2.0 PROJECT ALTERNATIVES

2.1 INTRODUCTION

The proposed development of the Redoubt Shoal Unit includes the following components:

- Drilling and operation of wells for production of oil, natural gas, and natural gas liquids
- Installation of oil, natural gas, and natural gas liquids processing equipment onboard the Osprey Platform
- Construction and operation of an onshore production facility located near Kustatan on the West Foreland
- Construction and operation of pipelines to transport oil, natural gas, and/or natural gas liquids (NGLs) from the Osprey Platform ultimately to existing pipeline systems located onshore at Trading Bay on the west side of Cook Inlet.

2.1.1 Options Development and Screening Process

Various location/engineering/environmental options were initially considered and eliminated during the options development and screening process (NCG 2001). Options eliminated as part of the initial planning stage include:

- Location of the production platform in deeper water directly over the Redoubt Shoal Unit: This option would have required construction of a platform in considerably deeper water where currents are particularly strong. Potential conflicts would occur with both the fishing industry and with marine traffic operating in the area. Maximum reaches from the proposed platform location to the potential reservoirs will be 20,000 feet, which is well within capabilities of existing technology; as such, the deep water option was not considered further.
- Offshore discharge of drilling muds and cuttings: This option could have resulted in potentially significant impacts on the marine environment and would have necessitated the preparation of an EIS. These materials will be disposed of by grinding and injection into subsurface formations
- Location of the Kustatan Production Facility at the former Kustatan Village site: This site could have resulted in potentially significant impacts on the cultural resources associated with that site. The facility and roads to the tip of the West Forelands now avoid areas of potential impacts on cultural resources associated with the former Kustatan Village.

These options are no longer being considered and are not evaluated further in this EA.

Options related to the transport of oil, gas, and natural gas liquids from the Osprey Platform to a new production facility near Kustatan or to the Trading Bay Production Facility are evaluated in this EA. In addition, the options related to the mode of construction of the transition through the bluffs at the West Foreland or Trading Bay areas are considered. Specific options include boring through the bluff (included in Alternatives 1 and 2), and bluff cut/trenching (included in Alternatives 1, 2, and 3).

2.1.2 Alternatives Identification

The following sections describe the major components of the proposed project and alternatives, including the Osprey Platform; underwater pipelines and utilities; onshore pipelines; and the proposed Kustatan Production Facility. Pipelines connecting the Kustatan Production Facility to existing onshore infrastructure are not evaluated as part of this EA because the pipelines/access roads from this location to the West McArthur River Unit and Trading Bay Production Facility were considered during the environmental review of the Tomcat Exploratory Drilling Project. Proposed pipeline routes are shown in Figure 2-1. The following alternatives are described in detail in Section 2.2:

- Proposed project (Alternative 1): Includes conversion of the Osprey Platform to production operations, construction of the Kustatan Production Facility, and construction of 1.8-mile underwater and 1.8-mile onshore pipelines/utilities from the Osprey Platform to the proposed production facility.
- Alternative 2: Includes conversion of the Osprey Platform to production operations, construction of the Kustatan Production Facility, and construction of 3.3-mile underwater pipelines/utilities from the Osprey Platform to the proposed production facility.
- Alternative 3: Includes conversion of the Osprey Platform to production operations, and construction of 10.5-mile underwater pipelines/utilities from the Osprey Platform to the Trading Bay Production Facility.
- Alternative 4: No action.

2.2 PROPOSED PROJECT (ALTERNATIVE 1)

2.2.1 Osprey Platform

The Osprey Platform, by design, is a movable drilling platform that has been constructed to support exploration drilling operations for the Redoubt Shoal Unit (Figure 2-2). The platform was placed onsite during late June 2000, approximately 1.8 miles southeast of the end of the West Foreland (latitude 60^{O} 41’ 46” N, longitude 151^{o} 40’ 10” W). The water depth at the site is approximately 45 feet (referenced to mean lower low water). The platform is designed to handle anticipated oceanographic, meteorological, and seismic design conditions for the area (see Table 2-1) (NCG 2001).

At the completion of the exploration drilling operations (which have been conducted under the general NPDES permit for Oil and Gas Exploration [AKG285024]), the Osprey Platform will be used to support offshore production operations as described below, or be removed if oil and gas are not found in commercial quantities. Platform conversion would include the addition of limited production equipment and the installation of underwater pipelines and utility lines.

If the platform is not to be converted to production, wells will be plugged and abandoned, the piling and conductors will be cut and the platform floated off-location (similar to the manner in which it was floated on location). These operations would be conducted in accordance with regulations and appropriate approvals from the AOGCC, the Alaska Department of Natural Resources (ADNR), and the Minerals Management Service (MMS).

Figure 2-3 provides a schematic of the process flow for production operations onboard the Osprey Platform. Production activities are summarized below.

2.2.1.1 Completion

After confirmation of a successfully producing formation, the well will be prepared for hydrocarbon extraction, or "completion." The completion process includes setting and cementing of the production casing; packing the well; and installing the production tubing. During the completion process, equipment is installed in the well to allow hydrocarbons to be extracted from the reservoir. Completion methods are determined based on the type of producing formation, such as hard or loose sand, and consist of four steps: wellbore flush, production tubing installation, casing perforation, and wellhead installation.

2.2.1.2 Fluid Extraction

The fluid that will be produced from the oil reservoir consists of crude oil, natural gas, and produced water. Production fluids will flow to the surface, through tubing inserted within the cased borehole, using electric submersible pumps. As hydrocarbons are produced, the natural pressure in the reservoir decreases and additional pressure must be added to the reservoir to continue production of the fluids. The additional pressure will be provided artificially to the reservoir using waterflooding, which is the injection of water into the reservoir to maintain formation pressure that would otherwise drop as the withdrawal of the formation fluids continues.

2.2.1.3 Fluid Separation

As the produced fluids (natural gas, crude oil, and produced water) surface from the wells, the gas will be separated from the liquids in a two-phase separator on the platform. The wet gases from the separator will pass through a glycol dehydrator to remove water and then will be used to support platform heating or will be shipped by pipeline to the Kustatan Production Facility. A low-pressure relief and vent system will be provided on the Osprey Platform. The low-pressure vent system will be connected to a flare scrubber and routed to a low-pressure flare. This flare is intended for use as vessel/piping safety depressurization in the event of platform emergencies.

Liquids will be pumped to the Wet Oil Surge Vessel and then pumped to the Kustatan Production Facility for oil-water separation. There will be no storage capacity onboard the Osprey Platform for separated liquids. The produced water separated from the crude oil at the Kustatan Production Facility will then be pumped back to the Osprey Platform by pipeline for downhole injection to maintain formation pressures within the Redoubt Shoal Unit.

2.2.1.4 Well Treatment

Well treatment is the process of stimulating a producing well to improve oil or gas productivity. It is not anticipated that stimulation will be needed for the wells. However, if well treatment is required at the Osprey Platform, the method used will be acid treatment. Acid stimulation is performed by injecting acid solutions into the formation. The acid solution dissolves portions of the formation rock, thus enlarging the openings in the formation. The acid solution must be water soluble, safe to handle, inhibited to minimize damage to the well casing and piping, and inexpensive.

2.2.1.5 Workover

Workovers or treatment jobs occur approximately once per year. Workover operations are performed on a well to improve or restore productivity, repair or replace downhole equipment, evaluate the formation, or abandon the well. Workover operations include well pulling, stimulation (acidizing and fracturing), washout, reperforating, reconditioning, gravel packing, casing repair, and replacement of subsurface

equipment. The four general classifications of workover operations are pump, wireline, concentric, and conventional. Workovers can be performed using the original derrick. The operations begin by using a workover fluid to force the production fluids back into the formation, to prevent them from exiting the well during the operation.

2.2.1.6 Well Drilling

Rotary drilling is the process that is used to drill the well. The rotary drill consists of a drill bit attached to the end of a drill pipe. The most significant waste streams, in terms of volume and constituents associated with the drilling activities, are drilling fluids and drill cuttings. Drill cuttings are particles (e.g., sand, gravel, etc.) generated by drilling into subsurface geological formations and carried to the surface with the drilling fluid. The drilling fluid, or mud, is a mixture of water, special clays, and certain minerals and chemicals used to cool and lubricate the bit, stabilize the walls of the borehole, and maintain equilibrium between the borehole and the formation pressure. The drilling fluid is pumped downhole through the drill string and is ejected through the nozzles in the drill bit and then circulated to the surface through the annulus. The drilling fluids will be separated from the drill cuttings on the platform for use as make-up drilling fluids.

2.2.1.7 Fuel Tanks

Primary fuel tanks will include a 20,000-gallon main tank (Tank 1) located in the platform Lower Deck, and two 4,000-gallon tanks (Tanks 2 and 3) integral to each of the two pedestal cranes. Tank 1 is filled directly by supply vessels through either of two marine transfer stations located on the platform. The two pedestal tanks may either be filled directly by marine transfers or from Tank 1. These primary tanks are constructed to Det Norske Veritas Standards (NCG 2001) and are equipped with level gauges and high level alarms. The platform serves as secondary containment for the entire volume of Tank 1; Tanks 2 and 3 do not have secondary containment for their entire volumes.

2.2.1.8 Permitted Discharges from the Osprey Platform

Deck Drainage. Deck drainage refers to any waste resulting from platform washing, deck washing, spillage, rainwater, and runoff from curbs, gutters, and drains, including drip pans and wash areas. This could also include pollutants, such as detergents used in platform and equipment washing, oil, grease, and drilling fluids spilled during normal operations (Avanti 1992). On the Osprey Platform, contaminated deck drainage will be treated through an oil-water separator prior to discharge (Amundsen 2000a). Non-contaminated deck drainage will be discharged with no treatment. The average flow of deck drainage from the platform will be 108,000 gallons per day (NCG 2001), depending on precipitation. This discharge will be in accordance with the appropriate water quality standards for the state of Alaska (18 AAC 70.020).

Sanitary Waste. Sanitary waste is human body waste discharged from toilets and urinals. The sanitary waste system on the Osprey Platform, an aerated marine sanitation device, will serve a 3- to 55-person crew residing on the platform at any one time. The expected maximum quantity of sanitary waste discharged is 2,020 gallons per day (United Industries Group 1998 and NCG 2001). The pollutants associated with this discharge include suspended solids, 5-day biochemical oxygen demand (BOD_5), fecal coliform, and residual chlorine. All sanitary discharges will be in accordance with the appropriate water quality standards and effluent treatability requirements for the state of Alaska (18 AAC 70, 18 AAC 72, and 40 CFR 133.105).

Domestic Waste. Domestic waste (gray water) refers to materials discharged from sinks, showers, laundries, safety showers, eyewash stations, and galleys. Gray water can include kitchen solids, detergents, cleansers, oil and grease. Domestic waste will not be treated prior to discharge. The expected quantity of domestic waste discharged is 4,000 gallons per day (NCG 2001). All domestic discharges will be in accordance with the appropriate water quality standards for the state of Alaska (18 AAC 70).

Boiler Blowdown. Boiler blowdown is the discharge of water and minerals drained from boiler drums to minimize solids build-up in the boiler. Boiler blowdown discharges are "not planned or likely, but possible to occur intermittently" (Amundsen 2000a). The expected quantity of boiler blowdown is 100 gallons per event. Boiler blowdown will be treated through an oil-water separator prior to discharge (Amundsen 2000a). This discharge will be in accordance with the appropriate water quality standards for the state of Alaska (18 AAC 70).

Fire Control System Test Water. Fire control system test water is seawater that is released during the training of personnel in fire protection, and the testing and maintenance of fire protection equipment on the platform. This discharge is intermittent, and is expected to occur approximately 12 times per year. The expected quantity of fire control system test water is 750 gallons per minute (gpm) for 30 minutes, for a total discharge per event of 22,500 gallons. Contaminated fire control system test water will be treated through an oil-water separator prior to discharge. This discharge will be in accordance with the appropriate water quality standards for the state of Alaska (18 AAC 70).

Non-Contact Cooling Water. Non-contact cooling water is seawater that is used for non-contact, once-through cooling of various pieces of machinery on the platform. The expected quantity of non-contact cooling water is 300,000 gallons per day (gpd). This discharge will be in accordance with the appropriate water quality standards for the state of Alaska (18 AAC 70).

Excess Cement Slurry. Excess cement slurry will result from equipment washdown after cementing operations. Excess cement slurry will be discharged intermittently while drilling, depending on drilling, casing, and testing program/problems (Amundsen 2000a). Approximately 30 discharge events are anticipated per year, with a maximum discharge of 100 barrels (or 4,200 gallons) per event. Excess cement slurry will not be treated prior to discharge. Discharge will be in accordance with the appropriate water quality standards for the state of Alaska (18 AAC 70).

2.2.1.9 Drilling Wastes

Water-based drilling muds and cuttings will be discharged to Cook Inlet during the exploration phase of operations (currently permitted) in accordance with the Cook Inlet General NPDES Permit; however, they will not be discharged as part of the production drilling operations. Drilling muds and cutting from the production phase are planned to be disposed of by grinding the muds and cuttings and injecting them into a Class II injection well located beneath the Osprey Platform. This process will be a continuous process and will not require storage of drilling effluents onboard the platform. The injection well will be constructed, tested, and operated in accordance with approved AOGCC procedures. Approximately 16 wells would be drilled during the production phase. Each well would take about 1 to 2 months to drill. Drilling wastes are described in more detail below.

Drilling Fluids. Drilling fluids are the circulating fluids (muds) used in the rotary drilling of wells to clean and condition the hole, to counterbalance formation pressure, and to transport drill cuttings to the surface. A water-based drilling fluid is the conventional drilling mud in which water is the continuous phase and the suspending medium for solids, whether or not oil is present. An oil-based drilling fluid has diesel, mineral, or some other oil as its continuous phase, with water as the dispersed phase. Production

drilling operations onboard the Osprey Platform will use a combination of both freshwater-based and oil-based drilling fluids. The freshwater-based drilling fluids will typically be used for the upper 2,500 feet of the well and the oil-based drilling fluids will be used for depths below 2,500 feet (NCG 2001). The drilling fluids will be separated from the drill cuttings on the platform for use as make-up drilling fluids.

Drill Cuttings. Drill cuttings are the particles generated by drilling into subsurface geologic formations and carried to the surface with the drilling fluid. The separated drill cuttings will be disposed of in a Class II injection well that has been permitted with the AOGCC.

Dewatering Effluent. Dewatering effluent is wastewater from drilling fluid and drill cutting dewatering activities. The dewatering effluent will be disposed of with the separated drill cuttings into a Class II injection well that has been permitted with the AOGCC.

Waterflooding Discharges. Waterflooding discharges are discharges associated with the treatment of seawater prior to its injection into a hydrocarbon-bearing formation to improve the flow of hydrocarbons from production wells, and prior to its use in operating physical/chemical treatment units for sanitary waste. These discharges include strainer and filter backwash water. All waterflooding discharges will be disposed of in a Class II injection well that has been permitted with the AOGCC.

Produced Water. Produced water refers to the water (brine) brought up from the hydrocarbon-bearing strata during the extraction of oil and gas, and can include formation water, injection water, and any chemicals added downhole or during the oil/water separation process. The produced water will be disposed of in a Class II injection well that has been permitted with the AOGCC.

Well Completion Fluids. Well completion fluids are salt solutions, weighted brines, polymers, and various additives used to prevent damage to the well bore during operations which prepare the drilled well for hydrocarbon production. The well completion fluids will be disposed of in a Class II injection well that has been permitted with the AOGCC.

Workover Fluids. Workover fluids are salt solutions, weighted brines, polymers, or other specialty additives used in a producing well to allow safe repair and maintenance or abandonment procedures. The workover fluids will be disposed of in a Class II injection well that has been permitted with the AOGCC.

Well Treatment Fluids. Well treatment fluid refers to any fluid used to restore or improve productivity by chemically or physically altering hydrocarbon-bearing strata after a well has been drilled. The well treatment fluids will be disposed of in a Class II injection well that has been permitted with the AOGCC.

Test Fluids. Test fluids are discharges that occur if hydrocarbons located during exploratory drilling are tested for formation pressure and content. This would consist of fluids sent downhole during testing, along with water from the formation. The test fluids will be disposed of in a Class II injection well that has been permitted with the AOGCC.

Produced Solids. Produced solids are sands and other solids deposited from produced water which collect in vessels and lines and which must be removed to maintain adequate vessel and line capacities. The produced solids will be disposed of in a Class II injection well that has been permitted with the AOGCC.

2.2.2 Underwater Pipelines and Utilities

A total of four pipelines/utility lines are planned between the Osprey Platform and the Kustatan Production Facility during the production operations (NCG 2001):

- One 6-inch pipeline to carry natural gas from the Osprey Platform to the Kustatan Production Facility. An estimated 5.8 million standard cubic feet per day of natural gas will be shipped at 150 psig and 130°F.
- One 8-inch pipeline to carry wet oil to the Kustatan Production Facility. An estimated 25,000 barrels per day of oil and 6,000 barrels per day of water will be shipped at approximately 350 psig and 130°F.
- One 8-inch pipeline to carry treated produced and fresh water from the Kustatan Production Facility back to the Osprey Platform for injection. The maximum rate of transport is estimated at 25,000 barrels per day at a pressure of 5,000 psig.
- One or two armored power cables to carry power for offshore production operations from the Kustatan Production Facility to the Osprey Platform. Plans are also being evaluated to place the cables inside a utility pipeline.

2.2.2.1 Design Criteria

Design criteria used for the proposed underwater pipelines are summarized on Table 2-2.

2.2.2.2 Construction Techniques

The pipelines will be made up onshore and pulled to the Osprey Platform using a winch system installed on a barge temporarily moored near the platform. This approach will avoid the use of lay barges, which are both expensive to mobilize and generally produce greater impacts than the pipeline pull method.

Nearshore, the pipelines will be buried to avoid problems with shore ice (a standard procedure in the Cook Inlet area). The proposed project assumes that the nearshore pipeline will be placed by trenching and cutting through the intertidal/shallow subtidal area and through the bluff. The pipe trench will be constructed from a 150-foot barge using either a backhoe or clamshell, with a production rate of approximately 10 cubic yards per minute (NCG 2001).

The technical feasibility of placing the pipeline through an augured hole through the intertidal area adjacent to the beach bluff is currently being evaluated. Engineering investigations and evaluations are currently underway (NCG 2001).

2.2.2.3 Spill Detection and Prevention

An estimated 25,000 barrels per day of oil and 6,000 barrels per day of produced water will be transported through an 8-inch pipeline between the platform and shore. Installation and operation of the pipeline will be in excess of Alaska Department of Environmental Conservation (ADEC) requirements for oil gathering lines. A Signal Conditioning and Data Acquisition (SCADA) system will be installed to monitor pressures and flow at both the platform and Kustatan Production Facility. A leak detection system will be installed to detect spills of at least one percent of the total daily throughput (an ADEC requirement for oil transmission pipelines). Procedures will be in place to immediately shut down the pipeline should a leak be detected. All pipelines will be configured so that it is possible to run smart pigs through the pipelines.

The pipelines would be operated under an Oil Discharge Prevention and Contingency Plan that is reviewed and approved by the ADEC. The U.S. Coast Guard (USCG) and MMS also have review and approval authority for this document under the Oil Pollution Act of 1990.

2.2.3 Kustatan Production Facility

The Kustatan Production Facility will be located on land owned by Forest Oil near the end of the West Foreland at the site of the Tomcat Exploratory Drilling Project. Although the detailed facility layout has not yet been finalized, the production facilities are expected to be contained within an upland area covering less than 10 acres (NCG 2001). A schematic of the overall process flow at the onshore facility is provided in Figure 2-4, and a preliminary layout for the facility is provided in Figure 2-5. The perimeter of the pad will be bermed to provide added secondary containment for spills on the site. Various components of the Kustatan Production Facility are described in the following sections.

2.2.3.1 Gas Handling System

Natural gas from the Osprey Platform will pass through a compressor to bring the natural gas up to 500-psig pressure. Natural gas generated during onshore separation processes will be compressed and pass through a dehydration unit to produce dry gas at 500 psig. Approximately 3.7 million standard cubic feet per day of dry natural gas will be used to fuel turbines and other equipment at the Kustatan Production Facility. The remaining gas (an estimated 2.1 million standard cubic feet per day) will be sent via sales pipeline for use at the West McArthur River Unit or the Trading Bay Production Facilities.

2.2.3.2 Oil Handling Systems

Wet oil from the Osprey Platform will pass through a wet oil exchanger surge vessel, flow splitter, and several dehydrator systems. The dry oil (having less than 2.5 percent water and solids) will be pumped to dry oil storage tanks, metered, and then sent via a sales pipeline to the Trading Bay Production Facilities. Reject oil ("dry" oil having excess water or solids) will be reprocessed through the system. Produced water removed from the oil stream will pass through a wash tank and water processing unit to skim any remaining oil from the water; skimmed oil will be sent to a slop oil tank and be reprocessed through the system.

2.2.3.3 Water Handling Systems

Water handling systems are required primarily to prepare water for use in formation pressure maintenance operations for enhanced oil recovery in the Redoubt Shoal Unit. All produced water will be processed and will provide about 6,000 barrels per day of water during the first year of operation. An additional 19,000 barrels per day of fresh water will be obtained during the first year from water wells drilled at or in the vicinity of the Kustatan Production Facility. It is estimated that produced water will gradually increase with time and within about 15 years will be able to provide all water requirements for maintenance of formation pressures (NCG 2001); correspondingly, fresh water requirements will be reduced over this same time period. Cleaned water will be sent back to the Osprey Platform through an 8-inch pipeline at a rate of up to 30,000 barrels per day and at a pressure of 5,000 psig.

2.2.3.4 Electrical Power Production

Peak power requirements are estimated to be 3,000 to 7,000 kilowatts (KW) for the Osprey Platform (the rate is dependent on whether drilling operations are being conducted) and 4,000 KW for the Kustatan Production Facility. A total of three 5,000-KW units are currently planned with natural gas for fuel

(about 1.6 thousand standard cubic feet per day per unit). Two 500-KW diesel engine generator sets are provided for emergency power; these sources are not intended to maintain production operations. One or two 15-kilovolt (KV) armored subsea cables will be used to supply power to the platform.

2.2.4 Onshore Pipelines

Under the proposed project, the underwater pipelines/utilities as discussed in Section 2.2.2 would come ashore at the tip of the West Foreland and travel an additional 1.8 miles onshore to the production facility near Kustatan. Two additional pipelines are planned between the Kustatan Production Facility and the Trading Bay Facility:

- One 6-inch pipeline to carry natural gas from the Kustatan Production Facility to the Trading Bay Production Facility. The pipeline would tie into an existing natural gas pipeline between the West Forelands #1 site and the West McArthur River Unit. The use of an existing gas pipeline between West McArthur River Unit and the Trading Bay Production Facility is also being evaluated. An estimated 2.1 million standard cubic feet per day of dry natural gas will be transported at 300 psig and 100°F. The West McArthur River Unit may have some demand for natural gas.
- One 8-inch pipeline to carry crude oil from the Kustatan Production Facility to the Cook Inlet Pipeline Company oil pipeline system located at the Trading Bay Production Facility. An estimated 25,000 barrels per day of oil will be transported at approximately 450 psig.

The pipelines would be placed in a trench adjacent to an existing access road between the Kustatan Production Facility and the West McArthur River Unit and next to existing pipelines between the West McArthur River Unit and the Trading Bay Production Facility. The line will have a nominal depth of burial of 3 feet. Appropriate bedding materials will be placed to reduce the potential for damage to the pipe. The pipeline locations were included in the original Corps of Engineers submittal for the road/pipeline route to the Tomcat Exploration Well. Access roads between the Kustatan Production Facility and the Trading Bay Production Facility currently exist.

A new access road would need to be constructed between the tip of the West Foreland and the Kustatan Production Facility. The road would be a 1.8-mile all-weather gravel road approximately 16 to 20 feet wide and 2 to 3 feet above the ground surface. The access road and pipelines would be contained within a right-of-way approximately 50 feet wide. The preliminary access road/pipeline alignment is shown on Figure 2-6.

Over half the length of the access road is located along privately owned lands. The access road would normally be used only as part of Forest Oil operations. Forest Oil intends to control access onto their lands, but access to privately held lands will be controlled by the individual landholders.

2.2.5 Resource Requirements

2.2.5.1 Osprey Platform

The proposed project would use the existing platform for production operations and would not require any additional resources other than water as discussed in the following sections.

2.2.5.2 Underwater Pipelines and Utilities

The underwater pipelines and utilities require the use of an approximate 100-foot wide corridor on the seafloor. The total area required for the 1.8-mile long pipeline is approximately 22 acres of seafloor; it would not restrict the area's use for any other activities other than placement of other marine structures and possible vessel anchoring.

2.2.5.3 Kustatan Production Facility

As previously indicated, the proposed Kustatan Production Facility will be located on properties currently owned by Forest Oil. The property is currently developed and a minor amount of site preparation is anticipated for these facilities (estimated total size of about 10 acres).

The proposed Kustatan Production Facility will require approximately 19,000 barrels per day of fresh water. Water is planned to be obtained from deep groundwater sources accessible through the Tomcat Exploration Well. This well was drilled in the fall of 2000 and failed to demonstrate adequate reserves of oil or gas for commercial development. Instead of plugging and abandoning the well, it will be used as a water supply well, drawing water from permeable zones at depths of about 12,000 feet. There are no other users of this non-potable water source in the general area. Forest Oil has applied for appropriate water rights from the ADNR for withdrawal of water.

2.2.5.4 Onshore Pipelines

It is estimated that all access road and pipeline construction activities can be conducted within a 50-foot wide corridor. Assuming that 1.8 miles of new onshore pipeline alignment would be required, less than 10 acres of previously undisturbed upland area would be disturbed from access road construction and development of possible material sites (gravel sources). It is estimated that less than 1 acre of wetlands might possibly be disturbed (NCG 2001).

Gravel requirements for the construction pad/access road are estimated at about 36,000 cubic yards. A reconnaissance of gravel resources in the area has been conducted and several potential gravel sources have been identified adjacent to existing roads in the area. Additional gravel sources may also occur along the proposed pipeline alignment. Gravel will be purchased by Forest Oil per prior agreements from the property and subsurface owners of the materials.

Pipelines between the Kustatan Production Facility and the West Forelands #1 site would be constructed within existing access corridors.

2.2.5.5 Other Resources

Manpower requirements during construction activities are anticipated to be a maximum of 60 persons. Manpower would be housed in existing facilities at either the Osprey Platform, West McArthur River Unit Production Facility, or at the Trading Bay Production Facility.

2.3 ALTERNATIVE 2: OFFSHORE PIPELINE TO KUSTATAN

2.3.1 Osprey Platform

The configuration and operation of the Osprey Platform would be the same as for Alternative 1 (Proposed Project).

2.3.2 Underwater Pipelines and Utilities

Under this alternative, the pipelines/utilities would be the same as discussed for the proposed project, with the exception that the underwater segment would be 3.3 miles long instead of 1.8 miles long. With the longer pipeline length, the pipeline pull method would not be possible. Instead, the conventional lay barge approach would be required.

Side scan sonar surveys of the proposed pipeline routing discovered the presence of a significant boulder bed that will significantly impact placement of the pipeline along this route.

2.3.3 Kustatan Production Facility

The onshore production facility near Kustatan would be the same as for Alternative 1 (Proposed Project).

2.3.4 Onshore Pipelines

Under this alternative, the 1.8 miles of pipelines/utilities between the tip of the West Foreland and the Kustatan Production Facility would not be constructed; only a short pipeline (i.e., less than 1,000 feet) would be required from shore to the Kustatan Production Facility. The pipelines between the Kustatan Production Facility and the Trading Bay Production Facility would be as described above for the proposed project.

2.3.5 Resource Requirements

Under this alternative, the 1.8 miles of pipelines/utilities between the tip of the West Foreland and the Kustatan Production Facility would not be constructed, and the associated land and gravel resources would not be required.

The length of underwater pipeline would be expanded from 1.8 to 3.3 miles, and the associated requirements for seafloor use would increase from 22 acres (proposed project) to approximately 40 acres.

All other resource requirements under this alternative would be similar to the proposed project.

2.4 ALTERNATIVE 3: OFFSHORE PIPELINE TO TRADING BAY PRODUCTION FACILITY

2.4.1 Osprey Platform

The configuration and operation of the Osprey Platform would be generally the same for this alternative. The major difference would be that higher pressures would be required to ship fluids and gas over a distance of 10.5 miles rather than 1.8 miles as in the proposed project.

2.4.2 Underwater Pipelines and Utilities

Under this alternative, the pipelines/utilities would be the same as discussed for Alternative 1 (Proposed Project), with the exception that the underwater segment would be 10.5 miles long instead of 1.8 miles long. With the longer pipeline length, the pipeline pull method would not be possible. Instead, the conventional lay barge approach would be required. In this option, trenching would be the only mode considered for construction of the shore approach, as there are existing pipelines and a beach bluff cut at this location.

2.4.3 Kustatan Production Facility

The onshore production facility near Kustatan would not be constructed under this alternative. Instead, the Trading Bay Facility would need to be modified in order to accept fluids from the Redoubt Shoal Unit Development Project directly and to provide power for supporting the Osprey Platform. Detailed engineering has not been done to evaluate the possible scope of modifications required.

2.4.4 Onshore Pipelines

Under this alternative, the underwater pipelines/utilities as discussed in Section 2.2.4 would come ashore near the Trading Bay Production Facility and travel an additional 0.1 miles to the facility. All other onshore pipelines, as discussed in the previous sections, would not be constructed under this alternative.

2.4.5 Resource Requirements

Under this alternative, the length of underwater pipeline would be expanded from 1.8 to 10.5 miles, and the associated requirements for seafloor use would increase from 22 acres (proposed project) to approximately 128 acres.

Resource requirements for the Kustatan Production Facility and the onshore pipelines would not be required. The approximately 0.1 mile long segment of onshore pipeline near the Trading Bay Production Facility would have negligible resource requirements as it passes through existing developed industrial areas.

Manpower requirements would be generally similar to the proposed project.

2.5 ALTERNATIVE 4: NO ACTION

This alternative would be selected if the project economics are not favorable for production of the Redoubt Shoal Unit. This may result from insufficient hydrocarbon reserves identified during the exploration activities, or selection of alternatives that require significantly higher costs than the proposed project (Alternative 1). In the event that the No Action Alternative is selected, there would be no modifications to the Osprey Platform, and the platform would likely be removed for use elsewhere. Pipelines/utilities would not be constructed. The Kustatan Production Facility would not be constructed under this alternative. No additional resources would be required for this alternative. Oil found at the Redoubt Shoal Unit would not be produced under the No Action Alternative.

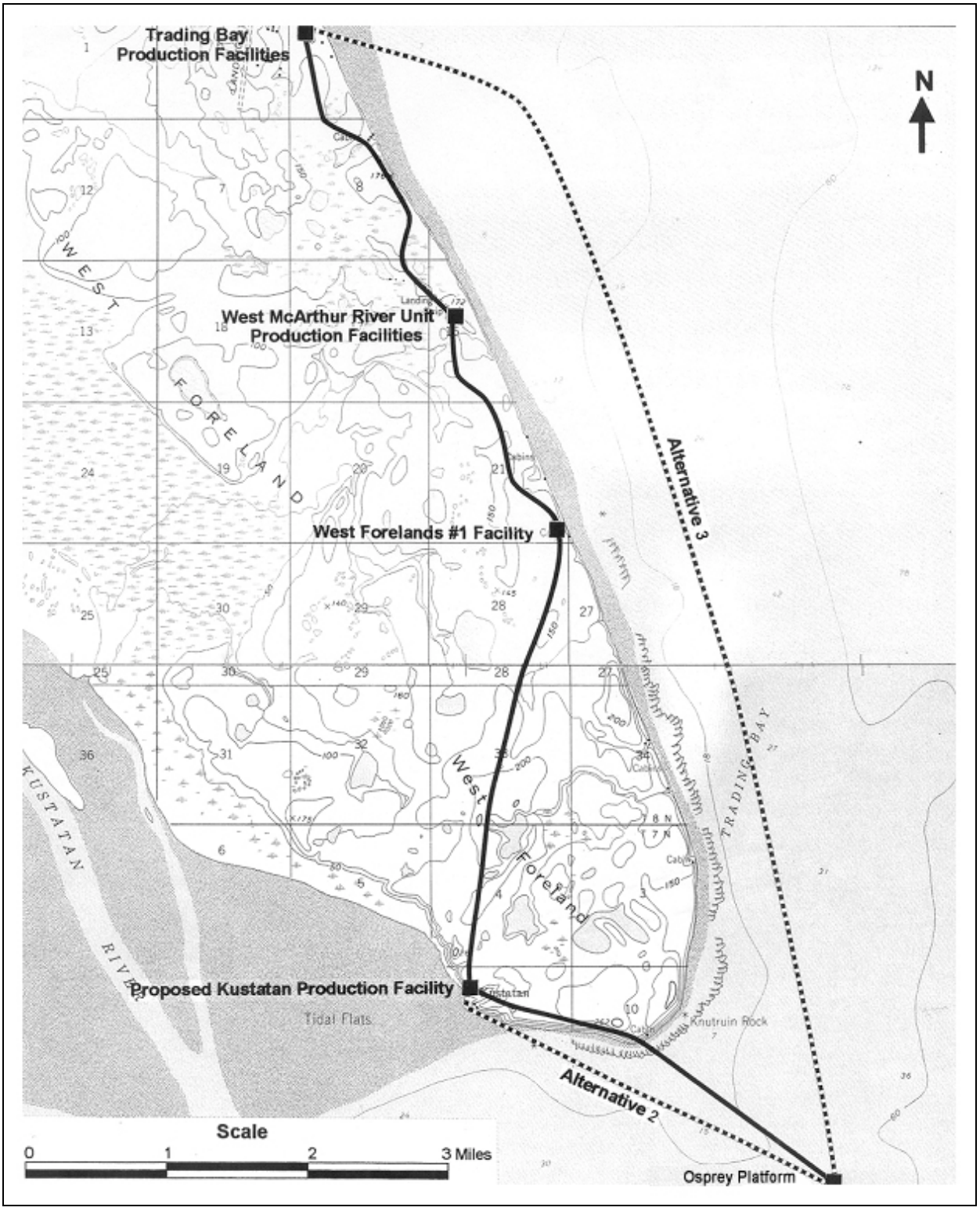

Figure 2-1. General Vicinity Map

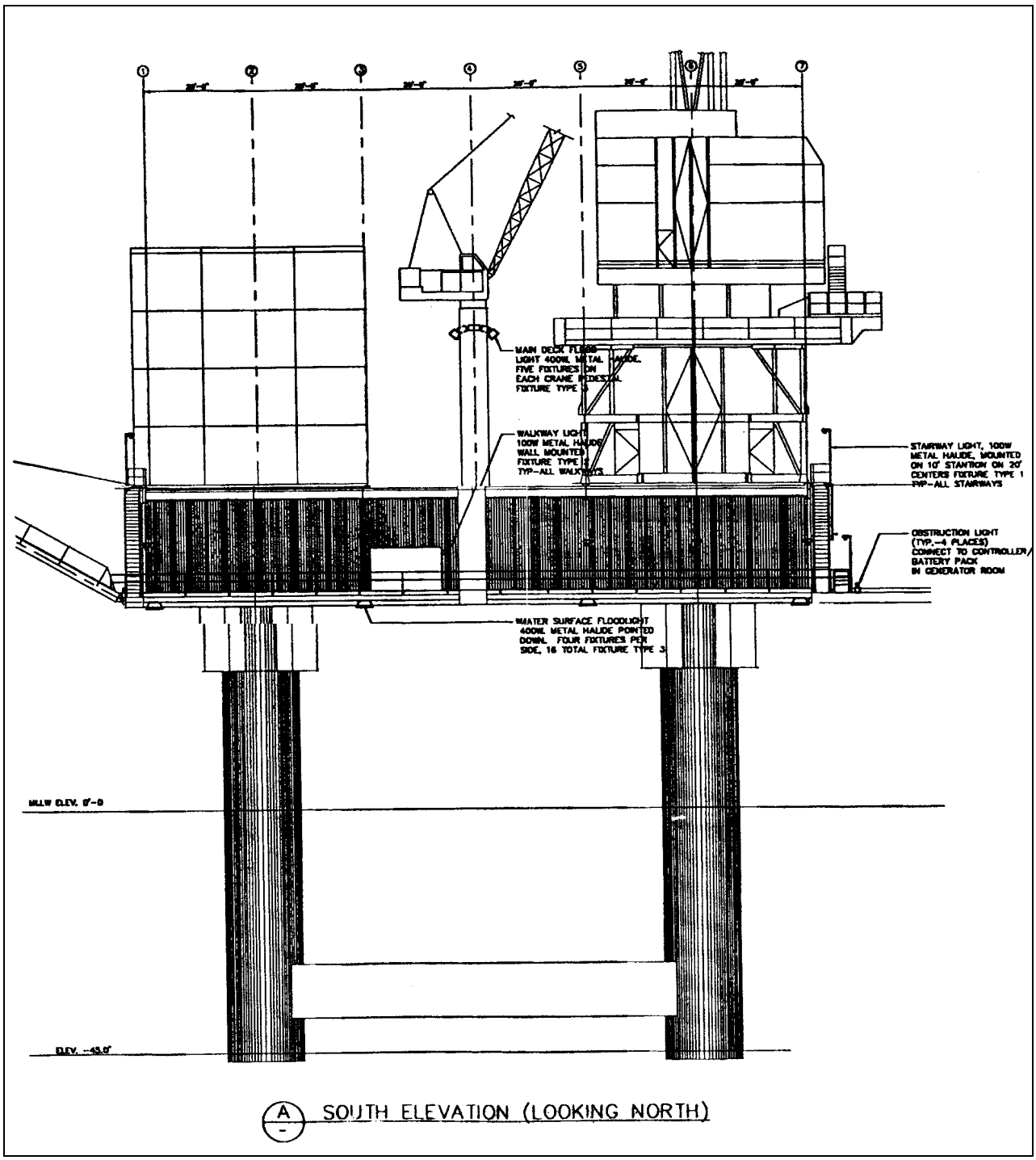

Figure 2-2. General Schematic of the Osprey Offshore Drilling Unit
(Source: NCG 2001)

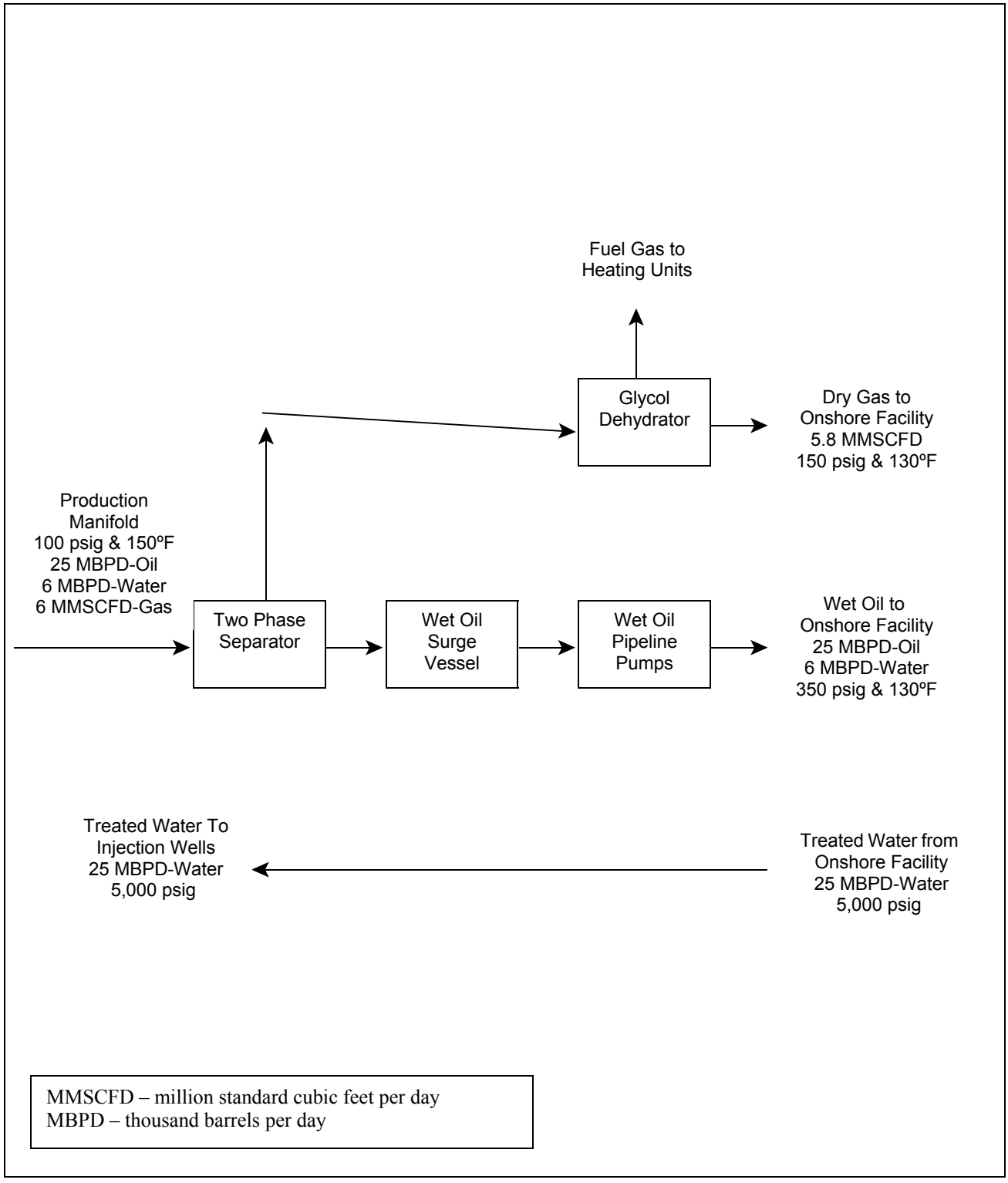

Figure 2-3. Process Flow Schematic for Osprey Platform Production Operations
(Source: NCG 2001)

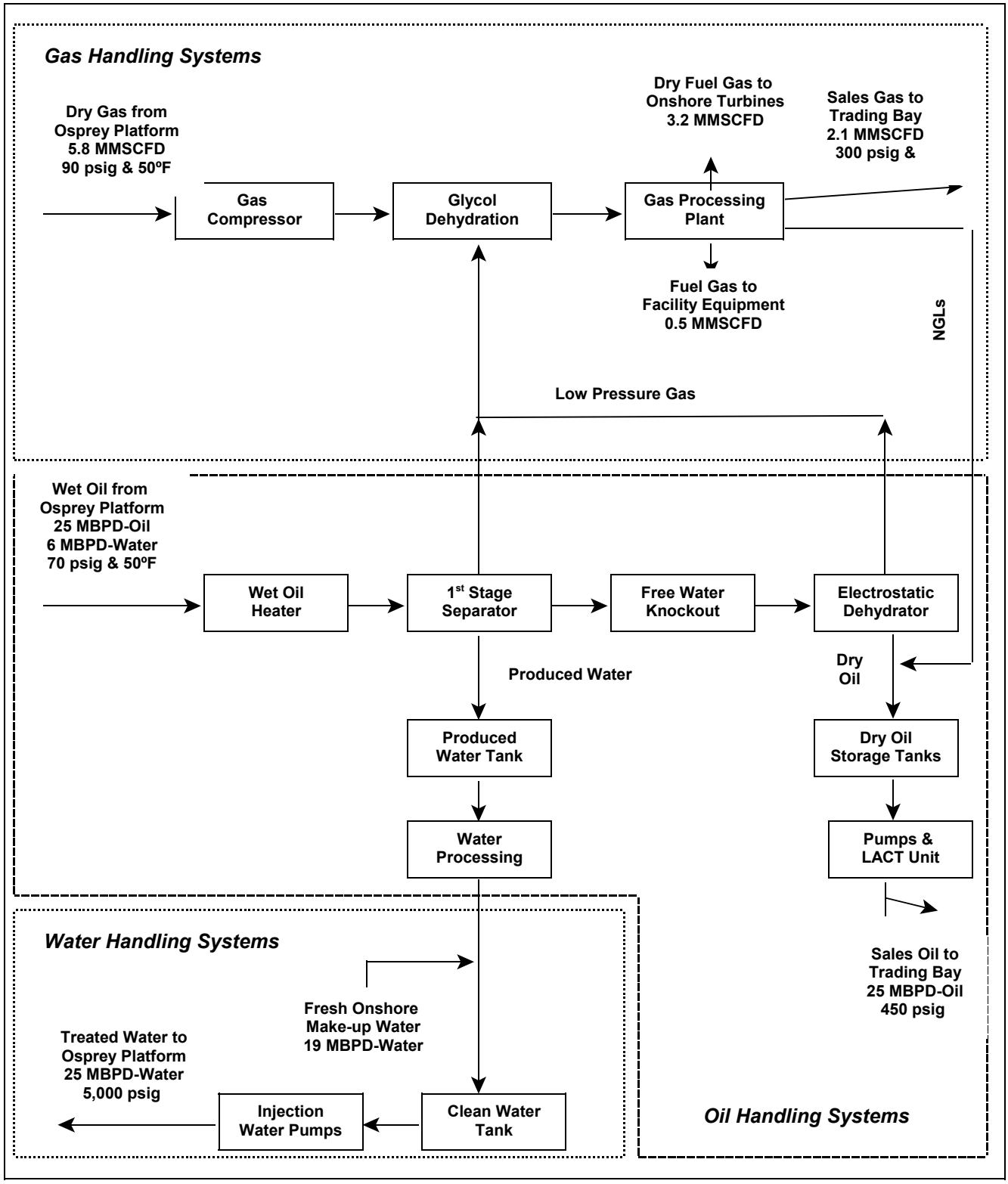

Figure 2-4. Process Flow Schematic for the Kustatan Production Facility
(Source: NCG 2001)

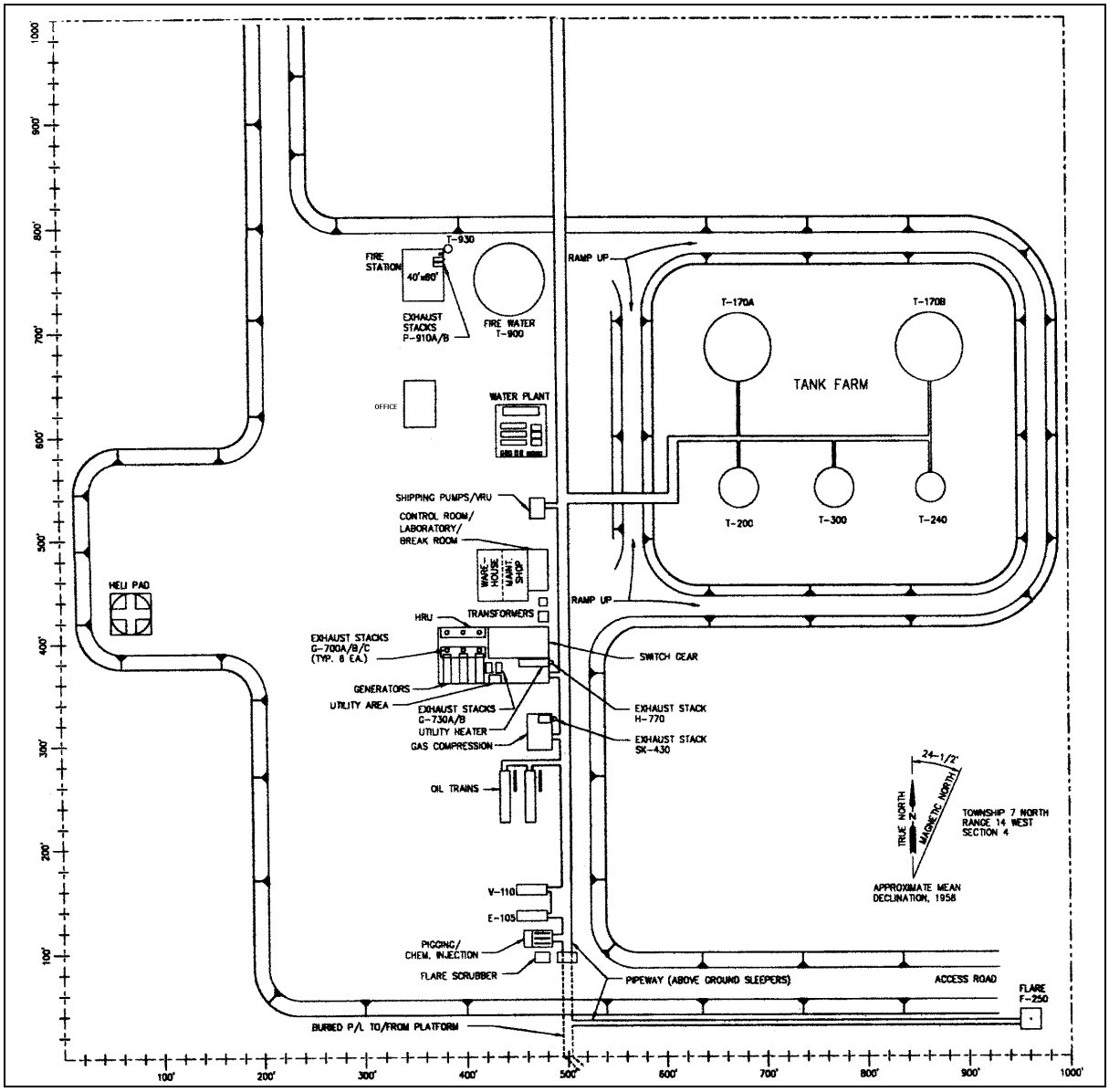

Figure 2-5. Preliminary Site Layout for the Kustatan Production Facility
(Source: NCG 2001)

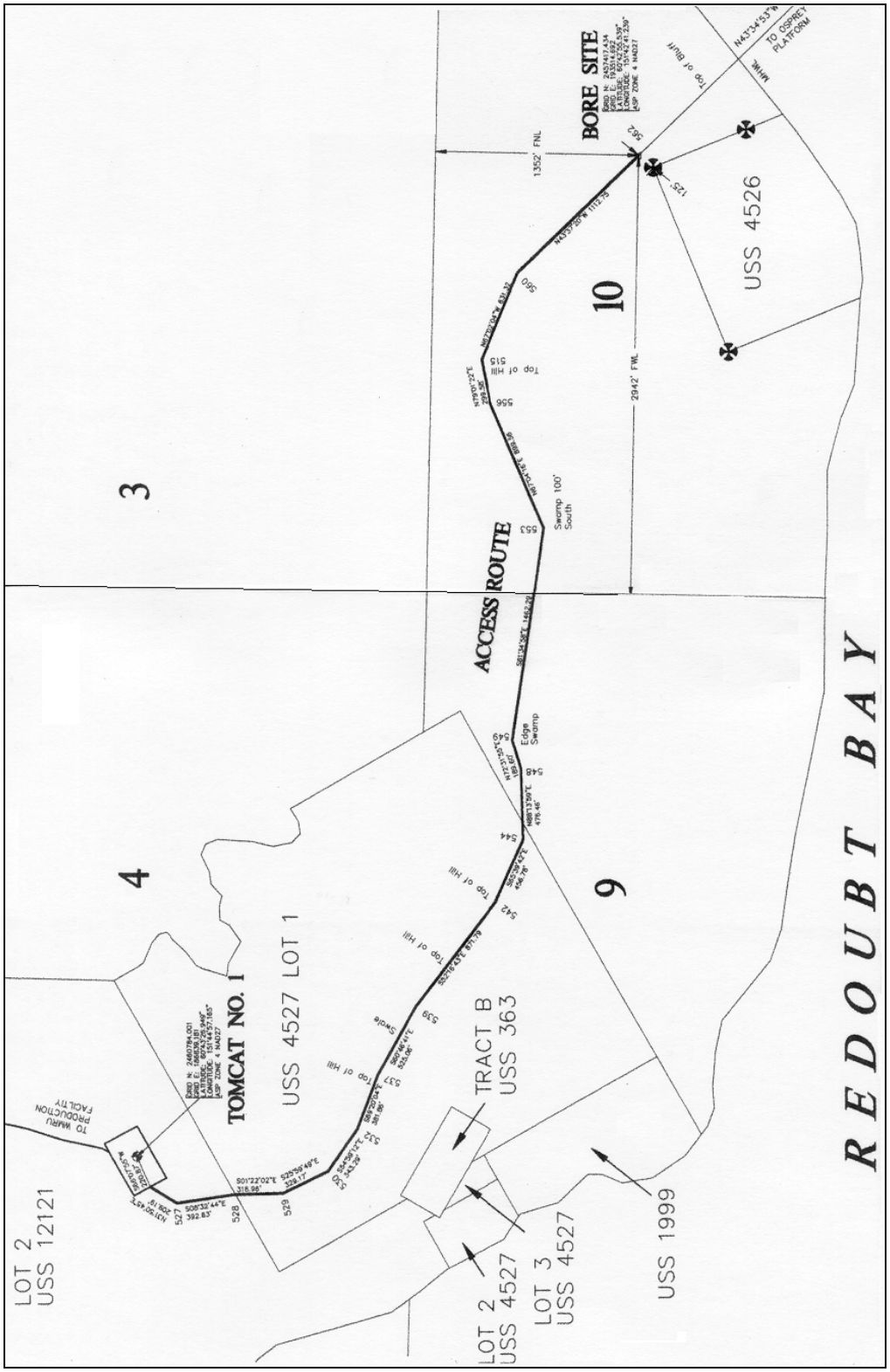

Figure 2-6. Location of Proposed Onshore Pipeline and Access Roads
(Source: NCG 2001)

Table 2-1
Design Criteria for the Osprey Platform

Criteria	Value
Extreme High Water above Mean Lower Low Water	24.2 feet
Extreme Low Water below Mean Lower Low Water	6.0 feet
Maximum Current Speed	13 feet/second
100-Year Ice Load:	
Ice Thickness	3.5 feet
Ice Compressive Strength	300 psi
Total Load on Legs	8,460 kips
Wind and Wave Criteria:	
Design Wind	80 mph
Maximum Wind Gust	100 mph
Design Significant Wave Height	15.3 feet
Maximum Wave Height	28.0 feet
Period of Maximum Wave	8.5 seconds
Minimum Ambient Air Temperature	-20°F
Minimum Ambient Water Temperature	29°F
Earthquake Design Criteria (per API RP 2A)	Zone 4
Mudline Scour	-5.0 feet

Source: NCG 2001

Table 2-2
Pipeline Design Criteria

Criteria	Value
Underwater Pipelines	
Earthquake Design Criteria per API RP 2A	Zone 4
Maximum Current Speed (Surface)	13 feet/second
On-Bottom Pipeline Stability -- Pipe Grade	
Oil and Gas Pipelines	API 5L X42
Water Injection Pipeline	API 5L X52
On-Bottom Pipeline Stability -- Wall Thickness	0.75 inches
Pipe Coating (Multi-Layer)	
Fusion Bonded Epoxy	8 to 10 mils
Copolymer Adhesive	8 mils
Polyethylene Shield	100 to 125 mils
Allowable Spans (to minimize vortex shedding)	
Gas Pipeline	23 feet
Oil and Water Injection Pipelines	26 feet
Onshore Pipelines	
Earthquake Design Criteria per API RP 2A	Zone 4
Minimum Burial	3 feet

Source: NCG 2001