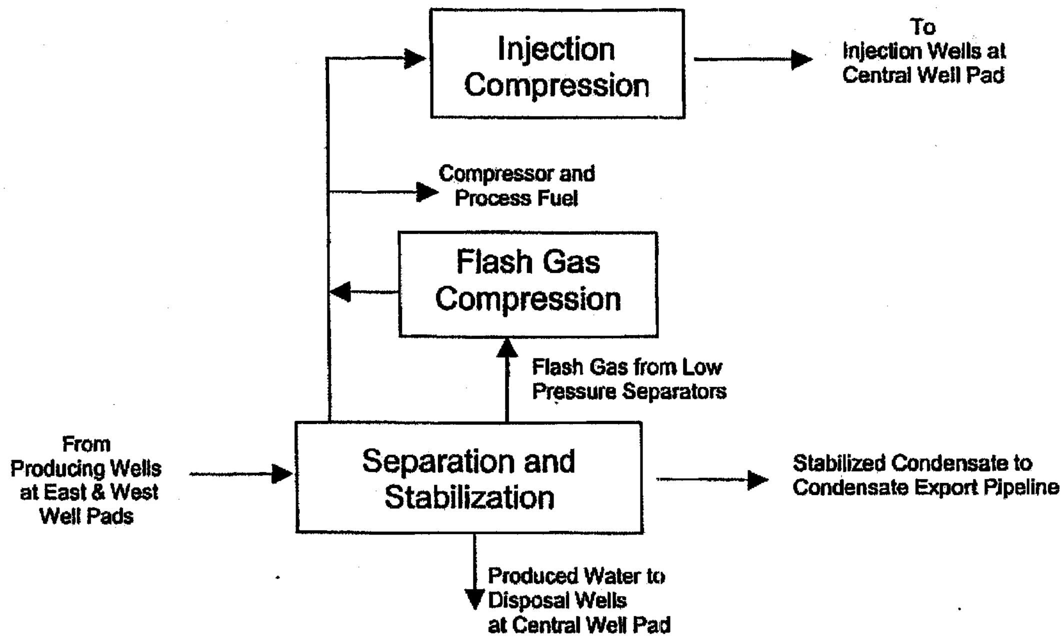
3.0 PROJECT DESCRIPTION

3.1 DEVELOPMENT PLAN

The progression used in this evaluation is development of the Point Thomson field first as a gas cycling project with the possibility of gas sales following at an unspecified future date. Under this development plan, 3-phase full well stream production gathered from two remote well pads (East and West Well Pads) is sent to a Central Processing Facility (CPF) where the gas condensate is separated and stabilized so that it meets sales pipeline specifications. The remaining gas is then compressed and re-injected at an adjacent Central Well Pad (CWP). Figure 3-1 is a simplified flow diagram showing the basic CPF process. Figure 3-2 is a map showing the overall layout of the well pads, CPF, and related pipelines and infrastructure (roads, dock, airstrip, etc.).

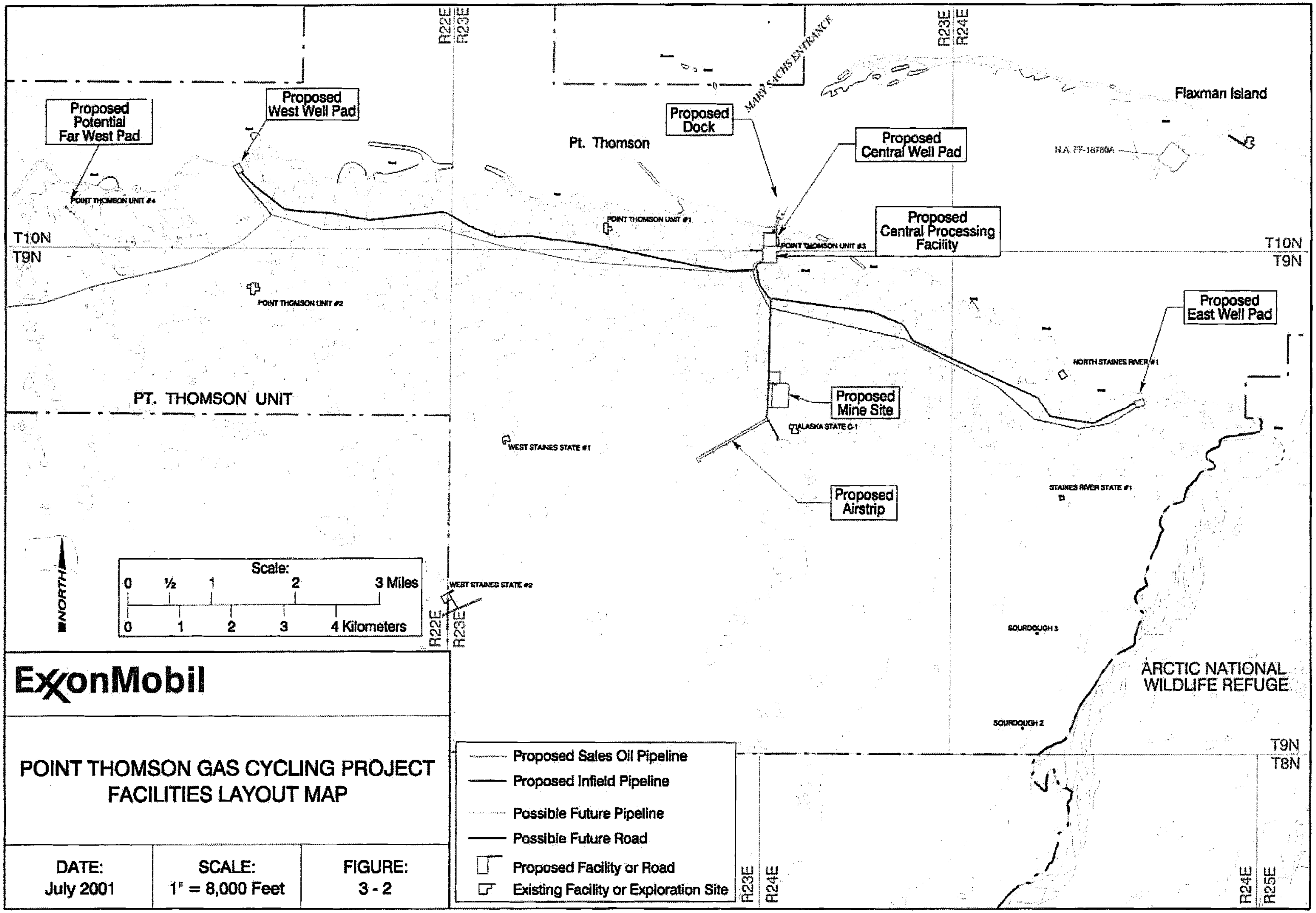
**Figure 3-1 Point Thomson Gas Cycling Project
Simplified Flow Diagram**



Alternative development components of the gas cycling project are analyzed and rationale for selection of proposed components are described in Section 2.0. Section 3.0 describes the components of the proposed development plan. The development basis consists of a three-train case in which production rates are dictated by the capacities of the three injection compressor trains. The term "train" is used to define a collection of facility components, usually organized in series, which together perform a basic process function. This term is typically used when referring to the number of similar groupings of components that are parts of an overall plant or facility. Therefore, "three trains" of injection compression indicates that there are three sets of equipment of similar design and capacity (Figure 3-3). Each train is discrete and does not share components with the other train. For the three train cycling case there are three trains of injection compression and two trains of flash gas compression.

In addition to condensate which is separated from the three-phase stream, the Point Thomson Sand has a shallow oil rim which may contribute a heavier oil that will be produced through the planned producer wells, separated in the gas cycling facilities, and sold along with the condensate.

In the same area as the Point Thomson field, several accumulations of Brookian-age reservoirs are thought to exist at shallower depths, and to be of the same general type as the Flaxman, Sourdough, and Badami reservoirs. Based on current evaluations, it is questionable whether the Brookian-Age reservoirs can be economically produced at this time. The potential of these reservoirs will be further explored while drilling through them to Point Thomson sand targets, but no pre-investment or special designs to facilitate their production are currently anticipated.

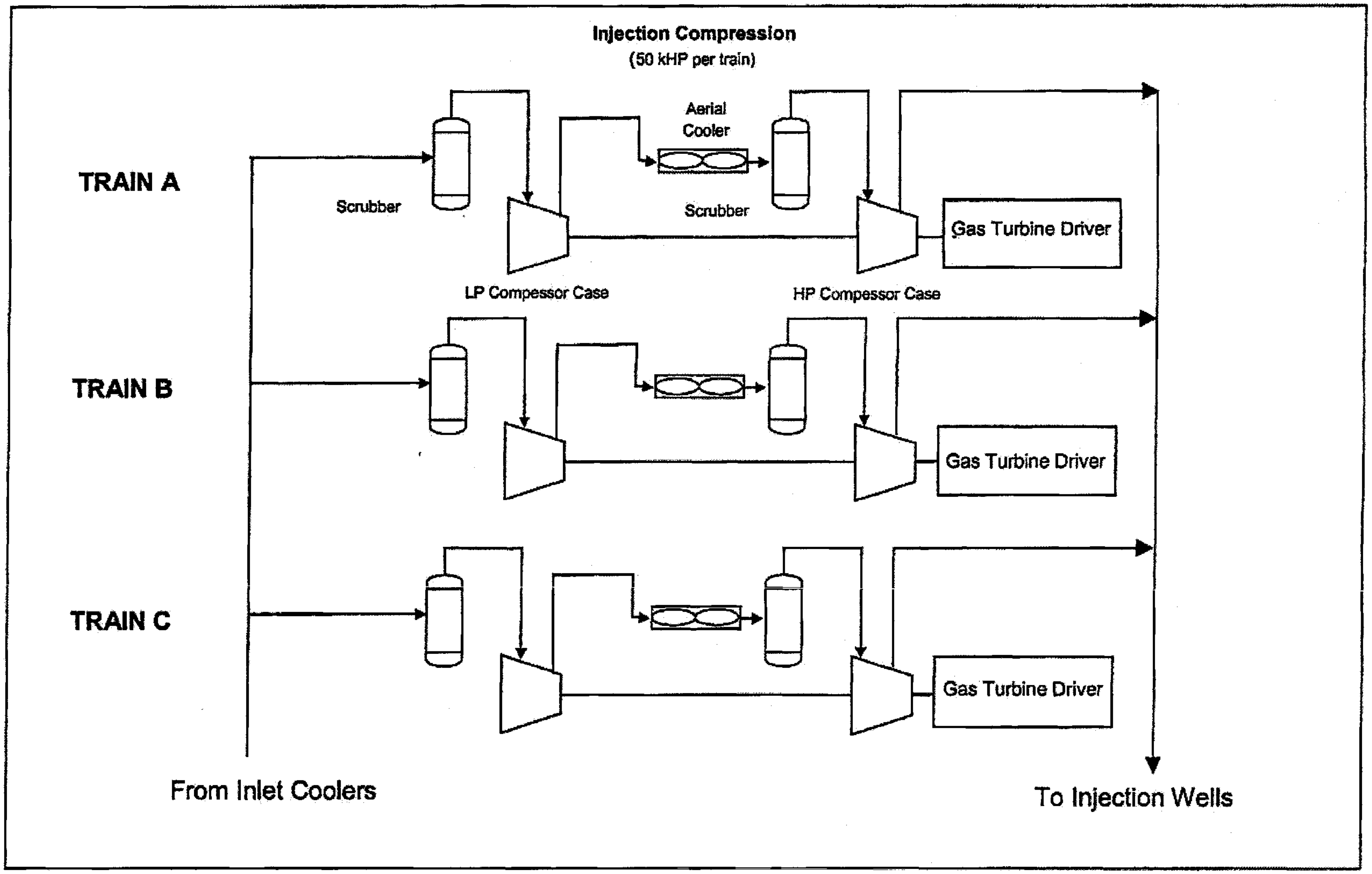


POINT THOMSON GAS CYCLING PROJECT
FACILITIES LAYOUT MAP

DATE:	SCALE:	FIGURE:
July 2001	1" = 8,000 Feet	3 - 2

Fig3_2.dgn

Figure 3-3 Three Train Injection Case



3.2 DRILLING PLAN

Point Thomson wells will be drilled to a vertical depth of approximately 13,000 feet (ft) (3,962 meters [m]) and use extended reach drilling to reach targets extending out to 20,000 ft (6,096 m). The production and injection wells will be large bore with 7-inch (in) (18-centimeter [cm]) nominal diameter tubing. Two rigs will be used and the rigs will likely be mobilized by barge a year before the CPF modules are delivered to Point Thomson. As an alternative, the rigs could be brought to the Point Thomson area over the seasonal sea ice road from Endicott.

Cuttings from the drilling rig(s) will be transported to a grind and inject (G&I) unit located at the CWP. A description of the G&I process is provided in Section 3.6.3. The first well drilled will be a United States Environmental Protection Agency (EPA) Class I non-hazardous disposal well. This well will be used initially to dispose of the ground slurry from the G&I unit. Later, this same well will be used to dispose of produced water and wastewater effluent from the camps.

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3.3 ROAD SYSTEMS

Both temporary and permanent road systems will be required for the project. Temporary roads will be ice roads, either constructed on land or on the grounded sea-ice adjacent to the shoreline. Permanent gravel roads will link facility pads, airstrip, and dock facilities.

3.3.1 Sea Ice Road – Endicott to Point Thomson

A sea ice road will be constructed from the existing permanent road system at Endicott to Point Thomson following the shoreline. The road from Endicott to Point Thomson will be approximately 42 mi(mi) (68 kilometers [km]) in length and will consist primarily of seawater with a fresh water cap. Several stubs to on-land water sources will also be required. The sea ice road will be necessary for the two construction seasons (as described in Section 3.10) and, depending on special activities and related logistics, may be required on occasion once the facilities are in operation. During the drilling and construction phase of the project, the sea ice road will be used to transport heavy equipment, materials, and supplies. The general route for the proposed sea ice road is shown on Figure 3-4.

3.3.2 Land Based Ice Roads

Ice roads on land will be required during the first two construction seasons. During the first winter, one road, approximately 3 mi (5 km) long, will extend from the general location of the CWP, past the proposed gravel mine site, to the fresh water source at the former gravel mine, as shown in Figure 3-5. The ice road for the pad and early gravel road construction will be approximately 40 ft (12 m) wide and 6 in (15 centimeters [cm]) thick.

During the second winter, land ice roads are also required along the pipeline right-of-way. They become the travel and working surface off of which the pipeline is built. Figures 3-6 and 3-7 show the proposed route of pipeline construction ice roads from East Well Pad to CPF (about 6 mi [9.7 km]), CPF to West Well Pad (about 7 mi [11 km]), and West Well Pad to Badami (about 16 mi [26 km]). The width of an ice road for pipeline construction is generally about 100 ft (30.5 m).

3.3.3 Permanent Gravel Roads

Permanent all-weather gravel roads are required to connect the well pads, airstrip, gravel mine, and fresh water supply source to the central CPF Pad. In addition, a gravel roadway is required from the dock site to the CPF Pad. Permanent roads and pads and the airstrip will be constructed during the winter from locally mined gravel to a nominal thickness above the tundra of 6 ft (1.8 m). Side slopes of the roads, pads, and airstrip will be constructed initially to a slope of approximately 1.7:1, horizontal to vertical. Following thawing, settling, and final grading and grooming during the ensuing spring, summer and fall, the nominal finished thickness of roads, pads, and the airstrip will be 5 ft (1.5m) and finished side slopes will be 2:1. Gravel roads for vehicle traffic are generally 30 to 35 ft (9 to 11 m) wide. However, the road from the dock to the CPF Pad is about 50 ft (15 m) wide to facilitate movement of the large, heavy modules brought in by sea lift.

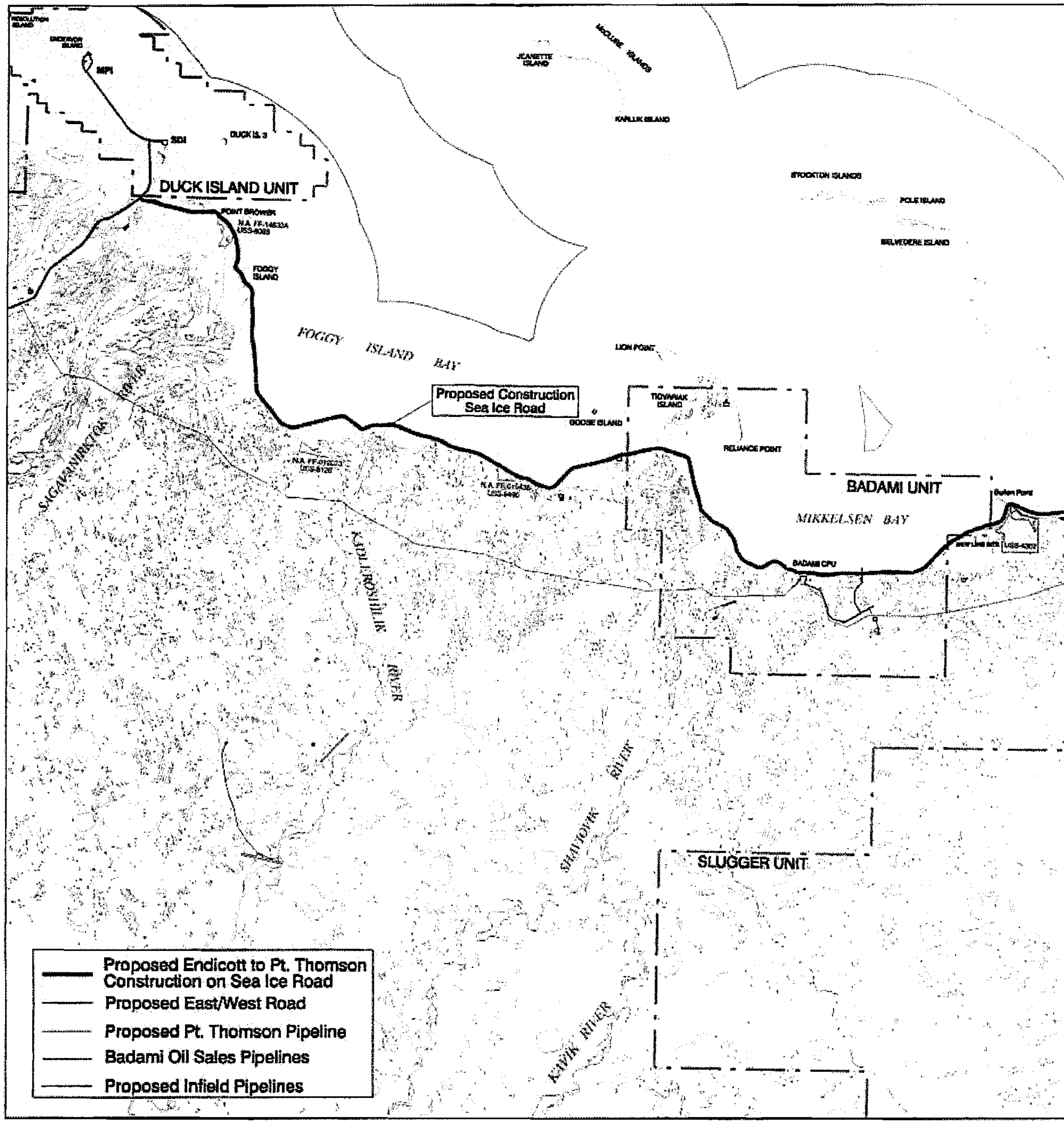
The minimum permitted footprint for roads, pads, and the airstrip must have the dimensions of the finished surface plus an approximately 10-ft (3-m) wide shoulder per side to account for the side slopes. An additional buffer area around the entire footprint perimeter (i.e., beyond the traveled surface plus side slopes) will also be included in the permitted area for construction. This additional buffer area at the perimeter is necessary as material will invariably spread beyond the toe over time, despite maintenance, due to the steepness of the side slopes prior to compaction of the surface to 5 ft (1.5 m). Table 3-1 summarizes the details of the various roads, and Figure 3-8 depicts typical road cross sections.

Culverts or bridges will be used to cross creeks and small streams. The largest streams in the project area are East and West Badami creeks. The design selected will depend on the various stream widths at the crossings. For the smaller streams, both culverts and "mini-span" bridges will be considered. Figures 3-9A through 3-9D detail half-pipe configurations used for typical large stream crossings. For small drainages, 18 in (46 cm) steel culverts will be used.

Table 3-1 Summary of Gravel Road Details

DESCRIPTION	APPROXIMATE DIMENSIONS
CPF to AIRSTRIP[1]	
Length	1.4 mi (2.3 km)
Width	30 ft (9 m)
Gravel Quantity	67,000 cy (51.225 m^3)
Year Constructed	1st winter
ABANDONED MINE SITE ROAD[2]	
Length	0.26 mi (0.4 km)
Width	30 ft (91 m)
Gravel Quantity	15,000 cy (11,468 m^3)
Year Constructed	1st winter
CPF to EAST WELL PAD	
Length	5.7 mi (9.1 km)
Width	35 ft (11 m)
Gravel Quantity	305,000 cy (233,000m^3)
Year Constructed	1st winter
CPF to WEST WELL PAD	
Length	6.6 mi (10.6 km)
Width	35 ft (11 m)
Gravel Quantity	365,000 cy (280,000m^3)
Year Constructed	1st winter
CPF to DOCK (Functional part of the CPF & CWP)	
Length	0.3 mi (0.4 km)
Width	50 ft (15 m)
Gravel Quantity	20,000 cy (15,000m^3)
Year Constructed	1st winter

[1]Gravel volume includes spur roads to mine site, gravel storage pad, and abandoned mine site.



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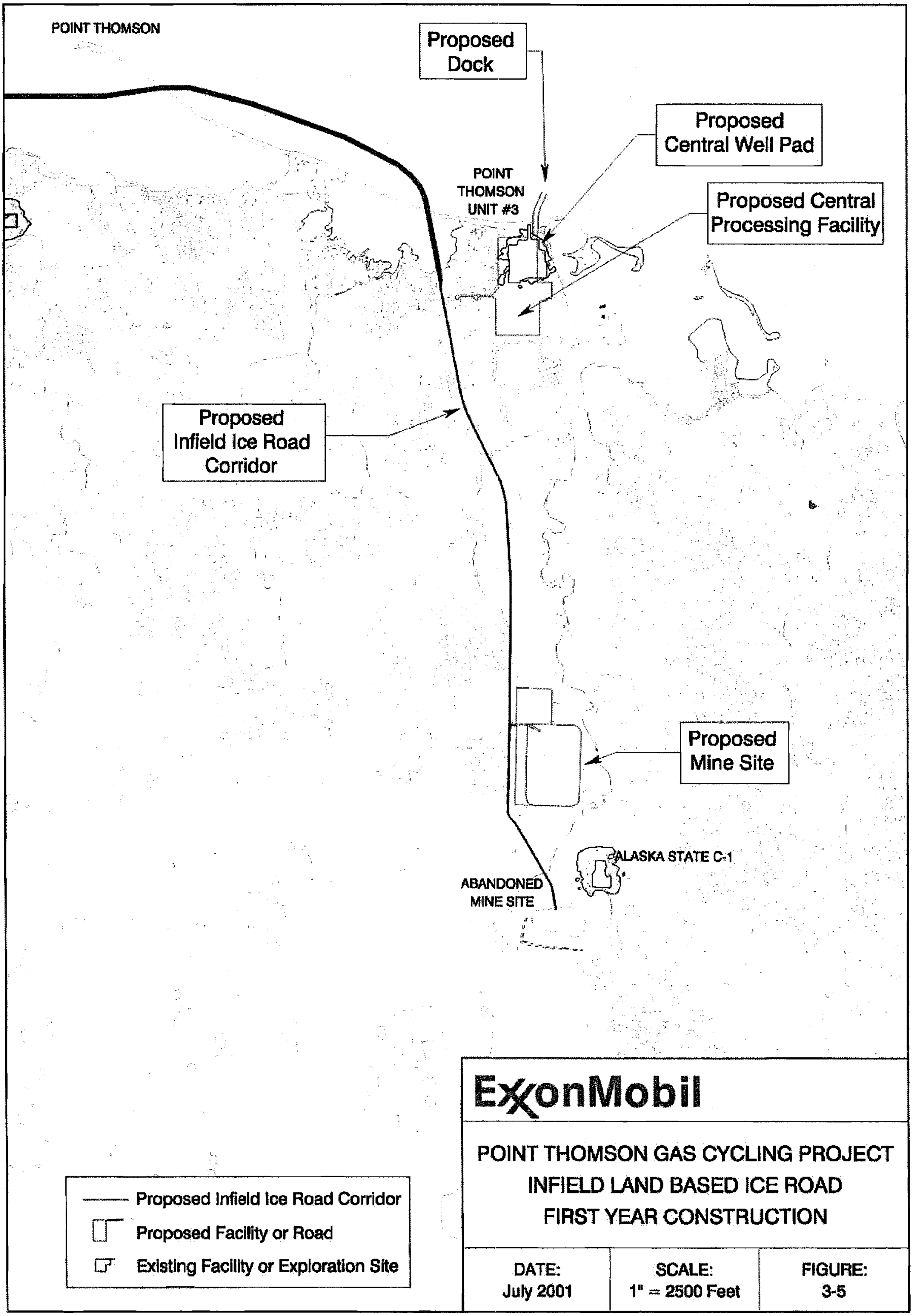
POINT THOMSON GAS CYCLING PROJECT
SEA ICE ROAD

DATE:	SCALE:	FIGURE:
July 2001	1" = 4 Miles	3 - 4



POINT THOMSON GAS CYCLING PROJECT
INFIELD LAND BASED ICE ROAD
FIRST YEAR CONSTRUCTION

DATE:	SCALE:	FIGURE:
July 2001	1" = 2500 Feet	3-5

fig3_5.dgn

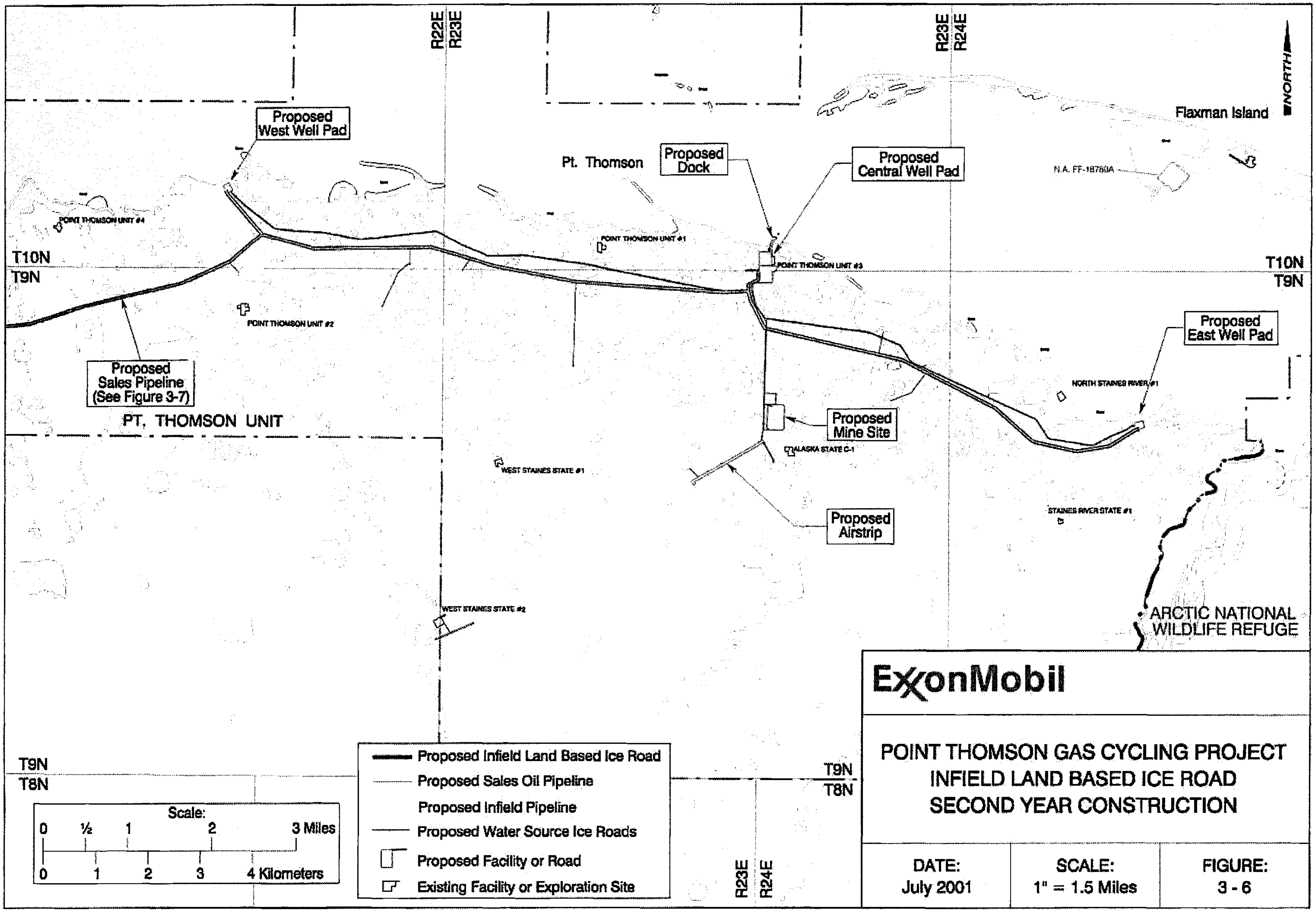
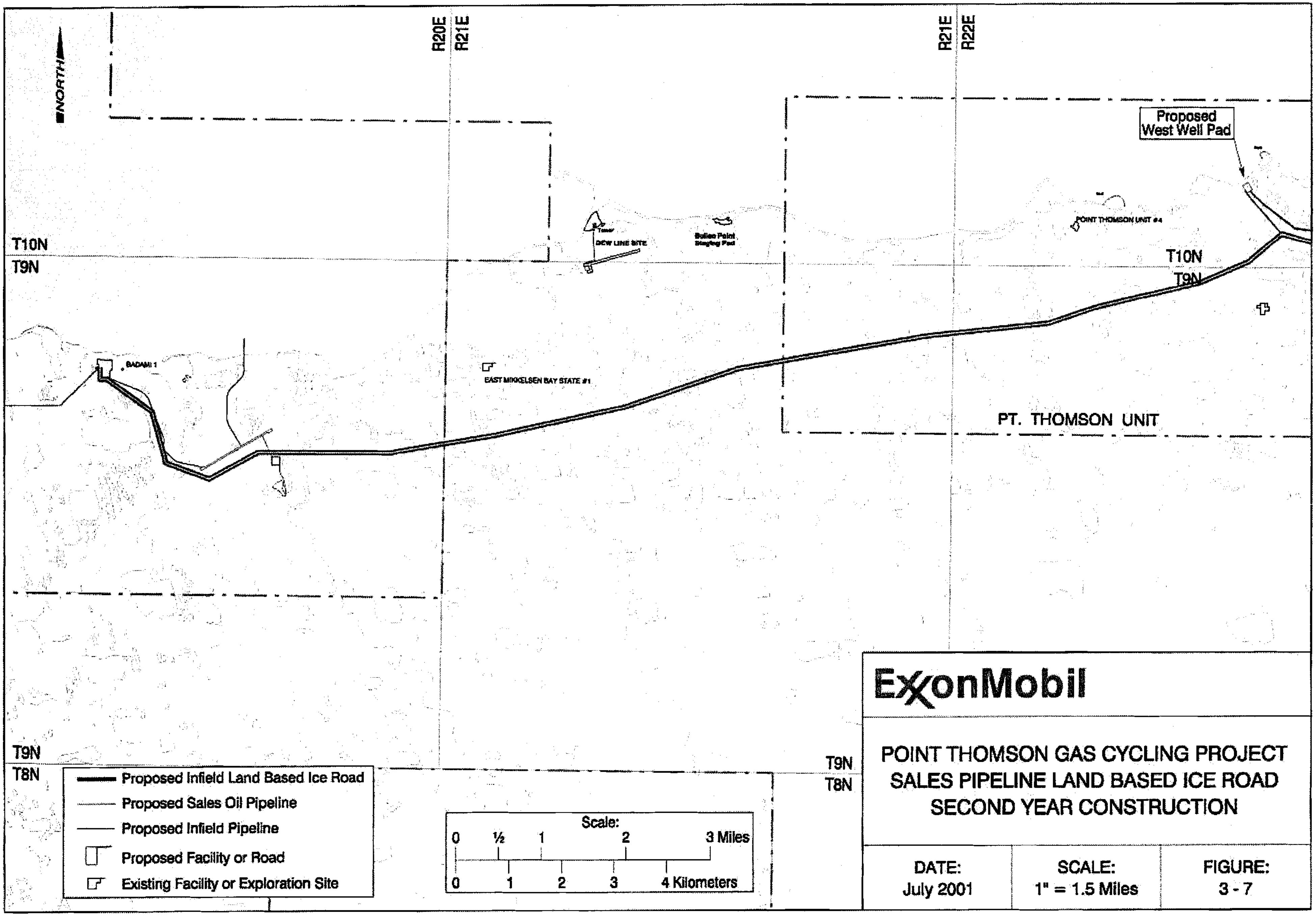

R22E
R23E
R23E
R24E
NORTH
Flaxman Island
Proposed
West Well Pad
Pt. Thomson
Proposed
Dock
Proposed
Central Well Pad
POINT THOMSON UNIT #4
POINT THOMSON UNIT #1
POINT THOMSON UNIT #3
POINT THOMSON UNIT #2
T10N
T9N
T10N
T9N
Proposed
East Well Pad
NORTH STAINES RIVER #1
Proposed
Sales Pipeline
(See Figure 3-7)
PT. THOMSON UNIT
Proposed
Mine Site
ALASKA STATE C-1
WEST STAINES STATE #1
Proposed
Airstrip
STAINES RIVER STATE #1
WEST STAINES STATE #2
ARCTIC NATIONAL
WILDLIFE REFUGE
T9N
T8N
T9N
T8N
Scale:
0 ½ 1 2 3 Miles
0 1 2 3 4 Kilometers
Proposed Infield Land Based Ice Road
Proposed Sales Oil Pipeline
Proposed Infield Pipeline
Proposed Water Source Ice Roads
Proposed Facility or Road
Existing Facility or Exploration Site
R23E
R24E
ExxonMobil
POINT THOMSON GAS CYCLING PROJECT
INFIELD LAND BASED ICE ROAD
SECOND YEAR CONSTRUCTION
DATE:
July 2001
SCALE:
1" = 1.5 Miles
FIGURE:
3 - 6

fig3 6.dgn

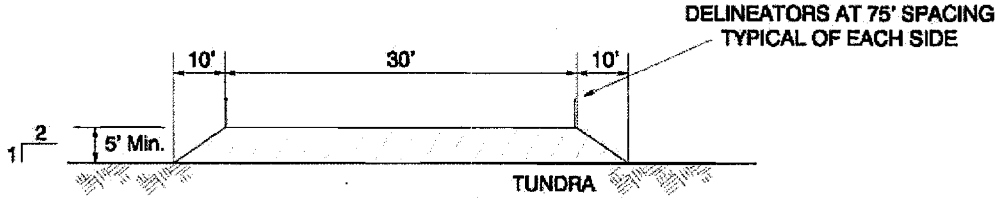


ExxonMobil

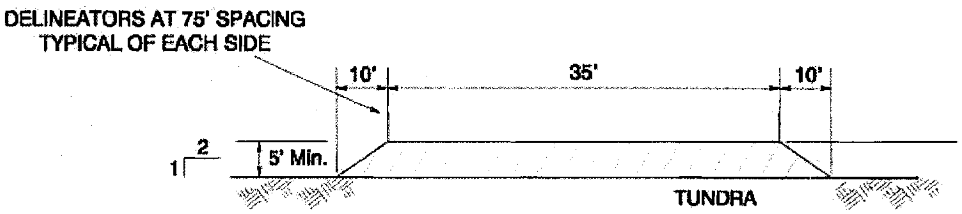
POINT THOMSON GAS CYCLING PROJECT
SALES PIPELINE LAND BASED ICE ROAD
SECOND YEAR CONSTRUCTION

DATE:	SCALE:	FIGURE:
July 2001	1" = 1.5 Miles	3 - 7

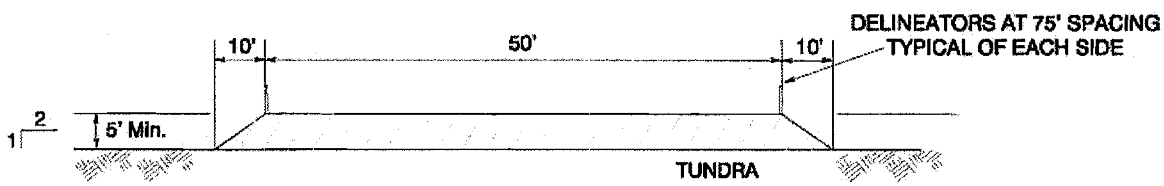
fig3 7.dgn



TYPICAL 30' ROAD SECTION



TYPICAL 35' ROAD SECTION



TYPICAL 50' ROAD SECTION

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POINT THOMSON GAS CYCLING PROJECT
TYPICAL 30-FT, 35-FT, AND 50-FT
ROAD CROSS SECTIONS

DATE:	SCALE:	FIGURE:
JULY 2001	Not to Scale	3-8

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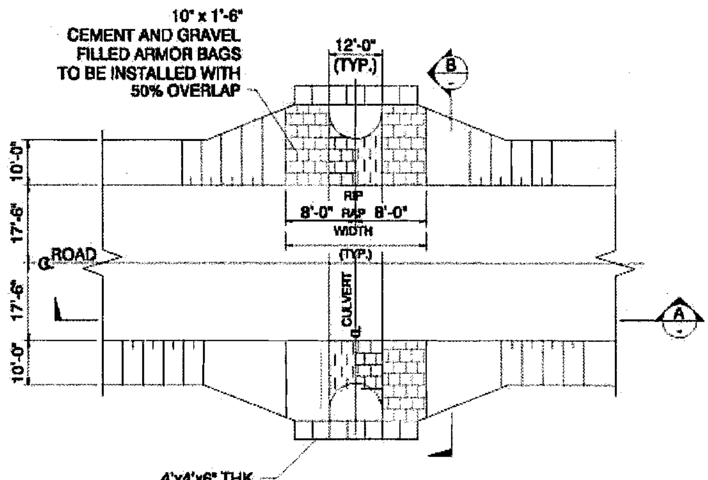
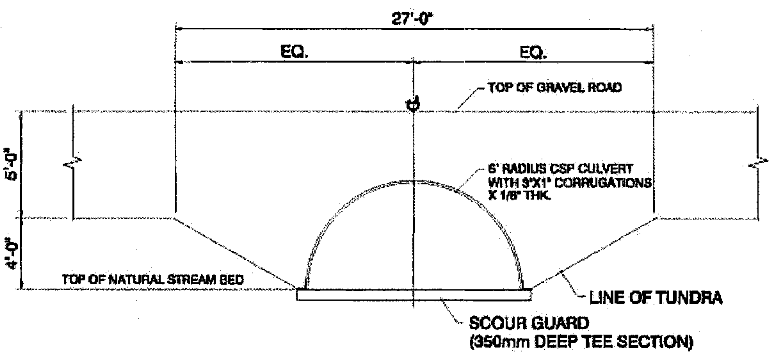
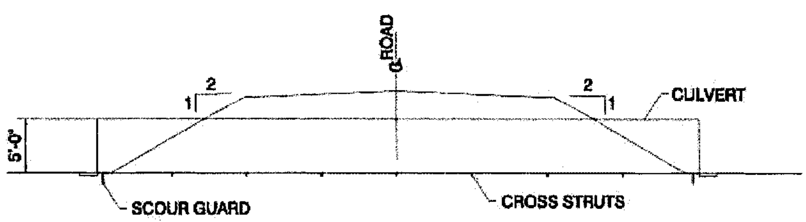


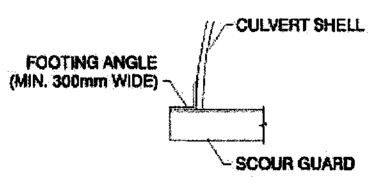
PLAN TYPE 1



SECTION A



SECTION B



DETAIL 1

ExxonMobil

POINT THOMSON GAS CYCLING PROJECT
SINGLE CULVERT

DATE:	SCALE:	FIGURE:
July 2001	Not To Scale	3 - 9A

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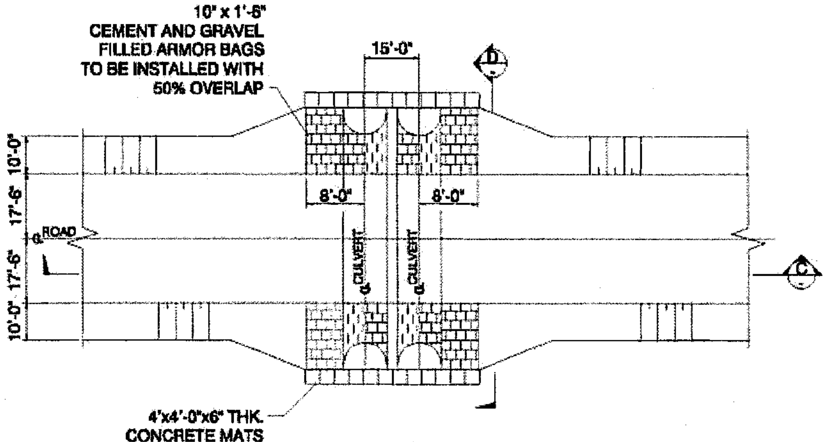
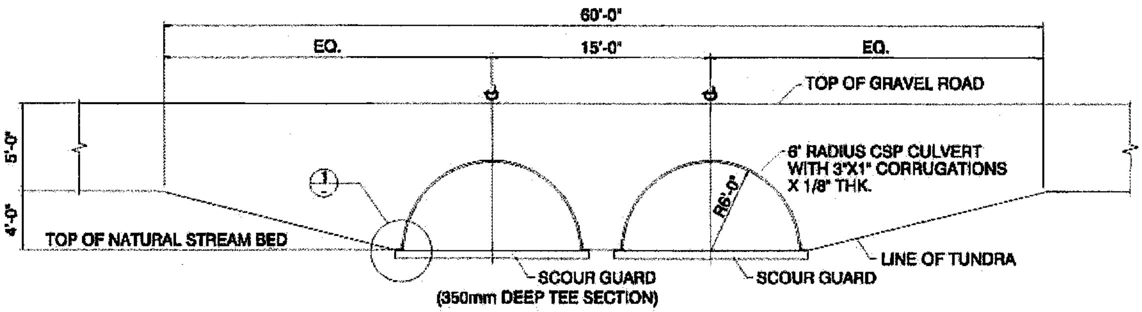
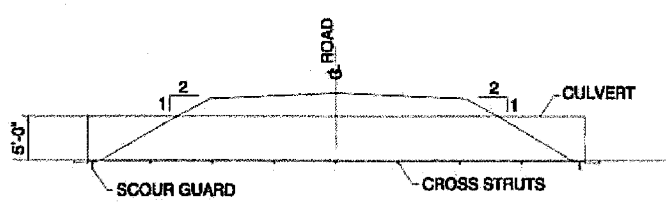


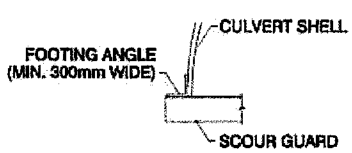
PLAN TYPE 2



SECTION C



SECTION D



DETAIL 1

ExxonMobil

POINT THOMSON GAS CYCLING PROJECT
DOUBLE CULVERTS

DATE:	SCALE:	FIGURE:
July 2001	Not To Scale	3 - 9B

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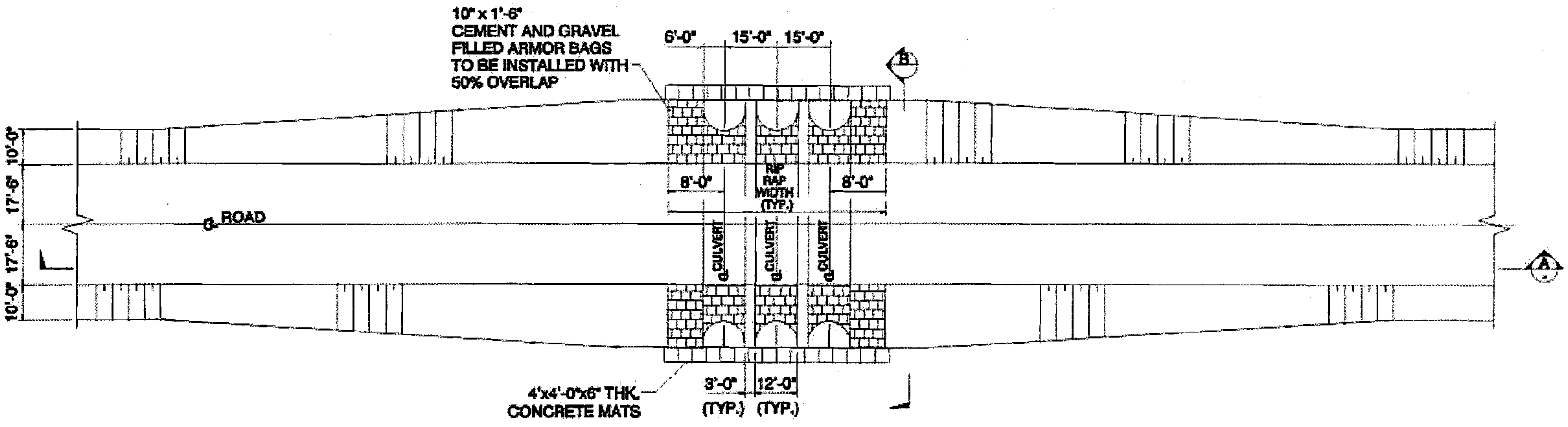
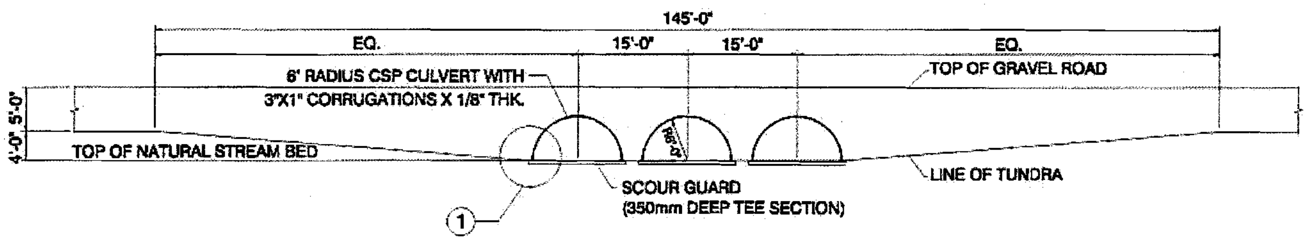
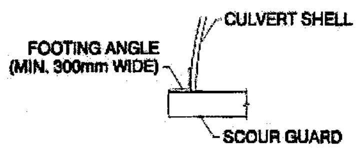


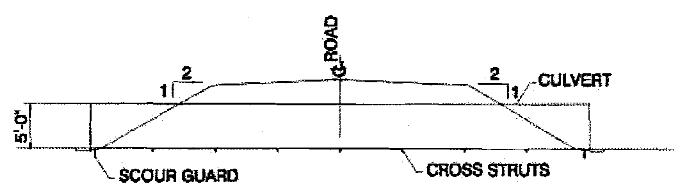
PLAN TYPE 3



SECTION A



DETAIL 1



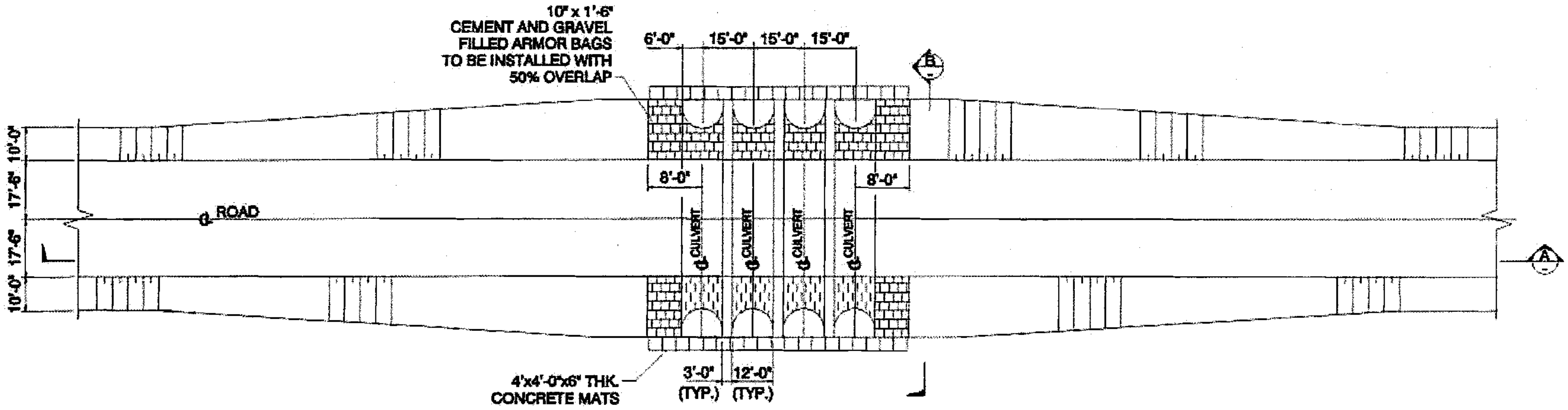
SECTION B

ExxonMobil

POINT THOMSON GAS CYCLING PROJECT
TRIPLE CULVERTS

DATE:	SCALE:	FIGURE:
July 2001	Not To scale	3 - 9C

ex14464cross.dgn



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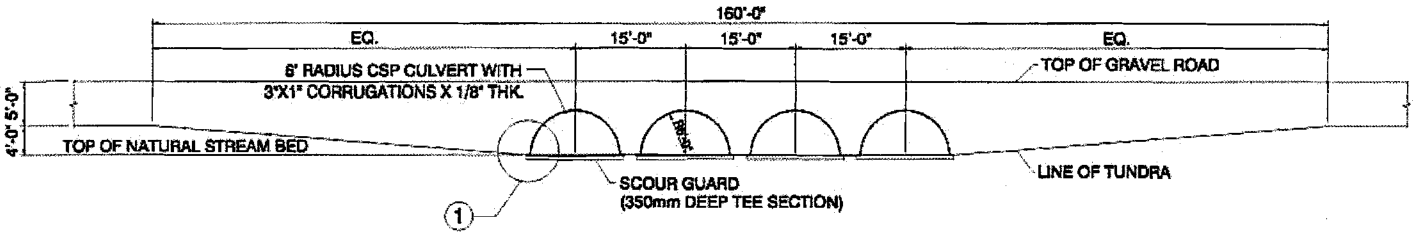
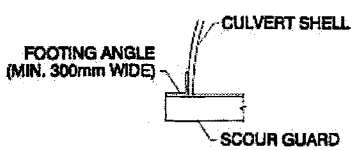
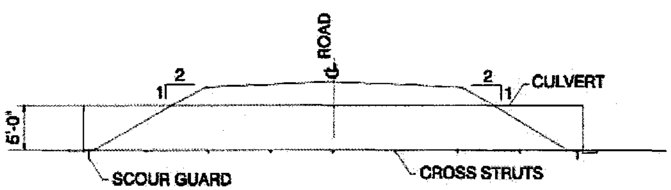


SECTION A



DETAIL 1



SECTION B

ExxonMobil

POINT THOMSON GAS CYCLING PROJECT
FOUR CULVERTS

DATE:	SCALE:	FIGURE:
July 2001	Not To scale	3 - 9D

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3.4 AIRSTRIP

Due to Point Thomson's remote location, an airstrip that is operable on a year-round basis is essential for the safety of plant operators as well as emergency response. Additionally, an airstrip provides a means of transporting people, supplies, and materials during those periods when access is not possible by either ice road or barge. The proposed location of the airstrip is approximately 2 mi (3.2 km) from the coast, south of the CPF Pad. Factors considered in the location were:

- Proximity to CPF and camp facilities,
- Location should be several mi from the coast to minimize fog restrictions,
- Alignment with prevailing winds,
- Proximity to a gravel source,
- Avoidance of any creeks or lakes, and
- Proximity to existing access roads.

The location of the is shown on the facilities layout (Figure 3-2) and details of its construction are provided on Figures 3-10A through 3-10C.

During operations the types of aircraft utilizing the strip most frequently will be the size of a Twin Otter for bringing in crew changes and supplies. However, for maintenance and servicing of large equipment, the runway must be large enough to provide landing and take-off capabilities for a fully loaded Hercules C-130. For potentially larger crew changes during the construction phase and for emergency evacuation of personnel, the airstrip must also be adequate for a Boeing 737 jet aircraft. A 5,150 ft (1,570 m) by 150 ft (46 m) airstrip is proposed. This length and width will satisfy the requirements of regular use by Twin Otters, Hercules C-130, and Boeing 737 aircraft.

Other proposed features of the airstrip are:

- Turn-around locations at each end measuring approximately 150 ft by 300 ft (45 m by 90 m),
- An all-weather road to the CPF Pad,
- A 10 ft by 20 ft (3 m by 6 m) control building,
- Electrical service via cable buried in the road from the power generating facilities at the CPF,
- Control and communication links to the CPF using fiber-optic cable, and
- Navigation and communication controls and an instrumentation system that provides 24 hour operation under conditions with a minimum half-mile visibility and a 200 ft (61 m) ceiling.

Gravel will be placed for the airstrip during the first winter's construction. Grading and compaction will be done through spring and early summer. Approximately 205,000 cubic yards (cy) (157,000 cubic meters [m^3]) of gravel will be required for the airstrip and associated features. The airstrip is expected to be ready for use by mid to late summer of the first year's construction.

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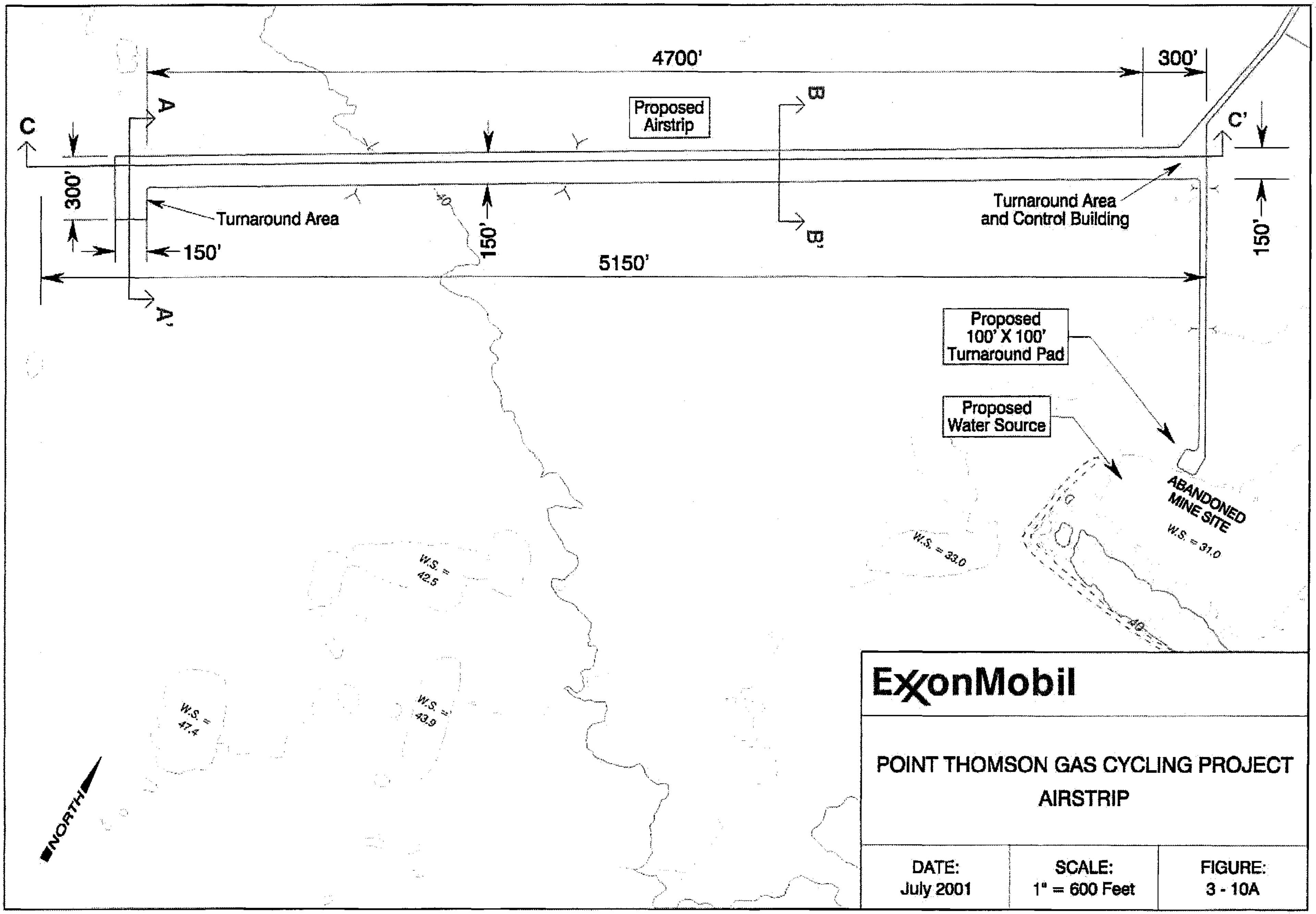

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POINT THOMSON GAS CYCLING PROJECT
AIRSTRIP

DATE:	SCALE:	FIGURE:
July 2001	1" = 600 Feet	3 - 10A

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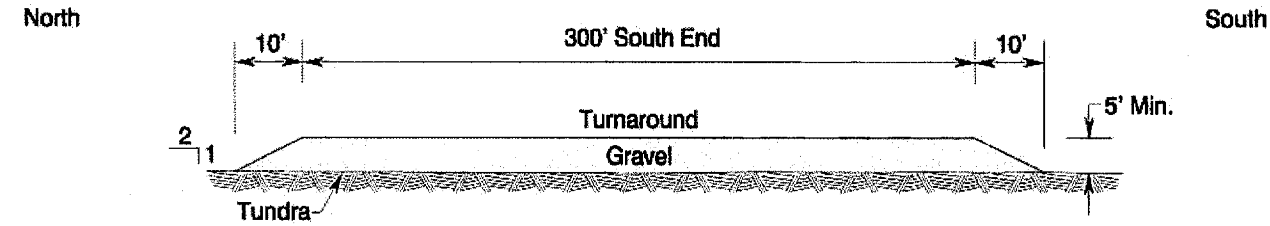
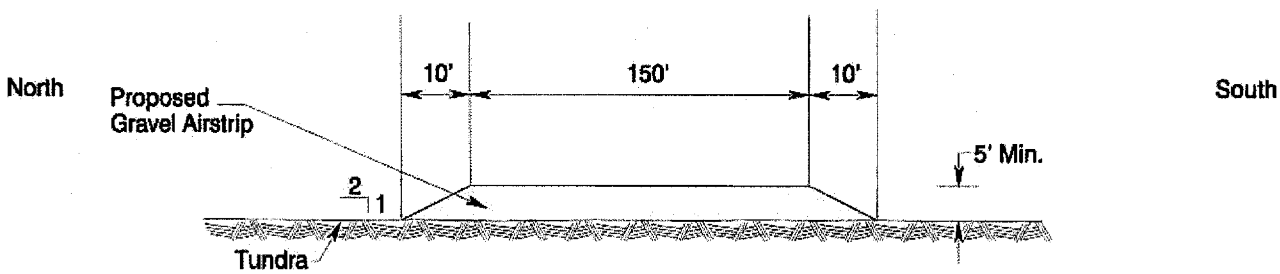


Section A - A'



Section B - B'

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POINT THOMSON GAS CYCLING PROJECT
AIRSTRIP CROSS - SECTIONS
(A - A' AND B - B')

DATE:	SCALE:	FIGURE:
July 2001	Not to Scale	3 - 10B

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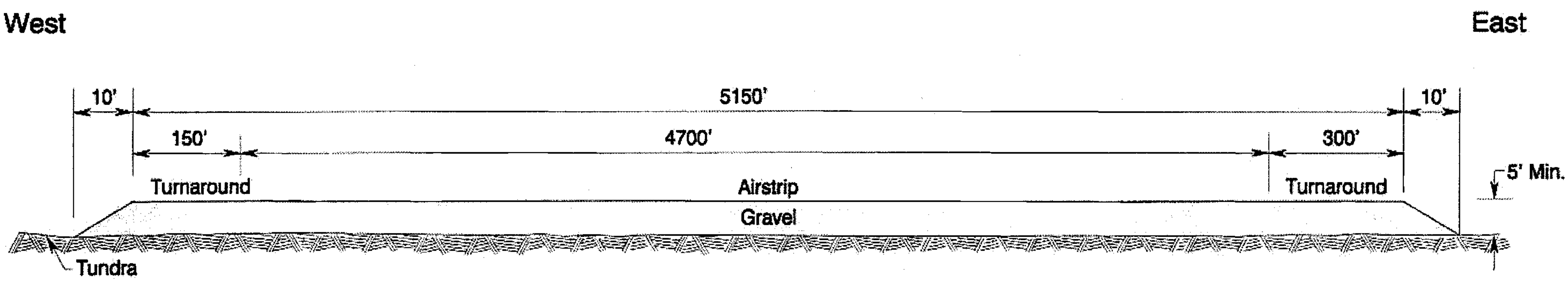

Section C - C'

ExxonMobil

POINT THOMSON GAS CYCLING PROJECT
PROPOSED AIRSTRIP
CROSS - SECTION (C - C')

DATE:	SCALE:	FIGURE:
July 2001	Not to Scale	3 - 10C

ex14464cross

3.5 DOCK

Due to Point Thomson's remote location, all major equipment and facilities required for the drilling and construction phase of the project must be brought in over ice roads in the winter or by sea lift with barges during the summer months. However, smaller loads and supplies could be brought in by air. Following construction, supplies for the on-going operation of the plant must also be brought in by one of these methods as well.

A dock will be used for delivery of drilling rigs and major sealifted facilities modules. It is also the most effective means of supplying large quantities of bulk materials during construction, drilling, and operations phases. It is also important for providing spill response capabilities. Facilities studies have concluded that the dock should be capable of landing barges transporting CPF modules weighing up to 6,000 tons (5,443 metric tons). This requires approximately 9 ft (3 m) of water depth. Figure 3-11 shows the dock in relation to the CWP and CPF Pad.

There are many economic, technical, and environmental issues related to the dock and its construction. The alternatives associated with dock construction are analyzed in Section 2.3.1. Analysis of various dock options concluded that a 750-ft (229-m) long dock reaching 7 ft (2 m) water depth combined with dredging to a water depth of 9 ft (3 m) at the dock face was the preferred alternative to provide this capability.

The dock will consist of a 750-ft (229-m) long by 100-ft (30-m) wide armored gravel fill structure. The dockhead will be 150-ft (46-m) by 100-ft (30-m) complete with sheet piling, cell walls, fenders, bollards, and face beams. Approximately 100,000 cy (76,500 m^3) of gravel are required for dock construction. It will be constructed during the first winter. Figures 3-12 and 3-13 provide dock plan view and cross section, respectively.

The following summer, a channel will be dredged to the 9-ft (3-m) isobath to accommodate unloading of the 6,000-ton (5,443 metric ton) modules. The shallow dredged area, shown in Figure 3-12, is estimated to be approximately 1,000 ft by 400 ft (305 m by 122 m). One or two 10 to 12 in (25 to 30 cm) suction dredges will be used to conduct the dredging process. The spoils [up to 30,000 cy (22,940 m^3) will be loaded onto barges for disposal at sea.

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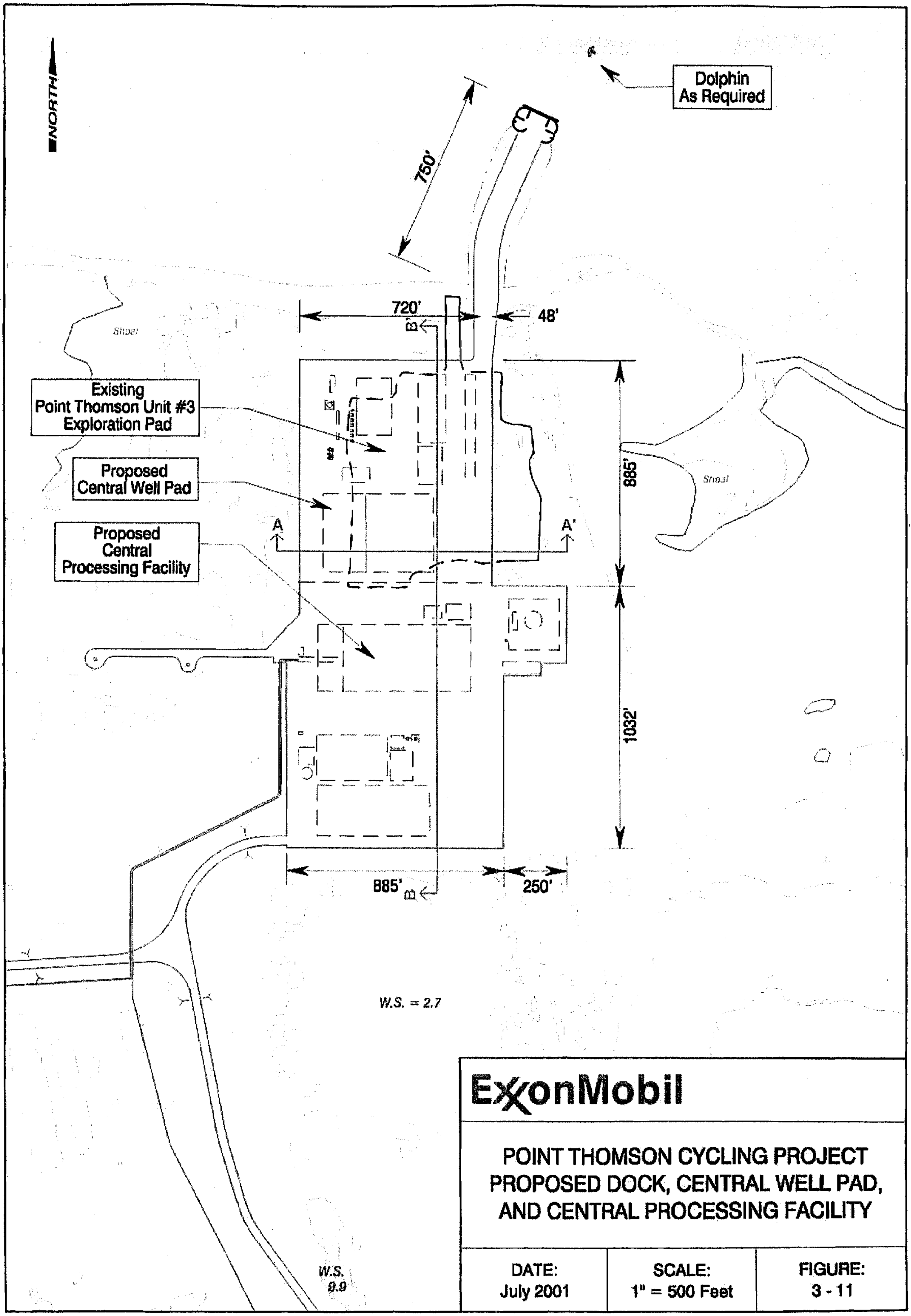

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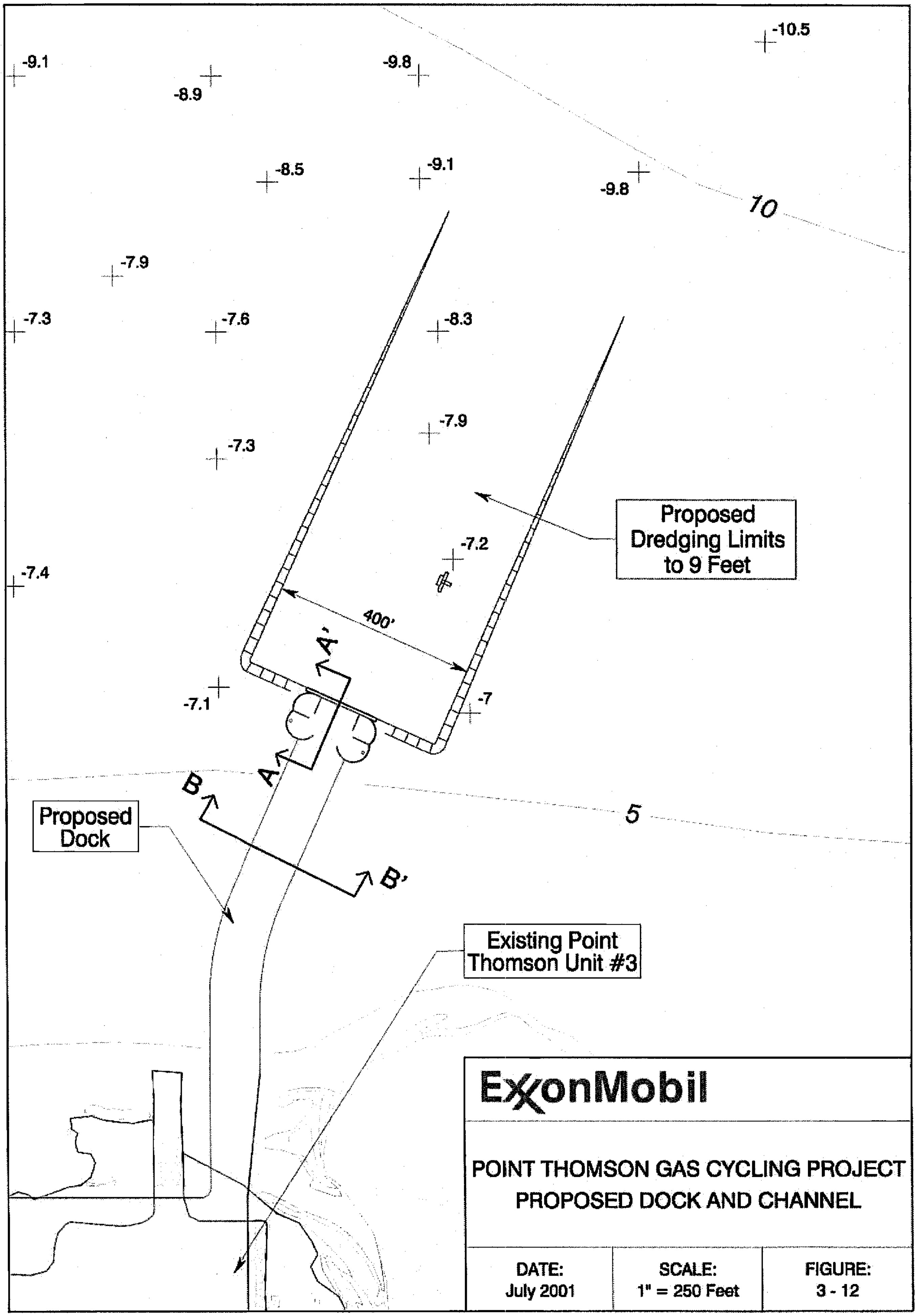
**POINT THOMSON CYCLING PROJECT
PROPOSED DOCK, CENTRAL WELL PAD,
AND CENTRAL PROCESSING FACILITY**

DATE:	SCALE:	FIGURE:
July 2001	1" = 500 Feet	3 - 11

ex14464plan.dgn



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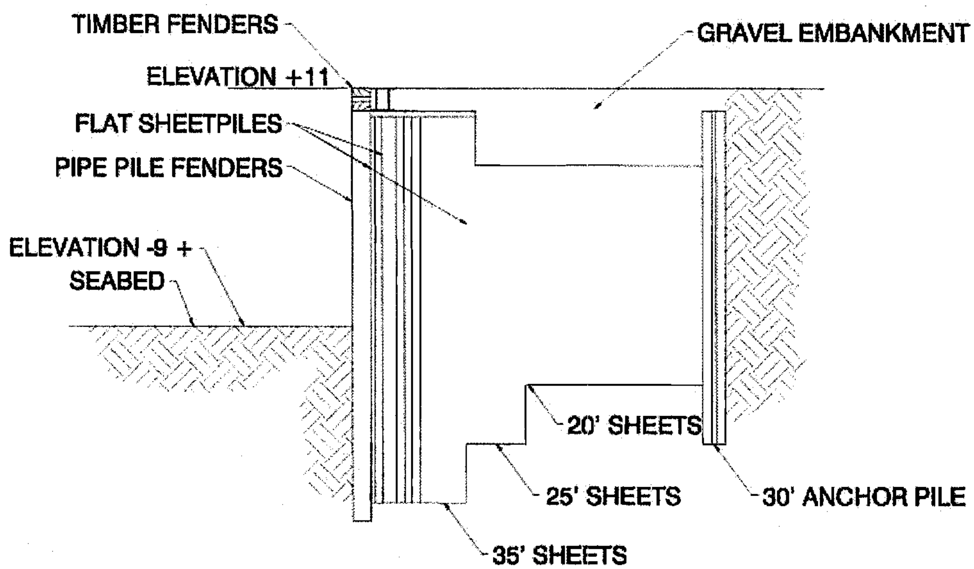
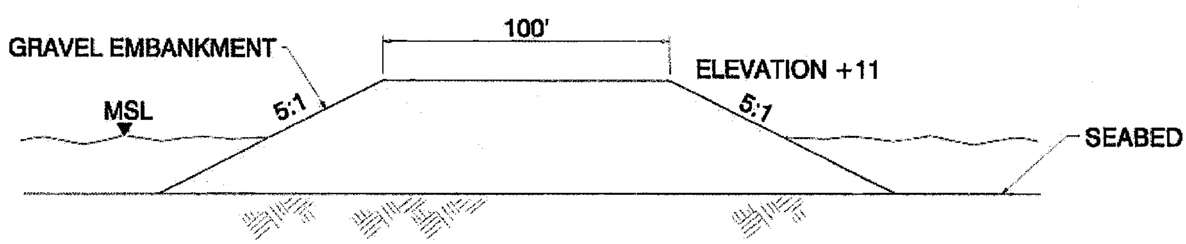
POINT THOMSON GAS CYCLING PROJECT
PROPOSED DOCK AND CHANNEL

DATE:	SCALE:	FIGURE:
July 2001	1" = 250 Feet	3 - 12

fig3_12



SECTION A



SECTION B

ExxonMobil

POINT THOMSON GAS CYCLING PROJECT
DOCK CROSS-SECTION

DATE:	SCALE:	FIGURE:
July 2001	Not To Scale	3 - 13

ex14464cross.dgn

3.6 GRAVEL PADS

3.6.1 General

Before any permanent facility construction or drilling can take place, gravel work pads must be constructed. They are built using gravel mined locally during the winter months, then graded and compacted during the following summer.

Pads must be of sufficient thickness to protect the underlying tundra and permafrost from thawing. Experience has shown that a finished pad thickness of 5-ft (1.5-m) is adequate for this protection. However, because construction usually takes place during winter months using frozen material, additional material is added to account for settlement and compaction that occurs during the summer following initial construction.

There are four facility/well pads and a gravel storage pad proposed for the Point Thomson Gas Cycling Project (See Figure 3-2). Two pads are for production wells, one is for gas injection and waste disposal wells, and the fourth pad serves as a location for the CPF and all related infrastructure, support equipment, and required services. A fifth pad is located adjacent to the gravel mine where gravel is stockpiled for future maintenance needs.

The nomenclature adopted for these pads is the "East and West Well Pads" for production wells; the "CPF Pad" where the Central Production Facility is located including process modules, personnel camps, and related facilities; and the "CWP", or Central Well Pad, for the injection and disposal wells. The CPF Pad and the CWP are adjacent, separated only by a common area that facilitates drainage.

Any run-off collected in this common area will be contained by berms and disposed of appropriately (see Section 3.12.1). The CWP is located approximately 200 ft (61 m) from the high water mark on the coast. The West Well Pad is 7 mi (11 km) from the CPF Pad in a north-westerly direction along the coastline; the East Well Pad is nearly 6 mi (9.6 km) south east of the CPF Pad.

The location of the pads within the Point Thomson Unit have been chosen based on a combination of environmental considerations and the requirement to reach bottom hole objectives in the Point Thomson Sands reservoir. Although most bottom hole targets are located offshore, the facilities will be located onshore and extended reach drilling, with a 20,000-ft (6,096-m) reach capability, will be used to minimize environmental impacts. In general, the West Well Pad will draw from one end of the reservoir, the East Well Pad will draw from the opposite end, and the CWP will be used to inject the gas back into the reservoir at the center.

As the project proceeds and additional information is obtained on the Point Thomson Sands reservoir an additional pad may be necessary to fully develop the reservoir. The additional pad would potentially be located about 3 to 6 mi (5 to 10 km) to the west of the West Well Pad. This pad is discussed in more detail in Section 3.6.5.

The locations of the pads for the development plan are shown on Figure 3-2. Table 3-2 lists the features of the pads, and a description of the facilities located on each pad is provided in the following sections.

Table 3-2 Summary of Gravel Pads

DESCRIPTION	APPROXIMATE SIZES
EAST WELL PAD	
Size (L X W - ft)	570 X 420 (174 m X 128 m)
No. of Wells (P = prod., I = Inj.)	7P and space for 2 future wells
Gravel Volume (cubic yard)	56,000 (43,000 m^3)
Year of Construction	1st Winter
WEST WELL PAD	
Size (L X W - ft)	550 X 410 (167 m X 125 m)
No. of Wells (P = prod., I = Inj.)	6P and space for 2 future wells
Gravel Volume (cubic yard)	53,000 (40,500 m^3)
Year of Construction	1st Winter
CENTRAL WELL PAD (includes portions of the 50-ft Dock Road)	
Size (L X W - ft)	885 X 768 (270 m X 234 m)
No. of Wells (P = prod., I = Inj., D = Disposal.)	8I, 1D and space for 2 future wells
Gravel Volume (cubic yard)	155,000 (119,000 m^3)
Year of Construction	1st Winter
CPF PAD (includes portions of the 50-ft Dock Road)	
Size (L X W - ft)	1,030 X 885 (313 m X 270 m)
No. of Wells (P = prod., I = Inj.)	N/A
Gravel Volume (cubic yard)	238,000 (181,000 m^3)
Year of Construction	1st Winter
GRAVEL STORAGE PAD/ MAINTENANCE STOCKPILE	
Size (L X W – ft)	700 X 700 (213 m X 213 m)
Gravel Volume (cubic yard)	200,000 (153,000 m^3)
Year of Construction	1st Winter

3.6.2 CPF Pad

The CPF Pad is the largest of the gravel pads and the location for the Central Production Facility which includes the main gas processing modules and related support and infrastructure facilities.

Figure 3-14A provides the plan view and Figure 3-14B shows the cross section of the CPF Pad. Some of the significant features of this pad are:

- Approximate area of 21 acres (85,000 square meters [m^2]),
- Finished (compacted) thickness is 5 ft (1.5 m),
- Constructed during the first winter's construction season, and
- Graded to provide drainage to one end – common with the CWP.

3.6.3 Central Well Pad

The CWP is located adjacent to and directly north of the CPF Pad. It contains the gas injection wells, the G&I facility, an electrical building, an early fuel gas treating facility, and storage areas for drilling activities.

Figures 3-15A and 3-15B provide the plan view and cross section of the CWP. Significant features of the CWP include:

- Approximate area of 15 acres (61,000 m^2),
- Incorporates existing Pt. Thomson #3 exploratory gravel pad,
- Finished (compacted) thickness is 5 ft (1.5 m),
- Constructed during the first winter's construction season at the same time the CPF Pad is constructed, and
- Graded to provide drainage to one end – common with the CPF Pad.

The Point Thomson G&I facility was designed to inject ground drill cuttings, waste mud and water from drilling activities, wastewater from construction camp and permanent camp operations, and produced water from operation of the Point Thomson facility. The G&I system will be located at the CWP and cuttings from the East and West Well Pads will be trucked to the G&I facility for processing and downhole disposal. Surface gravel from the upper holes will be washed and used for road and pad maintenance, rather than being processed at the G&I. At the drill site, the larger rock (1/8-in and bigger is allowed by permits for other recent projects) will be screened out, washed, and spread on the back slopes of existing pads and roads.

The G&I system has the capacity to grind the remaining cuttings to a 20 mesh size. Each mill train is capable of grinding approximately 6 cubic yards (cy) of rock per hour, which is more than 100 percent (%)of the volume of material expected. It is estimated that approximately 1.1 cy (0.84 m^3) of rock per hour will be produced from each drilling rig operation at Point Thomson.

Grinding and injection is generally performed in batches with a fixed volume ground up and converted to slurry for injection. The slurry injection pumps with capacities of approximately 125 gallons per minute (473 liters per minute) and maximum discharge pressures of approximately 5,000 pounds per square inch (psi) (3,515,000 kilograms per square meter [kg/m^2]) are typically used (Actual injection pressures of 3,000 psi [2,109,000 kg/m^2] are normal).

3.6.4 East and West Well Pads

These pads are both production well pads. The West Well Pad is located approximately 7 mi (11 km) northwest of the CPF Pad; the East Well Pad approximately 6 mi (9 km) southeast. Figure 3-16 shows the plan view for the East Well Pad and Figure 3-17 shows the plan view for the West Well Pad. Significant features and approximate dimensions of the East and West Well Pads include:

- West Well Pad which can accommodate up to eight wells is approximately 5 acres (20,200 m^2);
- East Well Pad which can accommodate up to nine wells is about 6 acres (24,000 m^2);
- Finished (compacted) thickness is 5 ft (1.5 m);
- Constructed during the first winter's construction season at the same time the CPF Pad is constructed; and
- Graded to provide drainage to one side.

3.6.5 Far West Well Pad

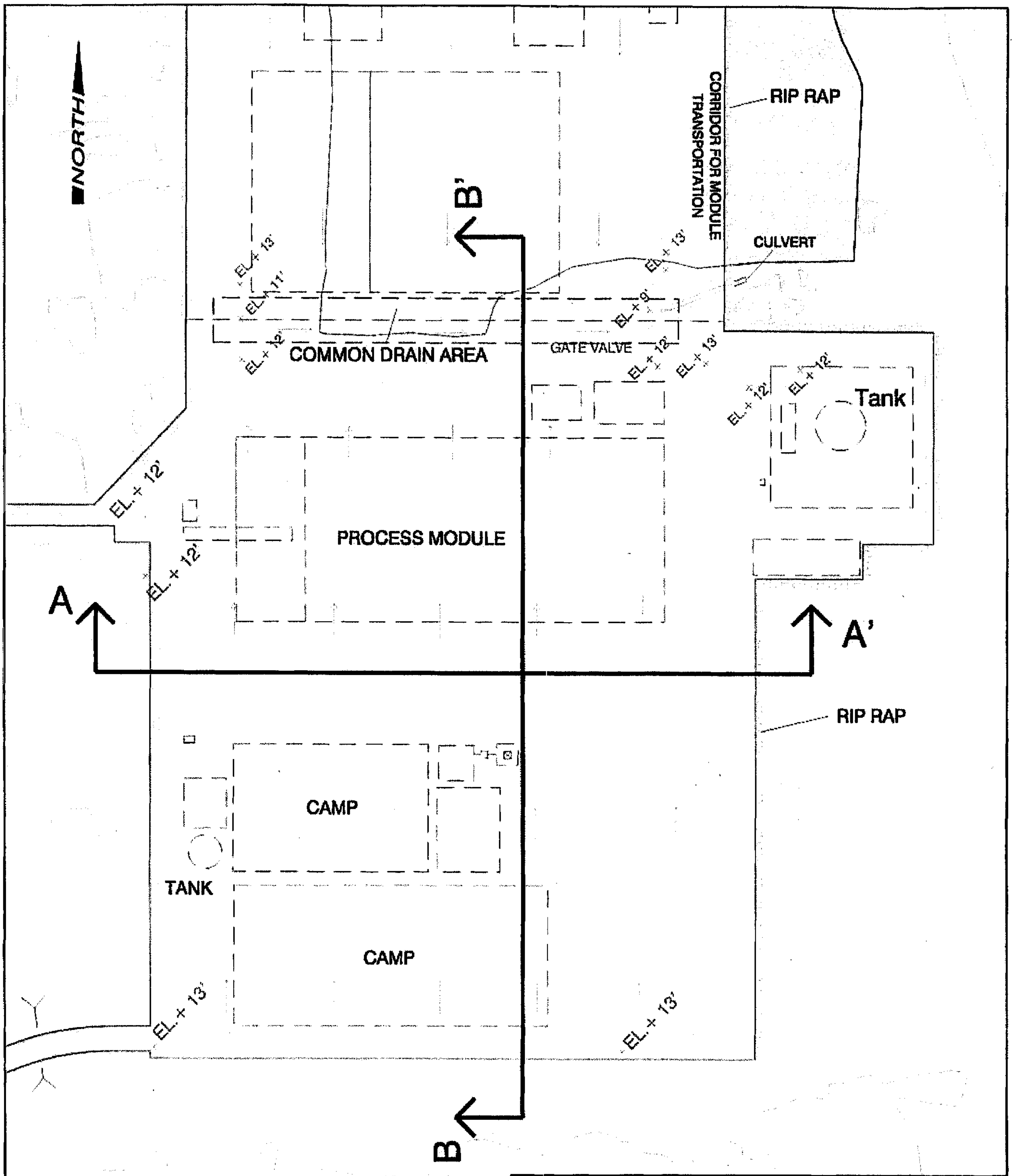
A potential additional production well pad location has been identified approximately 3 to 6 mi (5 to 10 km) further to the west from the West Well Pad. This Far West Well Pad would be approximately 5 acres (20,200 m^2) and accommodate possibly four to six wells. Although current plans do not include drilling and development for this pad, it may be determined that additional wells from this pad are necessary for optimum development of the reservoir. Should such a location prove necessary the road and pipeline systems would be extended to join this pad.

3.6.6 Maintenance Gravel Stockpile/Pad

A stockpile of gravel will be required to provide for maintenance of gravel roads and pads. This stockpile is created during the first winter's gravel mining operation. It is necessary to do this during the initial mining phases because it is anticipated that the gravel mine will flood with water following the first winter and become abandoned to further gravel mining.

The size of the stockpile is planned to be approximately 200,000 cy (153,000 m^3). This amount should be large enough to maintain road and pad systems for at least 20 years. Historically, the quantity has been estimated to be 10 to 15% of the total gravel requirement for the project.

A secondary use of the large gravel surface provided by the stockpile is to serve as a storage area. This will be particularly useful during the drilling phase of the project. The gravel storage pad will be immediately adjacent and north of the proposed mine site, with the west side of the pad adjoining the CPF/airstrip infield road. The gravel storage pad will cover approximately 11 acres (44,500 m^2).



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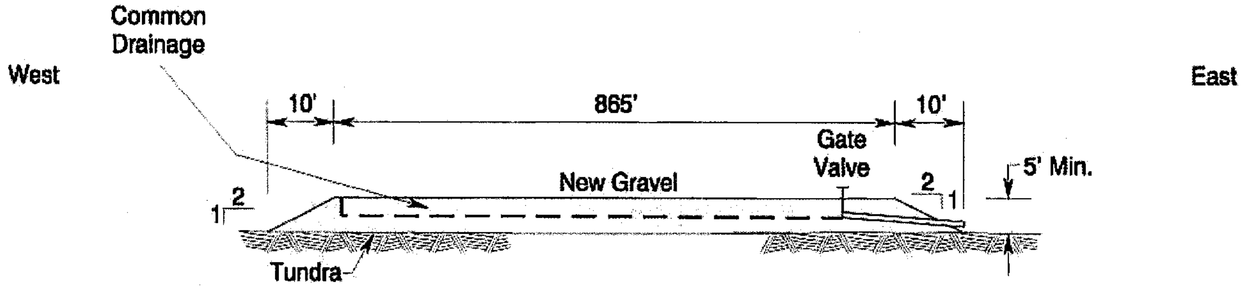
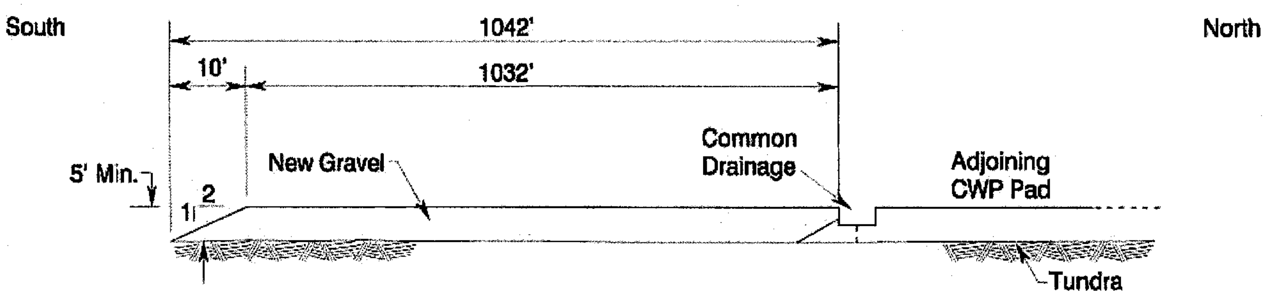
POINT THOMSON GAS CYCLING PROJECT
CENTRAL PROCESSING FACILITY

DATE:	SCALE:	FIGURE:
July 2001	1" = 200 Feet	3 - 14A

fig3_14a.dgn



Section A - A'



Section B - B'

ExxonMobil

POINT THOMSON GAS CYCLING PROJECT
CENTRAL PROCESSING FACILITY PAD
CROSS - SECTIONS

DATE:	SCALE:	FIGURE:
July 2001	NOT TO SCALE	3-14B

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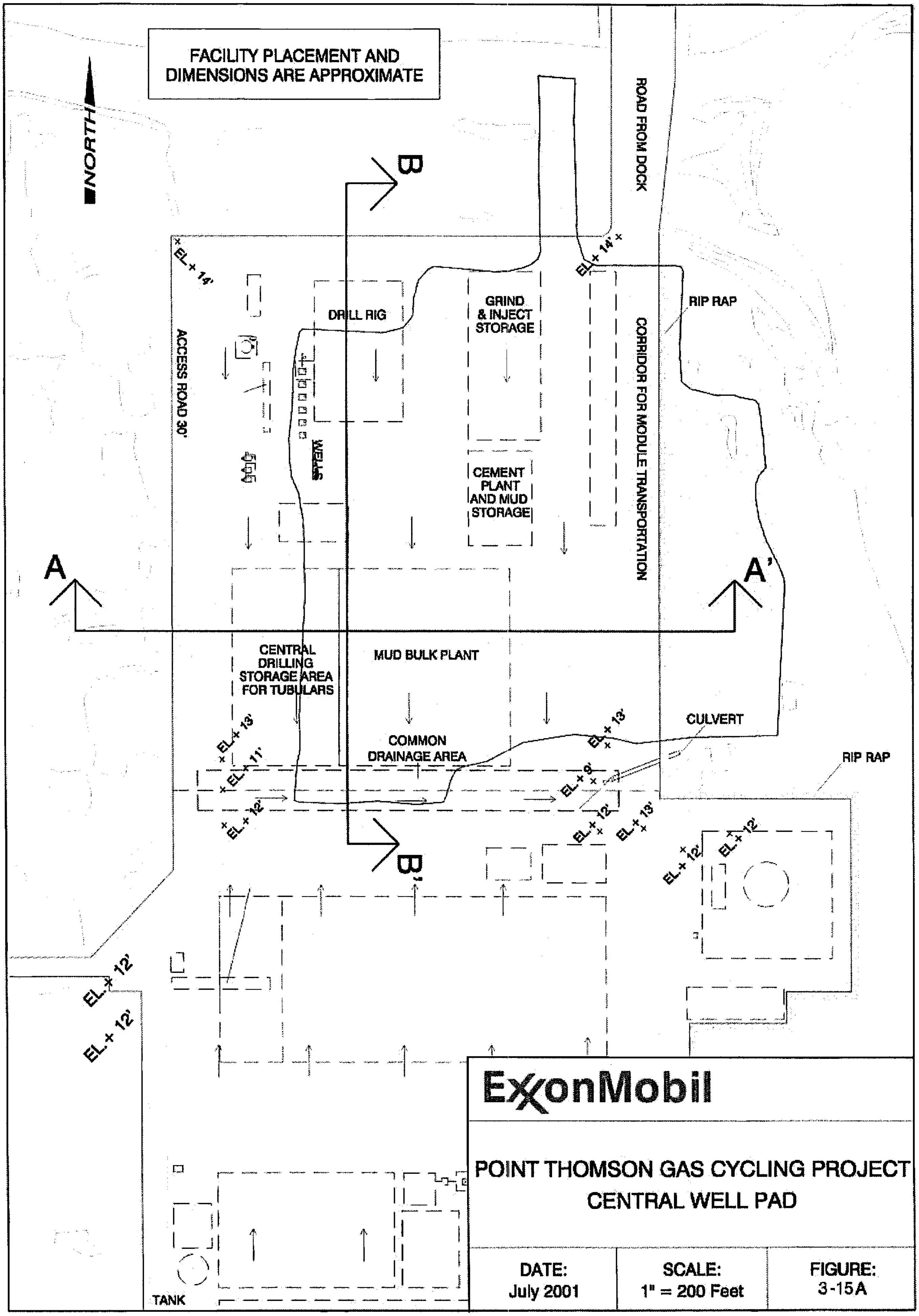
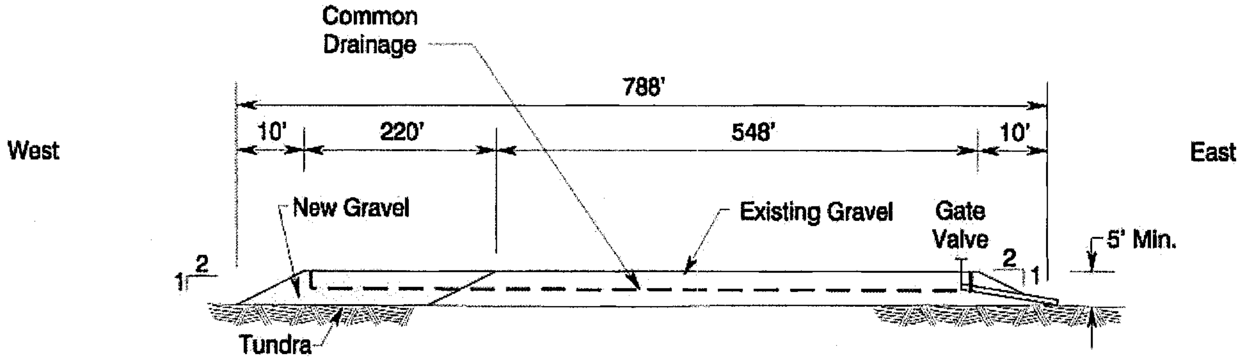
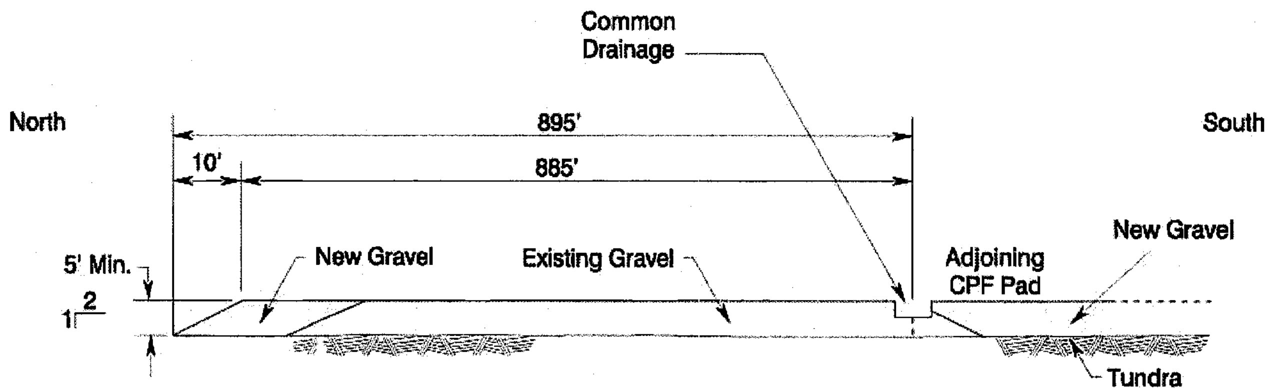

FACILITY PLACEMENT AND
DIMENSIONS ARE APPROXIMATE
NORTH
ROAD FROM DOCK
B
EL + 14'
EL + 14'
DRILL RIG
GRIND
& INJECT
STORAGE
RIP RAP
ACCESS ROAD 30'
CORRIDOR FOR MODULE TRANSPORTATION
WELLS
CEMENT
PLANT
AND MUD
STORAGE
A
A'
CENTRAL
DRILLING
STORAGE AREA
FOR TUBULARS
MUD BULK PLANT
COMMON
DRAINAGE AREA
CULVERT
RIP RAP
EL + 13'
EL + 11'
EL + 12'
EL + 13'
EL + 9'
EL + 12'
EL + 13'
EL + 12'
EL + 12'
B'
EL + 12'
EL + 12'
TANK
ExxonMobil
POINT THOMSON GAS CYCLING PROJECT
CENTRAL WELL PAD
DATE:
July 2001
SCALE:
1" = 200 Feet
FIGURE:
3-15A

fig3 15a.dgn



Section A - A'



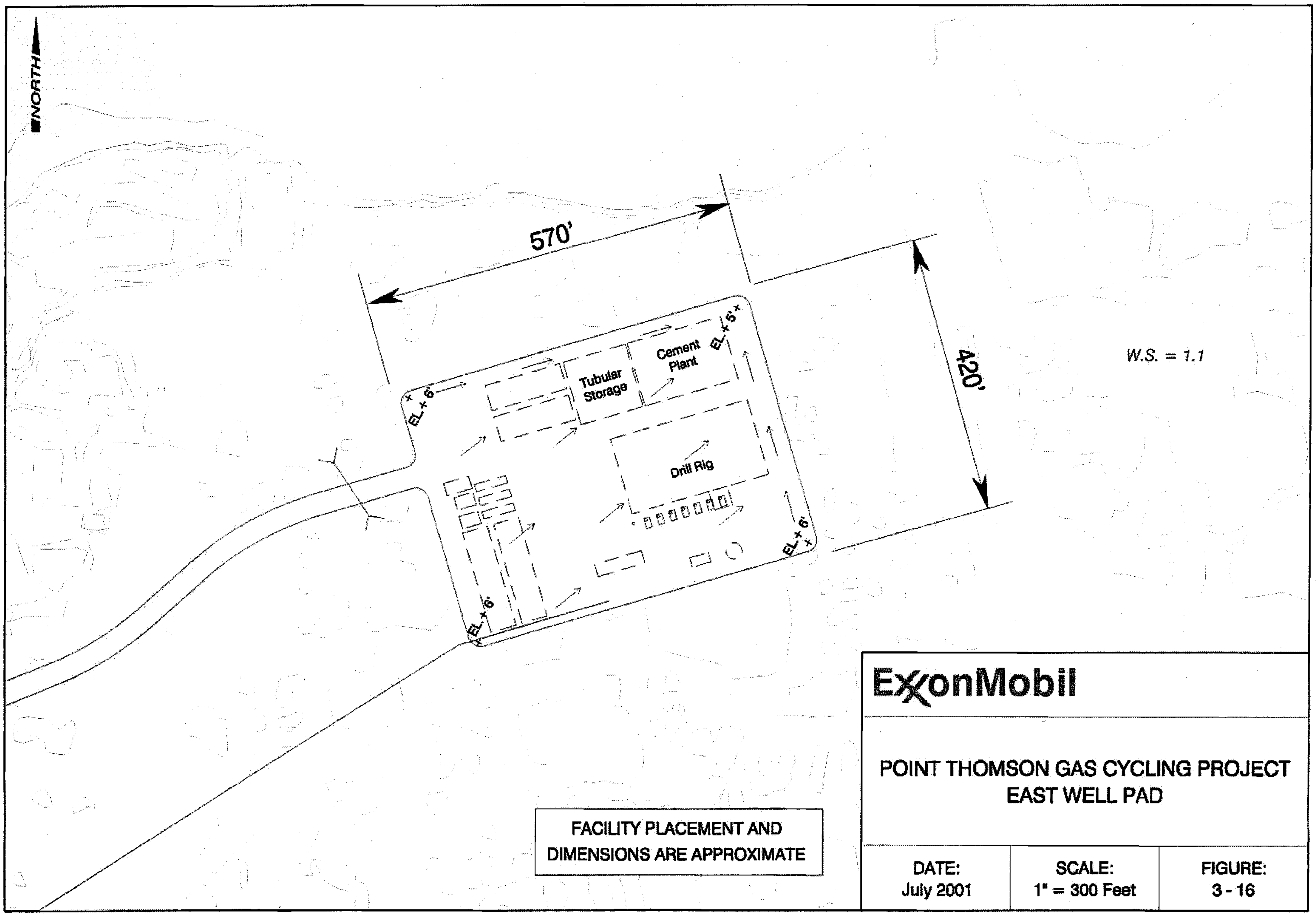
Section B - B'

ExxonMobil

POINT THOMSON GAS CYCLING PROJECT
CENTRAL WELL PAD
CROSS - SECTIONS

DATE:	SCALE:	FIGURE:
July 2001	NOT TO SCALE	3-15B

ex14464cross.dgn



FACILITY PLACEMENT AND DIMENSIONS ARE APPROXIMATE

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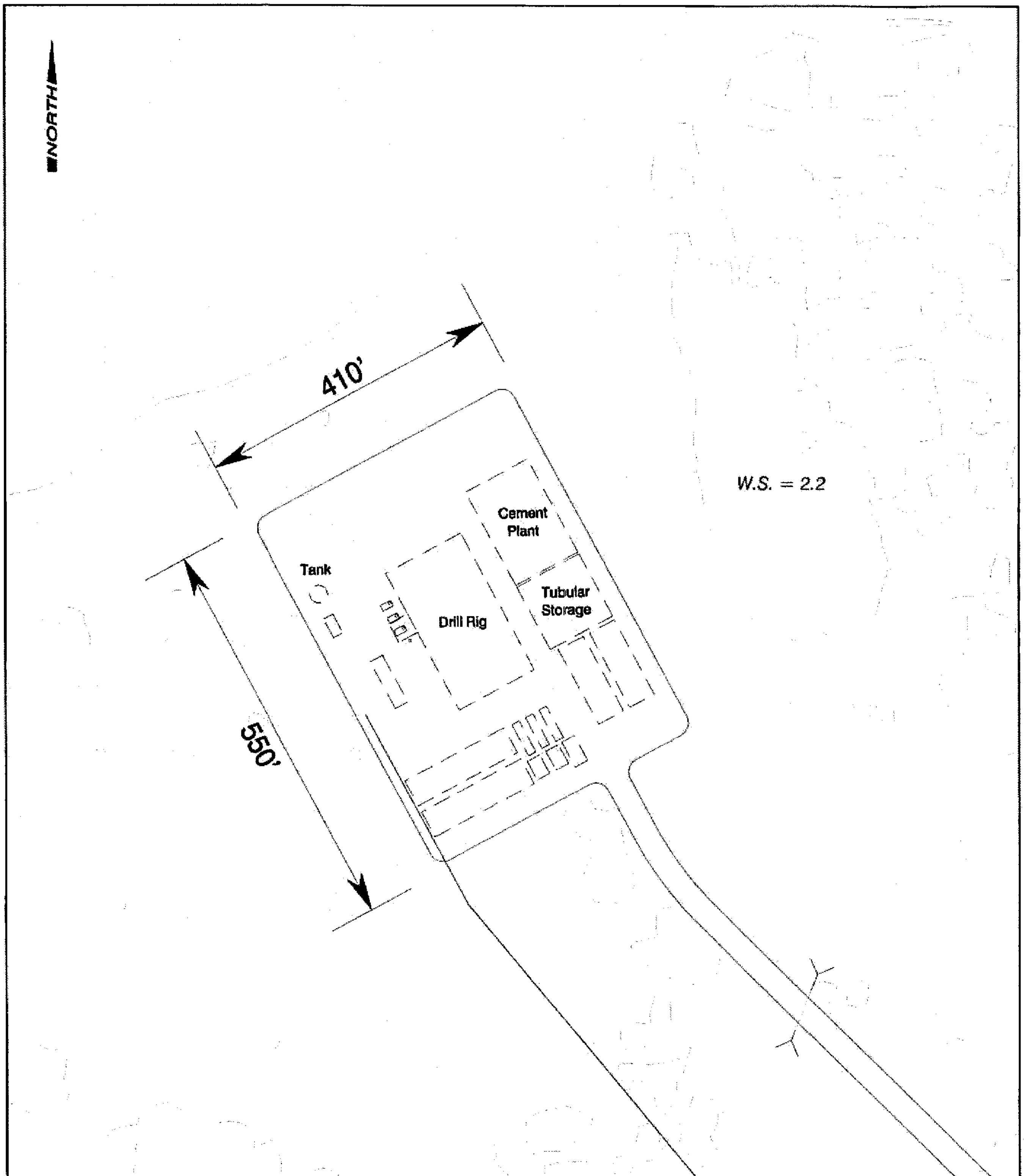
POINT THOMSON GAS CYCLING PROJECT
EAST WELL PAD

DATE:	SCALE:	FIGURE:
July 2001	1" = 300 Feet	3 - 16

ex14464plan.dgn



W.S. = 6.5

FACILITY PLACEMENT AND DIMENSIONS ARE APPROXIMATE

ExxonMobil

POINT THOMSON GAS CYCLING PROJECT
WEST WELL PAD

DATE:	SCALE:	FIGURE:
July 2001	1" = 200 Feet	3-17

ex14464plan.dgn

3.7 GRAVEL SOURCES

Potential gravel sources for new roads and pads are analyzed in Section 2.5 of this Environmental Report. The GM-2 gravel mine option is currently the preferred location for obtaining gravel for use in construction of the Point Thomson Gas Cycling Project.

Section 2.5 also analyzes the reuse of gravel from existing abandoned pads in the Point Thomson area. Site assessments of the existing pads will be conducted to determine the suitability of the sites for gravel reuse. Pt. Thomson Unit #3 is located at the proposed location of the CWP and will be reused *in situ* during the construction of the new pad.

Approximately 2,000,000 cy (1,529,110 m^3) of gravel and 470,000 cy (359,340 m^3) of tundra overburden are anticipated to be removed from the 38.9 acre (157,400 m^2) mine site. Use of recycled gravel from other locations (see Section 2.5.3) may reduce these volumes. The proposed mine site will be located approximately 220 ft (67 m) east of the CPF/Airstrip infield road and connected with this road by a short (220 ft [67 m]) access road located at the extreme north end of the mine site. Figures 3-18A and 3-18B show the plan view and cross section of the proposed gravel mine site, respectively. At this point in time, mitigating measures for impacts associated with mine site development are currently being developed. These will be refined and selected based on continued agency consultation.

The excavation pit will be mined on a one-time basis throughout the first winter construction season. Previous geotechnical investigations determined that the tundra organics (i.e. peat) and silt overburden is approximately 3.5 ft (1 m) to 12 ft (3.6 m) thick within the preferred gravel mine site (D. Miller & Associates 2000). It is anticipated that construction grade gravel extends throughout the site to a depth of 30 ft (9 m) to 40 ft (12 m).

Approximately 470,000 cy (359,340 m^3) of tundra organics (peat) and silt overburden will be removed and placed in a 220-ft (67 m) by 1,590-ft (485 m) stockpile located immediately adjacent to the west side of the gravel mine site, as shown in Figure 3-18A. The anticipated maximum height of the overburden stockpile is estimated to be 30 ft (9 m). It is anticipated that the majority of the overburden will remain as stockpiled material to support future restoration efforts; however, a portion of the stockpiled overburden could be returned to the mine site excavation immediately prior to completion of the mining operations.

Blasting is anticipated to be conducted in 20-ft (6 m) lifts to loosen the material for use as construction material. Excavation within the gravel pit may extend to a maximum depth of 60 ft (18 m) below the original ground surface (21 to 28 ft [6.4 to 8.5 m] above mean sea level), depending on the total gravel volume requirements and the quality of available material.

Once the gravel extraction activity is completed, it is anticipated that the mine site will fill with water during spring breakup, and provide an additional freshwater source for continued use throughout the project life span.

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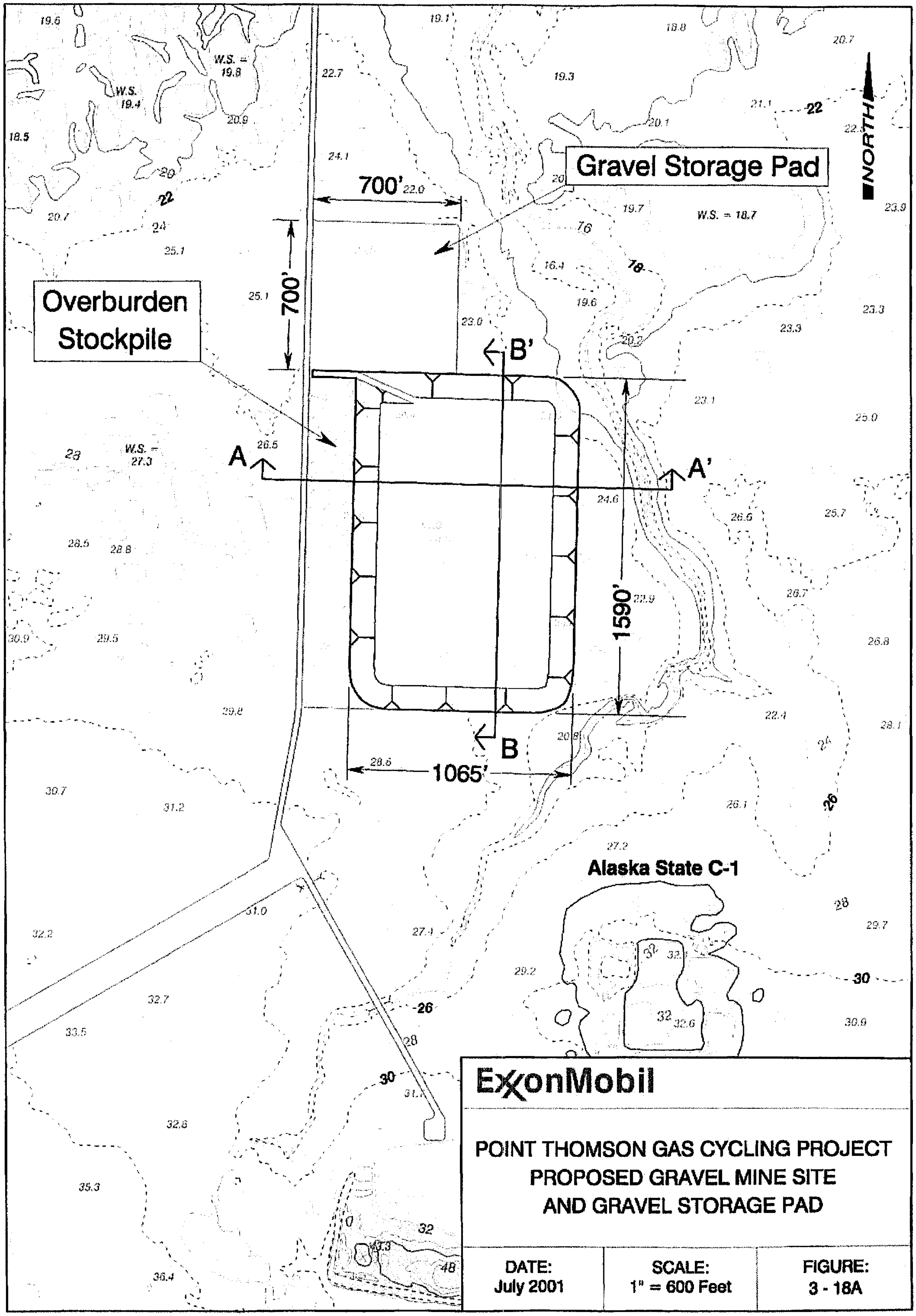

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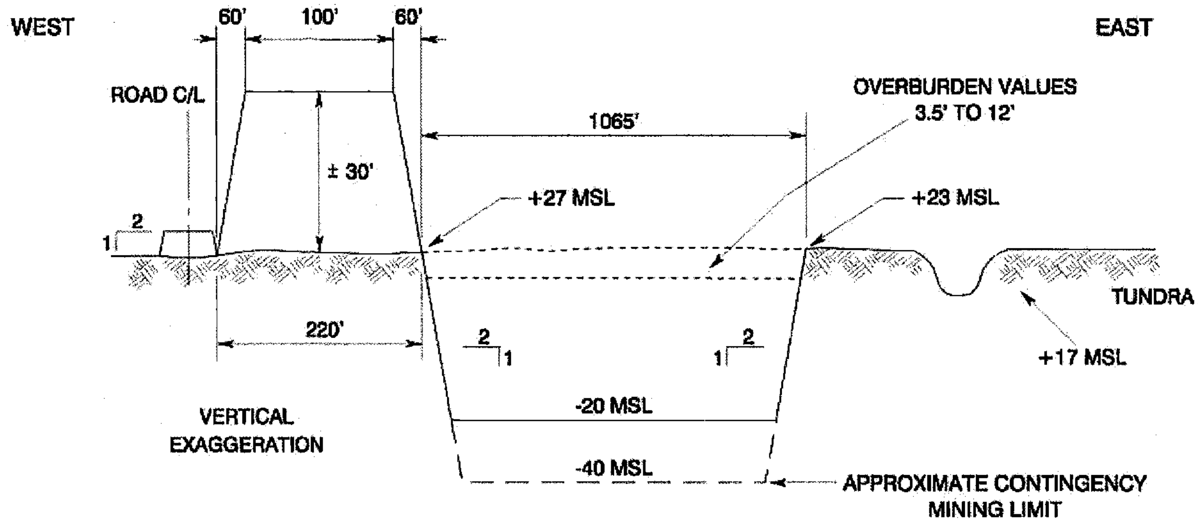
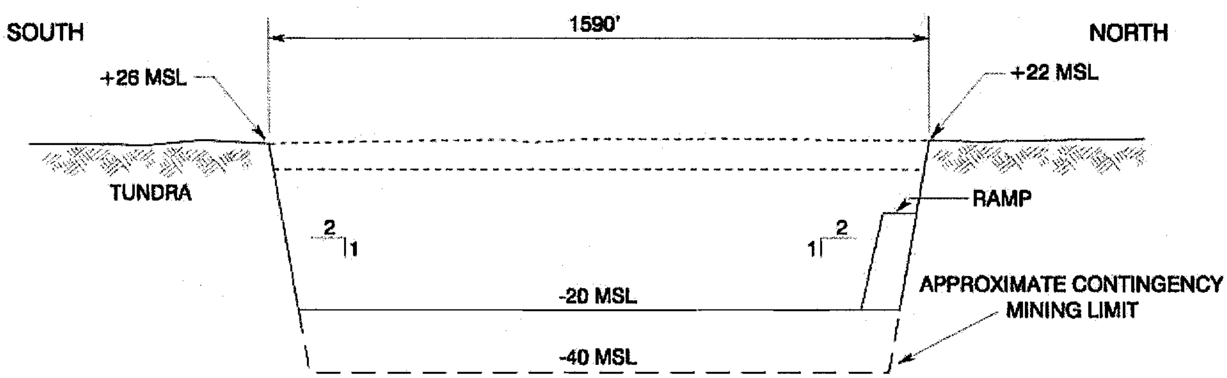
POINT THOMSON GAS CYCLING PROJECT
PROPOSED GRAVEL MINE SITE
AND GRAVEL STORAGE PAD

DATE:	SCALE:	FIGURE:
July 2001	1" = 600 Feet	3 - 18A



SECTION A - A'



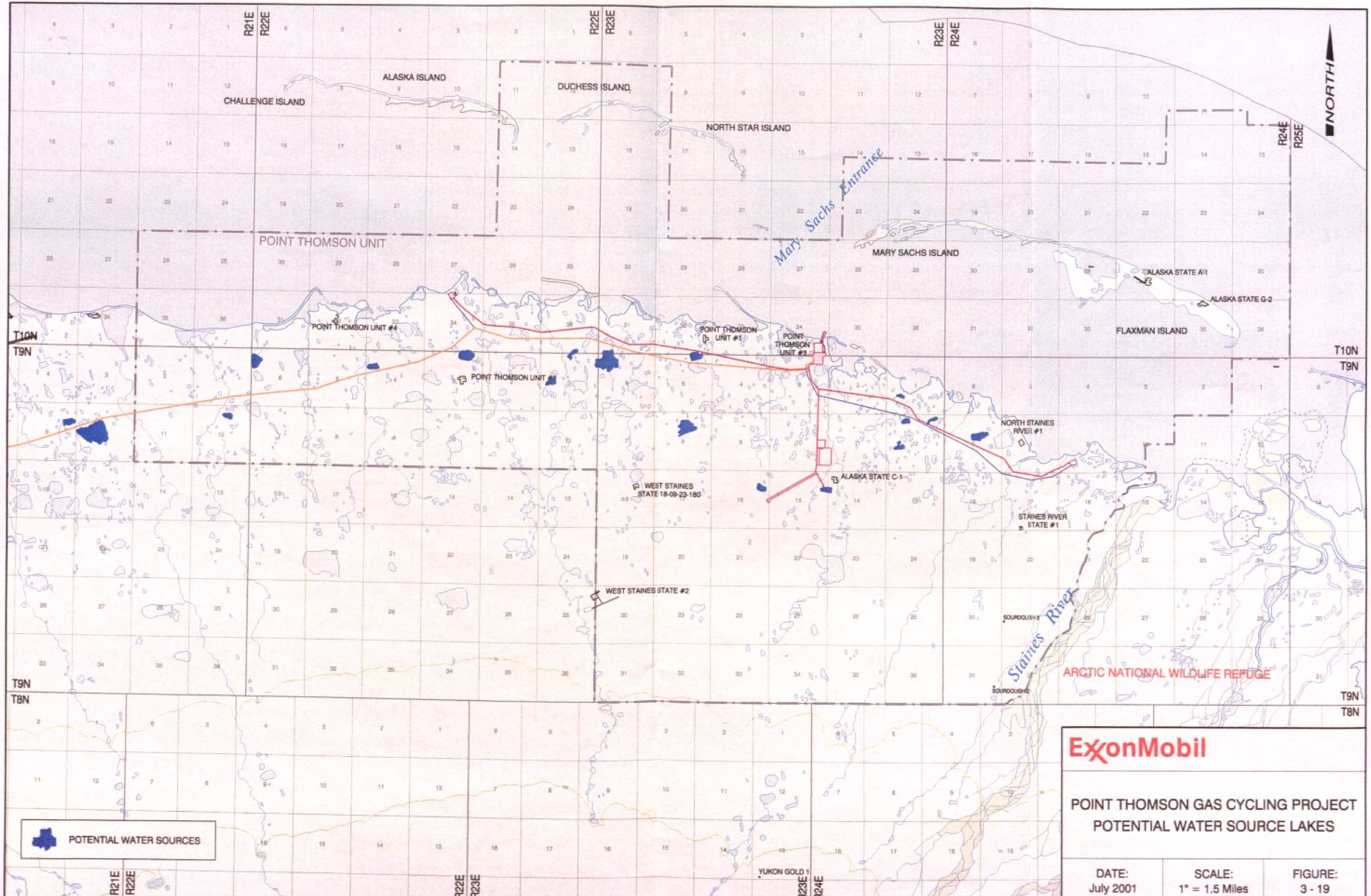
SECTION B - B'

ExxonMobil

POINT THOMSON GAS CYCLING PROJECT
PROPOSED MINE SITE
CROSS SECTIONS

DATE:	SCALE:	FIGURE:
July 2001		3 - 18B

fig3_18b.dgn



POINT THOMSON GAS CYCLING PROJECT
POTENTIAL WATER SOURCE LAKES

DATE:	SCALE:	FIGURE:
July 2001	1" = 1.5 Miles	3 - 19

fig3_19.dgn

3.8 FIELD FACILITIES

Wells, equipment, modules, buildings, and other infrastructure facilities located on the pads will be constructed or assembled over a two-year period. Initially, those components required to support the drilling and construction activities will be installed, followed by operation facilities.

3.8.1 Central Production Facility

3.8.1.1 Process Facilities, Pipelines, and Other Infrastructure

The processing modules, storage tanks, living quarters, and utility modules are located on the CPF Pad. The CPF Pad is the terminal end of the gathering pipelines and the origination point for the export condensate pipeline. High-pressure gas pipelines and utility lines extend northward for approximately 1,000 ft (305 m) to the CWP. High and low pressure flare lines connect to the flares located directly to the west of the CPF pad. Other infrastructure also located at the CPF includes the emergency and normal power generators, control room, warehouse and shops, operations and construction camps, and related storage and utilities.

A simplified flow diagram showing the basic CPF process was shown on Figure 3-1. Major rotating equipment includes injection compressor trains driven by three (3) gas turbines [approximately 50,000 horsepower each], flash gas compression (two trains of turbine-driven centrifugal compression), and product shipping pumps (three pumps sized for 50-percent capacity each). Other equipment includes a fired process heater, high-pressure aerial coolers for inlet, interstage, process and utilities cooling, separators, scrubbers, a condensate stabilizer, and an electrostatic treater.

3.8.1.2 Flare System

The bulk of the flammable fluid in the Point Thomson gathering system, plant, and gas injection system is natural gas. The flare system is used to safely burn gases which may occasionally need to be released when pipelines and facilities are depressurized for maintenance or when there is a temporary facilities upset. Depressurization and flaring might also be necessary if there is an emergency in the facility. Vented gas first flows to flare knock-out drums where liquids are separated prior to the gas being sent to the flare. There are two separate flare systems one for high pressure gases and one for low pressure gases. Emissions from the flare events are expected to consist mostly of methane, with small amounts of propane and carbon dioxide. Noise associated with high flare rate excursions is expected to be similar to that generated at other North Slope operations.

Gas flaring is limited to serious plant emergencies and when necessitated by maintenance. Two flare scenarios are assumed: maximum and typical. The maximum gas flow rate to the flare system is in the order of 1.5 billion cubic ft per day (42.5 million cubic meters per day). This scenario represents an abnormal emergency situation where gas is being vented at high rates from the gathering and injection pipelines and/or the plant vessels and piping. These are likely to be very rare events. The typical flare scenario represents minimal flaring at times when a single compression train is removed from service for routine or unplanned maintenance. These events could occur several times a year, and are likely to decrease in frequency as problems with new equipment are resolved.

Only flare pilot and purge volumes are burned during normal (non-flaring) conditions. There will be little perceivable noise from this normal state. Air emissions from the pilot and purge are included in the inventory for the CPF.

High and low-pressure system flare stacks will be located just to the west of the CPF Pad. Each flare stack will be approximately 100 ft (46 m) above the ground surface. Gas and air mix at the flare tips located at the top of the stacks. The flare stack height also aids in dispersion of the combustion products and reduces ground level heat radiation. To protect humans and wildlife from entering the zone of possible heat radiation, a fence will enclose the area beneath the flare stacks.

The location of the flare stacks was selected to meet a number of criteria. First, the stacks need to be located as close to the plant site as practical in order to minimize the length and resulting pressure drop of the flare lines. Secondly, the flares are located such that the heat radiation limit at any occupied area of the plant, roads or pipeline right-of-way is maintained below a heat radiation limit of 500 British thermal units (BTU) per hour per square foot. The flares are also located downwind of the plant (based on the prevailing wind direction). Finally, the stacks are situated such that the microwave path between Point Thomson and Badami is not obstructed during flaring.

3.8.2 Central Well Pad Facilities

During the early construction phase of the project, the CWP will be used primarily to support drilling operations. A Class I disposal well, G&I facilities, drilling equipment, drilling supplies, mud plant, temporary storage pit for drill cuttings, and the early fuel gas system will all be located at the CWP. A disposal well and approximately 8 injection wells will be drilled from the CWP. Space is also required for two additional wells on the CWP in the event that additional injection well capacity is required by operations and/or additional production well(s) are drilled from this pad. High-pressure gas pipelines will transport the gas from the CPF Pad to the injection wells located at the CWP.

Wells on the CWP will be aligned in a row and spaced 20 ft (6 m) apart. Flow meters will be installed on each injection well to measure the volume of gas injected. Separate pipelines will transport treated camp gray water and produced water from facilities on the CPF to the EPA Class I Underground Injection Certification waste disposal facilities (i.e., piping manifolds and disposal pumps) on the CWP.

3.8.3 East Well Pad Facilities

The East Well Pad will have approximately seven production wells with space provided for up to two additional wells, if needed. During the drilling phase, much of the pad area will be taken up with facilities and services to support drilling. When production begins, the facilities located on this pad will include production manifolds, well metering and control facilities, an electrical building, methanol tank and injection system, and a gathering pipeline pig launcher. Production wells will be aligned in a row and spaced 20 ft (6 m) apart. This spacing is larger than that for recent non-gas projects (as low as 10 ft) simply because the well count for a gas cycling project is very low and hence, the facilities' sizes, rather than the well count, is the driving factor determining pad size. In addition, the wider well spacing helps ensure underlying permafrost integrity and provides an additional safety margin in the event of a well control incident.

Production from each well will be measured using three phase meters, and thus, a test separator is not required.

3.8.4 West Well Pad Facilities

The facilities provided on the West Well Pad are very similar to those on the East Well Pad. Differences arise due to the number of wells planned. Approximately six production wells are currently envisioned for the West Well Pad, with space provided for up to two additional wells.

3.9 PIPELINE SYSTEMS

Corrosion-resistant alloy gathering pipelines (maximum working pressure [MWP] approximately 3,600 pounds per square inch gauge (psig)) will be used to transport three-phase production fluid from the production wells to the CPF. Pig launchers and receivers are incorporated into each gathering pipeline.

High-pressure (approximately 12,500 psig MWP) carbon steel pipelines will serve to move gas from the compressors at the CPF approximately 1,000 ft (305 m) to the CWP injection well.

A carbon steel pipeline (approximately 1,415 psig MWP and approximately 22 mi [35 km] long) will be used to transport condensate from the CPF to a connection point with the existing Badami pipeline. Pig launchers and receivers are included on this pipeline. From the tie-in point, the existing 12-in (30.5-cm) Badami pipeline extends another 25 mi (40 km) to tie-in with the Endicott pipeline. The Endicott pipeline extends another 16 mi (26 km) before connecting to the Trans Alaska Pipeline System Pump Station No. 1 at Prudhoe Bay.

Approximate nominal pipeline diameters will be as follows:

- Gathering lines (Well Pads to CPF) – 18 to 24 in. (46 to 61 cm)
- Condensate export line – 12 in (30.5 cm)
- Gas injection system – 6 to 10 in. (15 to 25 cm) (number and size to be determined later)

All of these pipelines will be insulated and installed aboveground (maintaining minimum 5 ft (1.5 m) clearance to bottom of pipe) on vertical support members (VSMs). Vibration dampeners will be installed, as needed, along the pipelines to prevent wind induced vibration. These will be located either above the pipe, or below the pipe with five feet of ground clearance.

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3.10 CONSTRUCTION PLAN

3.10.1 First Year Construction Scope

The objective of the first construction year is to have all required drilling support infrastructure in place by September 2005, the proposed start of development drilling. Scope of work includes gravel mine site development, construction of all pads, dock, and airstrip; and installation and commissioning of equipment required to support subsequent drilling operations as detailed in the previous section.

Civil construction is planned as a winter-only activity utilizing both sea and inland ice roads to minimize the tundra impact. Construction methods utilize proven conventional arctic onshore equipment and techniques. The construction schedule has been developed in consultation with Alaska-based contractors and BP Exploration (Alaska), Inc.

The majority of civil construction is expected to be complete by April 2005 with the exception of final gravel compaction and shaping activities during the June to July time frame. By late summer 2005 the dock and the airstrip are expected to be fully operational. All early infrastructure equipment will be installed and fully commissioned prior to start-up of drilling activities. Construction camps will be provided as self-contained units in terms of utilities such as water and waste treatment.

3.10.1.1 Ice Roads

Depending upon weather conditions, construction of a grounded sea ice road connecting Endicott to Point Thomson could begin late November 2004 and is expected to be completed towards late December to early January 2005. About 33 vehicle trips from Endicott to Point Thomson may be required for sea ice road construction. Up to 28 vehicle trips per day are expected on this road during the first year's construction to transport heavy equipment, construction camps, and personnel to the site.

The inland ice road runs from the dock location to the mine site to facilitate mine development activities. Construction of the inland road will start once construction equipment can be mobilized to the site. Fresh water from nearby permitted lakes will be the primary source for inland ice road construction. Ice chips can also be used to reduce the amount of free water that is withdrawn from the lakes. Ice road maintenance will continue throughout the winter season. Construction crews will be located at either a re-commissioned Badami construction camp or the Prudhoe Bay area until the Point Thomson construction camp is in place.

3.10.1.2 Gravel Haul and Placement

Gravel haul and placement activities include gravel mine development to support construction of the roads, pads, airstrip, dock, and gravel stockpile for future road maintenance. Construction activity for field development will begin as soon as possible in the winter of 2004-2005. A sea ice road will be constructed to mobilize equipment and materials to the Point Thomson area.

During the winter months, the gravel mine site will be developed, and gravel from the mine will be used to construct the field facilities (pads, dock, airstrip, in-field road system). Snow and ice will be removed from the tundra surface and stored near the construction sites. Gravel will then be laid, graded, and compacted. Typical construction equipment to be used will include bulldozers, front-end loaders, rollers, trucks, and other heavy equipment. Infield traffic for gravel placement during the January to April construction period may consist of more than 300 vehicle trips per day on the gravel roads from the gravel mine to the CPF Pad, airstrip, and dock locations plus another 200 gravel haul trips per day from the CPF Pad to the East and West Well Pads.

The dock will be constructed by flooding as necessary to ground the sea ice, then removing ice in the construction area. Final dock construction (sheet piles, dock head, etc.) and gravel compaction and shaping for all areas will continue through to July 2005. Gravel will be laid on the exposed sea-bed to construct the dock.

After the spring of 2005, some thawing and subsequent settlement of the gravel structures is expected to occur. These gravel structures will be regraded and recompacted as necessary while they are thawed in the summer of 2005.

Most of the heavy construction equipment will be demobilized from the site via ice road prior to the ice road being no longer serviceable in late April or early May 2005. Remaining heavy equipment will be demobilized via barge during July and August 2005.

All equipment and modules will be transported via sea ice-road or barge depending on supply and manufacturing lead times. Both the construction camp and the permanent camp, along with the utility module, will be installed during 2005 to support simultaneous pipeline construction and drilling activities during 2006. The civil contractor will provide temporary site communications until the permanent communications tower and equipment are installed.

All early power generation equipment, including the fuel gas treatment skids, power generators, and power building will be prepackaged and either trucked or barged to the site by August 2005. Final hook-up and commissioning of this equipment will be dictated by the drilling schedule. The G&I module will be prefabricated and transported to Point Thomson by August 2005.

3.10.1.3 Nearshore Dredging

As described previously, it will be necessary to dredge a shallow (1-2 ft) channel extending about 1,000 ft (305 m) from the end of the dock to the 9-ft (3-m) isobath. The dredging will be conducted during the summer after the first winter construction period (2005). One or two 10 to 12 in (25 to 30 cm) suction dredges will be shipped to Prudhoe Bay. As soon as possible after breakup, the dredges will be transported by barge to the Point Thomson area and dredging activities will commence. The operation is expected to take from 3 to 4 weeks and will be completed prior to the beginning of the fall whale hunt and associated offshore travel restrictions. Up to 30,000 cy (23,000 m^3) of spoils removed during dredging will be placed on several barges and transported to a permitted offshore dumpsite, planned to be located seaward of the barrier island complex.

3.10.2 Second Year Construction Scope

The objective of the second construction year is to install and commission all pipelines, the CPF modules, well pad facilities and remaining telecommunications and controls equipment to support fourth quarter 2006 first production. Pipeline construction is a winter-only activity utilizing both sea and inland ice roads to minimize impact to the tundra. About 70 vehicle trips per day will be required from the CPF Pad to each of the well pads and about 90 trips per day on the ice road to Badami. All pipelines are installed aboveground using VSMs. Other than possibly hydrostatic testing and caliper pigging activities, no summer construction work is planned for the pipelines. The construction schedule has been developed with input by, and consultation with, an Alaska-based contractor.

Construction workforce is expected to peak during the second quarter 2006 with simultaneous drilling operations, pipeline construction, and civil construction works for the CPF modules. Should actual workforce requirements exceed the combined construction and permanent camp facilities capacity, the Badami construction camp can serve as overflow contingency along with other available facilities in the Deadhorse area.

3.10.2.1 Second Year Ice Roads

Construction lead-time and vehicle trips for the sea ice road is similar to that of the first year, beginning November 2005, weather permitting, and completing towards early January 2006. Up to 36 vehicle trips per day are expected on this road to support pipeline construction and drilling in the second year.

Construction of the inland ice roads for both the infield gathering lines and export condensate pipeline is expected to begin mid-January 2006 based on the anticipated opening date for tundra travel, and will be complete by mid-February 2006. Construction of the ice road may require up to 75 vehicle trips per day from the CPF Pad to Badami.

Pipeline construction is planned to begin mid-January 2006 and finish by April 2006. Scope of work includes the gathering pipelines from both the East and West Well Pads, high-pressure gas pipelines from the CPF to the CWP Pad, and condensate export pipeline from the CPF Pad to the Badami tie-in. The gathering and export pipelines will be constructed simultaneously using proven conventional arctic onshore equipment and techniques.

The sales pipeline will be pre-insulated offsite and transported to the site by ice roads. All other pipeline materials (VSMs, piperacks, pipe spools, pig launch and receiver skids, etc.) will be prefabricated and trucked to Point Thomson beginning January 2006.

No field camps will be required on the pipeline right of way. Pipeline construction personnel will be housed in a temporary construction camp installed on the Point Thomson CPF Pad (Section 3.10.3). Warm-up shacks and on-site toilet facilities will be provided along the construction right-of-way and will be removed when construction is complete in spring 2006.

A firm plan has not been established for hydrostatic testing and caliper pigging of the pipeline. These activities may be performed during the summer and fall months prior to initiation of production if not completed during the winter construction. Three scenarios are being considered:

- Drawing fresh water from local water sources, filter and dispose to tundra after hydrotest.
- Use seawater, filter and dispose back to ocean after test.
- Use Glycol water mixture; after use dispose in the Point Thomson disposal well or send back to Prudhoe to recycle.

3.10.2.2 Truckable Skids for Well Pad and CPF

The smaller sized facilities and infrastructure installed prior to the major facilities sealift in 2006 will be prefabricated and assembled into truckable skids and transported to Prudhoe Bay by truck and then by truck (sea ice road) or barge to the site. Examples of equipment and facilites delivered in this fashion include:

- Pipe rack modules,
- Well metering/manifold skids,
- Pig launcher/receiver skids,
- Well lines,
- Methanol tanks and injection skids,
- G&I module,
- Control Systems, and
- All yard piping and electrical.

Concurrent construction and drilling activities will take place during installation of the well pad modules. The strategy is to have as much of equipment installed as feasible prior to the arrival of the CPF modules to minimize the time required to first production. This will also serve to level the onsite construction manpower.

3.10.2.3 CPF Modules

Process modules will be sea-lifted and are expected to arrive at the Point Thomson dock by August 15, 2006 assuming timely open-water access to the Beaufort Sea. Three months has been allocated as the minimum time needed to install and commission the first production train to support first production startup by fourth quarter, 2006. The facility will be in full production when the drilling program is completed.

3.10.3 Construction Camp

The Point Thomson camp will be installed in the winter 2004-2005. The construction camp will be a self-contained unit with its own utility services such as water and wastewater treatment. Waste management is discussed in Section 3.12. The camp may be leased from the existing North Slope inventory of old construction camps or a new one may be purchased.

The camp will be trucked to the site on sea ice roads in stages as required. The construction camp will be built in stages to the ultimate projected peak requirement of 450-person capacity. The camp will be designed to accommodate both men and women.

3.11 SPILL PREVENTION AND RESPONSE

The Oil Discharge Prevention and Contingency Plan (C-Plan) will be developed to cover all site operations and spill response considerations. The C-Plan will include:

- A spill prevention section to cover facility and pipeline operations;
- Identification of spill response equipment to be staged and/or deployed at sensitive areas along the pipeline route (primarily river crossings);
- Equipment to be staged at the facility; and
- Spill prevention and response considerations for a remote facility that processes natural gas and condensate.

Operations cannot commence until the C-Plan is approved by the Alaska Department of Environmental Conservation (ADEC).

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3.12 WASTE MANAGEMENT

All waste disposal procedures will conform to ADEC and EPA requirements. Project design goals are to minimize the use of freshwater and other environmental resources, and to ensure a zero drilling waste release into the environment.

3.12.1 Discharges

Liquid waste is to be disposed of in the disposal well and all solid waste is to be incinerated (where practical) and anything not burned is to be containerized and shipped to a suitable disposal site in Deadhorse or elsewhere. Domestic wastewater from the camp and collected stormwater runoff will be injected into the disposal well. Prior to drilling the disposal well, and should the well become inoperable, domestic wastes will be discharged to the tundra following permit requirements.

3.12.2 Wastes Generated

The majority of wastes generated during project construction will consist of drill cuttings and spent muds. Some drilling waste will also be generated during operations from well workover rigs. A temporary storage pit will be constructed to store the drilling cuttings until the Class 1 well is drilled and operational. In addition, this pit will provide temporary storage for the cuttings when the G&I facility is undergoing equipment repair. A critical factor for implementing the zero drilling discharge philosophy will be to grind any suitable solid or liquid waste and inject it down the disposal well. The G&I facility will contain systems for washing, classifying, screening, mixing, and injecting the solid and liquid waste. Drill cuttings obtained from installation of the surface casing will be washed and screened prior to injection. The larger particles may be retained as fill material (if clean) and the smaller particles, wash water, and fines will be transported to the onsite G&I facility for injection.

Domestic wastewater will be generated during both the construction and operations phases. During construction, a wastewater treatment system will be part of the construction camp (see Section 3.10.3). However, once the injection well is operational, domestic wastewater from the construction camp, and later the operations camp, will be injected. The volumes of camp sanitary and domestic waste expected to be generated has been estimated at 30,000 gallons per day (gpd) (114,000 liters per day) during the drilling phase and 7,500 gpd (28,400 liters per day) during the operating phase. If the injection well becomes temporarily unoperational, the wastewater will be discharged according to the appropriate permits.

In addition to the injectable wastes described above, solid wastes, including scrap metal and incinerator ash, will be generated during construction. These wastes along with trash and rubbish generated during operations, and will be hauled off-site for disposal at the North Slope Borough (NSB) landfill. Combustible wastes will be taken to the NSB incinerator or incinerated on-site. Waste lubricating oil will be packaged in drums for shipment to an approved recycling facility. Sewage sludge and combustible solid waste including kitchen waste will be incinerated on-site. The incinerator ash will be screened to remove any large pieces of unburned material and the fines will be disposed of using the on-site G&I facility. Only non-combustible, non-hazardous solid waste will be stored and transported off-site for disposal at the NSB waste disposal facility. Solid waste transportation could be by barge during open water, and by truck during winter on ice roads, and/or by aircraft.

Table 3-3 provides a summary of the expected per waste streams for the three train case.

Table 3-3 Waste Streams for the Three Train Case

DRILLING PHASE[1]			
Waste Stream	**Average Total Vol.**	**Average Daily Vol.**	**Max Daily Vol.**
Drilling cuttings (barrels [bbls])	5,000	80	125
Drilling fluids (bbls)	4,200	75	125
Water (bbls)	42,000	600	1000
Incineratorable Solid Wastes (pounds [lbs])	14,000	200	-
Non-incineratorable Solid Wastes (lbs)	21,000	300	-
OPERATING PHASE			
Produced Water (bbls)	N/A	5000	-
Camp Wastewater (bbls)	N/A	200	-
Incineratorable Solid Wastes (lbs)	N/A	300	-
Non-incineratorable Solid Wastes (lbs)	N/A	75	-

[1]Numbers shown for one drilling rig. Volumes will double during the time that two rigs are operated.

3.12.3 Waste Handling

Wastes that must be shipped off-site will be transported via winter sea ice roads or summer barges. Any wastes generated during spring and fall (when both sea ice road and barge travel could be interrupted by breakup and freeze-up) which must be transported off-site for disposal will be stored on-site in appropriate containers until they can be transported to existing off site facilities for disposal.

3.13 SUPPORT FACILITIES

3.13.1 Permanent Camp

The permanent camp will be located on the CPF Pad. The camp will be prefabricated and transported to site for installation. It will accommodate approximately 75 people (peak) with provisions to house both men and women.

3.13.2 Water Sources

Figure 3-19 shows the potential water source lakes for ice road construction and other activities in the Point Thomson area. Table 3-4 summarizes the anticipated water quantities and sources required for the Point Thomson project construction and operation. Table 3-5 provides previously permitted volumes for water sources used for earlier activities in the Point Thomson area and developments to the west.

3.13.3 Power

Early power generation equipment will be installed to supply power for the drilling and construction infrastructure and life support, at a minimum. Early power generation and distribution equipment will be the same size and type as will be required for the permanent facility. Fuel gas-fired turbine generators will provide for the main power generation needs, and reciprocating diesel generators will be available for any emergency and life support requirements. Additional backup power generators will be provided with the rig, camps and by the construction contractor.

The long-term power generation system will be configured with three fuel gas (produced natural gas back flowed from an early injection well) turbine generators each sized to handle 50 % of the permanent power load. Three emergency diesel generators will be available, each able to provide for 50 % of emergency and life support power requirements.

Power feeds to the East and West Well Pads will be stepped up 13.8-kilovolt through a transformer located at the generation module (where all power generation equipment will be connected) and reduced to operating voltages via transformers located at the well pads. Where practical, the power cables feeding the well pads will be incorporated into the permanent facilities design. Some of the early power may be provided through local above ground lines, but the permanent power cables will be buried in the gravel roads.

Table 3-4 Point Thomson Gas Cycling Project Water Use Plan – CPF Facility Construction and Operation

ACTIVITY	ITEM	WATER QTY (GALLONS)	POTENTIAL SOURCE(S)[1]
Ice roads	2005 sea ice road cap[2]	33,180,000	3,870,000 gallons (gal) from source(s) in the vicinity of the Pt. Thomson CPF and west production well pad; 14,310,000 gal from source(s) in the vicinity of the Badami Central Processing Unit (CPU); and 15,000,000 gal from source(s) in the vicinity of the Endicott causeway landfall.
	Point Thomson dock-to-mine site ice road construction[3]	1,480,000	Existing Point Thomson gravel mine site and shallow lakes between the Point Thomson dock and mine site.
	Spur ice roads to water sources[4]	11,390,000	6,000,000 gal from source(s) in the vicinity of the Pt. Thomson CPF and production well pads; and 5,390,000 gal from source(s) in the vicinity of the Badami CPU.
	2005 maintenance[5]	3,780,000	380,000 gal from source(s) in the vicinity of the Pt. Thomson CPF and production well pads; 1,400,000 gal from source(s) in the vicinity of the Badami CPU; and 2,000,000 gal from source(s) in the vicinity of the Endicott causeway landfall.
	2006 sea ice road cap[2]	33,180,000	3,870,000 gal from source(s) in the vicinity of the Pt. Thomson CPF and west production well pad; 14,310,000 gal from source(s) in the vicinity of the Badami CPU; and 15,000,000 gal from source(s) in the vicinity of the Endicott causeway landfall.
	Pipeline right-of-way ice road construction[6]	40,330,000	20,000,000 gal from source(s) in the vicinity of the Pt. Thomson CPF and the east and west production well pads; 20,330,000 gal from source(s) in the vicinity of the Badami CPU.
	Spur ice roads to water sources[4]	11,390,000	6,000,000 gal from source(s) in the vicinity of the Pt. Thomson CPF and production well pads; and 5,390,000 gal from source(s) in the vicinity of the Badami CPU.
	2006 maintenance[7]	7,560,000	760,000 gal from source(s) in the vicinity of the Pt. Thomson CPF and production well pads; 2,800,000 gal from source(s) in the vicinity of the Badami CPU; and 4,000,000 gal from source(s) in the vicinity of the Endicott causeway landfall.

Table 3-4 (Cont.) Point Thomson Gas Cycling Project Water Use Plan – CPF Facility Construction and Operation

ACTIVITY	ITEM	WATER QTY (GALLONS)	POTENTIAL SOURCE(S)[1]
Drilling & Construction[8]	2005 drilling[9]	10,620,000	Source(s) in the vicinity of the Pt. Thomson CPF and production well pads.
	2006 drilling[10]	19,470,000	Source(s) in the vicinity of the Pt. Thomson CPF and production well pads.
	2007 drilling[11]	8,850,000	Source(s) in the vicinity of the Pt. Thomson CPF and production well pads.
	Drilling fluid and cuttings disposal	NA	Not applicable
	2005 temporary construction camp[12]	8,760,000	Source(s) in the vicinity of the Pt. Thomson CPF.
	2006 temporary construction camp[12]	14,600,000	Source(s) in the vicinity of the Pt. Thomson CPF.
	2007 temporary construction camp[12]	5,480,000	Source(s) in the vicinity of the Pt. Thomson CPF.
	Camp waste disposal	NA	Not applicable
	VSM setting slurry	170,000	Source(s) in the vicinity of the Pt. Thomson CPF or the west production well pad.
Hydrostatic Testing	Gathering pipeline hydrostatic testing, summer/fall program[13]	550,000	Source(s) in the vicinity of the Pt. Thomson CPF and production well pads, accessible from the pads or access roads.
	Condensate export pipeline hydrostatic testing, summer/fall program[13]	720,000	Source(s) in the vicinity of the Badami CPU pad, accessible from the pads or access roads.
	Well pad and CPF piping and vessel testing	30,000	Source(s) in the vicinity of the Pt. Thomson CPF and production well pads, water will be blended with glycol to form a 60:40 mixture.
Commissioning	Fire water storage tank charge	510,000	Source(s) in the vicinity of the Pt. Thomson CPF.
	Potable water system initial charge	10,000	Source(s) in the vicinity of the Pt. Thomson CPF.
	Glycol heating and cooling systems initial charge, etc.	10,000	Source(s) in the vicinity of the Pt. Thomson CPF.
Operation	Permanent camp potable water, 7500 gal/day[14]	NA	Point Thomson gravel mine sites.
	CPF facility make-up water, 500 gal/year	NA	Point Thomson gravel mine sites.
2005 Totals	**Water use**	**69,210,000**	30,000,000 gal from source(s) in the vicinity of the Pt. Thomson CPF and production well pads; 24,210,000 gal from sources in the vicinity of the Badami CPU; and 15,000,000 from source(s) in the vicinity of the Endicott causeway landfall.
	20% contingency volume	**13,840,000**	Same as above.
	Total	**83,050,000**	

Table 3-4 (Cont.) Point Thomson Gas Cycling Project Water Use Plan – CPF and CPI Facilities Construction and Operation

ACTIVITY	ITEM	WATER QTY (GALLONS)	POTENTIAL SOURCE(S)[1]
2006 Totals	Water use	128,530,000	65,000,000 gal from source(s) in the vicinity of the Pt. Thomson CPF and production well pads; 46,530,000 gal from sources in the vicinity of the Badami CPU; and 17,000,000 gal from source(s) in the vicinity of the Endicott causeway landfall.
	20% contingency volume	25,700,000	Same as above.
	Total	154,230,000	
2007 Totals	Water use	14,330,000	All from source(s) in the vicinity of the Pt. Thomson CPF and production well pads.
	20% contingency volume	2,900,000	Same as above.
	Total	17,230,000	
Operations Totals	Water use	NA	7,500 gal/day from the Point Thomson gravel mine site or other sources in the area.

Notes:

1) Sources in the vicinity of the Pt. Thomson CPF include permitted Unnamed Lake and Pt. Thomson Old Mine Site as well as possible future permitted sources. Sources in the vicinity of Badami CPU include permitted Shaviovik Pit, Turkey Lake, and Badami Reservoir as well as possible future permitted sources. Sources in the vicinity of the Endicott causeway landfall include Duck Island Mine Site and Sag Mine Site C (a.k.a. Vern Lake) as well as possible future permitted sources.
2) Sea ice road cap is nominally 40 ft wide, 6 in thick and made from pure fresh water (790,000 gallons per mile [gal/mi] by 42 mi long).
3) Dock-to-mine site ice road is nominally 40 ft wide and 6 in thick, standard North Slope ice road construction from snow and fresh water (569,100 gal/mi by 2.6 mi long).
4) Spur roads to water sources will be nominally 40 ft wide and 6 in thick, standard North Slope ice road construction from snow and fresh water (569,100 gal/mi by 20 mi total length).
5) 90 day long maintenance period, 42,000 gal applied per day.
6) Pipeline right-of-way ice roads are nominally 100 ft wide and 6 in thick, standard North Slope ice road construction from snow and fresh water (1,430,000 gal/mi by 28.2 mi total length).
7) 90 day long maintenance period, 84,000 gal applied per day.
8) Water quantity for drilling includes sufficient water for the water-based drilling fluid, casing cement and operation of the G&I system for cuttings and drilling fluid disposal.
9) 3 wells at 1,770,000 gal fresh water per well.
10) 6 wells at 1,770,000 gal fresh water per well.
11) 4 wells at 1,770,000 gal fresh water per well.
12) 100 gal per day per person, average camp occupancy, 240, 400 and 150 persons in 2005, 2006 and 2007 respectively.
13) Hydrostatic testing could be conducted in the summer and fall following construction in which case access to the pipeline does not exist except at the trap and valve sites (i.e. located on pads). Pure fresh water would be used for testing and would be discharged onto the tundra following appropriate filtration and diffusion. Alternatively, the testing program could proceed in March and April, immediately after the pipelines are constructed in which case the ice roads are still in place and ambient temperature is still sub-freezing. A 60:40 water-glycol mixture would be used for testing and would be recovered and hauled to an approved facility for disposal upon completion of testing.
14) 100 gal per day per person, maximum camp occupancy 75 persons.

Table 3-5 Example Permitted Volumes for Water Sources in the Point Thomson Area and to the West

WATER SOURCE COMMON NAME	GENERAL LOCATION	CURRENT/PAST BPXA PERMIT #	PERMITTED VOLUME TOTAL FOR ALL SOURCES (CURRENT OR PAST)	ESTIMATED VOLUME (GAL)	ADF&G RESTRICTIONS?	COMMENTS
Duck Island Mine Site	Endicott Road	LAS 13290	221 acre ft per year (72,000,000 gal)	600,000,000	yes	past permitted volumes based on need rather than availability
Sag Mine Site C / aka Vern Lake	Endicott Road	LAS 13629		792,000,000	yes	
Badami Reservoir	Badami development	LAS 19045	61.6 acre ft per year (20,000,000 gal)	86,000,000	yes	drinking water source
Turkey Lake	south of Badami CPF			730,000	no	relatively shallow lake
Shaviovik Pit	Shaviovik River Delta, west of Badami CPF	LAS 14042	1125.27 acre ft per year (370,000,000 gal)	125,000,000	no	typically used in ice roads to Badami
Pt Thomson Old Mine Site	PTU development area			104,000,000	unknown	
Unnamed lake	PTU development area (Sec. 22&23, south of airstrip)			923,000	no	used for Yukon Gold and Sourdough ice roads

Note: Estimated water source volumes are based on surface area, known or estimated depth, and typical bathymetric profiles.

3.13.4 Communications

A communication tower and associated equipment will be installed on the Point Thomson CPF Pad. The existing communication system at Badami will act as a repeater system enabling the exchange of voice and data signals between Point Thomson and Prudhoe Bay, existing systems on the North Slope (e.g., Alaska Clean Seas), and the outside world. Power and communications cables will be buried in the gravel roads to the airstrip and to the outlying production well pads for operation and control of the airstrip and the production well pad facilities and gathering pipelines.

The private microwave connection will carry voice and data signals into the facility. The tower will be approximately 300 ft (91 m) tall, and will be the facility's tallest structure. A separate communication building will, for reasons of radio frequency (RF) efficiency, house all RF equipment. This building will be located near the foot of the main microwave tower.

The buried fiber-optic cable will carry multiple channels of voice, data, distributed control system signals, and basic process control system signals to/from the West, East, and Central Well Pads, and the CPF Pad. Supervisory Control and Data Acquisition System Ultra High Frequency radio will provide supervisory control and data acquisition to the pipeline remote terminal units. Plant radio systems will provide a voice communication system in the plant and pad areas. Spill response radio will provide additional secure communication along and adjacent to the pipeline.

3.13.4.1 Airstrip Facilities

Navigation and communication equipment will be located at the Point Thomson airstrip. This equipment will include:

- Non-directional beacon,
- Distance measuring equipment,
- Pulsed light approach slope indicator,
- Meteorological automatic radio,
- Universal communication,
- Runway lighting, and
- Global positioning system approach.

3.13.5 Storage/Tanks

Table 3-6 illustrates the tanks and storage areas that are required for the project. The tanks and associated instrumentation will be heat traced and insulated to avoid damage during freezing weather conditions.

Table 3-6 Proposed Tanks and Storage Areas

Location/Purpose	Size	Notes
CPF Pad:		
Potable Water	200 barrel (bbl)	Located inside the utility module building
Fire fighting-potable water	12,000 bbl	Located outdoors
Cold Storage area (chemical, lube oil, etc., drums and containers)	50 ft by 150 ft (15 m by 46 m)	Located outdoors, lined with high-density polyethylene attached to a 1-ft (30-cm) high retention curb
Diesel fuel	25,000 bbl	Located outdoors within a 200 ft by 200 ft (61 m) diked area, volume within dike is 1.25 times tank volume
Drag Reducing Agent tank	800 bbl	Located outdoors, insulated and heated
Central Well Pad:		
Methanol	2000 bbl	Located outdoors
Diesel fuel	200 bbl	Located outdoors
Corrosion inhibitor	100 bbl	Located outdoors
G&I system storage pit	15,000 bbl (115 ft by 265 ft [35 m by 81 m])	Open lined pit/diked area
East and West Well Pads:		
Methanol	2000 bbl	Located outdoors, each pad

Diesel fuel is required at the beginning of the project for drilling the first three wells and supplying the diesel driven generators. Later, with the power plant in operation, the tank will be used to store fuel to supply vehicles as well as the emergency generators. A 25,000 barrel (bbl) tank will be installed which provides sufficient fuel for approximately 4.5 months drilling activity using two rigs. The diesel tank will be designed to applicable American Petroleum Institute Code and will be located within a lined containment area. The tank will have a cathodic protection system, a leakage detection system, and an instrumentation and controls system adequate to safeguard the tank storage, loading and dispensing operations.

Methanol is required for hydrate and freeze protection during start-up and shut-down of the wells, the production and injection pad piping, the gathering lines from the East and West Well Pads, and the injection lines from the CPF Pad to the CWP. A methanol storage tank with a capacity of 2,000 bbl or more will be located on the CPF Pad.

Provision will also be made for the storage of other several other chemicals including drag reducing agent, corrosion inhibitor, various drum chemicals, etc. as required to support ongoing operations.

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3.14 OPERATIONS AND MAINTENANCE

Point Thomson will have a full time onsite operations, maintenance, and support staff sized to handle normal activities. At this time, normal onsite staffing, including all support (catering, housekeeping, security, etc.) is projected to be approximately 25 positions (50 full time employees). Normal staffing will be supplemented with temporary staffing for special work activities including major equipment maintenance and well work. It is currently assumed that management, administrative, and engineering support for the operations will be based in Anchorage, Alaska.

Normal transportation of personnel and light equipment to and from the site will be via charter aircraft. Up to three helicopter trips per week and one or two daily flights by other aircraft may be required to support operations activities. During the short summer open water season, bulk materials and supplies will be delivered by barge. Winter ice roads connecting Point Thomson to Prudhoe Bay may be constructed when justified by special activities (rig mobilization, major construction, etc.).

Before construction, drilling, or operations activities commence, a comprehensive Safety, Health, and Environmental management program will be developed and implemented in compliance with ExxonMobil's Operations Integrity Management System. Components of this program will include employee health and safety programs, environmental awareness training, polar bear training, first aid training, medical evacuation training, and other emergency response/ contingency plan training. Personnel responsible for sales pipeline operations and maintenance will meet all Alaska Department of Transportation training and testing requirements. All employees and contractors are required to immediately report to local supervisors any conditions they observe that might represent a hazard to human safety or to the environment so that prompt action can be taken to resolve these conditions.

These management systems will also help to ensure that all construction, drilling, operations, and maintenance activities are conducted in full compliance with all relevant federal, State, and local rules, regulations and permit conditions.

Automated leak detection equipment will be installed on the condensate sales pipeline. Ground based surveys and aerial patrols will also be conducted periodically along the pipeline right-of-way (ROW). Pipeline block valves and pressure relief systems will be periodically inspected in accordance with regulatory and industry standards. Infield pipelines and facilities will also be visually inspected for any leaks during routine daily operations and maintenance activities. A corrosion-monitoring program will be implemented utilizing corrosion coupons, ultrasonic testing, and instrumented pigging as appropriate to ensure pipeline and facility integrity. Specifics of these programs will be detailed in pipeline ROW applications and spill control plans.

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3.15 TERMINATION

The expected life of the Point Thomson gas field is approximately 30 years. This includes the possibility of shifting the project to a gas sales venture once a means for getting the gas to market is realized. In addition, the actual service life of the project will depend on several factors. Once the project is constructed, infield drilling or possible satellite development could extend the service life of the production facilities and pipeline system. Likewise, since the pipeline system will be operated as a common carrier, Point Thomson Owners or other entities could continue to use the pipeline for other, future purposes after the Point Thomson reservoir has been depleted.

ExxonMobil will decide when to abandon the project based on the need for continued use of the facilities. At the time the project is no longer needed, ExxonMobil would either begin abandonment procedures according to the permit conditions and regulations in force at that time, or enter into negotiations to transfer ownership of the project to another entity.

Actual detailed abandonment procedures will not be determined at this time, but will be developed as a project modification at the time ExxonMobil or any future owner or operator decides to terminate the project. Just as project construction is subject to numerous overlapping local, State, and federal authorities, abandonment will be subject to multiple agency reviews and approvals.

Permits issued by the Alaska Department of Natural Resources and United States Army Corp of Engineers typically contain provisions requiring abandonment and restoration of the area be completed according to the satisfaction of the agency, and will contain clauses requiring approval of abandonment procedures. The discretion allowed in identification of termination and abandonment procedures allows for full consideration of the environmental impacts of removal options, and allows evaluation of any benefits from leaving certain facilities or structures in place at the time of abandonment.

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4.0 AFFECTED ENVIRONMENT

4.1 METEOROLOGY

The climate of the Point Thomson area is Arctic Marine, characterized by extremely low winter temperatures and short, cool summers. Winds are persistent throughout the year, with blizzards occurring frequently during the winter. The sun remains below the horizon in the area from late November through mid-January.

Meteorological data for the area are limited; there are historical data collected at Barter Island, located about 60 miles (mi) (97 kilometers [km]) to the east. These data include daily measurements of temperature, wind speed and direction (velocity), precipitation, and other parameters for 1949 through 1988. The Alaska North Slope Eastern Region (ANSER) monitoring station at Badami, about 15 mi (24 km) west of the project area, has collected background climatic data including temperature and wind velocity since first quarter 1999, as well as precipitation since fourth quarter 1999. Temporary stations located at Flaxman Island (summer 1997 and 1998) and on the mainland south of Flaxman Island (summer 1999) recorded temperature and wind velocity.

4.1.1 Temperature

From year to year, the average monthly temperature, especially in winter, can vary widely. For example, at Barter Island, the average January temperature was 4.5 degrees Fahrenheit (°F) (-16.5 degrees Celsius [°C]) in 1981 and -21.8°F (-6°C) in 1983. The recorded minimum temperature at Barter Island was -59°F (-51°C) in February 1950 and the maximum was 78°F (26°C) in July of 1978 (USFWS 1987). In summer, variations are less pronounced, but more important because the accumulation of days above freezing (thaw index) greatly influences the depth of thaw in the soil and the rate of melting of ice on the water bodies. Table 4-1 compares temperatures recorded at Barter Island and Badami. The table shows that the mean temperature ranges and mean annual temperatures are comparable between the locations.

Table 4-1 Mean Annual and Mean Temperature Ranges Near Point Thomson

LOCATION	MEAN ANNUAL TEMPERATURE °C	MEAN TEMPERATURE RANGE °C	PERIOD OF MEASUREMENT
Barter Island	-12.3	-45.4 to 26.3	1949-1988
Badami	-12.7	-42.2 to 22.3	1999-2000[1]

[1]July to June
Sources: USFWS 1987, ANSER 2000

4.1.2 Precipitation

Precipitation in the Point Thomson area is light, but frequent, occurring as drizzle in summer and as light snow in the winter months. Although rain accounts for most of the annual precipitation along the coast, snow begins falling in September and usually remains on the ground from October through June (BLM 1979). Table 4-2 summarizes the precipitation data for the Barter Island and Badami stations.

Table 4-2 Precipitation Data Summary Barter Island And Badami

LOCATION	MINIMUM MONTHLY PRECIPITATION (INCHES [IN.])	MAXIMUM MONTHLY PRECIPITATION (IN.)	AVERAGE ANNUAL PRECIPITATION (IN.)	PERIOD OF MEASUREMENT
Barter Island	0.19 (April)	1.1 (Aug.)	6.19	1949-1988
Badami	0.28 (March)	1.5 (Dec.)[2]	NA	1999-2000[1]

[1]October to June
[2]No measurement taken in summer
Sources: USFWS 1987, ANSER 2000
NA – not available

The Barter Island data exhibits an average summer precipitation of 0.52 inch (in) (1.32 centimeters [cm]) in June, 1.01 in (2.57 cm) in July and 1.1 in (2.8 cm) in August. Rainfall rarely exceeds 0.5 in (1.27 cm) in any one day. A 10.8 in (27.4 cm) average annual snow depth recorded at Barter Island (USACE 1984) is representative of the area.

On the North Slope, relative humidity is generally high during the summer, reaching 80 to 95 percent (%) along the coast (LGL et al. 1998). Relative humidity in the winter months drops to about 60 %. On average, foggy conditions occur 76 days per year at Barter Island; ice fog forms when ambient temperatures drop below -20.4°F (-29° C) (USACE 1984).

4.1.3 Winds

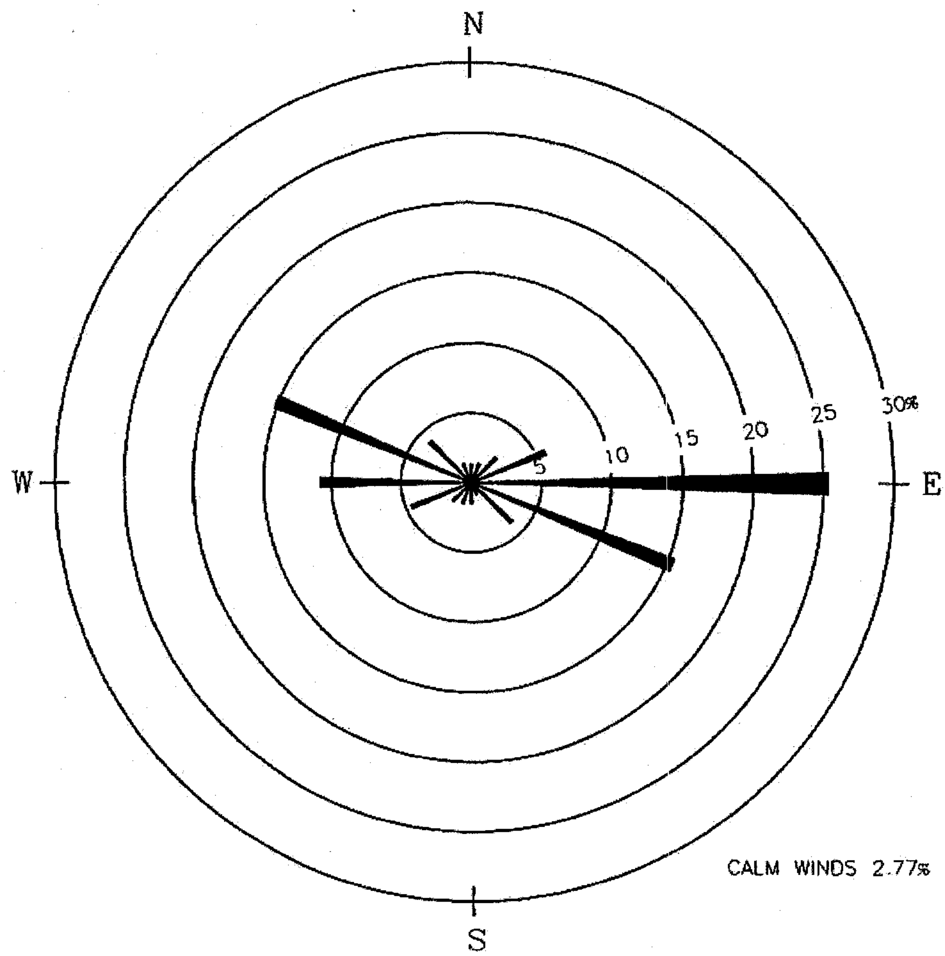
Winds on the arctic coast are persistent and tend to parallel the coastline. Easterlies occur about twice as frequently (60%) as westerlies (30%); the remaining time (10%) winds are calm or light and variable. Figure 4-1 provides a wind rose for Barter Island. Prevailing easterly winds consistently average 13.4 miles per hour (mph) (22 kilometers per hour [km/hr]) at Barter Island (usually East North East to North East). From January to April, the prevailing direction is westerly (WCC 1981). The windiest month usually is January (mean 15 mph [24 km/hr]) and the calmest is July (mean 10.7 mph [17 km/hr]). The peak gust (westerly) recorded at Barter Island was 75 mph (121 km/hr) in January 1980 (USFWS 1987). Sea breezes occur during about 25% of the summer and extend to at least 12.5 mi (20 km) offshore (MMS 1996). Persistence of the wind from either direction varies from 1 to 14 days with typical events lasting 2 to 5 days (Colonell and Niederoda 1990). Winds exceeding 31 mph (50 km/hr) occur about 2 to 8 % of the time.

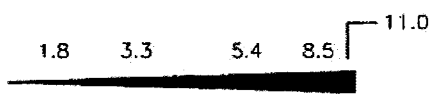
The Point Thomson area meteorological station data (summers 1997-1999) indicate that locally, east winds are prevalent during the summer and more than 90% of the wind speeds are less than 20 mph (32 km/hr). Maximum observed wind speeds of 31.1 mph (50 km/hr) were recorded during an easterly storm in late August 1999.

4.1.4 Air Quality

The ANSER monitoring station also measured several air quality parameters including concentrations of nitrogen oxide, nitrogen dioxide, sulfur dioxide, ozone, and particulate matter. Table 4-3 provides a summary of these parameters as recorded by this study. All concentrations shown in the table are well below the Alaska and National Ambient Air Quality Standards.

Figure 4-1 Wind Rose for Complete Year (1988) at Barter Island, Alaska





WIND SPEED CLASS BOUNDARIES
(METERS/SECOND)

NOTES:
DIAGRAM OF THE FREQUENCY OF OCCURRENCE OF EACH WIND DIRECTION. WIND DIRECTION IS THE DIRECTION FROM WHICH THE WIND IS BLOWING. EXAMPLE - WIND IS BLOWING FROM THE NORTH 1 3 PERCENT OF THE TIME.

FIGURE 1
WINDROSE
STATION NO: 27401
BARTER ISLAND, AK
PERIOD: 1988

BEE-LINE
SOFTWARE

Table 4-3 Air Quality Parameters Measured At Badami July 1999-June 2000

PARAMETER	AVERAGE ANNUAL CONCENTRATION	ANNUAL MEAN 24-HOUR CONCENTRATION	HIGHEST REPORTED 24-HOUR CONCENTRATION
Nitrogen oxide ($\mu g/m^3$)	3.6	NA	NA
Nitrogen Dioxide ($\mu g/m^3$)	3.3	NA	NA
Sulfur Dioxide ($\mu g/m^3$)	3.5	NA	NA
Ozone ($\mu g/m^3$)	46.1	NA	NA
Particulate matter ($\mu g/m^3$)	NA	2.2	25.7[1]

[1]Recorded during nearby construction activities
NA – Not Available
$\mu g/m^3$-micrograms per cubic meter
Source ANSER 2000

4.2 GEOMORPHOLOGY

The proposed Point Thomson Gas Cycling project is located in the Arctic Coastal Plain (ACP) physiographic unit (Wahrhaftig 1965). The plain rises gradually from the Arctic Ocean and extends southward to the base of the Arctic foothills along the northern edge of the Brooks Range. The coastal plain consists of perennially frozen marine, fluvial, aeolian, and lacustrine sediments underlain by Cretaceous and early Tertiary sedimentary rocks. This is a poorly drained, treeless, periglacial environment with a thick permafrost layer.

The proposed Point Thomson Gas Cycling Project infrastructure is located on the ancient Canning River alluvial fan. This fan can be divided into a coastal zone and an inland zone (LGL et al 1998). The coastal zone has been modified by coastal processes throughout a period when sea levels were higher than present. The division between the coastal zone and the inland zone is located approximately 2 to 3 mi (3 to 5 km) south of the coastline at an approximate elevation of 25 to 30 feet (ft) (7 to 9 meters [m]). Wind-oriented lakes dominate the landscape in the Canning River coastal zone and in the area west of the ancient Canning River alluvial fan, which starts at the southern limit to Mikkelsen Bay. Thaw lake basins originate in areas of restricted drainage where shallow ponds form during the warmer summer surface temperatures. The warmer temperatures cause the underlying ground ice to thaw resulting in subsidence. Most of these ponds and lakes are less than 4 ft (1.2 m) deep (BPXA 1995).

Thaw lakes are relatively uncommon on the Canning River inland fan zone as compared to the coastal zone. Small beaded tundra streams and drainages that cross the alluvial fan indicate that ground ice is present, but the lack of thaw lakes suggests that the dominant soil type is coarser than the soils in the coastal zone to the north (LGL et al 1998). Ground ice is present in a layer above the permafrost to the base of the active layer. The ground ice is generally in the form of wedge-ice that occurs the perimeters of polygons. Outwash material is found within the Canning River inland zone. A recent geotechnical investigation delineated sandy gravel and gravely sand outwash deposits with traces of silt (DM&A 2001). These deposits are proposed to be the material source for the construction of roads, airstrip, and pads for various facilities

4.2.1 Permafrost

Permafrost is defined as the thermal condition of soil or rock in which temperatures below 32 °F (0°C) persist over at least two consecutive winters and the intervening summer; moisture in the form of water and ground ice may or may not be present. Earth materials in this condition may be described as perennially frozen, irrespective of their water and ice content.

Although mean annual air temperature is basic in determining permafrost distribution, the mean annual ground temperature is the key that determines presence or absence of permafrost. Ground temperatures depend on the climatic history of an area, thermal properties of the earth materials, depth below the ground surface, season, moisture content of surficial soils, vegetative cover, solar gain during the summer, and thickness of insulating snow layers in the winter. In the project area, typical ground temperatures at a depth of 25 ft (7.6 m) range from 10°F to 20°F (-12 °C to -6.1 °C) (LGL et al. 1998).

Even in the coldest parts of Alaska, there exists a thin layer of soil known as the active layer. This layer thaws every summer and insulates the permafrost from the ground surface. The thickness of the active layer on the North Slope varies in thickness locally from 0.5 to 5 ft (15 cm to 1.5 m) or more adjacent to significant streams, and can change when the surface is disturbed. The thickness of the active layer in the project area ranges from less than 1 ft to 5 ft (30 cm to 1.5 m) and averages about 2 ft (60 cm) (LGL et al. 1998).

The amount of ice present in the surficial permafrost deposits can vary from none to nearly 100% by volume. The proportion of ice to mineral or organic material depends initially on the water present in the material before freezing, but during the freezing process (and during annual temperature cycles) the ice and soil may become segregated. The segregated ice may take the form of irregular masses or lenses. Ice lenses range in thickness from less than 1 in (2.54 cm) to several ft, commonly forming vertically oriented wedges that thin downward and may be tens of ft deep and several ft wide at the top (LGL et al 1998).

The amount of ice present and the soil type determines the thaw settlement behavior of a soil. Coarsely grained soils (sand and gravel) generally contain less ice by volume and experience less thaw settlement than silty-sands and silt that may typically contain considerable amounts of ice. During a recent geotechnical exploration program of the Point Thomson area, however, areas were encountered where considerable ice was found in coarsely grained soils (DM&A 1997).

4.2.2 Mainland Shore

Studies have shown the mainland shoreline in the Point Thomson area to be relatively stable (Kinnetic Laboratories, Inc. 1983). This stability is primarily due to the sheltering effect of the offshore barrier islands. Spits and bluffs tend to be more dynamic than the low mainland shore. The numerous low-lying sand and gravel spits located along the mainland shoreline also provide protection by dissipating wave and ice forces. These spits are formed and altered by continuous littoral sediment transport and overwash processes. Although high erosion rates of the bluffs along the mainland shoreline and the seaward side of Flaxman Island have been reported, historical maps indicate that little change in the shape of the coastline has occurred. In areas where extensive bluff erosion has been observed, thermal erosion was determined to be the primary cause (Kinnetic Laboratories, Inc. 1983).

4.3 HYDROLOGY

The Staines and Canning Rivers border the eastern portion of the project area and the Shaviovik River is located about 5 mi (8 km) west of the proposed West Well Pad location. The headwaters of the Canning River are in the Brooks Range, approximately 110 mi (177 km) south of the coast. The Staines River forms an alluvial delta just east of the proposed project area. The Shaviovik River, from its headwaters in Juniper Creek to the coast, is about 100 mi (160 km) long. Most of the flow from the Shaviovik River appears to discharge into Foggy Island Bay, west of the Point Thomson project area. Drainage area and discharge effects on Lions Lagoon from the Canning and Staines Rivers are discussed in Section 4.4.2.4.

Several minor tundra streams are located within the project area. These tundra streams are generally small, meandering, and drain into larger streams or Lions Lagoon. For the most part, the tundra streams are confined to a single channel, although larger streams may have braided channels. Many tundra streams are beaded, meaning that they consist of a series of small ponds interconnected by short, narrow stream segments.

As summarized in Section 4.2, wind-oriented lakes dominate the landscape in coastal zone of the Point Thomson area. Soil in the area is generally poorly drained due to the shallow depth to permafrost and the low slope of the terrain. The shallow thaw lakes follow a cyclic pattern of formation and drainage. Thaw lakes originate from low-center polygons and tundra ponds by wind-driven thermokarst erosion during the warm season (Britton 1957; Carson and Hussey 1961; Billings and Peterson 1980). Thaw lakes go through a cycle of development, expansion, drainage, and revegetation until they are incorporated by a stream that provides constant drainage. In contrast to the coastal zone, these thaw lakes are relatively uncommon on the Canning River inland fan zone. Small beaded streams and drainages that cross the alluvial fan indicate that ground ice is present. Several of these lakes, in addition to former mine sites at Point Thomson and Badami could be used as water sources for the Point Thomson project (see Figure 3-19).

4.3.1 Snowmelt Floods

Mean annual precipitation is approximately 5 in (12.7 cm) per year with total snow accumulation estimated to be approximately 10 in (25.4 cm). During the long winter, a substantial portion of the precipitation is lost to sublimation. Due to the transport of snow by drifting, the actual amount available in a particular small drainage basin can vary widely depending on the ability of the local relief to trap snowdrifts.

During snowmelt, the initial runoff occurs as sheet flow over the frozen ground surface where infiltration is practically nonexistent. As breakup continues, the snowmelt runs over the frozen surface of small streams and ponds behind snowdrifts. As breakup progresses, these small drifts thaw or are overtopped, and the accumulated melt water is released to flow downstream until it again ponds behind another snowdrift or flows into an open water stream or river. This storage and release process results in an unsteady and non-uniform flow during breakup. Typically snowmelt floods occur every year.

Once the breakup crest has passed a particular point on a stream, the recession is rapid. Typically, the flow on a small stream two weeks after the breakup crest will be less than 1% of the peak flow, and the intermittent drainages will be dry within two weeks. During breakup, the bed and banks of small drainages tend to remain frozen, thereby limiting erosion.

Floods on small streams have historically occurred solely as a result of snowmelt, which responds to a rapid seasonal increase in temperature. As a result, snowmelt floods on a given stream tend to occur at about the same time each year. In 1998, nearly all of the streams crested on May 29 or 30. At peak stage (water surface elevation) many of the channels were between 10 to 50 % blocked by snow. The peak discharge appears to have occurred at a lower water surface elevation, although typically above bankfull (LGL et al. 1998).

Strudel scour occurs along the coast when snowmelt floods overflow onto sea ice and drain through holes in the ice. Due to limited number of holes in the ice, the velocity of the water flowing through them can be strong enough to scour the seabed. The size and shape of the scour is dependent upon a number of parameters, such as the water depth, overflow depth, and seabed soil type.

4.3.2 Rainfall Floods

Summer floods are not anticipated to occur on the smaller streams within the project area. Similar small streams in the region have not produced floods because of the relatively small watershed (drainage basin), the low intensity of the rainfall, and the large capacity of tundra and thaw lakes to absorb and retard runoff. However, summer floods resulting from unusually heavy precipitation in the Brooks Range occur on rivers such as the Canning, Staines and Shaviovik Rivers. These floods are not frequent, but may be larger than typical break-up floods (BPXA 1995; LGL et al. 1998).