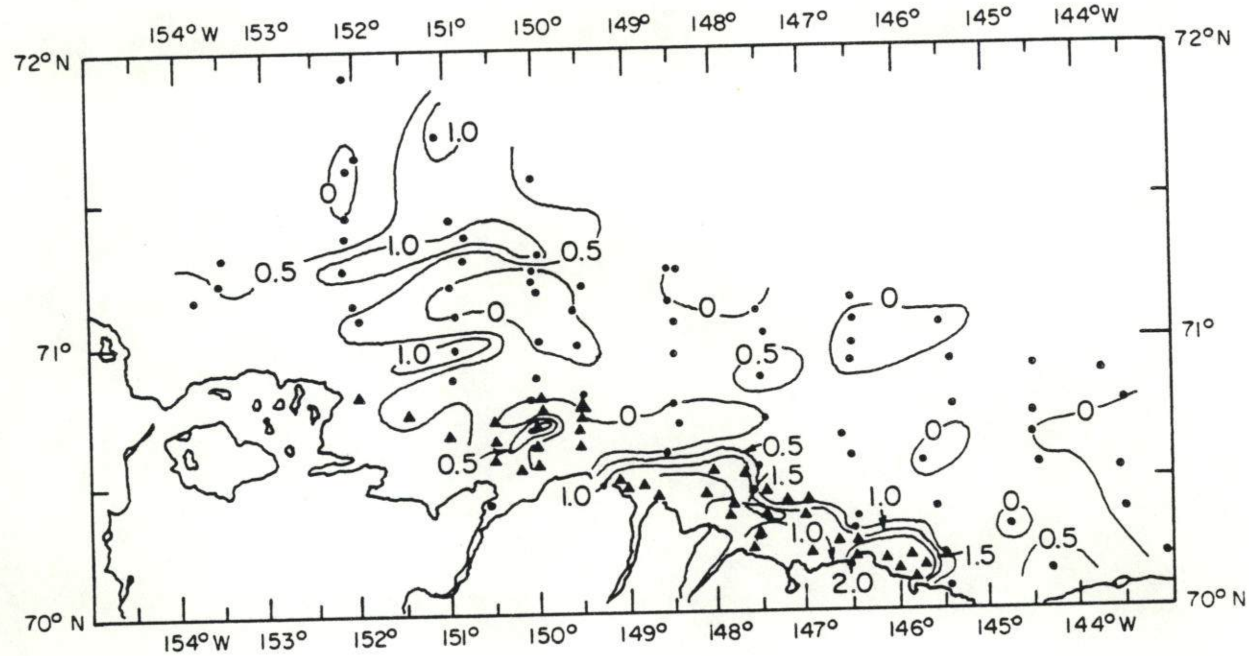


SOURCE: HUFFORD (1974)

HORIZONTAL DISTRIBUTION OF REACTIVE PHOSPHATE (μg-at PER LITER) IN SURFACE WATERS

Woodward-Clyde Consultants

FIGURE 3-13



SOURCE: HUFFORD (1974)

HORIZONTAL DISTRIBUTION OF NITRATE (µg-at PER LITER) IN SURFACE WATERS

Woodward-Clyde Consultants | FIGURE 3-14

(d) OTHER USES OF THE PROJECT AREA

(i) Commerical Fishing

The only continuous commercial fishing operation on the Arctic Coastal Plain is operated in the Colville Delta area by the Helmricks family. This fishing operatation operates during the fall and winter. Arctic cisco is the most important species taken. A secondary take of broad and humpback whitefish, and least cisco adds to the value of the principal catch. The average annual catch from 1964 to 1981 was 14,764 kg (32,548 lbs.) of Arctic cisco, 5,678 kg (12,518 lbs.) of least cisco, 4,696 kg (10,353 lbs.) of broad whitefish and 2,879 kg (8,552 lbs.) of humpback whitefish (USDI, 1984). Movements of these species are generally limited to the inshore brackish water zone or to fresh water.

(ii) Shipping

Scheduled shipping activities in the proposed exploratory drilling area include an annual sealift of supplies to Prudhoe Bay and Oliktok Point. Barges containing building modules and other oilfield equipment are towed eastward from Barrow, and usually arrive at Prudhoe Bay and Oliktok Point in August, depending on ice conditions. The barges and tugboats complete the return trip prior to freezeup. The scattered coastal villages and offshore oil exploration operations in the general project region are supplied by shipping runs as needed during open-water periods.

(iii) Military Use

There is no regular surface military use of the Lease Sale 71 area other than the existence of DEW-line stations at several locations along the Beaufort Sea coastline.

(iv) Small Craft Pleasure Boating, Sport Fishing and Recreation

The extreme remoteness and severe climate of the Arctic Coastal Plain and Beaufort Sea regions precludes the use of coastal areas for recreation.

(v) Kelp Harvesting or Other Commercial Uses (Mariculture)

Mariculture activities do not occur in the project area.

(vi) Cultural Resources

A cultural resource survey was not required for the proposed project. The specific drilling area is considered to have a very low probability of having any evidence of prior human habitation because of its offshore location. Shipwrecks have not been recorded in the project area, although several have been identified near Point Barrow (USDI, 1984). Ice gouging, sediment type and movement, and water depth in the drilling area make it highly unlikely that any identifiable cultural resources exist (USDI, 1984).

(vii) Areas of Particular Concern

An area of concern that relates to the proposed exploratory drilling project is the westward migration of bowhead whales that occurs in the fall in the region. Numerous whale sightings, as well as historical accounts, indicate that the proposed drillsite is located inshore of the region of the annual fall migration route of this species. Details of the bowhead whale hunt and lease stipulations are discussed in Section (3) (e)(vii).

Other biological resources of concern in the project area include the polar bear, bearded seal and ringed seal. Polar bears are considered likely to ultilize the project area during the late winter and spring periods. Bearded seals are most likely to utilize the project area during spring breakup. Female ringed seals may use the area for denning during the winter and spring. The Teshekpuk caribou herd ultilizes the area between Cape Halkett and Teshekpuk Lake for overwintering and calving in the spring. These are considered to be sensitive periods for this species. The coastal zone in the vicinity of Cape Halkett is also utilized as nesting and molting habitats for waterfowl, snow birds and other bird species. Traditional subsistence hunting sites, described in Section (3)(d)(xi), are also areas of particular concern in the project area.

(viii) Existing Pipelines and Cables

There are no known pipelines or cables located in the proposed exploratory drilling area.

(ix) Other Mineral Uses

Two federal sand and gravel lease sales were scheduled to occur in September, 1984 for the Lease Sale 71 and BF Oil and Gas Lease Sale areas, but were indefinitely postponed. The purpose of the sales was to provide the oil industry with offshore fill materials for artificial island and causeway construction.

(x) Ocean Dumping Activities

There are no designated ocean dumpsites in the Alaskan Beaufort Sea.

(xi) Subsistence Activities

The economy of the Arctic Coastal Plain (excluding the Prudhoe Bay and other oilfields) is based largely on subsistence. Hunting, fishing, trapping and gathering activities are important to the native Inupiat, and tie their cultural, social and economic lives together.

The primary offshore subsistence hunting activity is whaling. Seals and polar bears are also hunted; however, none of these activities is a primary subsistence resource (USDI, 1984). Whaling is an important part of Inupiat culture and industrial interference with whaling techniques and traditions is prohibited. Whaling crews from the villages of Kaktovik and Nuiqsut hunt bowhead whales in August in the area located from Anderson Point in Camden Bay to Humphrey Point east of Barter Island and to 30 km (18.6 mi) north of Barter Island. A secondary whaling area is located seaward of the barrier islands from Thetis Island to Flaxman Island (USDI, 1979; 1984). The project area is not located in any primary whaling areas.

The primary subsistence activities of the people of Nuiqsut, the only village located in the project area, are hunting moose and caribou, and fishing for freshwater and anadromous fishes. Secondary subsistence food sources include fur bearers, small mammals, ducks, geese, ptarmigan, bird's eggs, and plants and berries (USDI, 1984). In terms of quantity of food harvested, the caribou is the primary subsistence animal species. Seventy-six (76) percent of flesh harvested is from the caribou. Twenty (20) percent of food harvested is comprised of fish (USDI, 1984).

(xii) Native Claim Allotment

There are no Native Claim Allotment parcels in the immediate project area. The nearest parcel to the project area is located in the Colville River Delta, approximately 60 km (37.5 mi.) southeast of Cape Halkett.

(e) FLORA AND FAUNA

(i) Marine Environment

(a) Phytoplankton

On an annual basis, the level of primary production is relatively low in the nearshore Beaufort Sea. Results from several studies suggest that values in the area of the proposed exploratory drill site are about 20 g $C/m^2/yr$ (20 grams of carbon fixed per square meter per year) (Horner and Schrader, 1981; Schell et al., 1982). This level can be compared to a value of 121 g $C/m^2/yr$ recorded in the Bering Sea (McRoy and Goering, 1976). Ice (epontic) algae, single cell algal species that live on the bottom surface of the winter ice cover, provide almost all of the primary production for most of the year (Horner and Schrader, 1981). The ice algae are dominated by single-celled organisms, including pennate and centric diatoms.

In the late fall, an ice layer often forms and is accompanied by a small bloom of sea ice algae (Schell et al., 1982). Low light levels due to decreasing sunlight and an increasing snow layer limit this bloom. Throughout the winter, a low level of primary productivity is maintained. During this period, individual cells attach themselves to the under ice surface, and are incorporated into the ice layer as it thickens due to frazil ice formation in the water column.

The major bloom of ice algae occurs in the early spring. As the snow pack decreases and sunlight increases, the ice algae begins to grow rapidly. The bloom ends as the ice cover melts during breakup. The fate of the ice algae during the open water season is unknown. Ice algae are present for only a short time in the water column following breakup, and may sink to the bottom.

With the increase in light penetration into the water column after the ice and ice algae are no longer present, the phytoplankton community begins a growth phase. These organisms that live in the water column dominate primary production during the open water season. In the central Beaufort Sea region (Harrison Bay to Steffanson Sound) there appears to be a lack of the major spring blooms recorded in other polar environments (McRoy and Goering, 1974). This is believed to be at least partially due to nutrient limitations. The ice algae appear to utilize much of the nitrogen (nitrate) present before it becomes available to the phytoplankton (Horner and Schrader, 1981). Limited mixing of deep nutrient rich Arctic Ocean water with shallow inshore water is responsible for this action (Schell et al., 1982). Other sources of nitrogen in the nearshore are coastline erosion and river outflow. Carbon ratios recorded by Schell, et al. (1982) indicate that very little of this nitrogen is utilized.

(b) Zooplankton

Over 100 species of zooplankton have been recorded from the Beaufort and northeast Chukchi Seas (USDI, 1984). Copepods are the most common group in Harrison Bay (Horner, 1981), as well as in other areas of the Beaufort Sea (Horner and Schrader, 1981). Amphipods and mysids are also important zooplankton species groups.

Hydrozoans are common during the open water season. Other common zooplankton species groups include euphausiids, arrow worms, ostracods, decapods, pteropods, ctenophores, foraminiferans and larval stages of some benthic species groups (barnacles, polychaetes, hydrozoans, snails and sea stars) (Horner, 1981).

Food organisms consumed by zooplankton include ice algae, phytoplankton and microflagellates. Temporal distribution of zooplankton is probably controlled by availability of preferred food sources. Ice algae and microflagellates are available during the winter (ice) season, and phytoplankton and the microflagellates are available during the open water season. Only one species (the amphipod Gammarus setosus) has been found to utilize detritus from terrestrial sources (Schell et al., 1982). This is the only species capable of assimilating cellulose.

(c) Nekton

1) Marine Fish

The marine fishes include species that complete their entire life cycle in the marine environment. The Arctic cod, fourhorn sculpin, saffron cod, snailfish and Arctic flounder are the most common marine fish species in the project region. The locations of food sources, ice conditions during the winter and nearshore summer conditions (salinity, temperature) primarily control the distribution and abundance of the species. The numbers of species and individuals of marine fishes in the Beaufort Sea are considered to be low compared to other Alaskan waters (USDI, 1984).

The Arctic cod is considered to be the most important marine fish species in the Arctic Ocean. This species is a major consumer of zooplankton and is consumed by marine mammals, birds and larger fish (Bendock, 1977). Arctic cod has been recorded in very large numbers (12 to 27 million in Simpson Lagoon in 1978 (Craig and Haldorson, 1980); however, individuals are usually present in low numbers (USDI, 1984) throughout the range of the species. Spawning is believed to occur during January and February under the sea ice. The locations used for spawning are not known (Bendock, 1977).

The fourhorn sculpin occurs in suitable habitat present throughout the nearshore Arctic Ocean. This species is a demersal fish present in all nearshore habitats and some offshore habitats. Principal food species of the fourhorn sculpin include immature copepods, amphipods, juvenile Arctic cod (Bendock, 1977) and isopods (Craig et al., 1982). Additional marine fish species in the Beaufort Sea are present in relatively low numbers.

2) Anadromous Fish

The Arctic char, Arctic cisco, least cisco, Bering cisco, humpback whitefish, broad whitefish and boreal smelt are anadromous fish species commonly present in the nearshore Beaufort Sea during the open water period. These species usually occur in the brackish water present within 100 m (305 ft.) of the shoreline or in river plumes. During the open water period, individuals feed on the abundant pelagic and epibenthic invertebrates present in these areas. Individuals move back into the rivers and deeper lakes in the fall for spawning and overwintering. Chum and pink salmon have been reported from the central Beaufort Sea (Craig and Haldorson, 1981). However, numbers of both species have been low and their occurrence variable.

3) Resident Fish

Resident fish populations are not believed to occur in the freshwater lakes that Amoco plans to utilize for the onshore base camp. These lakes are generally shallow and freeze completely during the winter. The nine-spined stickleback may occur in the deeper lakes in the area.

4) Whales

The whale species most commonly present in the Beaufort Sea are the bowhead, gray and beluga whales. A detailed discussion of the bowhead whale and gray whale is included in Section (3) (e)(vii). Beluga whales are present in the Beaufort Sea from early spring through fall. Individuals follow opening lead systems north and east from their wintering areas in the Bering Sea. As many as 11,500 individuals may migrate from the Bering Sea to the eastern Beaufort Sea (Seaman et al., 1981). Available data generally indicate that the species utilizes offshore lead systems while migrating eastward past Point Barrow to the southern Beaufort Sea region (Fraker et al., 1978; Fraker, 1979; Fraker, 1980). The whales continue their migration in May and June. As the ice breaks up in the Beaufort Sea in the spring, beluga whales follow a migration corridor located further to the south (Fraker, 1980). During late June and early July, individuals move in to the Mackenzie River estuary (Sergeant and Hoek, 1974; Fraker, 1980).

The fall migration route of this species is not well documented. Seaman and Burns (1981) observed beluga whales migrating along the margin of the pack ice between Barter Island and Point Barrow. In recent years, a limited number of observations of westward-migrating beluga whales have been made in areas located immediately offshore of the Jones Islands (Johnson, 1979). Based on these observations, it is expected that a limited number of individuals probably pass through the lease sale area during the fall migration. Most individuals, however, probably move well offshore, near the ice edge. (Fraker et al., 1978).

5) Seals

The ringed seal, spotted seal and bearded seal are present in the Beaufort Sea. Of these species, the ringed seal is the most abundant, with a population of approximately 80,000 in the summer and 40,000 in the winter (USDI, 1984). The ringed seal has a circumpolar distribution (Burns, 1978) and is the most ice-adapted seal present in the Arctic Ocean region (Fay, 1974). This species prefers stable sea ice during the winter, and is present near the edge of the pack ice or in the vicinity of nearshore remnant ice in the summer (Burns and Eley, 1977; Burns et al., 1981). Ringed seals are the only seals in the Northern Hemisphere that consistently inhabit fast ice through the winter. The breathing and exit holes of this species have been found in Beaufort Sea ice thicker than 2.3 m (7.5 ft). Pupping occurs primarily in early April in dens along low pressure ridges. Since the proposed drilling area is located in a zone of limited ice ridging, ringed seal pupping may occur near the drillsite. Previous studies indicate that ringed seals generally avoid areas of human presence and activity (Burns and Eley, 1977).

Ringed seals do not concentrate in social herds, although large concentrations may be present in areas with large prey populations. Aerial observations of ringed seal densities on areas of fast ice located from Flaxman to Barter Island ranged from 0.4 to 2.4 seals per square mile in 1970, 1975, 1976 and 1977 (Burns and Eley, 1978).

A review of the food habits of the ringed seal is presented in Lowry et al., (1979). Euphausiids, amphipods, mysids and isopods dominated the diet of this species in the spring, summer and fall. Fish, especially sculpins and Arctic cod, were the predominant food species during the winter.

Bearded seals are widely distributed in the Arctic Ocean (Burns, 1978) and are usually present in areas of broken ice where the water is sufficiently shallow for feeding, i.e., 18.2 to 36.4 m (60 to 120 ft.)-deep; (Fay, 1974). Winter densities of the bearded seal are low in the Beaufort Sea (about 0.1 animal per square mile); most individuals are present in the Stamukhi zone (Burns and Eley, 1977). During the winter, bearded seals are much more abundant in the Chukchi and Bering Seas, where more favorable ice conditions exist in shallow water areas (Seaman et al., 1981). Few bearded seals remain with the summer pack ice as it retreats over deep water. Burns et al. (1981) found that bearded seals in the Beaufort Sea during the summer were associated with nearshore ice remnants present between Cape Halkett and Flaxman Island. Densities in the lease sale area are expected to be highest during the summer. Lowry et al. (1979) present a thorough review of the literature on the food habits of the bearded seal. Crabs, shrimp, and clams dominate the diet of this species, with fishes (saffron cod, Arctic cod, sculpins) and isopods also commonly reported.

Spotted seals have been observed along the coast of the Beaufort Sea only during the summer, and in low numbers (USDI, 1984). Most spotted seals have been observed in areas located west of Prudhoe Bay; thus, this species may occue in fairly large numbers in the project area.

(ii) Benthic Environment

The benthic communities of the Beaufort Sea include benthic microalgae, macrophytic algae (large seaweeds and kelps) and benthic invertebrates. The microalgae community, a contributor to primary production in the Beaufort Sea coastal ecosystem, consists of diatoms, flagellates, filamentous green, brown and red algae, and blue-green algae (USDI, 1984). Colonies of these species vary in size from microscopic films to visible mats, and form on most substrates in the photic zone. The preferred habitats of these colonies is the clear water areas in the lee of spits and islands. Benthic microalgae are utilized as food by epifaunal invertebrates which have been found in greater numbers in these clear water habitats (USDI, 1984).

Stands of macrophytic algae and kelp are present only sparsely in the Alaskan Beaufort Sea. Since macrophytes must attach to the ocean bottom, they are limited to areas of hard or rocky substrate. Isolated hard substrates can support large, diverse "boulder patch" communities. However, communities of this type were not found in Harrison Bay or the immediate area of the Mars Prospect (Broad et al., 1981).

In nearshore waters (<2 m (6 ft.)-deep), benthic invertebrates are generally poor in diversity and biomass, patchy in distribution and annually depopulated by shorefast ice. The benthos of the inshore environment (2-20 m (6-60) water depth) consists of many infaunal species (organisms present in ocean floor sediments) that are not found closer to shore (USDC, 1978). The principal infaunal species present beyond 2 m deep areas are polychaete worms and bivalve mollusks (USDI, 1979). The epifauna (organisms living on the ocean floor surface) of the project area is dominated by crustaceans (amphipods, mysids and isopods); echinoderms and gastropods are also common. These epifaunal organisms comprise a large part of the food resources utilized by fish, birds and marine mammals of the region (USDI, 1984).

The species diversity and abundance of benthic invertebrate communities generally increase with water depth in the inshore zone. However, intensive ice gouging in the shear zone [15-25 m (49.5-82.5 ft.) isobaths] substantially disturbs ocean floor sediments and reduces infaunal and epifaunal abundance. Ice gouging occurs with decreasing intensity to the 40 m (13.2 ft.) water depth.

(iii) Birds

Arctic bird populations are characterized by few resident species, a high percentage of water-associated birds and relatively low density breeding populations (Bergman et al., 1977). Most bird species that occur on the Arctic Coastal Plain are migratory, although a few species, such as the common raven and snowy owl, occur in the winter. The most common species that migrate along the Beaufort Sea coast during the spring and fall migration periods are the common eider, king eider, oldsquaw, brant, red phalarope and glaucous gull. The perigrine falcon is discussed under Section 3(e)(vii) Endangerers and Threatened Species.

The oldsquaw is a very common to abundant species present along the coast of the Beaufort Sea, with highest concentrations occurring near barrier islands and shallow lagoons. The oldsquaw, king eider, common eider, black guillemot and white-winged scoter are the bird species considered most likely to occur in the project area in the highest densities. These species feed principally on fish, especially Arctic cod, in offshore areas. Epibenthic crustaceans are the primary food items utilized by the oldsquaw closer to shore.

Simpson Lagoon and the area located from Pitt Point to Cape Halkett have been identified as major molting and fall migration staging areas. These and other coastal areas, primarily including lagoons present behind barrier islands, are utilized by large numbers of oldsquaw in late July and August, in the period when individuals are molting and staging prior to fall migration.

Migratory birds begin arriving on the northern coast of the Arctic Coastal Plain in late May, concentrating initially in open water areas near river deltas. Nesting begins on barrier islands and in coastal tundra areas in early June and continues into early July. The subsequent molting period occurs in the period mid-July to mid-August. Large groups of molting oldsquaw and eiders are present in coastal and offshore areas during the molting and fall migration staging periods. Common and king eiders typically occur further offshore than the oldsquaw. Staging continues until late August, and fall migration to wintering areas occurs subsequently with most birds leaving the Lease Sale 71 area by mid-September.

(iv) Polar Bear

Polar bears present in the Alaskan Beaufort Sea region are part of the northern Alaskan population, comprised of approximately 2,000 individuals (USDI, 1984). In the winter, spring and summer, polar bears occur on sea ice, generally within 320 km (200 mi.) of the shoreline where leads are common and seals are most abundant. Ringed seals are the primary food source for polar bears, although they also feed on bearded seals, walruses, carrion of various types and human refuse.

During the fall, pregnant females establish maternity dens in areas of drifted snow, usually on stable landfast ice, coastal cliffs, barrier islands, in river drainages or on the pack ice (Seaman et al., 1981; Lentfer, 1975). Denning areas are usually located from the edge of the landfast ice to 10 km (6.25 mi.) inland, although one den was found 48 km (30 mi.) inland (Lentfer and Hensel, 1980). Numerous observations of maternity dens or cubs recently out of dens have been made between the Colville and Sagavanirktok Rivers (Seaman et al., 1981). Polar bears may occur in the proposed exploratory drilling area in low numbers in the period October-April.

(v) Breeding Habitats and Migration Routes

Large numbers of fish, including marine and anadromous species, utilize Harrison Bay during migrations. However, very little is known about the use of this area for spawning by marine fishes that overwinter in deeper marine waters. Individuals move inshore during the summer to feed on abundant prey species. In the fall, these individuals return to deeper waters that are unaffected by ice. Anadromous species move through Harrison Bay during the migrations to and from spawning areas in freshwater and to summer food sources in inshore waters of the bay. Their movements are generally along the shore in the longshore brackish water plume or out into eastern areas of the bay in the Colville River plume.

Nesting and brood-rearing of shorebird and waterfowl species occur near the coast from early June through late July in a variety of tundra and aquatic habitat types on the Arctic Coastal Plain. Major coastal feeding and molting areas located west of Cape Halkett and from the Colville Delta east to Prudhoe Bay have been identified (USDI, 1984). Bird migration routes are generally parallel to the coastline, extending seaward to the barrier islands and adjacent areas of the Beaufort Sea, and inland a few kilometers. Migration is primarily eastward in the spring (May-June) and westward in the fall (August-September).

In offshore areas, winter ringed seal pupping habitats are present along the entire fast ice zone seaward of the 3 m (10 ft.) isobath. The Stamukhi zone is an important use area for breeding polar bears, bearded seals and non-breeding ringed seals in the winter and spring. The area located north of Harrison Bay [seaward of the 20 m (66 ft.) isobath] is included in the fall bowhead migration route in the Beaufort Sea (USDI, 1984).

(vi) Sensitive Underwater Features

Sensitive underwater features are not known to exist in the project area.

(vii) Endangered and Threatened Species

The bowhead whale and gray whale are classified as Federal endangered species, and are protected under the International Convention for the Regulation of Whaling of 1946, the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973.

Bowhead whales overwinter in the Bering Sea. The spring migration route of the species follows the retreating ice northward to Point Barrow, then eastward along offshore leads toward Banks Island in Canada. Bowhead whales spend summer months feeding in the eastern (Canadian) Beaufort Sea. The fall migration to wintering areas begins in August. The largest numbers of individuals pass through the Alaskan Beaufort Sea in September and early October (Braham et al., 1980; Fraker and Bockstoce, 1980; Ljungblad et al., 1981; Fraker, 1984). In contrast to spring migration, which occurs considerably north of the coast, fall migration occurs closer to the coast, north of the proposed drilling areas. Numerous observations of bowhead whales have been recorded seaward of the general project region with the maximum number being sighted in September.

In addition to the importance of this species as an Endangered species, the bowhead whale is vital to North Slope coastal villages (Barrow, Nuiqsut and Kaktovik) that traditionally hunt bowhead whales each fall as the whales migrate westward. Whaling crews from Barrow hunt the whales in spring and fall. A successful hunt of this species provides critical winter food sources for entire villages. In addition, the bowhead whale is of spiritual importance to the Inupiat culture.

The Lease Sale 71 stipulations require that a bowhead whale monitoring program be administered by the Federal government and/or lessees during bowhead whale migration through or adjacent to the lease sale area (USDI, 1982). The objectives of ths program are to: (1) determine bowhead whale distribution and abundance, (2) assess potential effects of exploration activities on whale behavior and (3) provide for ordering termination of exploratory drilling activities, if necessary.

Gray whales occur only sporadically in the Beaufort Sea, primarily in western areas (Rugh and Fraker, 1981). Populations of this species may now equal or exceed pre-exploitation levels (USDI, 1984). This species is rarely hunted by the Beaufort Sea Inupiat.

The polar bear, although not classified as an Endangered species, is protected under the Marine Mammal Act of 1972 and the International Agreement on the Conservation of Polar Bears of 1976 by Canada, Denmark, Norway, Russia, and the United States. The occurance, distribution, abundance, ecology and behavior of this species are discussed in Section (3) (e)(iv).

The Arctic peregrine falcon, which has been placed on the threatened species list, nests in northern foothill areas of the Brooks Range along the extreme southern end of the Arctic Coastal Plain. Approximately 8-10 pairs of this species nest in foothill areas located between the Shaviovik River and the U.S-Canada Border (USDI, 1984). Breeding pairs of this species also nest above the Colville River in foothill locations.

According to Murray (1980) three rare plant species known to occur in coastal Beaufort Sea areas are candidates for either threatened or endangered status. Salix ovalifolia var. glacialis is to be listed as endangered, while Thlaspiarcticum and Erigeron grandiforus ssp. muirii should be offered protection by a threatened status.

(vii) Fresh-water and Terrestrial Environments

a) Fish

The system of shall fresh-water ponds, lakes and small streams near Cape Halkett may support populations of the Arctic grayling, round whitefish and ninespine stickleback (USDI, 1984). Many of these lakes, ponds and streams are too shallow to allow fish to overwinter because they completely freeze in the winter. Aquatic systems which are sufficiently deep enough to remain partially unfrozen are most likely to support fish populations.

b) Mammals

The most important terrestrial mammal species in the Harrison Bay area is the caribou (USDI, 1984). One major herd and one minor herd of this species use the areas located near the western Harrison Bay shoreline. The major herd (the Western Arctic Herd) is comprised of approximately 180,000 individuals. The small herd (Teshepuk Herd) is comprised of approximately 3,000 to 4,000 individuals 9USDI, 1984). The Western Arctic Herd is present from the Colville River to the Chukchi Sea coast, and from the Brooks Range north to the Arctic Ocean. The Teshepuk Herd utilizes an area around Teshekpuk Lake west to Cape Halkett. This area is utilized for wintering and calving.

c) Terrestrial Vegetation

Arctic tundra ecosystems are floristically simple. The vegetational cover in the coastal Beaufort Sea area is composed of green mosses, lichens, creeping shrubs, perennial prostrate herbs and algae (Tikhomirov, 1959). Construction and transportation activities occurring after the ground is frozen and the plants are protected by a mantle of snow should have minimal effects on the vegetation.

(f) SOCIOECONOMICS

(i) Area Employment and Unemployment

A census of oil-related employment in the North Slope Borough indicated that approximately 6,300 people are employed in the Prudhoe Bay-Kuparuk oil fields. Alaska residence was claimed by 80 percent of the employees and 3 percent of these claimed residence in the North Slope Borough (USDI, 1984). Other employed natives work for the borough in service positions or for native corporations. Unemployment in the entire North Slope ranged from 5-8 percent in the period 1973-1981 (Maynard and Partch and Woodward-Clyde Consultants, 1984). However, these percentages do not reflect temporary workers, and persons not actively seeking work. The overall economy of the region is not entirely represented by unemployment statistics due to the importance of traditional subsistence activities as a means of support for many natives.

A 1982 employment survey of the village of Nuiqsut noted that 96 jobs were available on an annual full-time basis (Alaska Consultants, 1983). Table 3-2 provides information on employment in each job classification. One-hundred seventy-one (171) residents of Nuiqsut are in the 18-65 age group (working-age). The difference between the working age population and the number of full-time job positions appears to be large. However, a significant number of females were not a part of the working force. In addition, many of the village men prefer to work in temporary construction-related jobs; the extended leave periods associated with the jobs allow for the continuance of subsistence activities.

(ii) Location and Size of Related Population Centers

A number of industrial work camps and service bases are associated with oil and gas exploration and development on the North Slope. The largest of

Table 3-2. Average Annual Full-time Employment in Nuiqsut in 1982 a.

Industry Classification	Number of Jobs	Percent of Total
Agriculture, forestry, and fishing	0.0	0.0
Mining	7.5	7.9
Contract construction	9.5	9.9
Manufacturing	0.0	0.0
Transportation, communications and public utilities	1.0	1.0
Trade	3.5	3.7
Finance, insurance and real estate	3.0	3.1
Services	3.0	3.1
Government	68.0	71.2
Federal	(1.0)	(1.0)
State	(0.0)	(0.0)
Local	(67.0)	(70.2)
TOTAL	95.5	100.0

a Includes 2.5 full-time job equivalents with the Pingo Corporation and an additional 5 full-time job equivalents with other employers at Prudhoe Bay.

Source: Alaska Consultants, Inc. (1983)

these industrial centers is the Prudhoe Bay-Kuparuk oil field complex. For the most part, work camps and bases have remained isolated from traditionalInupiat settlements. Three of eight traditional Inupiat communities of the North Slope region are located along the Beaufort Sea coastline: Barrow, Nuiqsut and Kaktovik. Of these, the village of Nuiqsut, located approximately 48 km (30 mi.) inland on the Colville River Delta, is the Inupiat community located closest to the Prudhoe Bay complex and the Mars Prospect area. The 1980 U.S. Census indicated that Nuiqsut was copmprised of 208 residents (U.S. Bureau of Census, 1981). Of these residents, only 27 (13 percent) were non-natives; these individuals were associated with primarily public service positions such as school district employment. A North Slope Borough-sponsored census taken in July, 1982 counted 302 residents; however, this probably reflected a number of people present in Nuiqsut for temporary employment opportunities.

(iii) Community Services

The North Slope Borough provides community services for the eight traditional Inupiat communities. The Capital Improvement Program (CIP), which is funded by oil revenues, provides roads, schools, health facilities, electrical power, water and sewer services, and housing for community residents.

Nuiqsut was incorporated in 1975 as a Second Class city. Village government consists of a seven-member council from which the mayor is selected. All other governmental and community services are provided through the North Slope Borough. The North Slope Borough CIP has funded the construction of new school facilities, a public safety building, fire department, electrical generator, health clinic, street lighting, community water source and improved communication system for Nuiqsut.

The oil field complex at Prudhoe-Kuparuk is totally self-sufficient and provides health, safety, housing and transportation services for industry employees.

(iv) Public Opinion

In general, native inhabitants of North Slope villages are concerned that oil-related activities will adversely affect their traditional culture and subsistence lifestyle. Disturbance of bowhead whale migration patterns by exploration and development activities is of specific concern. In addition, there is concern that sea or ice hazards may result in offshore accidents that could lead to the loss of some subsistence animal foods because of major accidental oil spills (LGL, 1983). The Inupiat people recognize that the continued development of the North Slope oil fields can generate more revenue, capital improvements and job opportunities. However, the social organization and belief systems of the Inupiat people are so firmly tied to their subsistence lifestyle that they remain wary of any activities which may affect their natural, social and cultural environments.

Although an organized public survey has not been conducted outside of the North Slope Borough, it appears that people not residing in the borough do not oppose additional offshore petroleum exploration and development activities.

(v) Existing Transportation Systems and Facilities

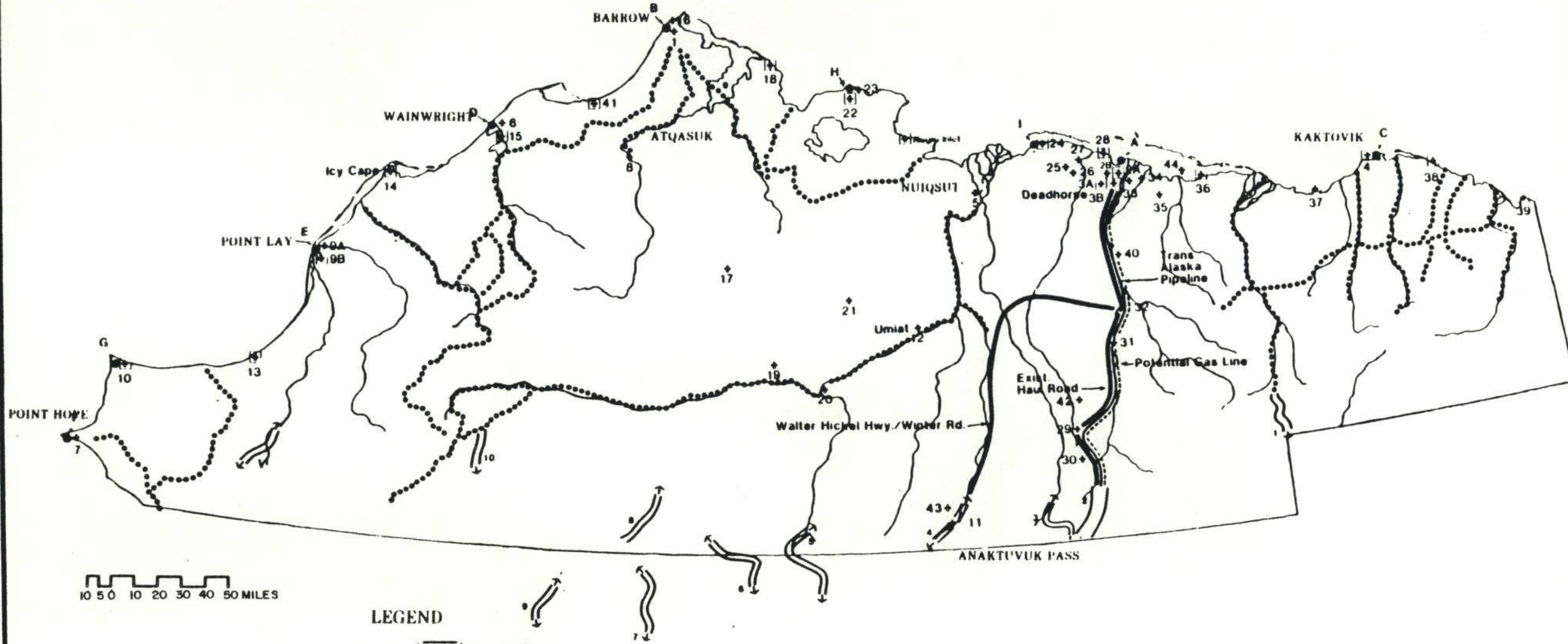
The Dalton Highway (Haul Road) is the only overland access road to the North Slope. Use of the highway, built during construction of the Trans-Alaska Pipeline, is restricted to commercial carriers north of Dietrich Camp. The complex at Prudhoe Bay has an extensive gravel road system linking the airport at Deadhorse, drill pads and support facilities. In addition, the road system is extended to the Kuparuk Field development located to the west. Figure 3-15 provides an overview of North Slope transportation systems. During the winter months, temporary ice roads provide additional access in developed areas.

Nearly every North Slope community, including Nuiqsut, has an internal rudimentary road system; however, none of the villages are connected by public roads or highways. Winter routes, including historic trails, connect some of the communities and the frozen rivers provide overland travel routes for snow machines.

Transportation by air is the primary means of travel to the North Slope. Barrow and Deadhorse are connected to Anchorage and Fairbanks by daily flights. Less frequent service is available to more remote sites and villages. A lighted runway and terminal was completed in 1983 at Nuiqsut; daily air service is now available to and from Barrow and Deadhorse.

Marine transportation in the Beaufort Sea is limited to the summer months due to winter ice cover. Presently, there are no deepwater ports on the Arctic Ocean coast. However, Prudhoe Bay has three barge docks which can accomodate vessels with drafts of 1.2, 1.8, and 3 m (4, 6, and 10 ft.), and the end of the West Dock has been expanded to accomodate deeper draft barges as part of the Prudhoe Bay Unit Waterflood Project.

Each summer, modular buildings and supplies are sealifted to the North Slope. Although there is no scheduled marine service to Nuiqsut, barges carrying provisions for the town arrive one time per year.



LEGEND

● Ports		Facility
A	Prudhoe Bay	Two Docks
B	Barrow	Beach Lightering
C	Barter Island	" "
D	Wainwright	" "
E	Point Lay	" "
F	Point Hope	" "
G	Cape Lisburne	" "
H	Lonely	" "
I	Oliktok Point	" "

Mountain Passes

1 Carter Pass
2 Atigun Pass
3 Itkillik River
4 Anaktuvuk Pass
5 Survey Pass
6 Nigu River
7 Nakmaktuak Pass
8 Inyorurak Pass
9 Hunt River
10 Nachrakh Pass
11 Kukpuk-Ipewik

●●●● Native Winter Routes

♦ Airport (♦) Airport, Dew-Line Station

1 Barrow
2A Prudhoe Bay
2B Prudhoe Bay Heliport
3A Deadhorse
3B Helmericks at Deadhorse
4 Barter Island
5 Nuiqsut
6 Wainwright
7 Point Hope
8A Atkasook
8B Atkasook (Ice)
9A Point Lay Dew
9B Point Lay
10 Cape Lisburne
11 Anaktuvuk Pass
12 Umiat
13 Cape Beaufort (Sabine)
14 Icy Cape
15 Wainwright Dew
16 Point Barrow
17 East Oumalik Well
18 Cape Simpson
19 Knife Blade Ridge
20 Puviak Bluff
21 Square Lake Well
22 Lonely
23 Kuugruagaaruk
24 Oliktok Point
25 West Kuparuk
26A Kuparuk
26B Kuparuk Heliport
27A North Kuparuk
27B North Kuparuk Heliport
28 Point McIntyre
29 Toolik Camp
30 Galbraith Lake
31 Happy Valle-
32 Sagwon
33 Coastal
34 East Fork
35 Kad River
36 Flaxman
37 Brownlow Point
38 Humphrey Point
39 Demarcation Bay
40 Franklin Bluffs
41 Peard Bay
42 Tighkpak
43 Tuluugak
44 Tigvariak Island

SOURCE: WICKERSHAM AND FLAVIN (1983)

TRANSPORTATION SYSTEMS ON THE NORTH SLOPE

Woodward-Clyde Consultants FIGURE 3-15

(vi) Supply and/or Existence of Coastal Resources

Sources of freshwater for human and industrial use on the North Slope include shallow ponds, deep thaw lakes, small meandering streams, wide braided rivers and groundwater. Since alluvial aquifers tend to be either brackish or saline, rivers and lakes provide the best source of freshwater. Sources intended for year-round use must be greater than 2 m (6 ft.) depth; these waters are less likely to freeze solid in the winter.

In order to ensure an adequate supply of freshwater, the Alaska Department of Natural Resources has developed a policy that links water and gravel management. The system specifies that gravel be extracted by digging pits; the pits are subsequently flooded by stream flow and provide a freshwater supply.

(4) ENVIRONMENTAL CONSEQUENCES

(a) GEOLOGIC HAZARDS

A site-specific shallow geohazards survey has been conducted of the proposed drilling area. The results of the survey will be submitted to MMS prior to or with the Application for Permit to Drill (APD).

(i) Seismicity

It is considered unlikely that seismicity and faulting will be hazards to exploratory drilling of the Mars Prospect. There is no historical evidence of earthquake activity in Harrison Bay. In addition, the relatively level seafloor in the project area minimizes the possibility of an earthquake resulting in slope failure near the drillstring. However, if a borehole or drillstring was damaged by an earthquake or intersected fault, control of downhole pressurized fluids or gas would probably be maintained by the drilling muds.

(ii) Permafrost

Permafrost present immediately adjacent to the drill string is considered likely to melt during drilling activities. However, through use of standard Arctic drilling techniques, such melting is considered unlikely to create a hazard to the exploratory drilling operation.

(iii) Shallow Gas

The Amoco Mars Prospect may be underlain with material with shallow gas associated with permafrost. However, current Arctic drilling technology is adequate to control any gas potentially encountered. The control methods include the use of drilling muds or the release of the gas and subsequent controlled flaring. Gas hydrates are not expected to be encountered at the Mars Prospect since it located is inside of the 60 m (197 ft.) isobath.

(iv) Sediment Instability

The relatively level seafloor in the project area (0.6° slope) minimizes the possibility of seabed slides and slumping. In addition, the probability of seismic activity is considered minimal, and unlikely to trigger slope failure due to liquefaction of poorly consolidated, silty sediments.

(v) Volcanism

There are no active volcanoes in the Diapir Field region. Thus, volcanism is considered highly unlikely to affect the proposed exploratory drilling operation.

(vi) Project Impacts on Geology

The construction of the grounded ice island will cause an insignificant disruption of sediments. Following melting of the ice island, sediments will return to their pre-construction state. Sediment scour around the ice island will probably be minor due to the relatively low velocity currents present in the Beaufort Sea under sea ice. In addition to these impacts, drilling operations will result in minor alterations of bedrock present in the drill hole.

(vii) Ice Gouging

If the well is a dry hole, it will be plugged and abandoned. If it appears that further testing for hydrocarbons is warranted, plugs will be set downhole and a subsea wellhead will be attached to the casing head. All equipment on the ocean floor will be placed below the level of probable ice gouging. Thus, ice gouging is considered unlikely to affect equipment present on the ocean floor. The presence of the ice island will prevent potential effects of ice gouging during the drilling operation.

(viii) Mitigation for Abnormal Pressure

Amoco plans to set 13-3/8 inch-diameter casing to a level immediately above the top of the most likely hydrocarbon-bearing formations. Amoco will then conduct a leak-off test to determine a maximum mud weight value. If the operational mud weight approaches one-half pound of the test value, Amoco will run 9-5/8 inch-diameter intermediate casing (or liner) and/or retest. It may also be necessary to run 9-5/8 inch-diameter intermediate casing for other opertional concerns such as shale problems or shallower formations of interest.

(b) METEOROLOGY

(i) Weather

(a) Temperature

Drilling at the Amoco Mars Prospect will occur during the winter when typical low temperatures reach -29°C (-20°F), and wind-chill corrected temperatures often reach to -44°C (-48°F). Extreme caution will be used by project personnel to prevent hypothermia and frostbite. All required cold weather working equipment and clothing will be utilized by project workers to reduce the potential adverse effects of low air temperatures.

(b) Sky Cover and Visibility

Helicopter and/or airplane flights to and from the Cape Halkett onshore support base landing strip and ice drilling island heliport may be temporarily restricted by fog or snow. Vehicular traffic associated with the project may also be affected by substantially reduced visibility. However, these types of events are not expected to last longer than a few hours, or at most a few days, due to the typical rapid movement of storm systems and changing meteorological conditions in the project area (USDI, 1979). Drilling operations are considered unlikely to be significantly affected by meteological conditions.

(c) Winds

The drilling rig on the ice drilling island is considered unlikely to be significantly affected by low to moderate winds. High winds may require temporary curtailment of operations. High winds may also affect helicopter or airplane flights to and from the project area; this may result in temporary curtailment of flight operations. Vehicle travel on project access roads is considered less likely to be affected by winds.

(d) Severe weather

1) Storms and Surges

Winter storm surges have been recorded on the Beaufort Sea coast; a strong storm in the project area may cause variations in sea level around the ice drilling island. Variations that occur from November to April may be drops in sea level of lesser magnitudes than surges that occur in September and October [up to 4 m (12 ft)].

2) Ice Movement

Since the proposed drilling site is located in an area of late winter floating landfast ice, some contact with moving sea ice may occur. The ice drilling island and protective ice berm are designed to withstand the structural forces imposed by contact with moving sea ice. Potential ice movement-related problems will be detected by an ice observation and monitoring program.

3) Snow

The major potential effect of snow on project operations would be reduced visibility due to blowing snow. Section (4)(b)(i)(b) includes a discussion of potential operational problems associated with visibility reductions.

4) Spray Icing

Superstructure icing can occur at all times of the year in the Beaufort Sea region, although conditions for heavy spray icing are usually most favorable in September. Ice coating of the project drilling rig and other structures are considered to be less significant problems due to the timing of the proposed project. The drilling rig will include a meteorological monitoring system. Data collected in the monitoring program will be utilized to predict potential icing conditions so that measures can be implemented to ensure safe operations.

(e) Precipitation

Precipitation is considered unlikely to significantly affect the exploratory drilling operation.

(ii) Air Quality

Impacts on air quality resulting from implementation of the Mars exploratory drilling program are expected to be minimal because of the relatively low volumes and concentrations of project-related emissions. No violations of federal or state air quality standards will occur as a result of project implementation. A detailed analysis of potential effects on air quality resulting from project implementation is presented in Appendix B. Project-related emissions will be below applicable Federal air quality exemption levels.

(c) PHYSICAL OCEANOGRAPHY

(i) Oceanographic Conditions

(a) Sea Temperature and Salinity

The discharge of drilling muds, cuttings, wastewater and other materials may cause local, short-term changes in the temperature and salinity of Beaufort Sea waters in the vicinity of the ice drilling island after spring breakup when materials previously deposited on sea ice are introduced into open waters. The volumes and characteristics of all discharges will meet applicable NPDES permit requirements for the project.

The very cold surface sea temperatures of the area are not expected to have any direct adverse effects on drilling operations. Project personnel will have only a very low risk of being exposed to open water.

(b) Ice Movement

The potential for ice ridging or ride-up exists in the area of the proposed island and access road. In order to increase protection of the drilling island and drilling equipment, the island will be protected by an ice berm on the seaward side. The berm is designed to withstand maximum probable lateral forces caused by contact with moving sea ice. A more detailed description of measures that will be implemented to protect the ice drilling island and access road from effects resulting from potential moving sea ice is presented in Section (2) (h)(i)(a).

(c) Currents

Winter under-ice currents in the Harrison Bay area are minimal and are not expected to result in direct adverse effects on the proposed exploratory drilling project. Currents could indirectly affect drilling operations through the movement of sea ice into the ice drilling island. The potential effects of moving sea ice are discussed in the previous subsection.

(d) Sea State

Since wave forces under sea ice are relatively low, the ice drilling island and ice road are considered unlikely to be adversely affected by waves.

(e) Tides

Astronomical and meteorological tides will probably not have significant effects on the exploratory drilling operation.

(f) Water Depth

The ice drilling island will be grounded in approximately 9 m (30 ft.) of water. Water depth is not considered likely to affect the proposed exploratory drilling operation.

(ii) Effects of Operations on Water Quality

The proposed drilling operation will probably have only a minor effect on water quality. Discharge effluents and procedures will meet the requirements of the general NPDES permit issued for the Beaufort Sea. Drilling muds and additives will be among those on the EPA-approved list accompanying the permit. All muds have been individually approved by EPA; some combinations may not be allowed, as determined on a case-by-case basis. Drilling mud, cuttings, wash water and treated sanitary and domestic water will be disposed of on the natural ice surface in the area of the ice drilling island. These materials will ultimately be discharged to open sea water following breakup in the spring. A study of changes in water quality conditions due to under-ice disposal of freshwater drilling mud and cuttings in shallow Beaufort Sea water [5 to 8 m (6 to 26 ft.)] showed that most solids settled to the bottom within 244 m (800 ft.) of the discharge point (NORTEC, 1981). This distance would be greater (probably up to a few thousand feet) in deeper water, but the density of settled solids on the seafloor will be significantly less due to greater lateral dispersion. In the NORTEC study, settled solids consisted of loosely consolidated flocs which were easily resuspended with only slight agitation, and were completely absent in 2 to 3 weeks. Potential effects of drilling fluids, muds, and cuttings on marine organisms is discussed in detail in Section (4)(e)(ii).

Desalinization brine and wasterwater from the ice drilling island camp will also be discharged onto the ice surface. The effects of these discharges on local and regional water quality will be negligible, with elevated pollutant concentrations limited to the immediate vicinity of the discharge point following spring breakup. Prior to release, all sanitary wastewater will be processed through a Met-Pro Chemical Sewage Unit. Domestic wastewater from the kitchen, showers, and washing machines associated with the drilling island camp will be treated similarly.

Most formation waters are residuals from ancient seas and have a composition similar to present-day seawater. If produced during testing formation waters will be re-injected into the well at the end of the drilling phase.

In summary, all discharges will be in accordance with requirements established by EPA in the NPDES permit process. The impacts on water quality of discharges of waste and liquid effluents from the proposed exploratory drilling operation are expected to be minor and short-term.

(d) OTHER USES OF THE AREA

(i) Shipping Activities

The proposed drilling program will have no effects on shipping in the area since the program will be completed in the winter. Designated shipping fairways and anchorages have not been identified along most of the Alaskan Beaufort Sea coast; thus, vessel traffic is not likely to be concentrated in a single area.

(ii) Commerical and Sport Fishing

Fish stocks supporting the commercial fisheries in the Colville River area are not expected to be significantly influenced by the proposed project, since most anadromous fish occur inshore of the proposed drillsite. If an oil spill occurs as a result of the proposed project, containment and cleanup along with natural processes may reduce potential adverse impacts on fish to a low level. Anadromous Beaufort Sea fish species are capable of rapid movement and would probably avoid contaminated areas. Sport fishing does not occur in the project area.

(iii) Military Use

Military uses of the project area are not known to occur at the present time.

(iv) Existing Pipelines and Cables

There are no pipelines or cables known to be located in the project area.

(v) Mineral Resource and Development

Effects on mineral resources or development are not considered likely to occur due to implementation of the proposed exploratory drilling program.

(vi) Cultural Resources

If cultural resources are found in the course of operations, the Regional Supervisor, Field Operations (RSFO) of the Minerals Management Service (MMS) will be notified. Efforts will be made by the operator to preserve the resource until the RSFO designates how it is to be protected, as per Stipulation No. 2 of the Lease Sale 71 Lease Terms and Stipulations. It is considered highly unlikely that identifiable cultural resources are present in the area of the proposed drillsite (USDI, 1984).

(vii) Mariculture Activities

Mariculture activities are not currently conducted in the Beaufort Sea.

(viii) Subsistence Activities

ANILCA Section 810 Subsistence Evaluation

The following subsistence evaluation is presented in response to the requirements of the Alaska National Interest Lands Conservation Act (ANILCA) (16 USC § 3120 Section 810). This evaluation examines the potential effects of the proposed exploration project on subsistence users and needs (through effects on animal populations and distributions, and access to subsistence resources). It also examines availability of other lands that could be used for the proposed activities, and alternatives to the proposed plan which would reduce or eliminate the need for land used for subsistence purposes.

Historic and current subsistence activities and locations in the project region have been well documented (USDI, 1984; Jacobson and Wentworth, 1982; Tornfelt, 1982; Libbey, 1983). The village using the project area for subsistence is Nuiqsut. Primary subsistence resources for the Inupiats of the Nuiqsut are caribou, ducks, geese and fish (USDI, 1984). An important secondary resource is seals (ringed and bearded). Nuiqsut is located inland on the east bank of the Colville River, approximately 72 km (45 mi.) southeast of the project area.

(a) Factors Affecting Subsistence Uses and Needs

To determine that a significant restriction of subsistence uses and needs is reasonably forseeable, the following three potential factors have been considered: (1) potential to reduce the populations of harvestable resources, (2) potential to reduce availability of resources by alteration of their normal distribution patterns and (3) limitation of access to subsistence resources. Restrictions on subsistence use would be significant if there were: (1) large reductions in the abundance of harvestable resources, (2) major redistributions of these resources, (3) substantial interference with harvester access to active subsistence sites or (4) a major increase in non-subsistence harvests by non-resident workers. Following is a more specific discussion of these factors.

1) Potential to Reduce the Populations of Harvestable Resources

Caribou will be minimally affected by the proposed exploratory drilling project. The area located from Teshukpuk Lake to Cape Halkett is the calving and overwintering areas for the Teshukpuk Caribou Herd (Alaska Clean Seas, 1983). Substantial disturbance of calving caribou could affect regional population levels though mortality and reduced reproductive success. However, drilling activities will be located sufficiently far from the coast that noise generated will probably not be detectable in onshore areas. Project airplanes and helicopters will fly at a 457 m (1500 ft.) minimum altitude. As a result, normal operations will probably not significantly affect calving and wintering caribou. Logistical support activities at the onshore support base at Cape Halkett and along the access route between Prudhoe Bay/Deadhorse and the Cape Halkett area during the project may result in some disturbance of migrating and wintering caribou. Disturbance may result in the avoidance of specific areas and related stress effects. Population-level effects are considered unlikely to occur. Subsistence use of caribou by the villagers of Nuiqsut is primarily oriented toward the much larger Western Arctic Herd. It is considered unlikely that implementation of the proposed project will result on any significant adverse effects on this herd.

The population of bowhead whales seasonally present in the Beaufort Sea is considered unlikely to be affected by the proposed exploration activities. Studies in the Beaufort Sea have indicated that some disturbance sources associated with petroleum exploration, development and production activities can cause behavior modification in whales, particularly bowheads. It is considered highly unlikely that implementation of the Mars Exploration Project will affect bowhead whales because operations will not occur in the period that bowhead whales are present in the project area. Phytoplankton and zooplankton are the principal food sources for bowhead whales; fish are the primary prey for beluga whales. None of these food sources are considered likely to be adversely affected by the proposed project to a significant extent [See Section (4)(e)]. In addition, most bowhead whale feeding activity occurs in areas located east of Barter Island prior to the westward migration (Lowry and Burns, 1980).

Waterfowl do not utilize the project area during the period of project operations. Therefore, no significant direct effects on waterfowl populations are expected to result from implementation of the proprosed project. In addition, marine and anadromous fish populations are also not considered likely to be significantly directly affected by the proposed drilling program.

Ringed seal populations are not expected to be negatively affected by exploration activities. Ringed seal pupping occurs in the general area of the ice drilling island and offshore section of the ice access road. Project operations on the ice drilling island and access road may result in disturbance of pupping ringed seals in adjacent areas. Disturbance may result in avoidance of disturbed areas and relatively minor stress and pup mortality. Principal food sources for ringed seals (crustaceans, Arctic cod, and other small pelagic fishes) will probably not be significantly affected by the proposed exploration activities. Implementation of the project will probably not significantly affect the bearded seal, because of low population levels and lack of pupping activity in the project area.

In the unlikely event of an oil spill, several subsistence resources could be negatively affected. Oil spills would be most harmful to waterfowl, particularly during the molting period when the individuals are flightless. Large concentrations of molting oldsquaw have been observed in Simpson Lagoon and other coastal lagoons (Johnson and Richardson, 1981). Oiling decreases the insulating capability and buoyancy provided by feathers, resulting in hypothermia and/or drowning. Ingestion of petroleum from preening may also be detrimental. If a major spill reached the Beaufort Sea coast, sheltered areas in the barrier island lagoons and on the lee sides of spits and peninsulas would retain oil for longer periods of time than more exposed areas; these calmer areas are preferred habitats for oldsquaw and other species in July and August during the molting period preceding fall migration.

Because project operations will occur in the period when bowhead whales are not present in the project area, the risk of individuals of this species contacting an oil spill is relatively low. Potential effects of oil contact on bowheads range from skin and eye irritation to possible baleen fouling and oil ingestion (Cowles, 1981). Mortality rates resulting from contact with oil are undocumented but are probably low based on field studies of oil contamination of cetaceans [see Section 4(g)(i)]. If beluga whales confined to a lead in the ice contacted spilled oil, temporary skin irritation may occur, with effects generally lasting a few days (Geraci and St. Aubin, 1979; 1982). However, the minor skin irritations that develop on these animals have been observed to be reversible (Geraci and St. Aubin, 1982). Adult ringed, spotted and bearded seals and Pacific walruses that come into contact with spilled oil may develop skin and eye irritation, possibly resulting in infection. These effects may increase physiological stress and result in mortality of some individuals (Geraci and St. Aubin, 1979). Newborn seal pups may suffer direct mortality from hypothermia due to an insufficiently developed blubber layer (USDI, 1984).

The potential effects of an accidental oil or fuel spill on biological resources are discussed in more detail in Section (4)(g). It is considered highly unlikely that an oil spill will occur during exploration, based on previous experiences with OCS exploration activities (USDI, 1981).

In conclusion, the proposed exploratory drilling program will probably have no signficiant effects on subsistence annimal species population levels.

2) Potential to Reduce Availability of Resources by Alteration of their Normal Distribution Patterns

It is considered unlikely that the proposed exploration project will significantly affect the population distributions of any subsistence species in the project region. Although only limited data are available on fish distribution in the project area, the proposed activities are not considered likely to affect distribution. Numerous studies have shown that anadromous fish confine their movements in the Beaufort Sea to a narrow band of brackish water present along the coast. Arctic cod (an important marine species) are present in very large numbers wherever they have been studied. The migrations of this species consist of onshore-offshore movements across wide areas of the coast. Thus, their distribution is unlikely to be affected except possibly in the immediate vicinity of the ice drilling island.

Substantial numbers of individuals of waterfowl or other subsistence bird species will not be present in the project area during project operations.

Some avoidance of the project area, including the ice drilling island and access road, by ringed seals is considered likely to occur. However, natural changes in distribution, which are primarily a function of the location of the ice edge, may be considerably larger than potential local avoidance areas. Therefore, no significant changes in ringed seal distributions are expected to occur as a result of project implementation. Similarly, bearded seals may also avoid the immediate project area, but this effect would be local and may not be discernible from natural distribution variations.

3) Limitation of Access to Subsistence Resources

Three primary concerns regarding access to subsistence resources have been expressed by Inupiats of the North Slope: (1) the potential implementation of regulations limiting hunting use in traditional areas (to protect oil field facilities), (2) increased competition for resources from non-resident hunters and (3) the presence of offshore facilities physically preventing access to traditional use sites (USDI, 1984). Implementation of the proposed project will not result in the implementation of any regulations regarding subsistence activities by Inupiats.

Limitations of access to subsistence resources are not expected to result from project implementation. Nuiqsut hunters use the area located east of the proposed drilling site for fall bowhead whale hunting. Since project operations will not occur during this period, access limitations will not occur. The potential displacement of ringed seals from the immediate project area may result in required modifications of the potential hunting of this species in the project area. The taking of subsistence animal species by project personnel, including company and contracted personnel will not be permitted by the operator. Thus, competition for subsistence resources with Inupiat hunters will not occur.

(b) Availability of Other Lands that Could be Used for the Proposed Action

Since the objective of the proposed exploration project is to determine the hydrocarbon potential of the formations underlying the lease tract, alternative sites do not exist.

(c) Alternative Actions that Would Satisfy Project Goals Without Eliminating or Reducing the Use of Lands Needed for Subsistence Purposes

There are no alternatives that would accomplish the goal of the proposed exploratory drilling project.

(ix) Native Claim Allotments

Native claim allotments are not present in the project area.

(e) <u>FLORA AND FAUNA</u>

Implementation of the proposed exploratory drilling program could potentially result in the following three general types of negative impacts on marine organisms including phytoplankton, zooplankton, benthos, fish, mammals and birds:

- Direct mortality of individuals,
- Physical and chemical habitat changes, and
- Disturbance of sensitive species.

The ultimate potential population-level effects of habitat alteration and disturbance are reduced reproductive success and increased mortality.

Following is an analysis of the potential effects of project implementation on marine phyloplankton, zooplankton, benthos, fish, mammal and bird species. This section emphasizes potential effects resulting from routine exploratory drilling operations. The analysis of potential effects of drilling mud, cuttings and other discharges on marine organisms as a group is presented in Section (4)(e)(iv). The potential effects of accidents, including oil or fuel spills, on marine organism groups are discussed in Section (4)(g). Potential impacts to marine biota resulting from onshore activities are discussed in Section (4)(f).

(i) Pelagic Environment

(a) Phytoplankton

The discharge of drilling mud, cuttings, wash water, and sanitary and domestic wastes onto the ice may reduce ice algae growth due to reduced light passage through the ice and reduced photosynthesis. As the sea ice melts during breakup, these materials will be dispersed into the water column. Increased turbidity caused by these discharges may result in decreasing light penetration and photosynthesis. Short-term effects on phytoplankton and ice algae would probably only occur within a plume extending approximately 300 m (1,000 ft.) from the discharge point (Ecomar, 1978). Effects on regional primary productivity levels of phytoplankton and ice algae would be relatively minor. The potential effects of accidental oil or fuel spills on phytoplankton are discussed in Section (4)(g).

(b) Zooplankton

Localized increases in turbidity caused by the dispersal of drilling muds, cuttings, wash water, and sanitary and domestic wastes into the water column during breakup could have a short-term negative effect on some passive or slow-moving zooplankton species present in the water column in the plume areas. Any decreases in the phytoplankton population, as discussed in the previous section, would also be expected to cause a decrease in the zooplankton population it supports. In addition, the temporary clogging of filter-feeding mechanisms of some zooplankton could occur, resulting in decreased filtering and feeding efficiency. However, because of the relatively small area affected and short period of effect these factors would probably have a negligible impact on regional zooplankton populations. The potential effects of accident oil or fuel spills on zooplankton are discussed in Section (4) (g).

(c) Nekton

1) Marine Fish

Significant effects of the proposed project on marine fish are not anticipated. Discharged effluents will probably have only a minor effect on fish because of the generally low toxicity of drilling effluents to fish (LC_{50} values greater than 1,000 ppm), the rapid dispersal of effluents, and the high mobility and low densities of fish in the project region (USDI, 1984). The potential effects of accidental oil or fuel spills on fish are discussed in Section (4)(g).

2) Anadromous Fish

The proposed exploratory drillsite is located offshore of the areas regularly used by the largest numbers of anadromous fish; thus, no significant impacts on these species are considered likely to occur.

3) Whales

The potential direct and indirect effects on bowhead and beluga whales of increased water turbidity resulting from the discharge of materials from the drilling unit into the Beaufort Sea during spring breakup would be minor. This is due to the relatively large geographic areas typically used by these species and the relatively small area affected by the discharge plume. Other effects on whales are not expected to occur, because the period of project operation will be during the late fall, winter and early spring during periods of heavy sea ice cover when whales are not present in the project area in significant numbers. The potential effects of accidental oil or fuel spills on whales are discussed in Section (4)(g).

4) Seals

Seals will probably avoid the immediate area around the ice drilling island and access road while the drilling program is in progress. The road and drilling pad will be in place well before seals start denning in February. It is expected that no dens will be located near areas of human disturbance. Burns and Kelly (1982) reported that ring seals often abandoned dens that were within 150 m of human activity. Food, rather than denning sites is likely the limiting resource for them (Burns and Kelly 1982). This suggests that the activities during drilling operations will eliminate some potential denning sites, but will not measurably disturb the seal population.

(ii) Benthic Environment

Project-related activities that could directly or indirectly affect benthic organisms are: drilling mud and other discharges from the ice drilling island, construction of the ice drilling island and access road, and potential accidental oil spills.

Significant changes in the benthic environment resulting from the proposed exploratory drilling program are considered unlikely to occur. Short-term effects will be limited to coverage of benthic habitat by the ice drilling island and grounded section of the ice access road to the island and temporary seabed accumulations of settled solids from the discharged drilling mud, cuttings and other materials. Covering of benthic organisms may result in mortality of reduced reproductive success caused by smothering, inability to feed or other mechanisms (Hirsch, et al. 1978). It is considered unlikely that local mortality of benthic organisms would result in significant long-term regional population declines of affected species. Recolonization of affected areas would probably occur in a fairly short time period (e.g., 1-2 years) (ESL, 1982).

Based on the results presented for shallow water by NORTEC (1981), seafloor accumulations of discharged solids will be minor following project completion. The time required for replacement of benthic infaunal organisms lost as a result of accumulations of settled solids could vary from a few weeks (worms) to a few years (bivalves). However, the relative area affected is so small that such losses would be insignificant on a regional basis. The potential effects of accidental oil or fuel spills on benthic organisms are discussed in Section (4)(g).

(iii) Breeding Habitats and Migration Routes

(a) Fish

The proposed drillsite is not located near any known significant fish breeding habitats or migration routes. Onshore activities will take place in areas believed to be devoid of fish populations.

(b) Whales

No species of whales are known to breed in the project area. In addition, no known whale migration routes are known to be located in the immediate project area. A more detailed discussion of the potential effects of the project on whales is presented in Section (4)(e)(vi).

(c) Seals

Ringed seal pupping occurs in the project area in the spring. Concentrated migration routes of the ringed seal or bearded seal have not been recorded in the project area.

(d) Birds

Concentrated bird migration routes are generally present in areas located shoreward of the 20 m (66 ft.) isobath. Although project activities may occur during spring migration, significant effects on migration patterns and behavior are not considered likely to occur.

(e) Polar Bear

Polar bears occur in the project area throughout the winter and spring. They may be attracted to some extent to the ice island drilling camp and onshore support base. If polar bears are attracted to the area, efforts to force individuals to move away may be required.

(iv) Potential Effects of Drilling Fluids, Muds and Cuttings

Extensive research has demonstrated that only very high concentrations of drilling fluids, muds and cuttings have toxic effects on marine organisms (National Academy of Sciences, 1982). Such concentrations of drilling fluids would occur only in the immediate area of the discharge point near the proposed drillsite (Ayers, 1981).

A summary of the available data on the effects of drilling fluids, muds and cuttings on marine organisms is presented below. The summary is presented in three subsections: (1) dispersal of discharges, (2) toxic effects (acute and sublethal) and (3) heavy metals accumulation. These subsections reflect primary concerns relative to the potential effects of these materials on marine organisms.

(a) Dispersal of Discharges

Several studies have been conducted to examine drilling mud plume dynamics and the water-column fate of drilling fluid discharges (Ray and Shinn 1975, Zingula, 1975; Environmental Devices Corporation, 1976; Dames and Moore, 1978; Ecomar, 1978; Ayers et al., 1980; Ray and Meek, 1980; NORTEC, 1981; National Academy of Sciences, 1982). The dilution of the drilling discharge plume is dependent on the type and characteristics of the mud used, effluent discharge rate, water depth, and surface and subsurface currents. Ray and Shinn (1975) found that drilling fluid discharged at rates of 1.8 and 11.0 liters/second (31 bbl/hr and 190 bbl/hr respectively) may be diluted by factors of 1,000 to 1 and 100 to 1 (parts ocean water to parts discharged drilling fluids), respectively, in the direction of the prevailing current approximately 305 m (1,000 ft.) from the discharge point.

In recent studies, all contaminant components of drilling fluids that were investigated either settled to the ocean bottom or diffused to near-background levels within 1 to 2 hours after discharge. Background levels of total suspended solids have been reached between 350 and 1,500 m (1,148 and 4,921 ft. respectively) from the discharge point (National Academy of Sciences, 1982).

(b) Toxic Effects (Acute and Sublethal)

The toxicity of more than 20 spend offshore-type drilling fluids has been evaluated with 58 species of marine animals from the Atlantic and Pacific Oceans, Gulf of Mexico and Beaufort Sea (McLeay, 1976; Carls and Rice, 1980; ERCO, Inc. 1980; Gerber et al., 1980; Houghton et al., 1980; Neff, 1980; Tornberg et al., 1980; Neff et al., 1981). In addition, the toxicity of crude oils to Arctic organisms has been investigated (Rice et al., 1976; Malins, 1977, Busdosh, 1978; Duval et al., 1982).

Although bioassay methods and conditions varied considerably, the results of these studies are fairly consistent. All but a few of the 96-hour LC_{50} values exceeded 10,000 ppm drilling mud added. The lowest LC_{50} was 500 ppm whole mud for larvae of shrimp exposed to a high-density lignosulfonate mud from Cook Inlet (Carls and Rice, 1980). In most cases, these investigators attributed the sensitivity of these species to their intolerance of high concentrations of suspended particulates. Toxicity studies on Arctic amphipods and mysids produced 96-hour LC_{50} valves between 2 and 4 ppm. (Rice et al., 1980). DuVal et al. (1982) found the sublethal effects of oil on an Arctic isopod to persist only for 48 hours beyond oil exposure.

A number of investigations of sublethal responses of marine animals to drilling muds have been conducted. Sublethal responses include impairment of chemosensory responses in lobsters (Derby and Atema, 1981); alterations in patterns of embryological or larval development of grass shrimp, lobsters, sand dollars and killifish (Neff, 1980; Crawford and Gates, 1981; Gerber et al., 1981; Sharp et al., 1982); decreased food assimilation and growth efficiency in mysid shrimp (Carr et al., 1980); decreased shell growth and condition in oysters, mussels and scallops (Gerber et al., 1980; Neff, 1980; Rubinstein, et al., 1980); alterations in rates of filtration, respiration and nitrogen excretion in mussels (Gerber et al., 1980); changes in enzyme activity in tissues of several species of marine animals (Gerber et al., 1980; 1981); histopathological lesions in coonstripe shrimp and salmon fry (Houghton et al., 1980); and polyp retraction and reduced growth rate in corals (Hudson and Robbin, 1980; Thompson and Bright, 1980). These studies show that in the majority of cases, significant deleterious sublethal responses occur only at drilling fluid concentrations which are nearly as high as those that are acutely toxic, and that damage is probably caused by the same mechanism (i.e., high concentrations of suspended particulates).

The few field studies which have been completed to investigate the effects of drilling mud discharges on demersal, benthic and biofouling communities present in the areas of offshore exploratory drilling vessels and production platforms tend to support conclusions derived from laboratory studies, i.e., that the effects of mud discharges on marine organisms are minimal, and when detected, are of short duration and restricted to the benthos present in the immediate area of drilling material discharge (Zingula, 1975; Gettleson, 1978; Benech et al., 1980; Houghton et al., 1980; Lees and Houghton, 1980; Menzie et al., 1980; Monaghon et al., 1980; Mauer et al., 1981).

(c) Heavy Metals Accumulation

The heavy metals typically present in drilling fluids include chromium, barium, lead, zinc, mercury, cadmium, copper and iron. A number of labortory investigations of the bioaccumulation of some of the heavy metals present in drilling muds or drilling mud ingredients have been performed (Brannon and Rao, 1979; Liss et al., 1980; McCulloch et al., 1980; Page et al., 1980; Rubinstein et al., 1980; Tornberg et al., 1980; Espey, Huston and Associates, 1981; Gerber et al., 1981; and Carr et al., 1982). These studies, which evaluated a wide variety of marine organisms, generally show that heavy metals associated with the drilling muds analyzed have limited bioavailability to marine organisms. Chromium appears to be the most readily accumulated mud-associated metal. Organically bound and particle-absorbed heavy metals are usually substantially less bioavailable than the metal ions in solution. Significant bioaccumulation of barium may also occur.

Crippen and Hood (1980) evaluated increased metal concentrations in surficial sediments and benthic fauna resulting from drilling fluid disposal from an exploratory well in the Beaufort Sea. Elevated levels of mercury, lead, zinc, cadmium, arsenic and chromium were recorded within

45 m (148 ft.) of the discharge point. The density and biomass of benthic organisms were lower in affected areas. A correlation between metal concentrations in sediments and infaunal organisms was not found. The analysis suggested that mercury may be bioaccumulated in infaunal organisms in affected areas.

Field and laboratory studies in the Beaufort Sea completed by NORTEC (1981) did not record any changes in the abundance of benthic organisms related to discharges of drilling fluids. In addition, metals were not found to accumulate in the tissues of invertebrates or fish. Drilling effluents were determined to be present only in discharge areas for short periods of time.

In summary, the available data generally suggest that discharges of drilling fluids, muds and cuttings result in relatively minor effects on benthic and other invertebrate organisms present in the immediate area of deposition. Other organisms that are more mobile and wide-ranging are probably not adversely affected by drilling effluents to a measurable extent.

(v) Sensitive Underwater Features

Sensitive underwater features are not known to exist in the project area.

(vi) Endangered or Threatened Species

The bowhead whale is the only Federal Endangered or Threatened Species known to occur in the general project region during the open water season in significant numbers. As discussed previously, exploratory drilling operations will not take place during the spring or fall migration periods of the species, and significant effects of project implementation are not considered likely to occur.

Arctic peregrine falcons are confirmed as nestors along the Colville River, primarily in the foothills of the Brooks Range. All nests of this species are probably located upstream south of Ocean Point [40 km (25 mi.) inland] (USDI, 1984). Since this area is located considerably inland from the project area and proposed air travel routes, impacts on breeding individuals of this species are not considered likely to occur. Spring migrants may occur in the project area on a short-term basis and are also considered unlikely to be significantly affected by project implementation.

(vii) Cumulative Impacts

Cumulative impacts are defined in this analysis as interactive and additive impacts that could result from implementation of the proposed exploratory drilling program when combined with the impacts of other projects and activities which occur in the same geographic area and time period. Other offshore exploratory drilling programs in the Lease Sale 71 area may occur in 1985 in the same general region of the Beaufort Sea as the proposed project [see Section 2(o)].

Potential cumulative impacts of these combined projects are of the same general type as described for the proposed Amoco Mars exploratory drilling project. Based upon the proximity and scheduling of other potential projects, it is anticipated that cumulative impacts will be negligible.

(f) ONSHORE IMPACTS

(i) Socioeconomics

(a) Effects on Local Employment

Drilling, construction and support crews will consist of skilled and unskilled personnel from Prudhoe Bay/Deadhorse and areas outside the North Slope Borough. Most required project personnel are currently employees of Amoco or contractors that will be hired for the project. However, locally available personnel will be hired when possible, particularly for camp construction and maintenance of the onshore support base at Cape Halkett.

(b) Effects upon Local Population Centers and Industry

Nuiqsut and the other North Slope Borough villages are not expected to experience an influx of residents due to the Mars Project. Implementation of the project is considered unlikely to affect local population centers and industry.

(c) Effects of Increased Demands on Community Services

The proposed project will be self-contained and will not require services or infrastuctures from Nuiqsut or any other North Slope Borough Villages.

(d) Public Opinion

Comments from the public and from environmental advocacy groups in response to the Environmental Impact Statement prepared for OCS Lease Sale 71 generally recommended sale cancellation or delay of the sale by two years. Negative opinions were based on concerns over the possible impact on or changes to the environment and Inupiat lifestyles. Positive public opinions regarding development of the Lease Sale 71 area included recommendations that the proposed action be implemented on the basis of economic benefit to the North Slope and on the benefits of having additional national energy supplies.

(e) Effects on Transportation Systems

Logistical support activities associated with the proposed project are not expected to significantly affect transportation facilities at Nuiqsut. The existing airplane landing strip at Camp Lonely will not be utilized. Existing transportation facilities at Prudhoe Bay/Deadhorse, primarily including the airport and road system, are adequate to support logistical components of the proposed project. Adequate regional transportation is provided for by the Alaska highway and air transportation system. These systems will probably accomodate the expected demands of the project, and regional impacts are not expected.

(f) Effects upon Competition for Scarce Coastal Resources

Existing services, supplies and facilities at Prudhoe Bay/Deadhorse are adequate for supporting the proposed project. Substantial competition for resources, land or dock space is not expected to occur as a result of implementation of the proposed project.

(g) Effects on Subsistence Activities

The possible effects of project implementation on subsistence are discussed in detail in Section (4)(d)(viii).

(ii) Demand for Goods and Supplies

(a) Supplies and Equipment

Most supplies and equipment will be transported to the Cape Halkett onshore support base and the drilling island from Prudhoe Bay/Deadhorse or other locations. Implementation of the project will create a demand for certain supplies and equipment from sources at Prudhoe Bay/Deadhorse.

(b) Water

Freshwater required for the project will be obtained from a tundra lake located near the onshore support base at Cape Halkett. Project implementation will not result in any significant competion for freshwater in the project region.

(c) Aggregate Energy

Electricity for the onshore support base and ice drilling island will be generated on-site. All fuels required for the project will be obtained at Prudhoe Bay/Deadhorse and transported to the project area. The demand for fuel supplies at Prudhoe Bay/Deadhorse is not expected to exceed supplies.

(d) Other Resources

Additional resources are not expected to be required to complete the proposed project.

(iii) Environmental Impacts

(a) Impacts of Construction of Onshore Support Facilities

Construction of the onshore support base, including the airplane landing strip, and the onshore section of the ice access road will result in the covering of a relatively small area of ice and snow-covered tundra and dry tundra lake bottom. This will probably not result in any significant adverse effects on tundra vegetation. The transport of equipment and supplies with Rolligons over areas of tundra habitats present between Prudhoe Bay/Deadhorse and the project area may result in some disturbance of tundra vegetation, depending on specific characteristics of snow cover at the time of movement. The effects of onshore construction activities, including ice road building, on birds will be non-existent, since no bird species overwinter in the project area. Additionally, polar bears are not likely to be found in the landfast area, and fish species will not be migrating during construction periods.

(b) Other Impacts of Proposed Activities on the Onshore Environment

Additional impacts of the proposed project on the onshore environment have not been identified.

(g) ACCIDENTS

(i) Potential Impacts of a Major Accident

The proposed exploratory drilling program is designed to minimize the probability that an oil or fuel spill will occur. The drilling unit is equipped with the equipment required under OCS orders to prevent oil spills. If a spill occurs, the drilling unit is equipped with containment and cleanup equipment and, if necessary, the services of oil spill cooperatives, private contractors and other appropriate groups will be obtained to assist in the containment and cleanup efforts (see accompanying Oil Spill Contingency Plan for Exploration).

This section presents an analysis of the potential effects of a major accidental oil or fuel spill on the following species groups of marine organisms; the epontic community, invertebrates, fish, mammals and birds. It is unlikely that a major oil spill would occur at the onshore support facility. Thus, any impact upon terrestrial flora and flauna is expected to be minimal and to occur in a localized area.

The type, magnitude, duration and other characteristics of impacts on marine organisms potentially resulting from a major accidental oil or fuel spill associated with the proposed exploratory drilling program would depend on a large number of complex variables, primarily including spill timing, volume and location, and meteorological, oceanographic and biological conditions.

The analysis presented here emphasizes general responses of important marine organisms present in the Lease Sale 71 area to the presence of large volumes of oil or fuel. The analysis is not based on a specific oil or fuel spill scenarios (in terms of spill timing, volume and location, and environmental conditions) and is also not necessarily a "worst-case" analysis.

(a) Epontic Community

If a major oil or fuel spill occurred during exploration activities, the oil would probably spread under the ice layer. Oil is toxic to the epontic community, consisting of ice algae and associated invertebrates, that is present within the ice and at the ice-water interface. The oil would not tend to collect in pockets in the forming ice layer, but is likely to be carried through channels formed by hypersaline brine. The oil would then be able to contact the communities present at each newly formed interface as freezing continues. Oil effects on the algae also consist of the blocking of sunlight to the community. The overall effect of an accidental spill would depend on the amount of oil spilled and the under ice dispersion pattern of the oil. It is expected that the oil would be dispersed to a larger area during spring break-up, and have only minimal effects on phytoplankton.

(b) Marine Invertebrates

Many laboratory and field studies have shown that hydrocarbons (and dispersants) have lethal and sublethal effects on invertebrates (Lewbel, 1983). Many studes have evaluated species present in intertidal areas. Intertidal species are less sensitive than subtidal species. Effects have included mortality of organisms, resulting in reduced densities and biomass, and subsequent replacement by other species (Lewbel, 1983). Larval stages of marine invertebrates are generally most sensitive to the effects of oil spills (Lewbel, 1983). In general, crude oils are less toxic than refined oils or fuels. An oil or fuel spill in the Lease Sale area would probably spread and evaporate at lower rates than in areas with warmer water. Biodegradation rates of spilled oil or fuel in Arctic environments are lower than in temperate environments, although biodegradation does occur (Lewbel, 1983). Oil or fuel which was spilled under sea ice would require a relatively long period of time to disperse and weather.

In addition to sublethal effects on individual organisms, specific effects of oil or fuel on marine invertebrate species include: (1) reduced growth, (2) reduced reproductive rates and (3) altered behavioral patterns. These effects are generally considered to be those most likely to result in direct, long-term consequences at the population level.

(c) Fish

A large number of studies of the effects of oil on fish have also been conducted; however, most of these studies have been based on laboratory analyses of lethal and sublethal effects of oil on eggs or fry of a variety of species (Lewbel, 1983). These types of studies have emphasized determination of toxic concentrations required to produce specific adverse effects on individual organisms. The results of these studies have shown that a variety of sublethal effects and mortality result from the exposure of fish, including adults, juveniles and eggs, to oil. In general, larval fish are more sensitive to oil than adults. Sublethal effects have included a variety of behavioral, physiological and biochemical changes (USDC, 1984). The principal results of these changes include reduced gonadal development and reproduction. Organisms which are capable of avoiding oil are still susceptible to uptake from oil-contaminated food, sediments and water. Mortality results from toxic effects and asphyxiation due to smothering.

In general, pelagic fish species may be more sensitive to the effects of oil spills than demersal species (Lewbel, 1983). The most significant mortality of fish in the Lease Sale area and adjacent areas would result if large volumes of spilled oil contacted large numbers of eggs and larvae in the peak spawning periods of various fish species (USDI, 1984). Eggs and larvae of anadromous fish species using the Lease Sale area occur inland in rivers and streams and would be less likely to be affected. Young-of-the-year Arctic cod, the most important marine species present in the Lease Sale area, are present in nearshore and offshore areas, but in such large numbers that potential local population losses due to contact when spilled oil would probably have insignificant effects on the regional population. There is little likelihood of freshwater fishes being affected by oil spills. The lakes near the onshore facilities are generally too shallow to support fish populations, due to complete freezing during the winter. Any lakes in the area deep enough to support fish populations will be carefully protected from all contamination sources to maintain high water quality for human use.

(d) Marine Mammals

The principal adverse effects of spilled oil on marine mammals would result from oil ingestion or coating (Lewbel, 1983). The collective results of recent studies indicate that pinniped species with substantial blubber for insulation (ringed and bearded seals) would not be significantly affected by moderate coating with oil (Cowles, et al. 1981). Species that utilize fur for insulation (polar bears) could be significantly affected. The skin of some cetacean species appears to be relatively insensitive to oil

(Geraci and St. Aubin, 1982), but there is debate about the sensitivity of the skin of bowhead whales. Significant data or observations are not available on this question. There is little evidence to support the hypothesis that cetaceans may be able to detect and avoid oil spills. Observations of three species of whales feeding within or near an oil slick present off of the New England Coast indicated that the whales did not avoid the oil (Goodale et al., 1981). The effect of inhalation of oil vapor is unknown. Exposure to spilled oil on the water surface would probably not result in inhalation of liquid-phase oil through blowholes (USDC, 1984; USDI, 1984). However, brief eye irritation following short-term exposure of cetaceans to oil has been observed (Geraci and St. Aubin, 1982). These investigators considered it unlikely that moderate volumes of oil would irreversibly affect the functioning of baleen filtering mechanisms.

Observed effects of oil ingestion and immersion on seal species have included absorption of oil into body tissues, severe eye irritation, minor kidney damage and thermoregulatory problems (Lewbel, 1983). Eye irritation was generally temporary. Seals between the time of birth and the laying down of the blubber are expected to be more vulnerable to the thermal effects of oil coating. However, Geraci and Smith (1977) found that seals aged 3-4 weeks had acquired enough of a blubber layer to prevent surface heat loss. Adult seals and walrus may suffer some temporary eye and skin irritation; these may lead to infection and increased physiological stress and possibly even death. Contact with oil by polar bears has been shown to result in licking of the contaminated fur and subsequent vomiting, diarrhea, increased thirst and death (Lewbell, 1983). Body heat loss was also recorded. Specific physiological effects included peripheral blood cell breakdown, lack of bone marrow response, acute anemia and kidney failure.

In addition to these types of direct effects on marine mammals, a potential indirect effect of oil or fuel spills on these species includes reductions in the populations of prey species. Potential effects on major prey species groups, particularly marine invertebrates and fish, have been previously discussed. Severe reductions in the availability of important prey of whales and seals could potentially result in abandonment of specific feeding areas, reduced reproductive success and mortality.

(e) Birds

The potential effects of major oil spills on marine birds are well-documented (Lewbel, 1983). Confirmed effects include stress, reduced reproductive success and mortality. Direct contact with oil can affect birds in three ways: (1) loss of insulation capability due to coating of plumage with oil, (2) toxic effects resulting from the ingestion of oil, and (3) toxic effects of oil on eggs and chicks.

The covering of feathers with oil reduces insulation capability by allowing water to penetrate the plumage and reach the body surface (Lewbel, 1983). This results in loss of buoyancy (leading to drowning), hypothermia and toxic effects. The ingestion of oil may result in the following effects: interference with absorption of food and water, lipoid pneumonia, fatty changes in the liver, gastric irritation and hyperplasia of the adrenal cortex. Ingested and externally applied oil can directly affect reproductive success through lowered egg production rates, and egg and chick mortality. A variety of physiological effects are probably involved in this response.

The relative susceptibility of different marine bird species to the effects of oil spills is dependent on numerous factors related to their ecology and behavior. Species which are relatively common in the Lease Sale area during the open water period which are considered to be highly susceptible to oil spills include the oldsquaw, king eider and common eider (Lewbel, 1983).

(f) Mariculture Activities

Mariculture activities do not occur in the Lease Sale 71 region.

(g) Subsistence Use of Resources

Major accidental spills of oil or fuel associated with exploratory drilling operations could affect subsistence uses of resources by affecting: (1) the availability of the resources, (2) the ability to harvest the resources and (3) the food value of the resources. The availability of fish, mammals, birds and other organisms utilized for subsistence purposes could be affected by mortality or reduced reproductive success associated with contact with spilled oil or fuel resulting in reduced population levels of the organisms. The potential effects of contact with oil and fuel by these types of organims are discussed above in Section (4)(g)(i).

The ability of people to harvest organisms utilized for subsistence purposes could be affected by the presence of spilled oil or fuel in harvest areas or the presence of cleanup equipment, supplies and personnel. The presence of spilled oil or fuel could result in required movement to unaffected areas, and if harvest patterns changed, increased cost and effort, and increased competition for limited resources. The food value of animals utilized for subsistence purposes could be affected by tainting. The specific types and magnitudes of potential adverse effects of accidental oil or fuel spills on subsistence utilization of resources would be dependent on a large number of factors which have been previously discussed.

(ii) Impacts from Hydrocarbon Discharges Resulting from Routine Operations

There will be no discharge of hydrocarbons into the sea resulting from routine operations during the proposed exploratory drilling operation. Exhaust from engines will release some hydrocarbons into the atmosphere as discussed in Section (4)(b)(ii).

(5) ALTERNATIVES TO THE PROPOSED ACTION

A discussion of alternatives is not required in Environmental Reports for plans of exploration.

(6) UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

A low number of unavoidable adverse effects are expected to result from implementation of the proposed exploration program. It is considered likely that these impacts will be minimal and short term.

(a) OFFSHORE

(i) Air Quality

A minimal impact on air quality is likely to result from implementation of the project. Any effects of airborne pollutants produced by drilling or transportation activities are expected to be localized and of short duration. Air quality will exceed federal standards at all times.

(ii) Water Quality

Water quality will be affected by the released drilling muds and other discharges upon following melting of the surface ice. The effect of the muds and other materials will be short-term and local. The regional impact of project discharges on water quality will probably be insignificant. All discharges will be in accordance with conditions and limitations of the EPA NPDES permit.

(iii) Plankton

Effects of discharging drilling mud, cuttings and other materials onto the surface ice include the elimination of ice algae growth due to the blocking of light. This impact would occur in only a relatively small area around the discharge site. Localized turbidity increases caused by drilling mud and other effluent dispersal during breakup could have short-term negative effects on some passive or slow-moving organisms. The affected area is expected to be small and the duration of increased turbidity will be short.

(iv) Marine Mammals

Project implementation may result in the disturbance of ringed seals, possibly including pupping individuals, in the immediate project area.

(v) Benthic Environment

Changes in the benthic community present in the project area due to smothering and toxic effects may occur in the area where muds, drill cuttings and other effluent materials settle following breakup. This would occur in a limited area and discharges are likely to be rapidly dispersed, resuspended and diluted. A relatively small area of benthic habitat and benthos will be adversely affected by construction of the ice-island resulting in coverage of the sea bottom. However, recolonization of the disturbed area will probably occur fairly rapidly.

(b) ONSHORE

The impacts of the onshore support activities for the Mars Prospect exploration are expected to be minimal and localized.

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APPENDIX A

VESSEL SPECIFICATIONS

The activities associated with oil exploration of the Mars Prospect do not include the use of any support vessels.

APPENDIX B

ANALYSIS OF IMPACT OF AIR EMISSIONS FROM PROPOSED EXPLORATION ACTIVITIES ON ONSHORE AIR QUALITY

(1) INTRODUCTION

Section 5(a)(8) of the Outer Continental Shelf Lands Act Amendments of 1978 requires the Secretary of the Department of the Interior to prescribe regulations with provisions "for compliance with the National Ambient Air Quality Standards pursuant to the Clean Air Act (42 U.S.C. 7401 et. seq.) to the extent that activities authorized under the Act significantly affect the air quality of any State." The Minerals Management Service (formerly called the Conservation Division of the U.S. Geological Survey) published final air quality regulations on March 7, 1980, which are applicable to all facilities proposed or operating on the OCS (see 45 F.R. 15142).

Under the MMS regulations, a three-step process is created to determine whether emissions from OCS facilities have the potential to have or are having a significant effect on the ambient air quality of any onshore area. In step 1 (see 30 CFR 250.57-1(d) and 250.57-2(b)), an exemption formula is used to "screen out" those facilities which, because of their low emissions levels and distance from shore, are unlikely to significantly affect an onshore area. Under step 2 (see 30 CFR 250.57-1(e) and 250.57-2(c)), significance levels are established to determine whether emissions not exempted under step 1 significantly affect an onshore area. Finally, under step 3, controls are specified for those facilities that have the potential to affect or are significantly affecting an onshore area.

Exploration activities of the type described in this Environmental Report (Exploration) fall within the definition of "temporary facilities" in Section 250.2(fff). Therefore, an identification of the air emissions from the proposed exploration activities and an analysis of the impacts of these emissions on onshore air quality is necessary as part of this submission.

(2) DESCRIPTION OF AIR EMISSIONS

The major stationary source of gaseous emissions from the proposed activities is the large diesel engines used to power the drill rig and mud pumps. Other minor stationary source emissions include two small diesel-fired boilers and diesel-fired heater, a small light plant (small internal combustion engine), and a flare. Amoco presently plans to burn or flare any liquid hydrocarbons that may be recovered during well testing.

Mobile source emissions also are produced by the operation of support vehicles, aircraft, and helicopters. These mobile emissions are not considered part of the facility; however, these emissions are included for informational purposes.

(a) Emissions Produced as a Direct Result of Actual Drilling Operations

The MMS air quality regulations require that the lessee describe each major source of emissions from a facility, the amount of the emissions by air pollutant expressed in tons per year, and the frequency and duration of emissions. An explanation of the basis for all calculations is also required.

The stationary air emissions calculations provided in this analysis are based on the use of a diesel engine-powered rotary drilling rig. The emissions herein reflect specific equipment information provided by a local drilling company operator. These emissions are representative of the drilling equipment to be used for this exploratory program.

(b) Flaring Emissions

Insignificant amounts of pollutants may be produced if natural gas or oil is flared during the testing phase. The emissions associated with such flaring, or whether any flaring will be necessary at all, is dependent upon identification and testing of hydrocarbon zones as they might occur in each well. An estimate of air emissions that might result from flaring is presented in Table B-1.

Table B-1

FLARING CALCULATIONS

1,500 MCF[a]	x $\frac{1{,}050\ BTU}{well}$	=	1,575 MMBTU/well		
CO:	$\frac{1{,}575\ MMBTU}{well}$	x	$\frac{0.2\ lb\ CO}{MMBTU}$[b]	=	315 lb/well
THC:	$\frac{1{,}575\ MMBTU}{well}$	x	$\frac{0.25\ lb\ THC}{MMBTU}$[b]	=	394 lb/well
NO_x:	$\frac{1{,}575\ MMBTU}{well}$	x	$\frac{0.12\ lb\ NO_x}{MMBTU}$[b]	=	189 lb/well
SO_x:	$\frac{1{,}575\ MMBTU}{well}$	x	$\frac{0.0177\ lb\ SO_x}{MMBTU}$[c]	=	27.9 lb/well
TSP:	$\frac{1{,}575\ MMBTU}{well}$	x	$\frac{0.015\ lb\ TSP}{MMBTU}$[b]	=	23.6 lb/well

[a] During drillstem testing, it is anticipated that approximately 1,500 MCF of natural gas will be flared off during five hours for each well.

[b] Source of emission factors: National Airoil Burner Company
Philadelphia, Pennsylvania

[c] Based on assumption that H2^S content of natural gas is 110 ppm. The actual H_2S content of natural gas will not be known until after the exploratory well is drilled and gas is tested. The example of 110 ppm represents the mean H_2S concentration in natural gas in other parts of Alaska.

(c) Drilling Engine Emissions

The drilling engines would consist of seven Caterpillar 3412 diesel-fired internal combustion (I.C.) engines. Only five of these engines would operate at any one time. The engines would be used to power the drawworks and the mud pumps. Three of the engines would have a maximum load of 650 brake horsepower. Each of these three engines would operate at 50 percent load for 60 days during the exploratory program. The other two engines would be rated at 602 brake horsepower (maximum) and would operate at 75 percent load. One engine would operate for 60 days and the other would operate for about 100 days. The following emission factors were supplied by the Caterpillar Engine Co. for each of these engines:

Pollutant	Emission Rate (gm/hp-hr)
NO_x	6.59
SO_2	0.661
PM	0.323
CO	1.18
THC	0.104

Table B-2 shows the annual air emissions for this source.

(d) Boiler Emissions

Two small diesel-fired steam boilers would be provided for exploratory operations. These two boilers would total approximately 180 horsepower. The total fuel consumption rate would be approximately 58 gallons per hour (J. Schwalenberg, personal communication, 1985). These boilers would operate at 100 percent load for approximately 80 days. The emission factors for this equipment are taken from Table 1.3-1 (AP-42) and are as follows:

Pollutant	Emission Factor (lb/1000 gal)
NO_x	2.0
SO_2	56.8 (assume 0.4%S, wt)
PM	2
CO	5
THC	0.28

Table B-2 presents the annual air emissions for this source.

(e) Heater Emissions

A small 4.2 MMBTU/hr diesel-fired heater would also be used for exploratory operations. (A heating value of 135,000 BTU/gal was assumed.) This heater would operate at 100 percent capacity for a period of 80 days. The emission factors for this heater are identical to those given for the steam boilers in section (d). Table B-2 shows the annual air emissions for this source.

(f) Light Plant Emissions

A 50 horsepower diesel-fired electrical generator would be used to supply lighting requirements during exploratory operations. This generator would run at 100 percent of capacity for approximately 100 days. The emission factors for this generator are taken from Table 3.3.3-1 of AP-42 and are as follows:

Pollutant	Emission Factor (gm/hp-hr)
NO_x	14.0
SO_2	0.931 (assume 0.4%S, wt)
PM	1.0
THC	1.12
CO	3.03

Table B-2 shows the annual air emissions for this source.

(1) Transport of Supplies

Initial transport of supplies for the set up of the onshore support base will be by Rolligon and truck. Upon completion of the ice road, ice airstrip and ice island, supplies and crews will be flown to the support base by large cargo airplanes, DeHavilland Twin Otter, and helicopter. Supplies and crews will be transported to and from the ice island by Rolligon and truck over the ice road. Emissions for the transport of supplies and crews are based on the information provided in the project description and emission factors from AP-42 and subsequent supplements. A summary of the transportation emissions is provided in Table B-2.

(2) Ice Road and Ice Island Construction

The ice island and road will be constructed as described in the project description. Emissions associated with the construction of the road and island will result from the diesel powered pumps used to spray the water. Caterpillar D-3508 1,000 horsepower diesel engines will be used to power the pumps. The following schedule of pump requirements is expected and was used in conjunction with emission factors from AP-42 to develop the emissions presented in Table B-2.

Table B-2

SUMMARY OF PROJECTED AIR EMISSIONS
FOR EXPLORATION ACTIVITIES

Source	Pollutant/Emission Rate (ton/year)				
	NO_x	SO_2	TSP	THC	CO
Activities in Federal Waters					
Stationary Sources[a]					
Drilling Engines	22.8	2.3	1.1	0.4	4.0
Boilers	1.1	3.2	0.1	0.02	0.3
Heaters	0.6	1.7	0.1	0.01	0.1
Light Plant	1.9	0.1	0.1	0.1	0.4
Flaring[b]	0.1	0.01	.01	0.2	0.2
Total	26.5	7.3	1.4	0.7	5.0
Mobile Sources					
C-130 Hercules	1.7	0.3	0.8	3.7	5.8
DeHavilland Twin Otter	0.01	--	--	0.04	0.1
Helicopter	0.1	0.01	0.01	0.2	0.4
Fork Lifts	2.2	0.3	0.1	0.1	0.2
Total	4.0	0.6	9.0	4.0	6.5
DOI Exemption Level	119.9	119.9	119.9	119.9	8020.5

[a] Information on equipment use and emission factors supplied by Parker Drilling Company in telephone conversation of 9/16/85.

[b] Table B-2 of ERE; August 1985.

APPENDIX C

COASTAL ZONE MANAGEMENT

CONSISTENCY EVALUATION

The exploration and development of petroleum resources within coastal areas of the State of Alaska must be in compliance with the standards set forth in the Alaska Coastal Management Program (ACMP) and published in the Alaska Administrative Code, Part 6, Chapter 80. Activities occurring in federal waters, beyond the jurisdiction of the State of Alaska should also be conducted in a manner which is consistent with the ACMP when these activities could have a direct and significant influence on coastal resources.

The ACMP standards which provide a basis for determining the consistency of proposed exploration activities are identified in the following discussion. The ACMP standards in 6 AAC Section 80.060 Recreation, 80.100 Timber Harvest and Processing, and 80.110 Mining and Mineral Processing are not applicable and are not discussed.

Exploration activities will be conducted in accordance with MMS regulations as contained in 30 CFR Part 250, OCS Orders, and all applicable stipulations, lease terms, and Notices to Lessees. All required permits or licenses will be obtained, and activities will be conducted in compliance with such permits and licenses.

POLICY | EVALUATION

6 AAC 80.040 COASTAL DEVELOPMENT

(a) In planning for and approving development in coastal areas, districts and state agencies shall give, in the following order, priority to:

(1) water-dependent uses and activities;

(2) water-related uses and activities; and

(3) uses and activities which are neither water-dependent nor water-related for which there is no feasible and prudent inland alternative to meet the public need for the use or activity.

(b) the placement of structures and the discharge of dredged or fill material into coastal water must, at a minimum, comply with the standards contained in Parts 320-323, Title 33. Code of Federal Regulations (Vol. 42 of the Federal Register, pp. 317133 - 47 (July 19, 1977). (Eff. 7/18/78, Reg. 67; am 8/18/79, Reg. 71)

Authority: AS 44.19.893
AS 46.40.040

Assessment: Exploratory drilling on the OCS is a water-dependent activity. Accordingly, the onshore coastal uses are to be given coastal development priority.

Drilling equipment undertaking exploration activities on the OCS are subject to the permitting procedures of the U.S. Army Corps of Engineers. A nationwide permit for OCS exploration and development activities has been promulgated. It imposes the following special conditions on the permittee:

(1) the discharge will not destroy a threatened or endangered species or destroy or adversely modify the critical habitat of such a species;

(2) the discharge will be free of toxic pollutants in toxic amounts; and

(3) certain "best management" practices set out in 33 CFR 330.6 of the Corps regulations must be followed.

Amoco's activities are covered by the nationwide permit issued by the Corps of Engineers under 33 CFR § 330.5 and will comply with all the applicable conditions and management practices designed to ensure protection of water quality and living marine resources. No new structures will be permanently placed in Alaska territorial waters during the proposed program.

Consistency: Amoco's proposed activities are consistent with this policy.

POLICY	EVALUATION
6AAC 80.050. GEOPHYSICAL HAZARD AREAS. (a) Districts and state agencies shall identify known geophysical hazard areas and areas of high development potential in which there is a substantial possibility that geophysical hazards may occur. (b) Development in areas identified under (a) of this section may not be approved by the appropriate state or local authority until siting, design, and construction measures for minimizing property damage and protecting against loss of life have been provided. (Eff. 7/18/78, Reg. 67) Authority: AS 44.19.893 AS 46.40.040	Assessment: The MMS has identified the possible presence of gas charged sediments in the project area. Faults are also present in the project area. No onshore activities are planned except for logistics support from existing facilities at Camp Lonely and new facilities on Cape Halkett. The well location has been selected to avoid, where possible, any identified anomalies. Potential risks to coastal resources from geophysical hazard areas will be properly mitigated. Consistency: Amoco's proposed activities are consistent with the enumerated policy.
6AAC 80.070. ENERGY FACILITIES. (a) Sites suitable for the development of major energy facilities must be identified by the state in cooperation with districts. (b) The siting and approval of major energy facilities by districts and state agencies must be based, to the extent feasible and prudent, on the following standards: (1) site facilities so as to minimize adverse environmental and social effects while satisfying industrial requirements; (2) site facilities so as to minimize adverse environmental and social effects while satisfying industrial requirements; (3) consolidate facilities;	Assessment: The proposed exploratory drilling activities are temporary and, therefore, not considered to be a major energy facility. It is anticipated that the effects on coastal resources from the proposed exploration activities will be minor. Necessary precautions will be taken to ensure that the drilling unit does not constitute a navigation hazard. The drilling rig will be equipped with navigation, lighting and safety equipment which complies with all U.S. Coast Guard requirements. Prior to the initiation of drilling, the U.S. Coast Guard will issue a Notice to Mariners informing vessel captains in the area of the exact location of the drilling unit in the Beaufort Sea.

POLICY	EVALUATION
(4) cooperate with landowners, developers, and federal agencies in the development of facilities; (6) select sites with sufficient acreage to allow for reasonable expansion of facilities; (7) site facilities where existing infrastructure, including roads, docks, and airstrips, is capable of satisfying industrial requirements; (8) select harbors and shipping routes with least exposure to reefs, shoals, drift ice, and other obstructions; (9) encourage the use of vessel traffic control and collision avoidance systems; (10) select sites where development will require minimal site clearing, dredging and construction in productive habitats;	An Oil Spill Contingency Plan has been prepared which explains in detail the steps which will be taken to prevent the spillage of oil and to effectively respond to a spill so as to prevent adverse impacts on the environment. State-of-the-art response equipment will be available on-site to allow rapid response to spill events; more equipment and personnel will be available from Deadhorse and other points within and outside Alaska as necessary to contain and clean up spilled oil. Personnel will receive extensive training in use and deployment of oil spill response equipment. The Oil Spill Contingency Plan outlines a strategy for protecting sensitive shoreline areas from spilled oil in the event a major spill would reach the shoreline.
(11) site facilities so as to minimize the probability, along shipping routes, of spills or other forms of contamination which would affect fishing grounds, spawning grounds, and other biologically productive or vulnerable habitats including marine mammal rookeries and hauling out grounds and waterfowl nesting areas;	The air quality impact analysis which appears in Appendix B of this report demonstrates that the emissions resulting from the proposed activities are minor in nature and should not have any adverse impact on onshore or offshore air quality.
(12) site facilities so that design and construction of those facilities and support infrastructures in coastal areas of Alaska will allow for the free passage and movement of fish and wildlife with due consideration for historic migratory patterns and so that areas of particular scenic, recreational, environmental, or cultural value will be protected;	All discharges into ocean waters will be temporary and will comply with standards, limitations and conditions imposed by the U.S. Environmental Protection Agency through the NPDES permit process. Any solid or liquid wastes trans-

POLICY	EVALUATION
(13) site facilities in areas of least biological productivity, diversity, and vulnerability and where effluents and spills can be controlled or contained;	ported to shore will be disposed in a manner and at a location consistent with all applicable laws and regulations.
(14) site facilities where winds and air currents disperse airborne emissions which cannot be captured before escape into the atmosphere;	No fishing occurs in the immediate project area.
(15) select sites in areas which are designated for industrial purposes and where industrial traffic is minimized through population centers; and	
(16) select sites where vessel movements will not result in overcrowded harbors or interfere with fishing operations and equipment.	
(c) Districts shall consider that the uses authorized by the issuance of state and federal leases for mineral and petroleum resource extraction are uses of state concern. (Eff. 7/18/78, Reg. 67; am 8/18/79, Reg. 71) Authority: AS 44.19.893 AS 46.40.040	An Environmental Training Program will be required by all personnel involved in the project. This program will familiarize personnel with the nature and value of near-by subsistence activities, the habits and sensitivity to disturbance of regional wildlife and other environmental issues. <u>Consistency</u>: The proposed temporary activities are consistent with this policy.
6AAC 80.120. SUBSISTENCE (a) Districts and state agencies shall recognize and assure opportunities for subsistence usage of coastal areas and resources.	<u>Assessment</u>: The proposed exploratory activities will occur in areas that are seasonally occupied by subsistence species, including whales, seals and polar bears.
(b) Districts shall identify areas in which subsistence is the dominant use of coastal resources.	
(c) Districts may, after consultation with appropriate state agencies, Native corporations, and any other persons or groups, designate areas identified under (b) of this section as subsistence zones	To mitigate potential adverse impacts to these resources due to the accidental discharge of oil, Amoco has prepared an Oil Spill Contigency Plan. This plan includes training drills to familiarize

POLICY	EVALUATION

in which subsistence uses and activities have priority over all nonsubsistence uses and activities.

(d) Before a potentially conflicting use or activity may be authorized within areas designated under (c) of this section, a study of the possible adverse impacts of the proposed potentially conflicting use or activity upon subsistence usage must be conducted and appropriate safeguards to assure subsistence usage must be provided.

(3) Districts sharing migratory fish and game resources must submit compatible plans for habitat management. (Eff. 7/18/78, Reg. 67)

Authority: AS 44.19.893
AS 46.40.040

6 AAC 80.130 HABITATS (a) Habitats in the coastal area which are subject to the Alaska coastal management program include:

(1) offshore areas;
(2) estuaries;
(3) wetlands and tideflats;
(4) rocky islands and seacliffs;
(5) barrier islands and lagoons;
(6) exposed high energy coasts;
(7) rivers, streams and lakes; and
(8) important upland habitat.

(b) The habitats contained in (a) of this section must be managed so as to maintain or enhance the biological, physical and chemical characteristics of the habitat which contribute to its capacity to support living resources.

(c) In addition to the standard contained in (b) of this section, the following standards apply to the management of the following

employees with the equipment and procedures, and lectures on the nature and sensitivity of subsistence resources.

In addition, Amoco will employ state-of-the-art technology while drilling the well. This technology will minimize the risk of accidental discharge of petroleum products

All other discharges will be in compliance with th
e limitations
imposed in the NPDES permit.

Consistency: Because of the seasonal timing of the drilling activities, no significant impacts to subsistence activities or resources are expected. Therefore, the proposed activities are consistent with the outlined policy.

Assessment: The proposed activities will primarily occur within offshore areas and are not expected to influence other coastal habitats. Activities that do occur in coastal areas are not expected to result in any signficant adverse effects on coastal resources. The proposed exploratory drilling activities are expected to have an insignificant impact on the important biological, physical or chemical habitats of the Beaufort Sea, including Alaska territorial waters and coastline.

The activities will comply with all applicable requirements of the Minerals Management Service, U.S. Environmental Protection Agency, U.S. Coast Guard and U.S. Army Corps of Engineers. This includes compliance with all MMS standards, criteria and requirements for casing design, casing, cementing, BOP installation and testing, mud

POLICY	EVALUATION

habitats:

(1) offshore areas must be managed as a fisheries conservation zone so as to maintain or enhance the state's sport, commercial, and subsistence fishery;

(2) estuaries must be managed so as to assure adequate water flow, natural circulation patterns, nutrients, and oxygen levels, and avoid the discharge of toxic wastes, silt, and destruction of productive habitat;

(3) wetlands and tideflats must be managed so as to assure adequate water flow, nutrients, and oxygen levels and avoid adverse effects on natural drainage patterns, the destruction of important habitat, and the discharge of toxic substances;

(4) rocky islands and seacliffs must be managed so as to avoid the harassment of wildlife, destruction of important habitat, and the introduction of competing or destructive species and predators;

(5) barrier islands and lagoons must be managed so as to maintain adequate flows of sediments, detritus, and water, avoid the alteration or redirection of wave energy which would lead to the filling in of lagoons or the erosion of barrier islands and discourage activities which would decrease the use of barrier islands by coastal species, including polar bears and nesting birds;

(6) high energy coasts must be managed by assuring the adequate mix and transport of sediments and nutrients and avoiding redirection of transport processes and wave energy; and

programs, well control, surveillance and training, directional survey, hydrogen sulfide detection and safety measures, testing, inspection and reporting. In addition, all standards, limitations and conditions for ocean discharges established in the NPDES permit process will be met.

Compliance with all regulatory requirements will ensure that the proposed activities will be conducted in a safe and prudent manner and that water quality and important habitat areas are not adversely affected.

Consistency: The proposed activities are consistent with the policy.

POLICY	EVALUATION
(7) rivers, streams, and lakes must be managed to protect natural vegetation, water quality, important fish or wildlife habitat and natural water flow.	
(d) Uses and activities in the coastal area which will not conform to the standards contained in (b) and (c) of this section may be allowed by the district of appropriate state agency if the following are established:	
(1) there is a signficant public need for the proposed use or activity;	
(2) there is no feasible prudent alternative to meet the public need for the proposed use or activity which would conform to the standards contained in (b) and (c) of this section; and	
(3) all feasible and prudent steps to maximize conformance with the standards contained in (b) and (c) of this section will be taken.	
(e) In applying this section, districts and state agencies may use appropriate expertise, including regional programs referred to in sec 30 (b) of this chapter. (Eff. 7/18/78, Reg. 67) Authority AS 44.19.893 AS 46.40.040	
6 AAC 80.140. AIR, LAND AND WATER QUALITY. Notwithstanding any other provision of this chapter, the statutes pertaining to and the regulations and procedures of the Alaska Department of Environmental Conservation with respect to the protection of air, land and water quality are incorporated into the Alaska coastal management program	<u>Assessment</u>: The MMS has published air quality regulations that are applicable to all facilities proposed or operating on the OCS. Appendix B presents an analysis of the air emissions from the proposed activities. These emissions are considerably less than the emission exemption amount. Activities in state waters or onshore will comply

POLICY	EVALUATION
and, as administered by that agency, constitute the components of the coastal management program with respect to those purposes. (Eff. 7/18/78, Reg. 67) Authority: AS 44.19.893 AS 46.40.040	with applicable water, air and oil pollution control statutes and regulations. <u>Consistency</u>: The activities proposed by Amoco are consistent with the stated policy.
6AAC 80.150 HISTORIC, PREHISTORIC, AND ARCHAEOLOGICAL RESOURCES. Districts and appropriate state agencies shall identify areas of the coast which are important to the study, understanding, or illustration of national, state, or local history or prehistory. (Eff. 7/18/78, Reg. 67) Authority: AS 44.19.893 AS 46.40.040	<u>Assessment</u>: No activities in Alaskan waters or lands will disturb historic, prehistoric or archaelogical resources. No known historic, prehistoric or archaeological sites exist on the lease block where Amoco plans to drill. In the unlikely event of a major oil spill, Amoco has prepared an Oil Spill Contingency Plan to prevent oil from reaching shore where such resources might be affected. <u>Consistency</u>: The proposed activities are consistent with the stated policy.