POINT THOMSON PROJECT EIS

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Contents — Volume 3

Tables

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Figures

5.18 RECREATION

The key findings for recreation are summarized below with a brief summary of the differentiating effects.

Key Impact Findings and Differentiators Among Alternatives

Key Findings:

Alternatives B, C, D, and E: Major impacts to recreation are probable and would last the life of the project. Impacts would likely be felt by recreationists beyond the ACP and the coastal and Canning River recreation corridors.

Alternative A: Minor impacts to recreation are probable in the coastal corridor and unlikely in the Canning River corridor/western refuge. Impacts could be limited and localized to the study area.

Differentiators:

- Differences between the build alternatives are small. The greatest difference is between presence of the project (any action alternative) and absence of the project (No Action Alternative).
- Alternative C would result in the greatest loss of area usable for recreation due to the gravel access road. Alternative E would result in the least loss of area usable for recreation due to the smaller project footprint.
- Alternatives C and D set several project components back from the coastline, reducing potential impacts to recreation by local population and visitors along the coastal corridor.
- Alternatives C and D set the airport farther west and farther away from the Arctic Refuge, minimizing impacts to the wilderness qualities of the refuge recreation experience in the lower Canning River corridor.
- Increased use of helicopters between pads under Alternative E likely would increase project visibility and audibility to recreationists.

Because recreation in the eastern ACP is principally a wilderness type recreation experience, even though both federal and state lands in the primary study area are not formally designated wilderness areas, the primary potential impact would be a change in wilderness qualities of the isolated backcountry environment in which recreation occurs. Such impacts could occur whether inside the Arctic Refuge's designated Mollie Beattie Wilderness, within the Refuge's nondesignated 1002 Area, or on state land and waters. As described in Section 3.17, a wilderness type recreation environment is one where little or no human-caused sights, sounds, or smells are evident outside the recreationist's own group and the group's support systems (i.e., the group's own boats, tents, camp stoves, and support aircraft for drop-off and pickup) and where other groups are rarely encountered.

However, this impact would be qualitative and has to do with the perceptions of the recreationist. Not all rafters, hikers, or hunters using the project area would perceive physical changes in the same way.

Besides backcountry or wilderness recreation as described above, there are more traditional tourist operations at low numbers in the area, including ice-breaking cruise ships, sight-seeing aircraft, and tour boats from Kaktovik. Most of these are assumed to operate in the general area and are not necessarily focused at, or adjacent to, the project site or in the recreation corridors identified. Nonetheless, proposed project facilities may be visible to tourists and may affect their experience. Subsistence camps and subsistence hunting also have a recreational element, and local residents camping or hunting in the project area may be affected.

5.18.1 Methodology

Table 5.18-1 describes how impacts are addressed in this section.

Table 5.18-1: Impact Criteria—Recreation

Impact Category*	Intensity Type*	Specific Definition for Recreation
Magnitude	Major	Change in recreational environment, recreational opportunity, or the quality of the experience that would likely be felt by most recreationists in the area or contemplating use of the area; change that is likely to be controversial for users and/or land managers.
	Moderate	Change in the recreational environment, recreational opportunity, or the quality of the experience that would likely be felt by some recreationists in the area; likely to generate little controversy for users or land managers.
	Minor	Little or no evident change in the recreational environment, recreational opportunity, or quality of the experience.
Duration	Long term	Impact would be irreversible or so long term that no end would be known; there would be no plan for elimination of impact at end of project.
	Medium term	Impact would last for several years but less than life of project, or known elimination of impact as part of the project's end.
	Temporary	Impact would last through project construction or similar clearly limited time frame that would be substantially less than the life of the project.
Potential to Occur	Probable	Virtually no avoidance.
	Possible	May occur or may not occur.
	Unlikely	Not expected to occur.
Geographic Extent	Extensive	Likely to be felt by recreationists beyond the local geographic extent (i.e., outside the coastal plain) e.g., by 'the idea' of loss of recreation opportunity; impact perceptible in the study area in such a way as to change the wilderness recreation experience that is currently available.
	Local	Influence mostly on people actually using the ACP and the coastal and Canning River recreation corridors.
	Limited	Influence only on people recreating in the area of the proposed project footprint or within about 1 mile of the project footprint.

* Impact categories and intensity types were developed based on CEQ NEPA regulations as described in Section 4.1, Impact Determination Criteria.

Adverse impacts to recreation could include:

1. Reduction of potential land area available for recreation and reduction of public use of shoreline (lands for camping, hunting, boat-beaching, etc.) by existence of proposed facilities or by prohibition of public access.
2. Avoidance of recreational activities in proximity to project features because of desire for privacy, loss of wilderness quality, fear of shooting facilities, noise, etc.

3. Visible and audible presence of industrial facilities in an otherwise undeveloped setting, including:
   - Change in or disruption of a backcountry recreation experience with high wilderness qualities by sight, sound, or smell from a distance.
   - Influence on where or whether recreationists choose to go in the arctic for a recreation experience with high wilderness qualities.
   - The loss of opportunity for planned or future recreation experiences with high wilderness qualities (no need to be onsite for these impacts).
4. Changes in wildlife movements that affect hunting and wildlife viewing.

Each of these potential impacts was analyzed using a method best suited to understand the magnitude of the impact, as detailed below.

Method for 1 and 2: Identify recreation corridors and recreation use areas for comparison with the project footprint. Calculate the land area actually lost to the permanent project footprint—lands literally unusable for outdoor recreation. (Acreages reported in this section do not count ice pads and ice roads, or a temporary overburden storage site.) Use a 1-mile buffer around the project footprint for each alternative to provide an example avoidance area that is comparable between alternatives. A buffer of 1 mile was selected as a conservative reasonable estimate based on the visual assessment work done for this project and based on concerns expressed by hunters during scoping about self-limitations on hunting around facilities. Individual tolerance for privacy, noise, wilderness values, or concern about hunting near facilities is acknowledged to vary. Acreages are reported in the second half of this section, under headings for each alternative.

Method for 3: Assess qualitatively the likelihood of adverse effects to or enhancement of the recreation experience based on the ability to sense the project from known travel corridors. Address perceptibility of changes in the physical environment, including motion or activity, industrial facilities, or transportation facilities, that may be at odds with backcountry recreation expectations for high wilderness qualities. Draw on visual and noise assessments. Address likely perceptions of wilderness recreationists and more standard tourists based on past history. The first half of section 5.18.3 describes these impacts.

Method for 4: Draw on wildlife assessments completed for this EIS, and extrapolate and assess impacts that may also affect recreationists.

The number of recreationists in the area could change as a result of the project, but this is difficult to measure, because the number of recreationists is not well documented, is small, and reportedly has fluctuated (i.e., no steady trend). Without a solid basis for predicting numbers of users, such quantification is not part of this methodology.

The recreation methodology acknowledges that actual recreational use of the study area is very low in comparison to many public recreation lands in Alaska and other states. The analysis is based on impacts to the recreation that does occur and on the recreation experience that is available.

5.18.2 Alternative A: No Action

Under Alternative A, no permit from the Corps for gravel fill and other construction activities regulated by the agency would be issued. Occasional helicopter operations for site monitoring and the protective wellhead covers for the two wells and rig mats would be the most noticeable features of Alternative A. The activity and remaining features likely only occasionally would affect the sense of solitude and other wilderness qualities listed above and in Sections 3.18, Recreation, and 3.14, Arctic National Wildlife Refuge Affected Environment, and would not limit people's potential use of the area for recreation, as described in the methods above. Most recreationists would have little or no awareness of the existence of the wells. The area would be largely quiet and visibly mostly undeveloped; wilderness recreation qualities largely would continue to exist along most of the coastline. Users of the coastal corridor likely would notice the 16-foot-tall bright orange well covers near the shoreline, even from the barrier islands (about 2 miles away), but without associated activity, the impact to the experience would be minor. With only occasional visits to the pad, the area would appear abandoned, and recreational opportunity and activity would be little affected.

Referring back to Table 5.18-1 at the beginning of this section, the magnitude of impact for Alternative A would be minor in magnitude, duration would be long term, potential to occur would be probable in the coastal corridor and unlikely in the Canning River corridor/western refuge, and geographic extent would be limited to local.

5.18.3 Impacts Common to All Action Alternatives

5.18.3.1 Construction

During construction of any of the action alternatives, the extra activity and noise of mobilizing equipment to the site and the outdoor activity associated with gravel mining and construction of road, runway, and drilling pad embankments would make the site somewhat more conspicuous to recreationists than during drilling and operations. The types of impacts would be essentially the same during all phases, with somewhat greater probability of occurrence during construction because the extra activity would tend to call attention to the facilities.

5.18.3.2 Drilling and Operations

This section focuses on the drilling and operations phases, at a time when all construction would be complete and drilling might still be occurring. The drilling and operations phases for any of the action alternatives are expected to result in the same kinds of recreational impacts at the same magnitude and extent.

Reduction of Potential Recreation Grounds/Avoidance of the Project Site

A most basic effect of the action alternatives would be the loss of undeveloped land that could be used for recreation. However, state lands for which the project is proposed are not designated recreation lands; they are general-use lands open to recreation but managed for oil and gas. Refuge lands have a more specific recreation component; no Arctic Refuge lands would be lost to development. The opportunity for the recreational use of the coastal corridor—a general swath of land several miles wide that includes both marine waters and inland areas—would be lost to the project footprint. Visiting recreationists and local users likely would avoid use within an area around the project—assumed for this analysis to be within a mile of the project, as stated above in Section 5.18.1. A GIS analysis determined the amount of land that would be lost to the project footprint for each action alternative, and what might be avoided for recreation, based on a buffer of 1 mile around the outside of all facilities (excluding marine waters). These numbers are reported under headings for the individual alternatives, below.

The waters used for recreation—marine waters and the Canning River—would be essentially unaltered by the project under any alternative. The primary exception would be if there were a significant spill of liquid hydrocarbons in marine waters, which would displace recreationists during the spill and cleanup effort and possibly for multiple seasons thereafter, depending on the condition of the coast and water. Such a spill would be possible but statistically not probable (see Section 5.24, Spill Risk and Impact Assessment). Therefore, use of study area waters for recreation likely would be unaffected.

Public Access and Use of the Shoreline

Under any of the action alternatives, public access to the general Point Thomson area would not be excluded; however, it would be managed to ensure public and facility safety and security. Visitors to the Point Thomson facilities would be required to check-in at the Point Thomson security checkpoint. (Appendix A, Department of the Army Permit Application) In Alaska, land below ordinary high tide (the beach) typically is open to the public for public access, except where permitted for specific uses such as large commercial or public docks or ports, or similar developments. Restricted areas would be identified in the Applicant's plan of operations. Physically and by terms of the state lease, project permits, and/or company policy, public access likely would be restricted across the emergency boat ramp.

The minor differences between the action alternatives are noted under the headings for the individual alternatives below.

Visible and Audible Presence of Industrial Facilities

Industrial facilities and activities loosely aggregated over about 8 miles of coastline and for about 3 to 4 miles inland would be visible and occasionally audible to recreationists on the lower Canning River corridor and Canning River delta, and on the coastal corridor, including Brownlow Point, Flaxman Island, and locations at similar distances on the water and inland along the coast. Facilities and activities with a visible and audible presence would include: three to four developed drilling and processing pads; tall structures, including a communications tower and a flare stack at the CPF and a drilling rig that would move between pads (150 to 200 feet tall); shorter airport communication and navigation towers (four towers between 30 and 55 feet tall), gravel connecting roads and likely plumes of dust that would be visible behind vehicles; and the drilling, compressor, generator, truck, and aircraft noise that would be audible. See Section 5.14, Arctic National Wildlife Refuge and 5.19, Visual Aesthetics, for complementary discussion.

Particularly on the coastal corridor, the facilities would be visible at relatively close range. The differences between the action alternatives, such as locating the East and West Pads on the coast or a half-mile inland, or locating the CPF on the coast or 2 miles inland, would make relatively little difference in the flat and open visual environment. Small differences are noted under headings for the individual alternatives, below. With separation distances of about 4 miles between pads, industrial facilities would be consistently in the view to people moving along the coastal corridor. As they move along the coast, any given facility would begin to fade behind as another became more apparent ahead, so that no facility would be more than about 2 miles away along a stretch of coast from the Arctic Refuge westward to Point Thomson, about 13 miles of coastline total. The additional industrial activity and the new structures associated with the Point Thomson Project would reduce the wilderness qualities of the recreation opportunity. See Section 5.18.10 for related discussion.

Effects to Recreation Opportunity. Recreation by people coming to the area specifically to see the industrial activity at Point Thomson would be very unlikely, although some recreationists visiting the area may be curious and come closer rather than staying far away. To tourists on a cruise ship or in aircraft who are likely, in the same day, to see other, larger oil and gas developments (e.g., Prudhoe Bay) and who are passing through without camping on the land, it would be likely that the project facilities would be a curiosity and an accepted and interesting part of the overall experience in the same way that bus tours through the Prudhoe Bay facilities to the Arctic Ocean are popular in combining industrial and natural features.

Arctic Refuge and Canning River corridor recreationists, 2 to 5 miles away from the nearest project developments, are much more likely to have a different (less wild) recreation experience, and to anticipate this difference even before they start a trip, due to the appearance of industrial facilities on the horizon, and possible layers of air pollutants, flares, or dust plumes from trucks, along with the sounds of aircraft, generators, the compressor, and other engines. See Sections 3.18.1 for discussion of recreationists' attitudes and expectations in designated and nondesignated wilderness environments.

The project likely would displace a few of the approximately 100 recreationists who use the state and federal lands near the lower Canning River to other river corridors that they perceive as "wilder" in the refuge or to Arctic national parks such as Gates of the Arctic National Park. The project would be likely to change the quality of the recreational experience of those who do use the general Canning River corridor. In the Arctic Refuge, loss of wilderness qualities such as natural scenery, quiet, and natural darkness (during dark times of year, when use levels are particularly low) would occur along the western edge of the refuge's ACP, a minimal-management area managed in part to maintain its wilderness qualities. Other losses could include the psychological and spiritual values associated with wild areas, such as a sense of solitude, as described in Section 3.18. These losses would extend within the refuge to the extent they were perceived—perhaps more than 10 miles from the facilities or more than about 8 miles into the refuge at the coast and about the same distance inland, and more than 20 miles for nighttime lights (see Section 3.18, Recreation, and 5.19, Visual Aesthetics). However, for those floating down the Canning River, the impact would likely fall on the last day or two of what may be a trip of 1 to 2 weeks. As part of the "return to civilization" portion of the trip, the impact would not be as severe as if it occurred in the middle of the trip.

The opportunity for a recreation trip with high wilderness qualities along the coastal corridor between Bullen Point and the Canning River delta would no longer be available. Those who wish to boat, kayak, camp, or hunt in the coastal area, including local residents, would do so with industrial facilities in view and sometimes within audible range, or would be displaced. For coastal subsistence or recreational hunters, the presence of the pipeline a short distance inland from the coast under some alternatives would be a continuous presence and they likely would feel inhibited about shooting at caribou without risk of striking the pipeline, even though the pipeline wall is proposed to be thickened to help prevent bullet penetration. Subsistence and other traditional coastal uses with a recreational component would likely continue, with displacement near the facilities, as described above. The unknown but low level of use in the corridor likely would not change in remaining available areas, but the experience would change. Opportunities for coastal recreation with high wilderness qualities would be available in the refuge in an area of perhaps 30 to 40 miles between the Canning River and Kaktovik, and also east of Kaktovik. Stretches of arctic coastline east and west of Barrow also would continue to provide backcountry recreation opportunity with wilderness characteristics but are not connected to public recreation lands in the same way the Point Thomson coastline is connected to the refuge and Canning River corridor, and are not commonly within view of the mountains.

The high profile of the Arctic Refuge is likely to mean that the change in the recreation environment in and near the refuge would become well known among backcountry recreationists, even casual recreationists who are not likely ever to visit the study area in person. Some of these people nationwide are likely to feel the loss of recreation opportunities with high wilderness qualities (see Section 5.14, Arctic National Wildlife Refuge, for further discussion). Construction of permanent facilities about 2 miles from the refuge boundary would likely be controversial among some recreationists in and outside of Alaska.

The Point Thomson facilities impacting recreation along the Canning River corridor include:

- ***Central Processing Facility Proximity.*** The CPF would be the site of the largest collection of buildings, storage tanks, communication towers, and flare stacks, most of which would be visible from the northern part of the Canning River corridor.

- ***East Pad.*** The East Pad would be the closest facility to the Canning River, at 4 to 5 miles in each alternative.
- ***Air Traffic/Airport Proximity.*** Air traffic would approach and take off from the project airstrip in easterly and westerly directions, and aircraft would be likely to use an area of approximately 3 miles east of the airstrip to make turns to and from Deadhorse. The airstrip itself would contain four navigation and communications towers of 35 to 55 feet, which would be lighted and visible from parts of the Canning River.
- ***Infield Roads/Vehicle Use.*** All alternatives would have similar needs for transportation between pads, mostly on gravel roads (except Alternative E). The length of roads differs between alternatives, suggesting that vehicle miles traveled would differ proportionately. Traffic would be most visible in summer as vehicles create dust in dry conditions. The roads themselves would not be visible from the Canning River corridor.
- ***Drilling Duration.*** The drilling rig would be one of the most prominently visible components of the project. After the drilling phase was complete, the drilling rig could be removed from the site completely, removing a strongly contrasting visual element from the surrounding vista. Drilling could be extended indefinitely, as discussed under Cumulative Impacts.
- ***Construction Duration.*** The construction phase would be the time of greatest activity, including the greatest use of helicopters before the airstrip was complete.
- ***Pipeline Effects to Recreation***. Distance of the export pipeline from the coast would vary within each alternative but with an overall range of 1 to 7 miles. At 1 to 2 miles, the pipeline would be expected to be readily visible. In the range of 5 to 7 miles, it would not likely be visible at all. Those alternatives with the pipeline at greater distances from the coast would help to protect the existing recreation resource along the coast, and these differences are further discussed under headings for the individual alternatives.

Wildlife Effects and Recreation

Section 5.9, Birds, and Section 5.10, Terrestrial Mammals, indicate likely displacement of caribou, birds, and other wildlife away from project components. Most displacement would be expected within one-half mile of the facilities. Effects to recreationists hoping to view or hunt caribou, muskoxen, bears, and birds may be affected slightly, but not predictably. The project under any build alternative would likely displace caribou in the post-calving period inland away from the immediate coastline in the 8- to 10-mile area generally occupied by the three proposed drilling pads. The export pipeline paralleling the coast at various distances under the alternatives may somewhat inhibit caribou from crossing (note, however, that the pipeline is planned in all cases to have a clearance of 7 feet above ground level to allow for caribou passage). These changes may mean slightly fewer caribou to view or hunt near the coast. Conversely, some caribou may be attracted to the shade of structures and to gravel roads and pads for insect relief and may at times congregate too near project components for hunters to safely hunt. These more industrial backdrops may not be the environment in which backcountry recreationists hope to view or photograph caribou. If brown bears, polar bears, foxes, or other animals became accustomed to human food found in association with the project (e.g., on the ground, in unsecured garbage cans, or in the backs of trucks), they could be more likely to seek food from recreationists camping within their range, but oil company practices would minimize availability of unsecured food or garbage.

5.18.4 Alternative B: Applicant's Proposed Action

As described in the analysis methodology (Section 5.18.1), under Alternative B, the area of the project footprint that would be lost for recreation would be approximately 280 acres at the Point Thomson Project site. Usability for recreation would be limited near facilities, e.g., 16,600 acres at the project site, and another 19,300 acres along the export pipeline, would be affected based on a 1-mile buffer around facilities.

The airport would be located about 5 miles from the Arctic Refuge boundary, with aircraft operations expected within about 2 miles, indicating that aircraft would be readily visible and audible from the lower Canning River corridor and associated Arctic Refuge lands.

The export pipeline location parallel to the coastline would vary in the 1- to 2-mile range over the length of its 22-mile run to Badami. It would lie within the terrestrial portion of the coastal corridor and often would be visible from the coastline and ocean. Coastal hunters, including subsistence hunters, likely would be inhibited from shooting in directions toward the pipeline in this relatively narrow band, although hunting likely would continue in this area.

The location of the East and Central Pads immediately on the coast would mean immediate proximity of facilities to the water, and public access to these areas would likely be restricted. Those walking through this area of the coastline may technically be able to get under the pier and past the sheet pile and barge bulkhead, but likely would avoid the area or feel inhibited because of the development. They may also feel inhibited about passing close to the West Pad (located near the coastline), particularly during the drilling and construction phases. Although little traditional beach walking occurs in this area, the project would restrict free passage for the public for hunting, or for hiking along the coast from a camp.

5.18.5 Alternative C: Inland Pads with Gravel Access Road

As described above under Methodology, the area of the project footprint that would be lost for recreation would be approximately 746 acres at the Point Thomson Project site under Alternative C and the all-season gravel access road. Also as described under Methodology, usability for recreation would be limited near facilities. As an example, 39,000 acres at the project site, and another 47,400 acres along the export pipeline and gravel access road would be affected based on a 1-mile buffer around the facilities. The airport would be located about 7 miles from the refuge boundary, with aircraft operations expected within about 4 miles, indicating that aircraft would be visible and likely audible from the lower Canning River corridor and associated refuge lands.

Alternative C would include a permanent new 44-mile, all-season gravel access road connected to the Endicott Spur and then to Deadhorse and the U.S. highway system. The road would parallel a new export pipeline several hundred feet to the north of the pipeline. Road activity likely would inhibit recreational hunters from shooting in directions toward the road and pipeline within 1 mile or more. The export pipeline would run 50 miles to Prudhoe Bay. The pipeline and road would lie inland from the coast in the range of 3 to 7 miles (generally about 5 miles). This location would be somewhat inland of the terrestrial portion of the coastal recreation corridor and in most locations would not be visible from the coastline and ocean. This inland separation would help to protect the existing coastline recreational experience, providing a greater open area between the ocean and the pipeline that recreational hunters might use without fear of striking the pipeline, vehicles, or workers. However, this circumstance would occur only for the eastern half of the pipeline run. The western half of the new export pipeline would parallel the existing Badami pipeline at distances of 1 to 5 miles, typically about 3 miles, with the new pipeline lying south of the existing pipeline. The space enclosed by the Point Thomson road and pipeline and the Badami pipeline would limit hunters' current freedom for shooting in this area. This western half of the export pipeline and somewhat more inland location appear to be an area less used by hunters than points farther east (see Sections 3.22 and 5.22, Subsistence and Traditional Land-Use Patterns).

The location of East and West Pads about one-half mile inland from the coast would allow free access to the coast nearest to these pads. The location of the CPF about 2 miles inland would mean that the Central Well Pad would appear to have less development and activity than the CPF pad, particularly during the operations phase. Recreationists may not feel inhibited about using the shoreline at relatively close range. However, although Alternative C would not include shoreline facilities, the immediate proximity of the drilling pad to the ocean would likely mean public access restrictions at this one location. Those walking through this area of the coastline may technically be able to get past the pad footprint, but likely would avoid the area or feel inhibited because of the development.

5.18.6 Alternative D: Inland Pads with Seasonal Ice Access Road

As described above under Methodology, under Alternative D, the area of the project footprint that would be lost for recreation would be approximately 350 acres at the Point Thomson Project site. Also as described under Methodology, usability for recreation would be limited near facilities. As an example, 22,700 acres at the project site, and another 20,000 acres along the export pipeline, would be affected, based on a 1-mile buffer around the facilities. The airport would be located about 6.5 miles from the refuge boundary, with aircraft operations expected within about 3.5 miles, indicating that aircraft would be visible and likely audible from the Canning River corridor.

The export pipeline location parallel to the coastline would vary in the 1 to 4-mile range (generally about 3.75 miles), mostly inland of the terrestrial portion of the coastal corridor and usually not visible from the coastline and ocean. This placement would help to protect the coastline recreational experience over most of the 22-mile run of the pipeline and would provide an open area between the ocean and the pipeline that recreational hunters might use with minimal fear of striking the pipeline. There would be no permanent road parallel to the pipeline.

The location of East and West Pads about one-half mile inland from the coast would allow free access along the coast nearest to these pads. The location of the CPF about 2 miles inland would mean that the Central Well Pad would appear to have less development and activity than the CPF pad, particularly during the operations phase. Recreationists may not feel inhibited about using the shoreline at relatively close range; however, although Alternative D would not include shoreline facilities, the immediate proximity of the drilling pad to the ocean would likely mean public access restrictions at this location. Those walking through this area of the coastline may technically be able to get past the pad footprint, but likely would avoid the area or feel inhibited because of the development.

5.18.7 Alternative E: Coastal Pads with Seasonal Ice Roads

As described above under Methodology, under Alternative E, the area of the project footprint that would be lost for recreation would be approximately 200 acres at the Point Thomson Project site. Also as described under Methodology, usability for recreation would be limited near facilities. As an example, 10,000 acres at the project site, and another 22,000 acres along the export pipeline, would be affected, based on a-1 mile buffer around facilities.

The impacts of Alternative E would be the same as those described in Alternative B, with the exception that Alternative E development would be relatively compact, with a 2-mile gravel road between Central Pad and the airport, but no other gravel roads connecting the East and West Pad with the Central Pad. Visible dust and movement of vehicles would not occur to access East and West Pads, but increased use of helicopters between pads likely would be equally visible to recreationists and more audible.

5.18.8 Impacts for Action Alternatives

The difference in overall effects to recreation among the four action alternatives would be minor. The common impacts discussed above are the most important. Referring back to Table 5.18-1, these impacts to recreation would be major; long term and effectively permanent; and extensive, including areas both local and outside Alaska. This assessment of impact is tempered by the very small numbers of recreationists who use the area. Nonetheless, a small number of users and low encounters with others is part of the definition of a recreation experience with high wilderness qualities (whether or not on federal lands designated as part of the National Wilderness Preservation System).Most recreationists in the area are believed to be seeking a backcountry or wilderness-type recreation experience or to be sensitive to changes in the visual environment. Therefore, for those who do use the area or contemplate using it, the projected impact is important, as summarized in Table 5.18-2. Also, this assessment is based on impacts to recreationists regardless of management of the land; state land where the project is proposed is not specifically managed for recreation of any kind and not for maintenance of wilderness qualities, although recreation does occur, and the recreation in the area is principally of a backcountry or wilderness type. Nearby Arctic Refuge lands are managed to provide wilderness-type recreation.

Table 5.18-2: Action Alternatives—Impacts Summary for Recreation[a]

Impact Category	Magnitude	Duration	Potential to Occur	Geographic Extent
Recreation	Major	Long term	Probable	Extensive

[a] Recreation use levels are known to be low (in keeping with wilderness type recreation experiences). Recreation impacts indicated are associated with the use that does occur.

5.18.9 Mitigative Measures

The Applicant has included the following design measures as part of the project design to avoid or minimize impacts on recreation.

- Mining gravel with blasting, installing offshore mooring dolphins and pilings, and constructing off-pad pipelines during winter when visitation to the project area and the Arctic Refuge is at the lowest level.
- Designing project features to reduce offsite visual impacts, as described in Section 5.19, Visual Aesthetics.
- Designing project features to reduce offsite effect of noise, as described in Section 5.20, Noise.
- Implementing aircraft flight path and height protocols to minimize coastal effects associated with noise and visual impacts of aircraft. Aircraft will generally fly at a 1,500-foot altitude and inland from the coast.

The Corps is considering the following measure to avoid or minimize impacts to recreation: avoid use of boats and barges east of the Central Pad and avoid use of small boats in the coastal corridor.

Measures being considered by the Corps to avoid or minimize visual aesthetic impacts (see Section 5.19.6) would also be applicable to recreation impacts.

5.18.10 Climate Change and Cumulative Impacts

5.18.10.1 Climate Change

Changes in climate may beneficially or detrimentally affect existing recreational uses in or near the project area for all alternatives. For example, changes in the habitats, ranges, and distributions of animals such as birds, moose, and caribou could negatively affect existing wildlife viewing and hunting opportunities (see Sections

5.9, Birds, and 5.10, Terrestrial Mammals). Conversely, longer periods of open water could increase opportunities for tourist ships within the Beaufort Sea.

5.18.10.2 Cumulative Impacts

Development of oil and gas production facilities and pipelines and other past and present projects on the ACP that have occurred since the early 1970s have added to cumulative effects on recreation in the study area. For a recreational traveler on the coastal corridor prior to 2009, Bullen Point would have been the first permanent building or substantial structure (a radar structure) west of the Canning River—about 22 miles away. The new developments described above, along with existing developments, mean that industrial facilities would be continuously visible from the Canning River, through the entire Prudhoe Bay complex, to areas west of the Alpine development—more than 100 miles of coastline—usually at a distance of no more than 3 miles (the longest distance would be 4.5 miles halfway between Bullen Point and the West Pad).

Reasonably foreseeable future projects would extend this impact on recreation opportunities, including further development at Badami and Shell Oil's plan to produce hydrocarbons a dozen or more miles offshore of the Canning-Staines River delta. The Alaska Pipeline Project would likely prompt further development of gas fields on the North Slope, including full development of the Thomson Sand Reservoir. Recreationists intent on hiking, hunting, boating, and/or camping in a wild environment on the ACP may experience increasingly limited opportunity to the extent that further development is implemented. However, oil and gas drilling in the 1002 Area of the Arctic Refuge is not considered to be reasonably foreseeable.

Recreational opportunities with high wilderness qualities would continue to exist along a portion of the Arctic Refuge coastline in the area between the western boundary of the Arctic Refuge and the community of Kaktovik, a stretch of 30 to 40 miles that would be far enough away to minimize views or any noise from industrial facilities, unless offshore developments were visible. Similar opportunities would continue to exist east of Kaktovik, particularly along the stretch of coast where the designated Mollie Beattie Wilderness abuts the ocean.

As a result of past, present, and RFFAs in the Point Thomson area, adverse cumulative effects to recreational resources in the eastern ACP may occur with increased industrial development and activity.

5.18.11 Alternatives Comparison and Environmental Consequences

The discussion of comparative effects of the project between the alternatives is tempered by the low levels of recreational use in the coastal and Canning River corridors. The analysis focuses on the use that does occur, including the recreational component of use by residents of the North Slope Borough, and recognizes also that low use is, in itself, part of the recreational experience currently available—an experience with high wilderness qualities and low encounters with other parties.

During construction of any of the action alternatives, the extra activity and noise of mobilizing equipment to the site and the outdoor activity associated with gravel mining and construction of road, runway, and drilling pad embankments would make the site somewhat more conspicuous to recreationists than during drilling and operations. The drilling and operations phases for any of the action alternatives are expected to result in the same kinds of recreational impacts at the same magnitude and extent.

A most basic effect of the action alternatives would be the loss of undeveloped land that could be used for recreation even though these state lands are not designated recreation lands, but are general-use lands open to recreation and managed for oil and gas. The opportunity for the recreational use of portions of the coastal corridor also would be lost to the project footprint. Visiting recreationists and local users likely would avoid use within an area around the project and, under any of the action alternatives, public access to, or public use of the project area may be restricted within the immediate vicinity of project facilities.

Industrial facilities and activities loosely aggregated over about 8 miles of coastline and for about 3 to 4 miles inland would be visible and occasionally audible to recreationists on the lower Canning River corridor, on the coastal corridor, and locations at similar distances on the water and inland along the coast. The additional industrial activity and the new structures associated with the Point Thomson Project would reduce recreation with high wilderness qualities in the project area. The project would alter the existing recreational opportunity of those who do use the lower end of the general Canning River corridor. Recreation opportunity with high wilderness qualities along the coastal corridor between Bullen Point and the Canning River delta would no longer be available.

The high profile of the Arctic Refuge is likely to mean that the change in the recreation environment in and near the refuge would become well known among recreationists who value experiences with high wilderness qualities, even casual recreationists who are not likely ever to visit the study area in person. Effects to recreationists hoping to view or hunt caribou, muskoxen, bears, and birds may be affected slightly due to displacement of wildlife in the project area, but not predictably.

The primary, although minor, differences among the four action alternatives are in the amount of land potentially useable for recreation that would be affected, the distance between the export pipeline corridor (and gravel road under Alternative C) and the coastline, and the accessibility to the coastline. The area of the project footprint and usable areas for recreation that would be affected are greatest under Alternative C, primarily due to the permanent gravel access road. Alternative E, due to its compact layout, would affect the least amount of land that could be used for recreation. The export pipeline under Alternatives B and E would be closer to the coastline and would often be visible from the coastline and ocean compared to Alternatives C and D where a greater separation would help protect the existing coastline recreation experience. At the seaward side of the pads and CPF under Alternatives B and E, the public likely would avoid the area or feel inhibited because of development right on coast. Although Alternatives C and D would not include shoreline facilities, the immediate proximity of the drilling pad to the ocean also likely would mean the public would avoid the shoreline at this one location.

The airstrip and associated facilities and operations would be visible and audible from the Arctic Refuge boundary under all action alternatives; however, Alternatives C and D provide greater distances between the Point Thomson development and the Arctic Refuge.

5.19 VISUAL AESTHETICS

The key findings for visual aesthetics are summarized below with a brief summary of the differentiating effects.

Key Impact Findings and Differentiators Among Alternatives

Key Findings:

Alternatives B, C, D, and E: Minor to major impacts to visual aesthetics are possible to probable and would last for several years. Structures on the pads and the CPF would be dominant with strong contrast from the coastal corridor. Visual impacts would likely be seen 5 miles from the project or farther.

Alternative A: No impact to low sensitivity areas. Minor impacts to medium and high sensitivity areas would be probable, long term, and within close range of the project site.

Differentiators:

- Differences between the build alternatives are small. The greatest difference is between presence of the project (any action alternative) and absence of the project (No Action Alternative).
- Alternatives C and D set several project components, including the central processing facility, back from the coastline, reducing the view of the facility from the coastal corridor.

A visual assessment was conducted for the project and is included as Appendix N to the Final EIS. This section summarizes material from the visual assessment.

5.19.1 Methodology

The visual assessment, including photographs taken in the field and visual simulations, was based on the Applicant's Proposed Action (Alternative B).This provided a reasonable basis for analysis because the likely area of the alternatives was known, and the range of data collected and analyzed, including the Key Observation Point (KOP) sites, is representative of the study area. As described in Section 3.19.4, the KOP sites include shoreline west of the Central Pad, inland southwest of the West Pad, Mary Sachs Island, Brownlow Spit, and aerial at 500 feet above ground level.

Table 5.19-1 defines the impact criteria used to evaluate the potential effects of the Point Thomson Project on visual resources.

Table 5.19-1: Impact Criteria—Visual Resources		
Impact Category[a]	Intensity Type[a]	Specific Definition for Visual Resource
Magnitude	Major	Change in visual environment would be generally strong or moderate contrast[b] in a high sensitivity[c] zone.
	Moderate	Change in visual environment would be strong or moderate contrast[b] in a medium sensitivity[c] zone, or mixed weak and moderate contrast[b] in a high sensitivity[c] zone.
	Minor	Change in visual environment would be up to a strong contrast[b] in a low sensitivity [a] zone.
Duration	Long term	Impact would be irreversible or of such long duration that it appeared permanent; no plan for elimination of impact at end of project.
	Medium term	Impact lasts for several years but less than the life of the project or known elimination of impact as part of the project's end.
	Temporary	Impact lasts through project construction or similar clearly limited time frame that would be substantially less than the life of the project.
Potential to Occur	Probable	Virtually no avoidance.
	Possible	May or may not occur.
	Unlikely	Not expected to occur.
Geographic Extent	Extensive	Likely to be seen beyond 5 miles from project developments and across much of the primary study area (20 miles) or farther.
	Local	Likely to be seen within 5 miles.
	Limited	Likely to be seen at close range within one-half mile.

[a] Impact categories and intensity types were developed based on CEQ NEPA regulations as described in Section 4.1, Direct and Indirect Impact Criteria Methodology.

[b] Contrast is defined in 5.19.1.1, below

[c] Sensitivity is described in Section 3.19.3.3 and shown in Figure 3.19-2.

There would be potential adverse impacts of the following types on visual resources resulting from the implementation of project alternatives:

- Elements in the visual environment that contrast in line, shape, form, color, or texture, for example, and that do not complement the baseline visual character of the study area.
- In an area like the study area for this project that has wilderness qualities and values, visual impact could include seeing any litter, overflying aircraft, structures, or other built or manufactured objects.

Different methods were used to evaluate each type of impact.

Method for 1 (Contrasting Visual Elements): Section 3.19, Visual Aesthetics, provides information about the KOPs. The visual assessment (Appendix N) includes greater detail regarding each KOP and its visual character under baseline conditions and its projected visual character under the proposed action. BLM methods for addressing visual impact (comparing the inventory of existing conditions to proposed future conditions), including visual simulation, resulted in determinations of visual contrast (more detail is provided on "contrast" below in Section 5.19.1.1). These contrast ratings were extrapolated to summarize visual impact of all alternatives evaluated in this Final EIS. Summertime simulations are included in this Final EIS as examples for comparison of impacts among alternatives. Wintertime simulations appear in the visual assessment (Appendix N).

Method for 2 (Wilderness Qualities): To assess visibility and the distance from which the project might be seen, the visual assessment team examined the presence, absence, and relative appearance of project features from various KOPs at graduated distances using a combination of field work, GIS modeling, and visual simulation. The discussion of visibility appears principally in Section 5.14, Arctic National Wildlife Refuge, and Section 5.18, Recreation. See also discussion below, particularly Sections 5.19.1.1 and 5.19.5.2.

Most visual assessments are prepared for sites where many people may be affected by changes to the viewed landscape. The Point Thomson Project would be viewed by small numbers of people each year. However, because the site is near the Arctic Refuge, and because visual sensitivity in that area is high, the visual assessment was undertaken. The BLM methodology provides for visual contrast ratings without regard to whether there is one viewer or thousands. In the study area, little more than 100 recreationists are known to use the Canning River corridor each year, and fewer than that are likely to use the coastal areas for travel, hunting, and recreation. Aircraft likely carry hundreds of people per year over the area, and ships offshore may carry hundreds more. Aircraft and ship passengers are not likely to be nearly as sensitive to visual changes as people using the study area on the ground. Also, the visual assessment was completed based on mostly clear sky conditions. Clouds and fog are common in the study area and can alter or entirely obscure the view.

5.19.1.1 Visual Impact Assessment

Section 3.19 summarizes the inventory of visual resources and visual quality from the visual assessment (Appendix N). This section of the Final EIS summarizes the "Visual Resource Contrast Rating" section of the visual assessment and assesses the potential impacts of project alternatives on visual resources based on visual sensitivity designations.

In a visual assessment, "contrast" is the term used to describe the degree of "opposition or unlikeness of different forms, lines, colors, or textures in a landscape" (BLM Manual 8400). Contrast refers to the visible change or difference between baseline conditions and proposed project conditions. It is possible to create large change without strong contrast, and it is possible for small physical changes to create strong contrast. For example, excavating a large hole such as for a mine, or constructing a building may not create visual contrast if it is hidden from all important viewpoints by thick forest or topography, so that the view is unaltered. Conversely, simple dots of fluorescent orange paint as trail markers on a hiking route over rock outcrops may be a glaring visual contrast in an otherwise natural environment.

Visual simulations were developed from information provided by the Applicant based on its current level of design for Alternative B. A selection of those simulations at graduated distances from various project components is used in this Final EIS as a primary basis for determining the visual impact of all the alternatives, because all action alternatives would include the same features in different configurations. The visual assessment does not address ice roads in simulations or contrast rating but does address conditions in general during winter snow-cover periods. Contrast ratings and general visibility were found to be similar summer and winter. This discussion focuses on summer conditions for simplicity.

The visual analysis below (Section 5.19.2) is written from the perspective of the KOPs and is based on visual simulations of the proposed action when the drilling rig is in place. The simulations are shown in Figure 5.19-1 through Figure 5.19-14 for the KOPs. The analysis includes a focus on the Arctic Refuge because of its proximity to the project. The evaluation of potential impacts is based on the sensitivity of areas within the study area (see Section 3.19.1.3 and Figure 3.19-2), with a focus on medium- and high-sensitivity areas.

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POINT THOMSON PROJECT EIS

Figure 5.19-1

Shoreline Key Observation Point – View Within 0.2 Mile

Preexisting Conditions

Date: 09/29/2010 Photosimulation Author: HDR Boise Inc.
Sources: ExxonMobil, USGS, AK DNR, URS

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POINT THOMSON PROJECT EIS

Figure 5.19-2

Shoreline Key Observation Point – View Within 0.2 Mile

Proposed Conditions

Date: 09/29/2010 Photosimulation Author: HDR Boise Inc.
Sources: ExxonMobil, USGS, AK DNR, URS

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POINT THOMSON PROJECT EIS

Figure 5.19-3

Inland Key Observation Point – View from Within 0.8 Mile

Preexisting Conditions

Date: 10/07/2010 Photosimulation Author: HDR Boise Inc.
Sources: ExxonMobil, USGS, AK DNR, URS

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POINT THOMSON PROJECT EIS

Figure 5.19-4

Inland Key Observation Point – View from Within 0.8 Mile

Proposed Conditions

Date: 10/07/2010 Photosimulation Author: HDR Boise Inc.
Sources: ExxonMobil, USGS, AK DNR, URS

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POINT THOMSON PROJECT EIS

Figure 5.19-5

Mary Sachs Island Key Observation Point – View from about 1.8 Miles
Preexisting Conditions

Date: 10/07/2010 Photosimulation Author: HDR Boise Inc.
Sources: ExxonMobil, USGS, AK DNR, URS

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POINT THOMSON PROJECT EIS

Figure 5.19-6

Mary Sachs Island Key Observation Point – View from about 1.8 Miles

Proposed Conditions

Date: 10/07/2010 Photosimulation Author: HDR Boise Inc.

Sources: ExxonMobil, USGS, AK DNR, URS

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POINT THOMSON PROJECT EIS

Figure 5.19-7

Brownlow Spit Key Observation Point in Daylight – Views of East Pad and Central Pad Preexisting Conditions

Date: 08/23/2011 Photosimulation Author: HDR Boise Inc.
Sources: See References chapter for map source information

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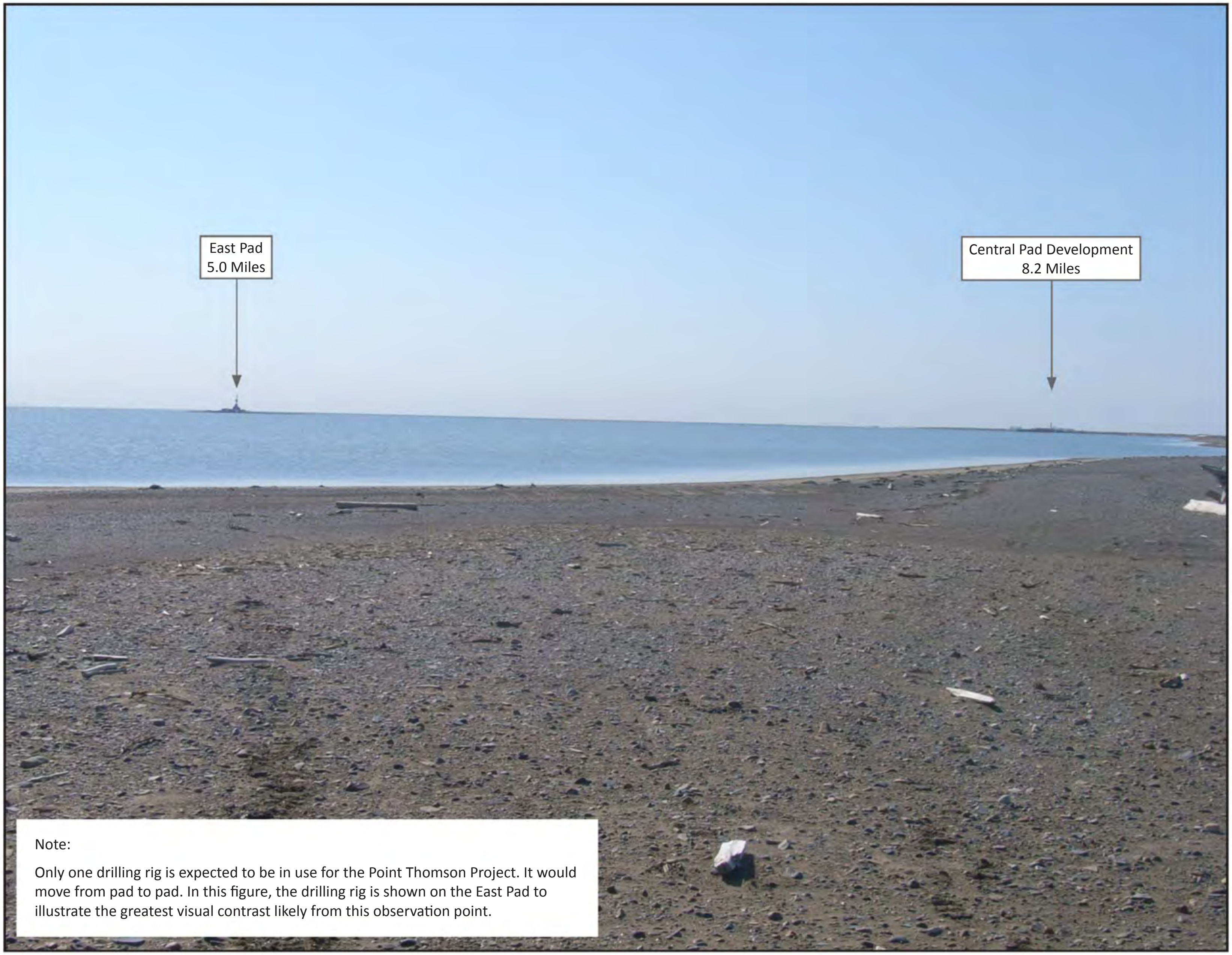

POINT THOMSON PROJECT EIS

Figure 5.19-8

Brownlow Spit Key Observation Point in Daylight – Views of the East Pad and Central Pad Proposed Conditions

Date: 08/23/2011 Photosimulation Author: HDR Boise Inc.
Sources: See References chapter for map source information

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POINT THOMSON PROJECT EIS

Figure 5.19-9

Brownlow Spit Key Observation Point in Winter, Dark – Views of East Pad and Central Pad Conditions March 2010

Date: 08/23/2011 Photosimulation Author: HDR Boise Inc.
Sources: See References chapter for map source information

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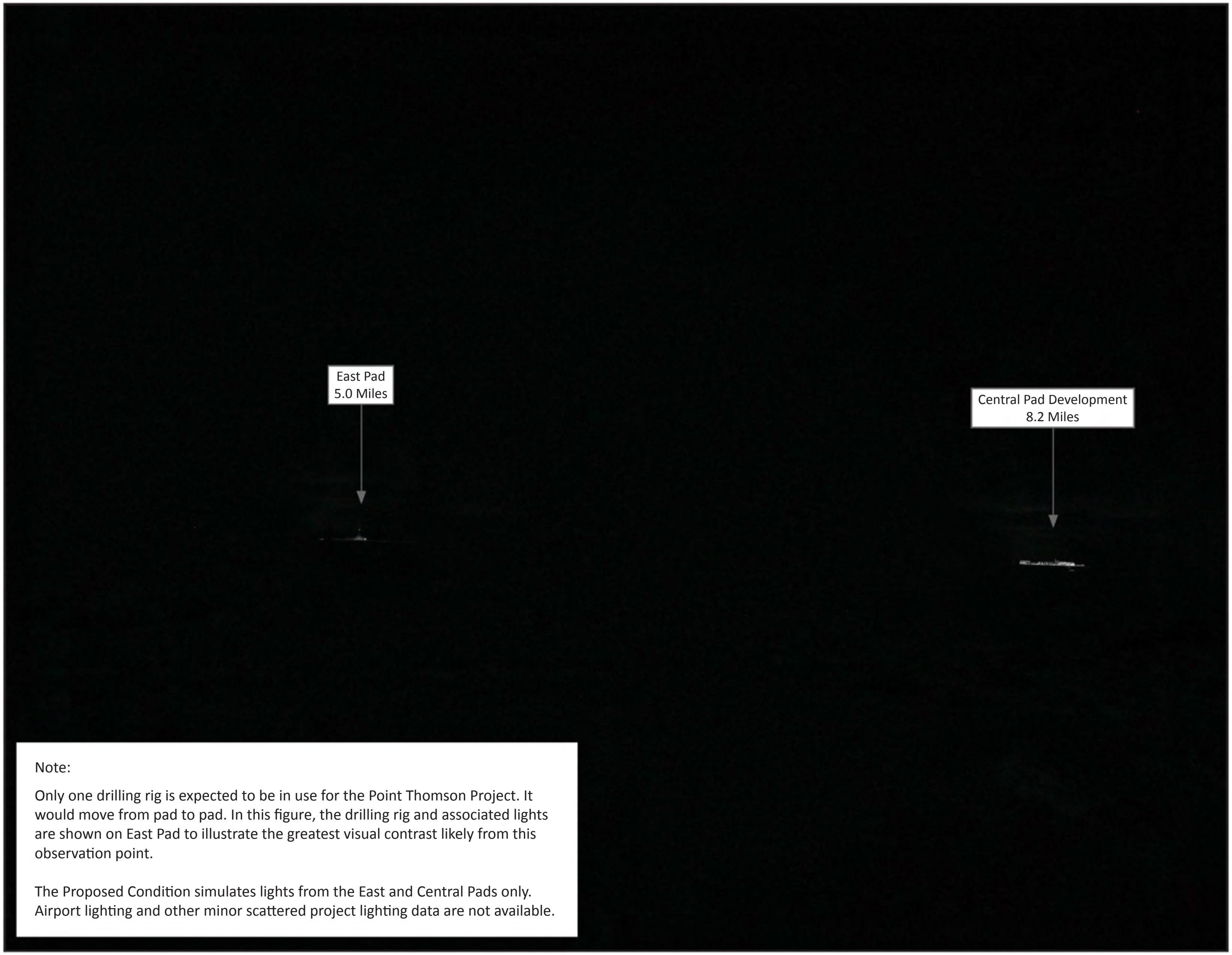

Note:

Only one drilling rig is expected to be in use for the Point Thomson Project. It would move from pad to pad. In this figure, the drilling rig and associated lights are shown on East Pad to illustrate the greatest visual contrast likely from this observation point.

The Proposed Condition simulates lights from the East and Central Pads only. Airport lighting and other minor scattered project lighting data are not available.

POINT THOMSON PROJECT EIS

Figure 5.19-10

Brownlow Spit Key Observation Point in Winter, Dark – Views of East Pad and Central Pad Proposed Condition

Date: 08/23/2011 Photosimulation Author: HDR Boise Inc.
Sources: See References chapter for map source information

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POINT THOMSON PROJECT EIS

Figure 5.19-11

Aerial Key Observation Point – View from 500-Foot Elevation
Preexisting Conditions

Date: 08/23/2011 Photosimulation Author: HDR Boise Inc.
Sources: See References chapter for map source information

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POINT THOMSON PROJECT EIS

Figure 5.19-12

Aerial Key Observation Point – View from 500-Foot Elevation

Proposed Conditions

Date: 08/23/2011 Photosimulation Author: HDR Boise Inc.

Sources: See References chapter for map source information

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POINT THOMSON
PROJECT EIS

Figure 5.19-13

Inland View of Pipeline – View from 225 Feet
Preexisting Conditions

Date: 08/23/2011 Photosimulation Author: HDR Boise Inc.
Sources: See References chapter for map source information

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Figure 5.19-14

Inland View of Pipeline – View from 225 Feet

Proposed Conditions

Date: 08/23/2011 Photosimulation Author: HDR Boise Inc.

Sources: See References chapter for map source information

POINT THOMSON PROJECT EIS

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5.19.2 Project Components with Greatest Influence on the Visual Environment

The visual analysis, including the visual simulations, focused on the drilling and initial production phases of the project when full build-out of all project components would be complete and drilling still would be ongoing. This time period was selected for the analysis because it is the time period when the project would be most visible—the drilling rig would be in place on one of the pads and noise associated with construction activities may focus visitor (e.g., subsistence harvesters and recreationists) attention on the facilities. The following discussion of visible project components applies to all build alternatives.

Drilling Rig

One drilling rig is proposed for use on the project, which would be moved between each of the pads until drilling activities were completed. The drilling rig would be the most visually impacting condition for each of the pads because the tower extends to 180 feet above the level of the pad and because the modular components of the rig are large and extend above the level of the pad. For this reason, visual simulations show the drilling rig in illustrations of Central, East, and West Pads. The Brownlow Spit KOP provides views of both the Central and East Pads, and for this location, images show the drilling rig on the East Pad.

Once drilling was completed at a given pad, the drilling rig would be removed and a much less visually dominant system of valves and pipes would connect to the well. Once all the wells associated with this project were completed, the drilling rig would be removed from the project area, and the operations phase would proceed without further drilling. Removing the drilling rig would reduce the visual effects by removing the tall tower, a dominant vertical line that would contrast strongly with the flat, horizontal nature of the area and be visible for many miles.

Other Towers

Besides the drilling rig, the project would include other tall structures that would introduce a contrasting vertical line and would be visible over long distances. Six permanent towers would be:

- A 160-foot-high communications tower at the Central Pad for ultra high frequency (UHF), VHF, and microwave communications; closed-circuit television; public address and general alarm; and meteorological equipment. Microwave communications typically involve a large round box- or dish-shaped antennae aimed at the horizon.
- A communications tower associated with the existing Badami development (up to 200 feet above pad level) for UHF and microwave communications.
- Four shorter airport towers for aircraft communications and navigation—one at 30 feet above pad level, two at no more than 45 feet, and one at 55 feet.

Temporary towers used during construction phase would include towers for satellite and microwave communications at 35 to 55 feet above pad level at:

- Construction camps near the Central Pad/Central Processing Pad (three towers).
- The Badami construction camp (one tower in addition to the permanent communication tower).
- Ice road construction camps along the route of the ice road from Endicott (one temporary communications tower at each of several camps).

Long-term Structures

Each action alternative includes a variety of modules and storage tanks on the various pads to accommodate operations throughout project life, including:

- Operations personnel camps and camp utility modules.
- CPF modules, including high- and low-pressure flare stacks.
- Fuel, materials, and waste storage areas.
- Infield pipelines, including the freshwater pipeline, gathering lines, and reinjection line.
- Airport control buildings and helipad.

Alternatives B and E would also include barge offloading facilities. All action alternatives would include emergency response boat launch ramps.

5.19.3 Arctic National Wildlife Refuge Issues Relevant to All Action Alternatives

One purpose of the visual assessment for the project was to assess potential visual impacts to the Arctic Refuge. The portion of the Arctic Refuge within the study area was given a high sensitivity rating because the land is managed as a Minimal Management area for in part for its wilderness qualities (see Sections 3.18.3 and 3.22.4.1). The following KOP and assessment locations were established before field studies in coordination with the lead and cooperating agencies specifically to address issues for the Arctic Refuge:

- The Brownlow Spit KOP is located immediately outside the Arctic Refuge boundary on the Beaufort Sea coast and is meant to be representative of views from within the refuge on the Canning River delta at similar distances. Photographs were taken during summer and winter in daylight and in dark conditions. Visual simulations were created.
- The Canning River Takeout Bluff KOP is located about 20 miles inland within the Arctic Refuge, east of the Canning River near the point that recreational river rafters often end their trips and leave the river. It was treated the same as other KOPs, with photos and field notes taken. However, as further described below, no visual simulation was produced, because it was determined that the project facilities would be too far away to appear in a simulation.
- A Mollie Beattie Wilderness area site was located about 30 miles from the project site within the designated Mollie Beattie Wilderness, as measured from the coast at Point Thomson. It was to be modeled for visual simulation without visiting the site. However, no visual simulation was produced because it was determined that the project facilities were too far away to appear in a simulation.

As indicated previously, one type of visual impact in an area managed for its wilderness qualities and values is the presence of manmade objects in the view. The Arctic Refuge, including the 1002 Area closest to the project, is managed in part to maintain wilderness qualities (see Section 3.13, Land Ownership, Land Use, and Land Management, and Section 3.14, Arctic National Wildlife Refuge). The first effort for the parts of the Arctic Refuge represented by the Canning River Takeout Bluff KOP and the Mollie Beattie Wilderness KOP was to determine whether the project would be visible. The presence of exploratory drilling structures and equipment at the Central Pad site aided the field effort substantially, because the drilling rig onsite in 2010 would be the same one that would be used for the proposed project.

Field observations in winter and summer determined that the existing facilities were virtually invisible with the naked eye at a distance of 20 miles. From the Canning River Takeout Bluff KOP and a site nearby at a similar distance, it was barely possible to make out the vertical line of the drill rig tower with the naked eye for people who were specifically looking for it and knew where to look. If observers looked away, it was difficult to find the object again. The object did not appear in photographs taken at those sites. It was therefore determined to be impractical and not useful to attempt a visual simulation from the Canning River Takeout Bluff site or from the Mollie Beattie Wilderness site 10 miles farther away. Nevertheless, because no topography blocks some of the views at these distances, it would be likely that lights from the project under any of the action alternatives would be visible in dim and dark conditions at distances up to 20 miles on flat ground and at distances of 30 miles and beyond on terrain gradually rising toward the Brooks Range. See further discussion of visibility in Section 5.14, Arctic National Wildlife Refuge, and Section 5.18, Recreation).

Because of minimal visibility, the Canning River Takeout Bluff and Mollie Beattie Wilderness sites are not included in the alternative impact evaluations. Figures showing images from Brownlow Spit are the most representative of views from closer portions of the Arctic Refuge.

5.19.4 Alternative A: No Action

Under Alternative A, no permit from the Corps for gravel fill and other construction activities regulated by the agency would be issued. Occasional helicopter operations for site monitoring and the protective wellhead covers for the two wells and rig mats would be the most noticeable features of Alternative A. Most recreationists or hunters on the Canning River corridor would have little or no visual awareness of their existence. Travelers on the coastal corridor would be aware of the two 16-foot-tall orange well covers as they passed, even from the barrier islands (a distance of approximately 2 miles) or points farther away. Those who happened to be on the shoreline in snow-free seasons would see well covers as well as the existing gravel pads and rig mats. There would be relatively minor long-term impact over current conditions. Note that the well covers did not exist at the time the visual simulations occurred and are not shown in the visual assessment figures, but they appear in Figure 2.4-1. A brief summary of the KOPs follows.

Shoreline KOP: Figure 5.19-1 shows baseline conditions. An old gravel pad exists but is nearly invisible. At this close range, the two 16-foot-tall well covers shown in Figure 2.4-1 would create a strong visual contrast to the surrounding natural environment mostly because their form is different than anything in the natural environment, their orange color does not complement surrounding natural colors, and their sides make vertical lines in an otherwise horizontal environment. From positions farther away, the contrast of the well covers would be moderate at most (see Figure 5.19-2).

Inland KOP: The Inland KOP is located inland from Point Sweeney. Figure 5.19-3 shows baseline conditions in this area. Under Alternative A, these baseline conditions would remain essentially unchanged. The well covers may attract visual attention but would be far enough away that the contrast would be minimal. See Figure 5.19-4 for a visual simulation of the proposed conditions.

Mary Sachs Island KOP: Figure 5.19-5 shows the baseline conditions at the Central Pad from 1.8 miles away. Under Alternative A, the well covers shown in Figure 2.4-1 would be visible, but the apparent size and visual prominence would be much reduced compared to the view from the Shoreline KOP. Contrast as viewed from this KOP would be minor to moderate (see Figure 5.19-6).

Brownlow Spit KOP: Figure 5.19-7 and Figure 5.19-9 indicate baseline conditions looking toward East Pad, 5 miles away, and Central Pad, located about 8 miles away. Although both sites would retain their baseline gravel pads under Alternative A, the pads would not be visible (see Figure 5.19-8 and Figure 5.19-10). The well covers at the Central Pad would be unlikely to be readily visible to the naked eye at this distance. The visual environment would appear primarily undisturbed with an expansive, open, flat, and wild character of ocean, beach, ice pack, and distant mountains. This view is similar to the view from inside the Arctic Refuge boundary near the mouth of the Canning River.

Aerial KOP: Figure 5.19-11 illustrates the preexisting appearance of the Central Pad area from an elevation about 500 feet and from about 4.7 miles inland. The view from the air under Alternative A would be substantially the same as under baseline conditions. Central Pad and its well covers would not be readily visible because of distance, and the visual landscape would appear essentially unaltered and natural (see Figure 5.19-12). Aircraft flying closer to the site would see the old gravel pad and well covers more readily, similar to what those in aircraft flying overhead would have seen prior to 2009.

5.19.4.1 Alternative A: Impact Evaluation

Table 5.19-2 summarizes the visual impacts of the No Action Alternative. From close range (e.g., the Shoreline and Mary Sachs Island KOPS up to 2 miles away) there would be some strong and moderate contrast in medium sensitivity areas.

Table 5.19-2: Alternative A—Impact Evaluation for Visual Resources

Impact Category	Magnitude	Duration	Potential to Occur	Geographic Extent
Low Sensitivity[a] Areas	No impact	No impact	No impact	No impact
Medium Sensitivity[a] Areas	Moderate	Long term	Probable	Local
High Sensitivity[a] Areas	Minor	Long term	Unlikely	Limited

[a] Sensitivity is described in Section 3.19.1.3 and shown on Figure 3.19-2.

5.19.5 Action Alternatives

The action alternatives were assessed together because their visual effects would be similar. Overall, the action alternatives would place a large new industrial development in an area where previously there was little or no development visible. The development phases (construction, drilling, and operations) were combined because the focus of the visual assessment was the greatest period of visual impact, at the juncture of these phases when the drilling rig would be onsite.

5.19.5.1 Construction, Drilling, and Operations

All alternatives would place three drilling pads on or near the shoreline. The CPF would be located on the Central Pad (Alternatives B and E) or 2 miles inland on a Central Processing Pad (Alternatives C and D). In all cases, these developments would be dominant in views from the water and coastline. In all alternatives the export pipeline would be elevated 7 feet off the ground, and it would run 22 to 50 miles west from the project site. It would be located 1 to 2 miles inland for Alternatives B and E or 3 to 7 miles inland for Alternatives C and D. In a key difference, the pipeline would be more visible from the coast under Alternatives B and E, but it would look identical at any given distance from the pipeline under all alternatives. An airport would be located inland, south of Central Pad, with air traffic expected commonly within 2 to 4 miles of the Arctic Refuge boundary and readily visible from the western edge of the Arctic Refuge, although the greater the distance between typical air traffic and the refuge, the less likely it would be to affect the visual experience of refuge visitors.

The major project features that would be visible from some or all KOPs include the facilities on the pads, the export pipeline, and the airport. Figure 5.19-1 through Figure 5.19-12 present simulations of select project features at a given distance (listed on the figure). Distances farther away or closer would affect visual prominence of the feature. However, unless the feature would be not visible at all, the visual contrast rating typically would not change between alternatives, as further described below.

Shoreline KOP

Figure 5.19-1 shows the drilling rig as the main component seen from close range (approximately 875 feet) at the shoreline. This view would be similar for Alternatives B and E. Under Alternatives C and D, the drilling rig would look as it does in the figure, but other components seen in the background would be located 2 miles inland at the Central Processing Pad (outside the view of the figure to the right); structures on the Central Processing Pad would be readily visible from the shoreline location but would appear more like the view shown in Figure 5.19-6 in distance and relative size and prominence. The visual contrast rating for the main view of the Central Pad (Alternatives B and E) or Central Well Pad (Alternatives C and D) would be strong; under Alternatives C and D, the Central Processing Pad development would be clearly visible 2 miles inland—also a strong contrast despite the distance.

The East and West Pads would be readily visible 3 to 4 miles distant from the Shoreline KOP. Under Alternatives B and E they would be located on the coast and under Alternatives C and D they would be located about a half mile inland. They would be similarly dominant visual features for all alternatives.

Under Alternatives B and E, three developments would be dominant visual features on or near the coast; under alternatives C and D, there would be four dominant visual features, with the Central Processing Pad located farther inland.

Contrasts for roads and pipelines would be weak by comparison to facilities, though a reflection of sunlight on pipelines may occur at certain times of day, increasing pipeline contrast and visibility. Such reflection could make the difference between seeing and not seeing the pipelines. Nonglare coating, included by the Applicant as part of the project design, would be expected to reduce reflection but likely would not eliminate it.

Inland KOP

The Inland KOP is located inland from Point Sweeney. The West Pad and the export pipeline are the nearest project features to this location. Under Alternatives B and E, the West Pad would be located about 0.8 miles to the northeast (Figure 5.19-4). Under Alternatives C and D, the West Pad would be about 0.3 mile to the northeast of the KOP, and approximately 0.5 mile southwest of the Alternative B location. Under Alternatives C and D, the drilling rig would be at a similar distance and apparent scale as the drilling rig component shown in Figure 5.19-1, with an apparent prominence between that shown in Figure 5.19-1 and Figure 5.19-3. Other structures on the West Pad would be lower and oriented horizontally, and would be much less visually prominent than the drilling rig itself. Therefore, when the drilling rig was not present, the visual prominence and contrast of structures on the West Pad would be reduced, but those structures would remain readily apparent at this close proximity.

The export pipeline would have strong visual contrast for line and form and moderate and weak contrast for color and texture. On sunny days, the angle of the sun could potentially create a bright reflection. From the Inland KOP, because the pipeline would be visually prominent with or without reflection, the reflection may increase visual contrast but would not make the difference between seeing and not seeing the pipeline. Under Alternatives C and D, the export pipeline would be routed to the south (off the right-hand edge of Figure 5.19-4) and would not be as prominent, but the contrast for color and texture would be expected to be stronger under C and D than under Alternatives B and E, in which it would cross in front of the West Pad and the contrast would be reduced against other industrial structures.

Mary Sachs Island KOP

The Mary Sachs Island KOP is located north of the Central Pad on the tip of an offshore island and represents views from nearby barrier islands or from passing boats. In winter, snowmobiles may pass by on the sea ice. Under all action alternatives, the drilling rig would look the same as shown in Figure 5.19-6. Under Alternatives B and E, the rest of the facilities would be located approximately as shown in the figure. Under Alternatives C and D, the rest of the facilities, including the communications tower, would be located 2 miles inland to the southwest (C) or directly south (D), twice as far away from the KOP as the drilling rig. The view of the Central Pad development from this point would have strong visual contrast. This rating would apply to all four alternatives. Under C and D, there also would be the CPF development clearly visible about 4 miles away with a similar contrast rating. Taken alone, the visual contrast for the CPF may be reduced because of distance, but with the drilling rig remaining at a distance of 2 miles, and with more developments in the view, the contrast rating would be the same. Contrast and visibility of pipelines would be minimal, though sunlight reflected on the pipelines, even with a proposed nonglare coating, could cause the otherwise unnoticeable structure to become visible.

Brownlow Spit KOP

East Pad development would be the closest project component to Brownlow Spit. This KOP presents a view similar to views at the mouth of the Canning River inside the Arctic Refuge and from common stopping places on Brownlow Point, Flaxman Island, and the Canning River delta for local residents. Figure 5.19-8 and Figure 5.19-10 simulate the appearance of the developments from this point in daylight and dark conditions. Under Alternatives C and D, the East Pad would be located approximately a half mile inland compared to the view modeled in the figures (up to 5.5 miles away from the KOP instead of 5 miles, as shown in the figures). It would look similar to Figure 5.19-8 and Figure 5.19-10. Under Alternatives B and E, the Central Pad and CPF would be located together as shown in the figures. Under Alternatives C and D, most of the development shown on the Alternative B Central Pad would be shifted to the south 2 miles (shifted left in the simulations) but at approximately the same distance (9 miles under Alternative C, 8 miles under D). While the apparent size of the developments would be small because of distance, they would be the only dark (silhouetted) and vertical elements visible in any direction. Therefore, the developments would retain more visual prominence and greater visual contrast than might otherwise be expected at these distances. However, removal of the drilling rig from the Point Thomson study area following completion of all wells would reduce the visual contrast from this KOP and other sites at similar distances by removing a strong vertical line. The communications tower and flare stack still would be visible at the Central Pad in the background distance zone, so visual contrast would remain.

The visual contrast for the view of the East and Central Pad developments from this point in daylight would be moderate for all alternatives, except that texture would not be discernible at this distance. Although the locations of project features would shift somewhat in the view depending on alternative, the general scale and appearance of the features would be the same. Removing the drilling rig entirely from the project site may reduce the daylight contrast rating from this location to weak (i.e., it can be seen but does not attract attention), although with aircraft traffic and other elements not depicted in the simulations, the project likely would continue to attract attention. Project lights in dim and dark conditions would create strong contrast as the only artificial lights visible. The simulation in Figure 5.19-10 represents primarily clear air conditions; under conditions of light fog and low clouds, it is likely that artificial lights would reflect back and forth off clouds and snow cover and create a more diffuse and widespread glow than depicted, and visible at greater distances. In some thick fog conditions the site and its lights may not be visible at all, even in dim and dark periods.

Aerial KOP

The view from the air would be similar overall under all action alternatives. Viewers in the air would be residents and visitors to Kaktovik, primarily flying to and from Deadhorse, project personnel coming and going from the project's airstrip, and recreationists principally visiting the Arctic Refuge and flying in and out of the Canning River at informal landing spots at the top and bottom ends of the river's delta, almost exclusively in summer. The number of nonproject viewers on a daily basis would be small. Figure 5.19-12 illustrates the appearance of the Central Pad under Alternative B from the Aerial KOP, at an elevation of 500 feet AGL and 4.7 miles south of the Central Pad drilling rig. The other action alternatives would vary from this view as follows:

- Under Alternative C, the airstrip would be located farther west and farther inland, outside of the view of Figure 5.19-12, and the Central Processing Pad would be located closer, about 2.5 miles from the viewer in the left portion of the image. The drilling rig would remain at 4.7 miles away. Similar views farther west would include the new airstrip built on the former West Staines Airstrip.
- Under Alternative D, the airstrip would be located farther west and farther inland, outside of the view of Figure 5.19-12, and the Central Processing Pad would be located about 2.5 miles from the viewer in the center portion of the image. The drilling rig would remain at 4.7 miles away. Similar views farther west would include the new airstrip located quite close to the former West Staines Airstrip, so that the view would contain two engineered linear features located together.
- Under Alternative E, the airstrip would be centrally located in Figure 5.19-12 and slightly farther away from the viewer. A single infield gravel road would lead toward the Central Pad. The gravel road barely visible in the foreground to the right would not appear under Alternative E.

The rating for all alternatives for the aerial view shown in Figure 5.19-12 for Central Pad developments would be strong visual contrast of line and form and moderate and weak contrast for color and texture. Contrasts for roads and pipelines would be weak by comparison, though a reflection of sunlight on the pipeline may occur at certain times of day, increasing pipeline contrast and visibility. A nonglare coating on the pipeline would reduce the reflection.

Pipeline View

The export pipeline throughout its run from Point Thomson to its western end would look much like the simulation shown in Figure 5.19-14 under any of the action alternatives. Under Alternatives B, D, and E, the visual impact of the pipeline would extend about 22 miles to Badami. Under Alternative C, it would extend about 50 miles to Prudhoe Bay, parallel to a 44-mile gravel road. The western half of this longer pipeline would parallel the existing Badami pipeline with 1 to 2 miles of separation, and the incremental change of adding a second pipeline would be lower in this area than the change of building a first pipeline in the area farther east.

At 2 to 3 miles away, the pipeline would be expected to be visible from the coast. In the range of 5 to 7 miles, it would not likely be visible from the coast. Alternatives C and D, with the pipeline at more than 3 miles inland from the coast, would help to protect the visual resource along the coast.

Under any of the action alternatives, views of the cylindrical and visually infinite form of the pipeline would have a strong visual contrast from the close vantage point shown in the simulation (225 feet). The contrast would be moderate for line, color, and texture. From other points at greater distance, the overall horizontal lines of the pipeline would not contrast sharply with the flat horizon, and the visual contrast would fade from moderate to weak with distance.

Notes Specific to Alternative E. Under Alternative E, following the construction and drilling phases, some components would be removed, and the ice pad portions of the Central Pad would be allowed to melt, resulting in a smaller change in the visual environment than shown in the simulations depicting the Central Pad. The reduction in pad size later in the project life would reduce the visible extent of development but not the visual contrast ratings.

Without infield gravel roads connecting the outlying pads, vehicle miles driven, including visible dust plumes, headlights, and flashing lights associated with driving, would be relatively low in the summer. Alternative E would feature a greater number of helicopter flights between pads whenever ice roads were not available, and helicopter operations would be visible from many of the observation points. Helicopter noise would likely highlight aircraft presence so that people would see the aircraft.

5.19.5.2 Impact Evaluation for the Action Alternatives

Table 5.19-3 provides the visual impact assessment for the study area based on visual sensitivity designations described in Section 3.19 and the impact criteria table at the beginning of this section. All action alternatives would have similar impacts within the sensitivity areas. Most of the study area is on state land designated as a medium visual sensitivity area and most of the coastal corridor falls within this medium sensitivity area. A smaller portion of the study area is on federal land (Arctic Refuge) designated as high sensitivity area because it is managed in part for its wilderness values and qualities. Project components with the most visual contrast include vertical structures, particularly towers. During daylight, visibility of project components would extend well beyond 5 miles. Nighttime lighting of pads would create strong contrasts over long distances in an area without existing manmade lights. The visual effect of the project would be long term, effectively permanent. However, even with the extensive reach of lights, only a small portion of the Arctic Refuge as a whole would be affected. Those portions of the Arctic Refuge and state lands nearest to the project site would experience the greatest visual contrast when the drill rig was present. When and if the drilling rig were completely removed from the project site (projected to occur after four to five drilling seasons), the daylight visual contrast would be reduced, particularly where viewed features were in the background distance zone (greater than 5 miles away), such as from points in the Arctic Refuge, but communications towers, the flare stack, the visual bulk of the CPF, and movement of exhaust plumes, road dust, snowplow plumes, aircraft, and vehicles would continue to create contrast beyond the 5-mile foreground-middle ground zone.

The impact of the action alternatives on visual resources in medium- and high-sensitivity areas would be substantial for the following reasons:

- As the first major development in the study area, the proposed project would contrast strongly with the surrounding viewshed from many different vantage points and distances.
- Project components would be visible during daytime and nighttime for a long time period.
- The project would be visible within the coastal corridor and from the northwest corner of the Arctic Refuge with weak to strong contrast, depending on the project phase and lighting conditions.

Table 5.19-3: Action Alternatives—Impact Evaluation for Visual Resources

Impact Category	Magnitude	Duration	Potential to Occur	Geographic Extent
Low Sensitivity[a] Areas	Minor	Medium term	Possible	Extensive
Medium Sensitivity[a] Areas	Moderate	Medium term	Probable	Extensive
High Sensitivity[a] Areas	Major	Medium term	Probable	Extensive

[a] Sensitivity is described in Section 3.19.1.3 and shown in Figure 3.19-2.

5.19.6 Mitigative Measures

The Applicant has included the following design measures as part of the project design to avoid or minimize impacts on visual aesthetics.

- Designing the lighting on pads to reduce off-pad and distance effects, including light hoods to reduce outward-radiating light. An in-depth lighting study, taking into account both visual aesthetics and site security/safety, is planned during the detailed design stage to address additional light mitigation.
- Painting project facility buildings a color that reduces offsite visual effect. Main facility color selection will be made in the detailed design stage with input from Kaktovik and other stakeholders.
- Designing buildings and stacks as the minimum height and footprint needed to perform their functions.
- Burying power lines and fiber-optic cables, or placing them on pipeline VSMs, to avoid additional overhead structures.
- Texturing and coating pipelines and gathering lines to reduce glare and contrast.

The Corps is considering the following measures to avoid or minimize impacts to visual aesthetics:

- Prepare and implement a visual impact and lighting mitigation plan that includes specific measures such as nonreflective paint/coatings that blend in with natural landscape, keeping infrastructure as short as practicable, shielded lighting, installation of shaded windows on east sides of buildings, shielding pilot flames for gas flares and establish them as low as possible on towers, and minimizing large flares and smoke plumes associated with flaring. This plan should be reviewed and approved by the Corps, in consultation with others, prior to start of construction.

5.19.7 Climate Change and Cumulative Impacts Associated with the Action Alternatives

5.19.7.1 Climate Change

Climate change effects such as MAAT increases have the potential to change the visual resources in the area under all alternatives by enabling changes in the topography (through thermokarsting), in the vegetation types, and the amount of sea ice visible in a given year. However, of the potential climate change effects, the effect with the greatest potential to affect the impacts of the action alternatives on the visual resources in the project area would be in cloud cover from storms. As stated above, dim and dark conditions increase the contrast of lights in the project area, and an increase in the frequency of storms due to climate change (ACIA 2005) could subsequently increase the number of high-contrast lighting occurrences over the life of the project.

5.19.7.2 Cumulative Impacts

Past actions that have affected visual resources within the project area include military operations at Bullen Point and oil and gas exploration and development. Visual effects that result from military operations generally include increased air and marine activity. Effects to visual resources resulting from past and present oil and gas exploration are similar to those described for the action alternatives. Construction of any of the alternatives would result in new development in an area of medium visual sensitivity and within the foreground-middle ground distance zone (5 miles) as seen from transportation and recreation corridors and the northwestern corner of the Arctic Refuge (high visual sensitivity). These changes attributable to the proposed project would be part of a trend of past and present actions of industrial development on the ACP. Past development and production of oil and gas has impacted the visual resources of approximately 10 percent of the North Slope area at one time or another, but impact at a single point is unlikely to be higher than 1 percent in recent years (BLM 2004). Impacts to visual resources occur as industrial development creates a network of roads and pipelines connecting nodes of highly industrialized but compact sites. The "network" appearance is most visible from the air. From the ground, the visual character would be one where industrial structures are visible over long distances. The Point Thomson Project would extend this network trend of pipelines, roads, and nodes of development about 30 miles eastward along the coast into a previously minimally developed area.

The trend of increasing industrial development would continue under most RFFAs. In the vicinity of the Point Thomson Project, RFFAs include the construction of a natural gas export pipeline and a Shell Oil proposal to drill for oil and gas offshore from Point Thomson. A natural gas export pipeline from Prudhoe Bay could spur production of natural gas from existing and new wells across the North Slope, and would likely result in additional development at Point Thomson, including new wells and a new export pipeline for gas. As part of full field development, it would be possible that the single drill rig would remain at Point Thomson for many years drilling future wells, or that additional drilling rigs would be put into service so that multiple rigs could be visible simultaneously. These changes would extend the duration of impacts caused by the greater visual contrasts associated with the drilling rig. If constrained to the existing drilling pads, the visual impact would not be substantially different than presented in this section, except that the drilling rig would remain in the area for an extended period of time. If development extended to new drilling pads on the mainland or offshore, the visual impact would expand.

The Shell Oil proposal (Joling 2010) would include greater offshore activity near the study area, potentially including a drilling ship, multiple other vessels, and helicopters. This development would likely lead to the construction of one or more drilling platforms, which would be visible from a broad area of the coastline, including a large area of the Arctic Refuge coastline. Lights or flares could be particularly visible. The industrial developments on land and particularly at sea would be visible by whaling boats, the cruise ships that ply the Northwest Passage once or twice per year, and by other boats that may increasingly venture north as forecast reductions in the polar ice cap are realized.

The visual quality of the environment would be altered most when industrial facilities are initially developed in an area, as is proposed with the Point Thomson Project. Future development within view of the Point Thomson facilities would be an incremental, additional change, but the overall visual contrast of those future projects may be less strong, depending on what is ultimately constructed. Cumulative effects would include noticeable changes in nighttime views from vantage points within the coastal corridor and from within the Arctic Refuge. Views from the nearshore environment within the barrier islands would also be noticeably altered. However, these effects would be localized and noticeable by between several hundred and a few thousand sensitive viewers on an annual basis.

Alternative C may be somewhat more likely than the other action alternatives to lead to new development and additional cumulative effects in the area between Prudhoe Bay and the Arctic Refuge because it would result in a private gravel access road connected to the U.S. highway system, making future access substantially easier for potential developers. To the extent these developments actually occurred and were aided by construction of the road under Alternative C, they would create greater visual impact in the area. In summary, adverse cumulative impacts to visual resources in the Point Thomson area may occur.

5.19.8 Alternatives Comparison and Consequences

Differences between the build alternatives are small. The greatest difference is between presence of the project (any action alternative) and absence of the project (No Action Alternative). For the No Action Alternative, most recreationists or hunters on the Canning River corridor would have little or no awareness of the well covers on the Point Thomson site; however, travelers on the coastal corridor would be aware of them as they passed, even from the barrier islands. Under the No Action Alternative, there would be relatively minor long-term impact over current conditions.

Under all action alternatives, the pads and CPF would be dominant with strong contrast from the coastal corridor. Although removal of the drilling rig from the pads following completion of all wells would reduce the visual contrast, visual contrast would remain due to visibility of the communications tower and flare stack.

Among the action alternatives, the greatest difference is between Alternatives B and E (where the major project features that would be visible from some or all KOPs include facilities on the pads, the export pipeline, and the airport) and Alternatives C and D (where the pads and their facilities are located further inland, but are still visible). Distances farther away or closer would affect visual prominence of the feature. However, unless the feature would not be visible at all, the visual contrast rating typically would not change between alternatives. In another key difference, the pipeline would be more visible from the coast under Alternatives B and E, but it would look identical at any given distance from the pipeline under all alternatives. Under Alternatives C and D, the export pipeline would be routed to the south and would not be as prominent.

The environmental consequences of impacts to the viewshed in the study area include:

- Potential changes in the perception of wilderness qualities and values within the northwestern corner of the Arctic Refuge.
- Potential changes in the experience of visitors to the northwestern corner of the Arctic Refuge.
- Potential changes in the perception and experience of subsistence resource users traveling through or staying in the coastal corridor in summer and winter.

These issues are further addressed in Section 5.14, Arctic National Wildlife Refuge, and Section 5.18, Recreation.

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5.20 NOISE

The key findings for noise are summarized below with a brief summary of the differentiating effects.

Key Impact Findings and Differentiators Among Alternatives

Key Findings:

Alternatives B, C, D, and E: Noise impacts under all build alternatives are probable and would be major to moderate, temporary in duration, and local to extensive during construction. Noise impacts during operations would be probable, and would be major to minor, of medium term duration, and local to extensive during operations.
Alternative A: Moderate, temporary, possible, and extensive impacts.

Differentiators:

- All alternatives are predicted to experience the greatest increase in noise above existing levels at Sea Coast during construction, drilling, and operations.
- No increase in noise over existing levels is predicted at Canning River West Bank for all alternatives.
- Alternatives B and E are predicted to experience a larger increase in noise over existing levels than Alternatives C and D at Brownlow Spit, Flaxman Island, and the Sea Coast during winter construction and drilling and at Mary Sachs Island during summer construction and drilling.
- On a long-term basis, operational noise from Alternative E is distinctly different from the other build alternatives due to the extensive use of helicopters.
- The most dominant noise sources during operations for all alternatives are the CPF and aircraft overflight (fixed-wing and helicopter).
- Modeling of project-related noise levels in the Arctic Refuge generally showed little difference between the alternatives, but would be higher during construction in winter compared to summer. For all alternatives, the increase over existing noise levels in the Arctic Refuge would be less than 10 dBA at a distance of 10 miles from the western border of the Refuge.

This section describes the potential increase in airborne noise levels from construction, drilling, and operations associated with each of the Point Thompson action alternatives during summer (ice-free period) and winter (when the ground and waters are frozen). Spring and fall noise levels are assumed to range between summer and winter levels. For an explanation of the metrics and abbreviations used in measuring noise levels, see Section 3.20, Noise.

The broad coastal plain surrounding the study area is principally undeveloped, but is known to have noise-sensitive human and wildlife uses year-round. Noise emissions associated with construction, drilling, and operations have the potential to affect people and wildlife in the area. These effects are discussed in Section 5.22, Subsistence and Traditional Land Use Patterns, and Section 5.11, Marine Mammals. Existing data on underwater noise levels presented in Section 3.20, Noise, were used to assess effects on marine mammals.

5.20.1 Noise Impact Assessment Criteria

Potential noise impacts were assessed by evaluating project-related noise levels and the increase over ***existing noise conditions*** associated with each action alternative shown in Table 5.20-1.

Table 5.20-1: Impact Criteria: Noise*

Impact Category	Intensity Type	Specific Definition for Noise Intensity
Magnitude	Major	Dominates the soundscape
	Moderate	Occasionally punctuates the soundscape
	Minor	Calculated noise levels are comparable to periods of quietest natural sound (i.e., when no wind occurs)
Duration	Long-term	Irreversible impact on soundscape
	Medium-term	Impact lasts through operational phase of project
	Temporary	Impact lasts only through project construction and/or drilling
Potential to Occur	Probable	No avoidance
	Possible	Potential to occur (may be able to mitigate)
	Unlikely	May occur, but unlikely to occur
Geographic Extent	Extensive	Project area and beyond
	Local	Project footprint
	Limited	Within or adjacent to project components

* Impact categories and intensity types were developed based on CEQ NEPA regulations as described in Section 4.1, Impact Determination Criteria.

5.20.2 Noise Assessment Methodology

Details on equipment and scheduling of construction, drilling, and operations, and associated noise levels were collected from the following:

- The Applicant's description of the proposed action (ExxonMobil 2009a), and the Section 404 (b)(1) Practicability Analysis of Point Thomson Project Preliminary Draft Environmental Impact Statement Alternatives Rev. May 13, 2011 (ExxonMobil 2011a)
- The typical construction, drilling, and operations methods and equipment (Appendix G, North Slope Construction Methods)

- The type and number of mobile vehicles and equipment used in the Applicant's proposed action (Appendix D, RFI 30)
- The logistics and timing of activities associated with the proposed action (Appendix D, RFI 55)
- Estimates of the number and types of equipment that are likely to be used each month (Appendix D, RFI 78)
- The sound power and pressure levels for common construction, drilling and operations, blasting, and other activities (Appendix O, Noise Technical Report)

Sound power levels from pertinent equipment were entered into a noise model (Cadna-A, Computer Aided Noise Abatement, version 4.1.137, DataKustik GmbH) designed for evaluating environmental noise from stationary and mobile sources on land and water. These results were combined with noise levels from project-related use of airplanes and helicopters (FAA 2009c). In this manner, noise from all aspects of the proposed project was included.

Increased noise levels from construction, drilling, and operations during summer and winter conditions were calculated and compared to baseline (measured) conditions in 2010 as presented in Section 3.20, Noise. Baseline conditions include existing median noise levels (measured in 2010) from currently permitted Point Thomson activities and other human-caused noise in the area (expressed as the equivalent noise level or L_{eq}). Noise contours for noise predicted from each action alternative were mapped to show the magnitude and geographic extent of project noise. Noise contour maps are presented in this section for the construction and drilling phase during winter (see Figure 5.20-1 through Figure 5.20-4) because this condition represents the scenario with both the greatest project-related noise emissions and the most favorable propagation conditions. Additional noise contour maps for construction and drilling in summer and operations in summer and winter are shown in Appendix O, Noise Technical Report. The noise contour figures use color shading to depict how project-related noise is expected to travel through the study area. Assumptions used in the modeling were based on average project area conditions listed below in Table 5.20-2.

Table 5.20-2: Assumptions for Noise Modeling

Factor	Winter	Summer
Terrain	Flat	Flat
Ground Absorption[a]	0.40	1.0
Temperature[b]	-8°F	46°F
Humidity[c]	80%	78%
Prevailing Wind Direction[d]	240°	80°
Wind Speed[e]	4.4 m/s	4.4 m/s
Atmospheric Stability Class[d]	E	D

[a] This analysis assumed the ground is covered with snow in winter and covered with moist/wet tundra in summer.

[b] Based on the average temperature in Deadhorse during the months of July and January

[c] Based on the average humidity in Deadhorse during the months of July and January

[d] AEA 2008

[e] Faster wind speeds occur in the project area (AEA 2008), but data collected during high winds (>11 mph) were not useable, and higher winds can mask human-caused noise

5.20.2.1 Construction and Drilling Noise Assessment Methodology

The construction and drilling noise assessment predicted the loudest months' noise level of construction and drilling in both the summer and winter. Information provided by the Applicant was processed to identify the loudest month of construction and drilling activities. This analysis assumed that the sources, duration, and sound pressure levels from construction and drilling activities are the same for each of the alternatives. This conservative assumption is based on the best information available at the time of the analysis and potentially over-estimates the noise impacts. Noise emissions were assigned to each piece of equipment proposed for each construction activity listed below. An overall noise emissions value was then calculated for each month of the multiyear construction and drilling phase.

The construction activities were categorized as follows:

- Sea ice roads
- Gravel and ice roads
- Export pipeline
- Logistics and drilling
- Piling
- Infrastructure
- Facilities and sealift
- Camps
- Engineering, planning, and construction support

Results of these calculations indicate that the loudest summer and winter months of construction and drilling noise would likely be July and February of Year 3 during construction of the proposed action. Therefore, these two months were the basis for the analysis of construction and drilling noise in summer and winter for each action alternative. The construction noise analyses assumed that drilling occurs in the wintertime on the East Pad, while other construction activities occur elsewhere. However, the location of some construction and drilling activities actually differs among the alternatives. In addition, noise from construction and drilling is temporary, and would be lower in some months than is depicted in this assessment.

5.20.2.2 Operations Noise Assessment Methodology

The operational noise assessment evaluated noise emissions associated with the following aspects of the proposed project:

- CPF on the Central Pad
- Aircraft transportation
- Barge transportation
- Roadway transportation
- Road maintenance (summer)
- Snow removal (winter)

The analysis of noise from operations was based on published noise emissions data for mobile noise sources (FHWA 2006), as well as equipment noise data provided by the Applicant. Noise sources during operations include both stationary equipment and mobile sources; the use of some sources varies by season while others are in use year-round.

The primary stationary noise sources included gas or oil-fired turbines, generators, boilers, heaters, and process equipment. The loudest sources are associated with the CPF. To simplify the analysis, the Applicant identified sources associated with the CPF with noise emissions equal to or louder than 80 dBA. Only this subset was included in the noise analysis. These noise sources dominate the noise emissions from the CPF, drowning out lesser noise sources; therefore this screening step was determined to be reasonable.

Mobile noise sources associated with the proposed action include small planes, helicopters, sea barges, passenger vehicles, water trucks, front-end loaders, and other sources. Vehicular traffic was modeled as evenly distributed on all roadways, including both infield gravel roads in the summer season and ice roads during the winter season.

In addition to year-round activities, the assessment of summer noise included only mobile noises sources used during the summer such as sea barges, tug boats and road maintenance activities with motor graders, front-end loaders, backhoes, and water trucks The assessment of winter operational noise included snow removal activities with front end loaders and motor graders.

5.20.3 Alternative A: No Action

The No Action Alternative results in no construction, drilling, or operations in the project area beyond currently-permitted activities (in 2010). Under Alternative A the existing wells at the Central Pad would remain capped and occasional helicopter flights to the site would occur to conduct well monitoring. These infrequent helicopter flights would have an effect on noise levels in the project area, particularly in areas directly in the flight path, however flights to the site would occur no more than four times a year.

5.20.3.1 Alternative A: Impact Evaluation

There are no noise impacts from construction, drilling, or operations under Alternative A because those project activities would not occur. However, monitoring activities at the site would result in a change in noise levels in the project area and beyond. The assessment of impacts for Alternative A are summarized in Table 5.20-3 below.

Table 5.20-3: Alternative A—Impact Evaluation for Noise[a]

Magnitude	Duration	Potential	Extent
Moderate	Temporary	Possible	Extensive

[a] Definitions of the intensity types are shown in Table 5.20-1

5.20.4 Alternative B: Applicant's Proposed Action

Under Alternative B, the Applicant proposes to enlarge the existing Central Pad, construct several additional pads (including the East Pad, West Pad, airstrip, and more), drill additional wells, construct a new pipeline to Badami, and construct and operate the CPF. Noise emissions from these and other activities were assessed in this analysis. Large noise emissions sources under Alternative B include construction activity associated with ice roads and pipelines, aviation and marine transport, power generation at the CPF, and drilling. The turbines used during operations at the CPF would be the largest noise source during operations.

5.20.4.1 Alternative B: Construction and Drilling

Estimated noise levels for Alternative B are shown in Table 5.20-4 and also graphically in Figure 5.20-1. The dominant features shown on the figure are the noise contours from the airplane and helicopter flight path, noise from barge and other water-based activities (in summer), drilling (in winter), and noise from activities closer to the proposed pads including the Central Pad.

Noise in the project area may increase from 0 to 21 dBA depending on existing conditions and distance from the noise sources (Table 5.20-4). Construction and drilling noise may be audible in nearby areas (up to 8 miles away), represented by Brownlow Spit, Mary Sachs Island, Sea Coast, and Flaxman Island monitoring locations. The largest anticipated increase in noise would be measured at the Sea Coast monitoring location, about 2.5 miles northeast of the Central Pad. This increase of 21 dBA would be perceived as more than a doubling of loudness.

The potential for an increase in noise in the project area varies by season and activity. Existing background noise levels in summer are generally louder than during winter due to the influence of running water and increased wildlife activity. As a result, project-related noise would be less likely to increase noise levels above existing background noise during summer. The acoustic absorption properties of the tundra also vary by season. In summer, the tundra is soft and acoustically absorptive, which would gradually reduce noise levels as sound pressure waves travel away from their noise source. In winter, however, denser (colder) air and nonabsorptive ground cover may contribute to increased sound propagation. This analysis conservatively assumes that drilling would occur on the East Pad during February of Year 3 based on the winter construction scenario modeled in the analysis of all action alternatives. This results in louder noise levels in winter than in summer. Noise from tug boat use would dominate summer noise levels at locations close to the shore, like the Sea Coast monitoring location. Intermittent events such as blasting may create increases in measured noise levels and may be audible on short-term basis.

Areas further away from construction and drilling activities, represented by the Canning River West Bank and Coastal Plain monitoring locations (19 to 20 miles south), would experience a 0 to 2 dBA increase over existing conditions during winter (Table 5.20-4). Increases of up to 2 dBA are generally considered to be below the threshold of human perception, although a change in the spectral distribution (changes in the tonality of perceived sound) may result in audible tones or low frequency hums during periods of low or no winds. As a result of increased existing background noise during the summer, estimates of project-related noise levels do not indicate an increase above the existing noise level in summer (Table 5.20-4) at locations not adjacent to the project footprint (i.e. Brownlow Spit, Canning River West Bank, Coastal Plain).

Table 5.20-4: Alternative B—Increases in Noise above Existing Levels due to Construction and Drilling				
Monitoring Location	Existing Noise Level, Leq dBA	Construction Drilling Noise Level, Leq dBA[e]	Existing + Construction + Drilling Noise Level, Leq dBA	Increase Over Existing, dBA[f]
Winter				
Brownlow Spit	35	38	40	5
Canning River West Bank	48	29	48	0
Coastal Plain	32	29	34	2
Mary Sachs Island	37	39	41	4
Sea Coast	35[a]	56	56	21
Flaxman Island	37[b]	40	42	5
Summer				
Brownlow Spit	43[c]	19	43	0
Canning River West Bank	51	6	51	0
Coastal Plain	31	7	31	0
Mary Sachs Island	44[d]	45	48	4
Sea Coast	43	46	48	5
Flaxman Island	44	26	44	0

[a] The Sea Coast monitoring location (2.8 miles east of the Central Pad) was not used during initial data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Brownlow Spit (8.3 miles east of the Central Pad).

[b] The Flaxman Island monitoring location (6.3 miles northeast of the Central Pad) was not used during the winter monitoring season, so the existing noise levels were estimated based on a representative noise monitoring location, Mary Sachs Island (1.7 mi northeast of the Central Pad).

[c] The Brownlow Spit monitoring location (8.3 miles east of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Sea Coast (2.8 miles east of the Central Pad).

[d] The Mary Sachs Island monitoring location (1.7 mi northeast of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Flaxman Island (6.3 miles northeast of the Central Pad).

[e] The levels in this column, for winter, are mapped on Figure 5.20-1.

[f] The magnitude of impact for this alternative was based on the predicted increases in this column.

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POINT THOMSON PROJECT EIS

Legend

- Arctic National Wildlife Refuge
- Upland
- Existing Pipeline

Proposed Layout - Noise Contour Data

- Noise Receptors
- Contours (5 dBA)
- Alternative B Features

Noise Contours (dBA)

0-5	25-30	50-55	75-80
5-10	30-35	55-60	80-85
10-15	35-40	60-65	85-90
15-20	40-45	65-70	90-95
20-25	45-50	70-75	95-100

The data displayed is concept level and has not been engineered.

N

0 2 4 Miles

Figure 5.20-1

Alternative B - Construction Winter Noise Contours

Date: 24 October 2011
Map Author: HDR Alaska Inc.
Source: See References chapter for map source information

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5.20.4.2 Alternative B: Operations

Noise modeling results for Alternative B operations are expressed in Table 5.20-5, and also graphically in Appendix O, Noise Technical Report. Airplane and helicopter flights, barge and other water-based activities (in summer), and activities closer to the proposed pads, including the Central Pad, are the dominant noise sources during operations in Alternative B.

As indicated in Table 5.20-5, noise from operations is predicted to increase from 0 to 4 dBA above the existing noise in the project area depending on existing conditions and distance from the noise sources. The largest increase in noise above existing noise levels (4 dBA) is predicted to occur at Sea Coast, about 2.5 miles away. Generally a 3 dBA increase is considered barely noticeable to the human ear, although this does not account for a change in the spectral distribution of the noise. Therefore, this increase may occasionally result in audible tones or low-frequency hums. Calculated noise levels from the proposed operations are lower than 2010 existing average ambient noise levels in more distant portions of the project area represented by monitoring locations at Brownlow Spit, the west bank of the Canning River, the Coastal Plain, and Flaxman Island (Table 5.20-5).

Table 5.20-5: Alternative B – Increases in Noise above Existing Levels due to Operations

Monitoring location	Existing Noise Level, Leq dBA	Operations Noise Level, Leq dBA	Existing + Operations Noise Level, Leq dBA	Increase Over Existing, dBA[e]
Winter				
Brownlow Spit	35	15	35	0
Canning River West Bank	48	6	48	0
Coastal Plain	32	13	32	0
Mary Sachs Island	37	31	38	1
Sea Coast	35[a]	36	39	4
Flaxman Island	37[b]	18	37	0
Summer				
Brownlow Spit	43[c]	14	43	0
Canning River West Bank	51	8	51	0
Coastal Plain	31	9	31	0
Mary Sachs Island	44[d]	33	44	0
Sea Coast	43	37	44	1
Flaxman Island	44	18	44	0

[a] The Sea Coast monitoring location (2.8 miles east of the Central Pad) was not used during initial data collection in 2010, so the existing noise levels were estimated based on a representative monitoring location, Brownlow Spit (8.3 miles E of the Central Pad).

[b] The Flaxman Island monitoring location (6.3 miles northeast of the Central Pad) was not used during the winter monitoring season, so the existing noise levels were estimated based on a representative noise monitoring location, Mary Sachs Island (1.7 miles northeast of the Central Pad).

[c] The Brownlow Spit monitoring location (8.3 miles east of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Sea Coast (2.8 miles east of the Central Pad).

[d] The Mary Sachs Island monitoring location (1.7 miles northeast of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Flaxman Island (6.3 miles northeast of the Central Pad).

[e] The levels in this column are shown graphically in Appendix O, Noise Technical Report.

The dominant sources of noise from operations vary depending on season, proximity to the Central Pad, and the presence of other noise. The most common dominant noise sources are the CPF (primarily the turbines) and aircraft overflight (Table 5.20-6); this is true for all action alternatives. Other activities that may seasonally create elevated noise levels include road maintenance and snow removal activities at the East Pad.

Noise from the CPF and roadway transportation would occur more frequently or continuously during operations. Activities such as aircraft overflight, road maintenance, and snow removal would be intermittent and would dominate the near-field soundscape when in operation. Other intermittent noise sources not included in the operations noise assessment are public address (PA) announcements and vehicle backup beepers. These activities would occur occasionally during operations and would increase noise in the immediate vicinity (within 0.5 miles) of the Central Pad. Based on a review of the audio recorded during winter 2010, PA announcements from the Central Pad were audible at Flaxman Island. The fact that a sound is audible does not mean it always increases the nominal noise level (see Section 3.20, Noise). Also, audibility is very difficult to predict over distances as large as the project area.

Table 5.20-6: Alternative B—Dominant Noise Sources from Operations

Monitoring location	CPF	Aircraft Overflight	Roadway Transportation	Road Maintenance Activities	Snow Removal Activities
Winter[a]					
Brownlow Spit	X	X	—	—	—
Canning River West Bank	—	X	X	—	X
Coastal Plain	X	X	X	—	X
Mary Sachs Island	X	X	—	—	—
Sea Coast	X	X	—	—	—
Flaxman Island	X	X	—	—	—
Summer					
Brownlow Spit	X	X	—	—	—
Canning River West Bank	X	X	—	—	—
Coastal Plain	X	X	—	—	—
Mary Sachs Island	X	X	—	X	—
Sea Coast	—	X	—	X	—
Flaxman Island	X	X	—	X	—

[a] Data used to represent winter noise conditions were collected from late April to early June. Temperatures remained cold during this period and snow cover was 100%. The assumptions used to represent both winter and summer seasonal conditions are presented in Appendix O, Table 4.

Based on monitoring data, noise from operations during winter and summer may be audible from 2 to 3 miles from the Central Pad, particularly when winds are below 11 mph. Visitors to the western-most portions of the Arctic Refuge may experience project-related noise when winds are very still. When winds are not still, wind-induced noise may potentially mask project-related noise. This is particularly true of winds above 11 mph from any direction. As discussed in Section 5.20.4.1, Construction, the acoustically absorptive tundra may also help reduce project-related noise levels at locations inside the Arctic Refuge during the summer. In winter, however, denser (colder) air and nonabsorptive ground cover may contribute to sound propagation. Audibility is very hard to predict, and in some cases, winds from the west may transport noise farther eastward than would otherwise occur. It is very difficult to estimate where, or the extent to which project-related noise would be audible under various wind speeds and directions. However it is likely that project-related noise would be lower in the eastern portions of the study area when the winds blow from the east.

5.20.4.3 Alternative B: Impact Evaluation

Table 5.20-7 provides the impact evaluation for noise under Alternative B. Noise from construction and drilling is predicted to dominate the ambient landscape in the immediate vicinity (within 0.5 miles) of the noise sources, having a major magnitude, but would only occasionally punctuate the ambient soundscape at places like Mary Sachs Island and beyond (more than 3 miles) due to aviation activities and shipping, having a moderate magnitude (Figure 5.20-1). The construction and drilling noise effects would be temporary, with probable potential to occur. The geographic extent of those effects would be local, however, noise from aviation and tug boat use would have a greater geographic extent. While the magnitude of construction noise impacts is considered major, such noise would be reduced when drilling is complete, and its overall duration is temporary.

Noise from operations is predicted to dominate the soundscape near the noise sources (within 0.5 miles), but would only occasionally punctuate the soundscape at places like Mary Sachs Island and beyond (more than 3 miles away). These noise impacts could potentially occur over a geographic range that extends beyond the project area (due to aviation routes extending farther west than Badami), but have only a medium-term duration (for the life of the project). (Table 5.20-1 and Table 5.20-7)

Table 5.20-7: Alternative B—Impact Evaluation for Noise

Phase	Magnitude	Duration	Potential	Extent
Construction and Drilling activities on land	Major	Temporary	Probable	Local
Aviation to support construction and drilling	Moderate	Temporary	Probable	Extensive
Sea-based shipping to support construction and drilling	Moderate	Temporary	Probable	Extensive
Operational activities on land	Major	Medium term	Probable	Local
Aviation to support operations	Minor	Temporary	Probable	Extensive
Sea-based shipping to support operations	Minor	Temporary	Probable	Extensive

5.20.5 Alternative C: Inland Pads with Gravel Access Road

The intent of Alternative C is to minimize impacts to coastal resources such as marine mammals, marine fish, subsistence activities, and coastal processes, and to avoid potential impacts from coastal erosion. To minimize impacts, this alternative would move project components inland and as far away from the coast as practicable and feasible. To provide year-round access to Point Thomson, this alternative would also include the construction of approximately 46 miles of gravel access road from Point Thomson to Endicott Spur Road. Alternative C would not include barging or associated facilities for sea access to Point Thomson. Noise emissions from these and other activities were assessed in this analysis. Large noise emissions sources under Alternative C include construction activity associated with ice roads and pipelines, gravel road construction, aviation transport, power generation at the CPF, and drilling. The turbines used during operations at the CPF would be the largest noise source during operations.

5.20.5.1 Alternative C: Construction and Drilling

Estimated noise levels from Alternative C are shown in Table 5.20-8, and also graphically in Figure 5.20-2. The dominant features shown on the figure are the noise contours from airplane and helicopter flight paths, drilling (during winter construction), and noise from activities closer to the proposed pads, including the Central Pad.

Noise from construction and drilling in Alternative C is predicted to increase noise levels from 0 to 12 dBA, depending on existing conditions and distance from the noise sources (Table 5.20-8). Noise from construction and drilling is predicted to noticeably increase during winter (up to 3 dBA) in areas close to the construction and drilling sites (within 4 to 8 miles). These areas are represented by the Brownlow Spit, Mary Sachs Island, Sea Coast, and Flaxman Island monitoring locations. The largest anticipated increase in noise (12 dBA) is shown for the Sea Coast monitoring location during winter (Table 5.20-8). This could be perceived as a clearly noticeable increase in noise level.

Areas further from construction and drilling, represented by the Canning River West Bank and Coastal Plain monitoring locations (more than 19 miles away) , would experience a minimal increase over existing conditions. Existing background noise levels during the summer are generally louder than in winter due to the influence of running water and increased wildlife activity. As a result, estimates of project-related noise levels do not indicate an increase above the existing noise level during summer (Table 5.20-8) at locations not adjacent to the project footprint (i.e. Brownlow Spit, Canning River West Bank, Coastal Plain). Increases of 0 to 2 dBA are below the threshold of human perception, although a change in the spectral distribution (changes in the tonality of perceived sound) may result in audible tones or low frequency hums. Intermittent events such as blasting may create increased noise levels and may be audible on a short-term basis, particularly in areas closest to the blasting site.

Table 5.20-8: Alternative C – Increases in Noise above Existing Levels due to Construction and Drilling

Monitoring Location	Existing Noise Level, Leq dBA	Construction + Drilling Noise Level, Leq dBA[e]	Existing + Construction + Drilling Noise Level, Leq dBA	Increase Over Existing, dBA[f]
Winter				
Brownlow Spit	35	37	39	4
Canning River West Bank	48	29	48	0
Coastal Plain	32	29	34	2
Mary Sachs Island	37	38	41	4
Sea Coast	35[a]	47	47	12
Flaxman Island	37[b]	39	41	4
Summer				
Brownlow Spit	43[c]	16	43	0
Canning River West Bank	51	6	51	0
Coastal Plain	31	7	31	0
Mary Sachs Island	44[d]	43	47	3
Sea Coast	43	48	49	6
Flaxman Island	44	24	44	0

[a] The Sea Coast monitoring location (2.8 miles E of the Central Pad) was not used during initial data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Brownlow Spit (8.3 miles E of the Central Pad).

[b] The Flaxman Island monitoring location (6.3 miles NE of the Central Pad) was not used during the winter monitoring season, so the existing noise levels were estimated based on a representative noise monitoring location, Mary Sachs Island (1.7 mi NE of the Central Pad).

[c] The Brownlow Spit monitoring location (8.3 miles E of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Sea Coast (2.8 miles E of the Central Pad).

[d] The Mary Sachs Island monitoring location (1.7 mi NE of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Flaxman Island (6.3 miles NE of the Central Pad).

[e] The levels in this column, for winter, are mapped on Figure 5.20-2.

[f] The magnitude of impact for this alternative was based on the predicted increases in this column.

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POINT THOMSON PROJECT EIS

Legend

- Arctic National Wildlife Refuge
- Upland
- Existing Pipeline

Proposed Layout - Noise Contour Data

- Noise Receptors
- Contours (5 dBA)
- Alternative C Features

Noise Contours (dBA)

0-5, 5-10, 10-15, 15-20, 20-25, 25-30, 30-35, 35-40, 40-45, 45-50, 50-55, 55-60, 60-65, 65-70, 70-75, 75-80, 80-85, 85-90, 90-95, 95-100

The data displayed is concept level and has not been engineered.

0 2 4 Miles

Figure 5.20-2

Alternative C - Construction Winter Noise Contours

Date: 24 October 2011
Map Author: HDR Alaska Inc.
Source: See References chapter for map source information

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5.20.5.2 Alternative C: Operations

Operational noise modeling results for Alternative C are shown in Table 5.20-9 and also graphically in Appendix O, Noise Technical Report. Airplane and helicopter flights, snow removal (during winter), and activities closer to the proposed pads, including the Central Pad, are the dominant noise sources from Alternative C.

In winter, noise from Alternative C operations in areas close to the CPF (less than 4 miles) is predicted to increase up to 2 dBA, represented by the Sea Coast monitoring location (Table 5.20-9). Generally a 1-dBA increase would not be considered noticeable to the human ear, although a change in the spectral distribution may result in audible tones or low frequency hums. Noise from operations is not predicted to increase above existing noise levels in areas more than 19 miles away, represented by the Coastal Plain and Canning River West Bank monitoring locations (Table 5.20-9). Noise from operations is not predicted to increase above existing levels at any site during summer, due to elevated existing noise levels.

Table 5.20-9: Alternative C– Increases in Noise above Existing Levels due to Operations

Monitoring location	Existing Noise Level, Leq dBA	Operations Noise Level, Leq dBA[e]	Existing + Operations Noise Level, Leq dBA	Increase Over Existing Leq, dBA
Winter				
Brownlow Spit	35	13	35	0
Canning River West Bank	48	7	48	0
Coastal Plain	32	8	32	0
Mary Sachs Island	37	22	37	0
Sea Coast	35[a]	33	37	2
Flaxman Island	37[b]	13	37	0
Summer				
Brownlow Spit	43[c]	12	43	0
Canning River West Bank	51	9	51	0
Coastal Plain	31	10	31	0
Mary Sachs Island	44[d]	21	44	0
Sea Coast	43	30	43	0
Flaxman Island	44	13	44	0

[a] The Sea Coast monitoring location (2.8 miles E of the Central Pad) was not used during initial data collection in 2010, so the existing noise levels were estimated based on a representative monitoring location, Brownlow Spit (8.3 miles E of the Central Pad).

[b] The Flaxman Island monitoring location (6.3 miles NE of the Central Pad) was not used during the winter monitoring season, so the existing noise levels were estimated based on a representative noise monitoring location, Mary Sachs Island (1.7 miles NE of the Central Pad).

[c] The Brownlow Spit monitoring location (8.3 miles E of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Sea Coast (2.8 miles E of the Central Pad).

[d] The Mary Sachs Island monitoring location (1.7 mi NE of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Flaxman Island (6.3 miles NE of the Central Pad).

[e] The levels in this column are shown graphically in Appendix O, Noise Technical Report.

The dominant sources of noise from operations vary depending on season, proximity to the Central Pad, and the presence of other noise. The most common dominant sources at each representative monitoring location would be the CPF (primarily turbines) and aircraft overflight (Table 5.20-10). Other activities that would create seasonally elevated noise levels include road maintenance and snow removal (Table 5.20-10).

Table 5.20-10: Alternative C – Dominant Noise Sources From Operations

Monitoring Location	CPF	Aircraft Overflight	Roadway Transportation	Road Maintenance Activities	Snow Removal Activities
Winter[a]					
Brownlow Spit	X	X	X	—	—
Canning River West Bank	—	X	X	—	X
Coastal Plain	—	X	X	—	X
Mary Sachs Island	X	X	—	—	—
Sea Coast	—	—	X	—	X
Flaxman Island	X	X	—	—	—
Summer					
Brownlow Spit	X	X	—	—	—
Canning River West Bank	X	X	—	X	—
Coastal Plain	X	X	—	—	—
Mary Sachs Island	X	X	X	X	—
Sea Coast	—	X	X	X	—
Flaxman Island	X	X	X	—	—

[a] Data used to represent winter noise conditions were collected from late April to early June. Temperatures remained cold during this period and snow cover was 100%. The assumptions used to represent both winter and summer seasonal conditions are presented in Appendix O, Table 4.

Noise from the CPF and roadway transportation would occur more frequently or continuously during operations than during construction. Activities such as aircraft overflight, road maintenance, and snow removal activities would be intermittent but would dominate the soundscape when in operation. Other intermittent noise sources not included in the operations noise assessment include PA announcements and vehicle backup beepers. These activities would occur occasionally during operations and would increase noise in the immediate vicinity (within 0.5 miles) of the Central Pad. Based on a review of the audio recorded during winter 2010, PA announcements from the Central Pad were audible at Flaxman Island.

Analysis results indicate that operational noise associated with Alternative C is expected to be slightly less than operational noise from Alternative B at the monitoring sites closest to the Central Pad. Visitors to the western-most portions of the Arctic Refuge may experience project-related noise when winds are very still. When winds are not still, there is potential that wind-induced noise may mask project-related noise. This is particularly true of winds above 11 mph from any direction. In summer, the acoustically absorptive tundra may also help reduce project-related noise levels at locations inside the Arctic Refuge. In winter, however, denser (colder) air and nonabsorptive ground cover may contribute to sound propagation. Audibility is very hard to predict, and in some cases winds from the west may transport noise farther eastward than would otherwise occur. It is very difficult to estimate where, or the extent to which project-related noise would be audible under various wind speeds and directions. However it is likely that project-related noise would be lower in the eastern portions of the study area when the winds blow from the east.

5.20.5.3 Alternative C: Impact Evaluation

Table 5.20-11 provides the impact evaluation for noise under Alternative C. Noise from construction and drilling is predicted to dominate the ambient landscape in the immediate vicinity (within 0.5 miles) of the noise sources, having a major magnitude. Project-related noise would only occasionally punctuate the ambient soundscape at locations farther away (more than 3 miles) including distant areas like the Canning River West Bank and Coastal Plain monitoring locations (19 to 20 miles south) due to aviation activities and shipping,, having a moderate magnitude. The construction and drilling noise effects would be temporary, with probable potential to occur. The geographic extent of those effects is local, however, noise from aviation would have an extensive geographic extent. While the magnitude of construction noise impacts is considered major, such noise would be reduced when drilling is complete, and its overall duration is temporary. (Table 5.20-1 and Table 5.20-11)

Noise from operations is predicted to dominate the ambient soundscape near the noise sources (within 0.5 miles), but would only occasionally punctuate the ambient soundscape at places like Mary Sachs Island and beyond (more than 3 miles away). These noise effects have a probable potential to occur over a geographic range that extends beyond the project area (due to aviation routes extending farther west than Badami), but have only a medium-term duration (for the life of the project). (Table 5.20-1 and Table 5.20-11)

Table 5.20-11: Alternative C—Impact Evaluation for Noise[a]

Phase	Magnitude	Duration	Potential	Extent
Construction and Drilling activities on land	Major	Temporary	Probable	Local
Aviation to support construction and drilling	Moderate	Temporary	Probable	Extensive
Sea-based shipping to support construction and drilling	Moderate	Temporary	Probable	Extensive
Operational activities on land	Major	Medium term	Probable	Local
Aviation to support operations	Minor	Medium term	Probable	Extensive
Sea-based shipping to support operations	Minor	Medium term	Probable	Extensive

[a] All four categories must have the highest intensity type in order for the noise impact to be considered significant. Definitions of the intensity types are shown in Table 5.20-1.

5.20.6 Alternative D: Inland Pads with Seasonal Ice Access Road

The intent of Alternative D is to minimize impacts to coastal resources such as marine mammals, marine fish, subsistence activities, and coastal processes, and to reduce potential impacts to the proposed project from coastal erosion. To minimize impacts, project components would be located further inland and as far away from the coast as is practicable and feasible. This alternative is characterized by access to and from Point Thomson occurring primarily via an inland seasonal ice road running east from the Endicott Spur Road to the northern end of the Point Thomson Project area.

Alternative D is similar to Alternative C; however, it differs by proposing a seasonal ice access road as opposed to the inland 45-mile gravel access road in Alternative C. Noise emissions from the proposed activities were assessed in this analysis. Large noise emissions sources under Alternative D include construction activity associated with ice roads and pipelines, aviation transport, power generation at the CPF, and drilling. The turbines used during operations at the CPF are the largest noise source during operations.

5.20.6.1 Alternative D: Construction and Drilling

Noise modeling results for Alternative D are expressed in Table 5.20-12 and also graphically in Figure 5.20-3. The dominant features shown on the figure are the noise contours from airplane and helicopter flight paths, drilling (during winter construction), and noise from activities closer to the proposed pads, including the Central Pad.

Noise in the project area would increase from 0 to 18 dBA depending on existing conditions and distance from construction and drilling (Table 5.20-12). Construction and drilling noise could be noticeable in nearby areas (3 to 8 miles away from the CPF), represented by the Brownlow Spit, Mary Sachs Island, Sea Coast and Flaxman Island monitoring locations (Table 5.20-12). The largest anticipated increase (18 dBA) in noise would occur at the Sea Coast monitoring location during the winter (Table 5.20-12), and would be perceived as a doubling of loudness over existing conditions. This predicted noise level would be similar to that in a typical office (Chapter 3, Table 3.20-1).

Areas further away from construction and drilling areas, represented by the Canning River West Bank and Coastal Plain monitoring locations (19 miles from the Central Pad), would experience no increase, or a minimal increase, over existing conditions (Table 5.20-12). Existing background noise levels during summer are generally louder than in winter due to the influence of running water and increased wildlife activity. As a result, estimates of future project-related noise levels do not indicate an increase above the existing noise level during summer (Table 5.20-12) at locations not adjacent to the project footprint (i.e. Brownlow Spit, Canning River West Bank, Coastal Plain). Increases of less than 3 dBA are below the threshold of human perception, although a change in the spectral distribution (changes in the tonality of perceived sound) may result in audible tones or low frequency hums. However, intermittent events such as blasting could create elevated noise levels that are audible on short-term basis.

Table 5.20-12: Alternative D—Increases in Noise above Existing Levels due to Construction and Drilling

Monitoring Location	Existing Noise Level, Leq dBA	Construction Drilling Noise Level, Leq dBA[e]	Existing Construction Drilling Noise Level, Leq dBA	Increase Over Existing, dBA[f]
Winter				
Brownlow Spit	35	37	39	4
Canning River West Bank	48	29	48	0
Coastal Plain	32	29	34	2
Mary Sachs Island	37	37	40	3
Sea Coast	35[a]	53	53	18
Flaxman Island	37[b]	39	41	4
Summer				
Brownlow Spit	43[c]	16	43	0
Canning River West Bank	51	6	51	0
Coastal Plain	31	7	31	0
Mary Sachs Island	44[d]	43	47	3
Sea Coast	43	48	49	6
Flaxman Island	44	24	44	0

[a] The Sea Coast monitoring location (2.8 miles E of the Central Pad) was not used during initial data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Brownlow Spit (8.3 miles E of the Central Pad).

[b] The Flaxman Island monitoring location (6.3 miles NE of the Central Pad) was not used during the winter monitoring season, so the existing noise levels were estimated based on a representative noise monitoring location, Mary Sachs Island (1.7 mi NE of the Central Pad).

[c] The Brownlow Spit monitoring location (8.3 miles E of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Sea Coast (2.8 miles E of the Central Pad).

[d] The Mary Sachs Island monitoring location (1.7 mi NE of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Flaxman Island (6.3 miles NE of the Central Pad).

[e] The levels in this column are mapped, for winter, on Figure 5.20-3.

[f] The magnitude of impact for this alternative was based on the predicted increases in this column.

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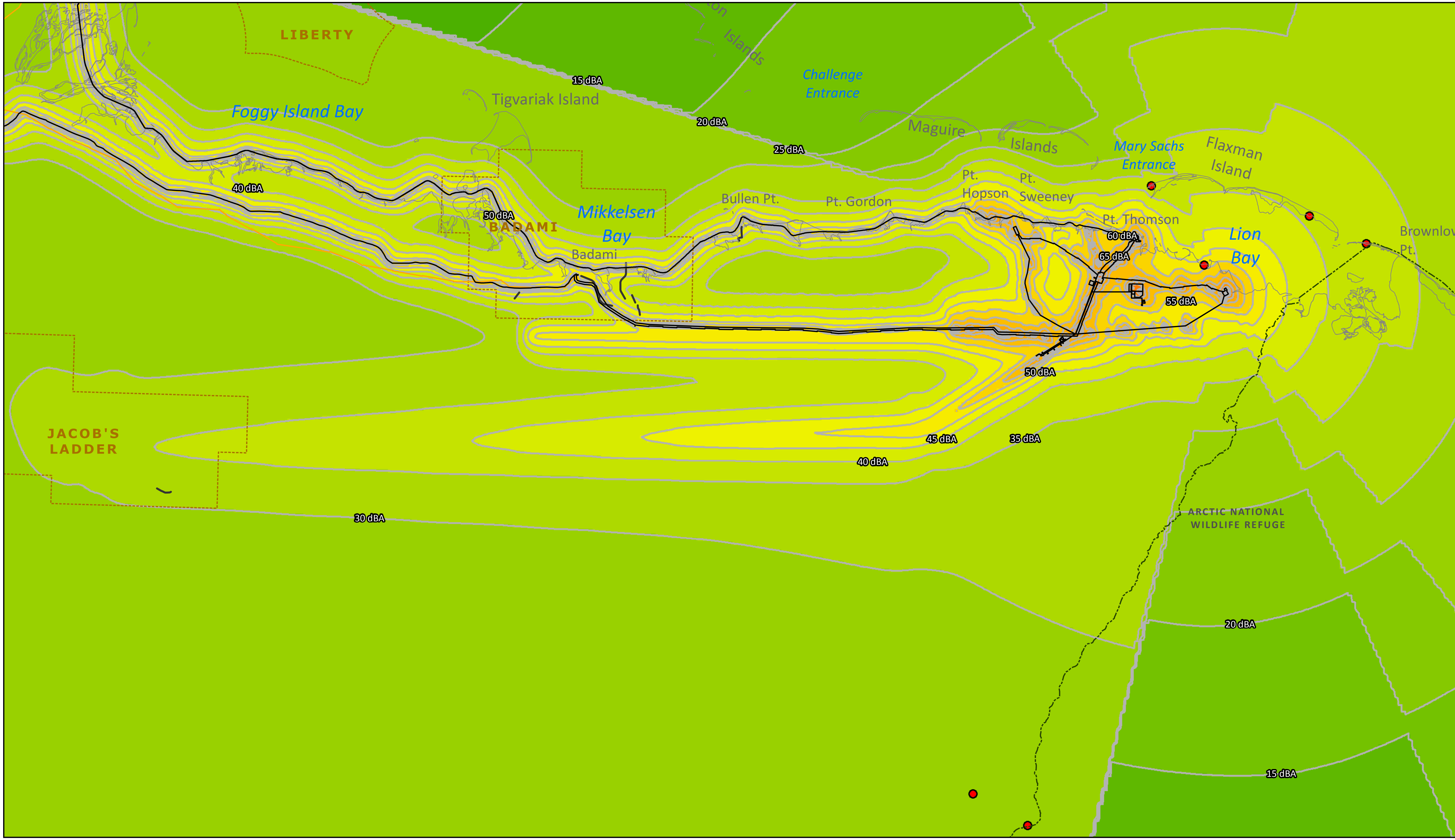

POINT THOMSON PROJECT EIS

Legend

- Arctic National Wildlife Refuge
- Upland
- Existing Pipeline

Proposed Layout - Noise Contour Data

- Noise Receptors
- Contours (5 dBA)
- Alternative D Features

Noise Contours (dBA)

0-5	25-30	50-55	75-80
5-10	30-35	55-60	80-85
10-15	35-40	60-65	85-90
15-20	40-45	65-70	90-95
20-25	45-50	70-75	95-100

The data displayed is concept level and has not been engineered.

N

0 2 4 Miles

Figure 5.20-3

Alternative D - Construction Winter Noise Contours

Date:24 October 2011
Map Author: HDR Alaska Inc.
Source: See References chapter for map source information

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5.20.6.2 Alternative D: Operations

Operational noise modeling results for Alternative D are expressed in Table 5.20-13 and also graphically in Appendix O, Noise Technical Report. Airplane and helicopter flights, snow removal (during winter), and noise from activities closer to the proposed pads, including the Central Pad, are the dominant noise sources from Alternative D.

Noise from operations in areas close to the CPF (within 4 miles), represented by the Sea Coast monitoring location, is predicted to increase between 0 and 3 dBA (Table 5.20-13) under this alternative. Generally a 3-dBA increase is considered barely noticeable to the human ear. However, a change in the spectral distribution of noise may result in audible tones or low-frequency hums. Noise from operations in more distant portions of the project area, represented by the other monitoring locations, would not be audible above existing noise levels (Table 5.20-13).

Table 5.20-13: Alternative D– Increases in Noise Levels above Existing Levels due to Operations

Monitoring location	Existing Noise Level, Leq dBA	Operations Noise Level, Leq dBA[e]	Existing + Operations Noise Level, Leq dBA	Increase Over Existing, dBA[f]
Winter				
Brownlow Spit	35	13	35	0
Canning River West Bank	48	6	48	0
Coastal Plain	32	7	32	0
Mary Sachs Island	37	23	37	0
Sea Coast	35[a]	34	38	3
Flaxman Island	37[b]	14	37	0
Summer				
Brownlow Spit	43[c]	12	43	0
Canning River West Bank	51	9	51	0
Coastal Plain	31	10	31	0
Mary Sachs Island	44[d]	23	44	0
Sea Coast	43	31	43	0
Flaxman Island	44	14	44	0

[a] The Sea Coast monitoring location (2.8 miles E of the Central Pad) was not used during initial data collection in 2010, so the existing noise levels were estimated based on a representative monitoring location, Brownlow Spit (8.3 miles E of the Central Pad).

[b] The Flaxman Island monitoring location (6.3 miles NE of the Central Pad) was not used during the winter monitoring season, so the existing noise levels were estimated based on a representative noise monitoring location, Mary Sachs Island (1.7 miles NE of the Central Pad).

[c] The Brownlow Spit monitoring location (8.3 miles E of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Sea Coast (2.8 miles E of the Central Pad).

[d] The Mary Sachs Island monitoring location (1.7 mi NE of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Flaxman Island (6.3 miles NE of the Central Pad).

[e] The levels in this column are shown graphically in Appendix O, Noise Technical Report. .

[f] The magnitude of impact for this alternative was based on the predicted increases in this column.

The dominant sources of noise from operations vary depending on season, proximity to the Central Pad, and the presence of other noise. The most common dominant sources at each representative monitoring location would be the CPF (primarily turbines) and aircraft overflight (Table 5.20-14). Other activities that may create seasonally elevated noise levels include road maintenance and snow removal.

Noise from the CPF and roadway transportation would occur more frequently or continuously during operations. Activities such as aircraft overflight, road maintenance, and snow removal would be intermittent and would dominate the soundscape when in operation. Other intermittent noise sources not included in the operations noise assessment include PA announcements and vehicle-backup beepers. These activities would occur occasionally during operations and would increase noise in the immediate vicinity (within 0.5 miles) of the Central Pad.

Table 5.20-14: Alternative D – Dominant Noise Sources from Operations

Monitoring location	CPF	Aircraft Overflight	Roadway Transportation	Road Maintenance Activities	Snow Removal Activities
Winter[a]					
Brownlow Spit	X	X	X	—	—
Canning River West Bank	—	X	X	—	X
Coastal Plain	—	X	X	—	X
Mary Sachs Island	X	X	—	—	—
Sea Coast	—	X	X	—	X
Flaxman Island	X	X	—	—	—
Summer					
Brownlow Spit	X	X	—	—	—
Canning River West Bank	X	X	—	X	—
Coastal Plain	X	X	—	—	—
Mary Sachs Island	X	X	X	—	—
Sea Coast	—	X	X	X	—
Flaxman Island	X	X	X	—	—

[a] Data used to represent winter noise conditions were collected from late April to early June. Temperatures remained cold during this period and snow cover was 100%. The assumptions used to represent both winter and summer seasonal conditions are presented in Appendix O, Table 4.

Analysis results indicate that operational noise associated with Alternative D is expected to be slightly more than operational noise from Alternative C but less than Alternative B at the Sea Coast monitoring sites. The increase may be measurable/modeled, but it is unlikely to be perceivable. At other noise monitoring locations, estimates of operational noise are the same or less than under Alternatives B and C.

Visitors to the western-most portions of Arctic Refuge may experience project-related noise when winds are very still. When winds are not still, there is potential that wind-induced noise may mask project-related noise; this is particularly true of winds above 11 mph from any direction. In summer, the acoustically absorptive tundra may help reduce project-related noise levels at locations inside the Refuge. In winter, denser (colder) air and nonabsorptive ground cover may contribute to sound propagation. However, audibility is very hard to predict. In some cases winds from the west may transport noise farther eastward than would otherwise occur. It is very difficult to estimate where, or the extent to which project-related noise would be audible under various wind speeds and directions. However it is likely that project-related noise would be lower in the eastern portions of the study area when the winds blow from the east.

5.20.6.3 Alternative D: Impact Evaluation

Table 5.20-15 provides the impact evaluation for noise under Alternative D. Noise from construction and drilling is predicted to dominate the ambient landscape in the immediate vicinity (within 0.5 miles) of the noise sources, having a major magnitude impact. Noise would only occasionally punctuate the ambient soundscape at locations farther away (more than 3 miles) including distant areas like the Canning River West Bank and Coastal Plain monitoring locations (19 to 20 miles south) due to aviation activities and shipping, having a moderate magnitude impact. The construction and drilling noise impacts would have a temporary duration with probable potential to occur. The geographic extent of those effects is local, however, noise from aviation would have a greater geographic extent. While the magnitude of construction noise impacts is considered major, the magnitude reduces when drilling is complete, and its overall duration is temporary (Table 5.20-15).

Noise from operations is predicted to dominate the ambient soundscape in the immediate vicinity of the noise sources (0.5 miles away), but would only occasionally punctuate the ambient soundscape at places like Mary Sachs Island and beyond (more than 3 miles from Central Pad). These noise impacts have a probable potential to occur over a geographic range that extends beyond the project area (due to aviation routes extending farther west than Badami), but have only a medium-term duration (for the life of the project) (Table 5.20-1 and Table 5.20-15).

Table 5.20-15: Alternative D—Impact Evaluation for Noise[a]

Phase	Magnitude	Duration	Potential	Extent
Construction and Drilling activities on land	Major	Temporary	Probable	Local
Aviation to support construction and drilling	Moderate	Temporary	Probable	Extensive
Sea-based shipping to support construction and drilling	Moderate	Temporary	Probable	Extensive
Operational activities on land	Major	Medium term	Probable	Local
Aviation to support operations	Minor	Medium term	Probable	Extensive
Sea-based shipping to support operations	Minor	Medium term	Probable	Extensive

[a] All four categories must have the highest intensity type in order for the noise impact to be considered significant. Definitions of the intensity types are shown in Table 5.20-1

5.20.7 Alternative E: Coastal Pads with Seasonal Ice Roads

The intent of Alternative E is to minimize the development footprint in order to reduce impacts to wetlands and surrounding water resources. This alternative would reduce the amount of gravel fill needed for some of the project components. In particular, the footprints of the East and West Pads would be a combination of ice and gravel (multiyear, multiseason ice pads). During drilling, the gravel pad footprint would be expanded by ice to support other needed facilities. During operations, the ice pad footprint would be removed and only the gravel fill would remain to support the wellheads and required infrastructure. An expanded Central Pad, incorporating both the central well and processing infrastructure, would compensate for the two smaller ice/gravel combination pads. Also, the gravel footprint would be reduced by the use of ice roads in much of the infield road system. This alternative has a gravel road between the air strip and Central Pad.

Noise emissions from these and other activities were assessed in this analysis. Large noise emissions sources under Alternative E include construction activity associated with infield road and pipelines, aviation and marine transport, power generation at the CPF, and drilling. The turbines used during operations at the CPF are the largest noise source during operations. Operational noise from Alternative E is distinctly different from the other build Alternatives due to the extensive and long-term reliance on helicopters for tasks that surface transportation resources facilitate under other Alternatives. While aircraft use under Alternative E is not dramatically different from other build alternatives on an hourly basis, long-term reliance on aircraft distinguishes Alternative E from the other action alternatives in terms of noise.

5.20.7.1 Alternative E: Construction and Drilling

Construction noise modeling results are expressed in Table 5.20-16 below and also graphically in Figure 5.20-4. The dominant features shown on the figure are the noise contours from airplane and helicopter flight paths, noise from barge and other water-based activities (in summer), drilling (in winter), and noise from activities closer to the proposed pads, including the Central Pad.

Noise in the project area would increase from 0 to 22 dBA, depending on existing conditions and distance from construction and drilling (Table 5.20-16). The largest anticipated increase in noise would occur near the Sea Coast/Mary Sachs monitoring locations during winter (22 dBA). This would be perceived as more than a doubling of loudness, resulting in a level between a quiet living room and conversational speech (Table 5.20-16 and Table 3.20-1). Other areas close to construction sites (within 8 miles) would have noticeable increases in noise levels seasonally, resulting in levels similar to a quiet house (Table 5.20-16 and Table 3.20-1). These areas are represented by the Brownlow Spit, Mary Sachs Island, and Flaxman Island monitoring locations (Table 5.20-16).

Areas further away from construction work areas, represented by the Canning River West Bank and Coastal Plain monitoring locations (more than 21 miles from CPF), would experience no increase or a minimal increase over existing conditions (0 to 2 dBA, Table 5.20-16). Existing background noise levels during summer are generally louder than in winter due to the influence of running water and increased wildlife activity. As a result, estimates of future project-related noise levels do not indicate that project-related noise is expected to cause an increase above the existing noise level during summer (Table 5.20-16) at locations not adjacent to the project footprint (i.e. Brownlow Spit, Canning River West Bank, Coastal Plain). Increases of up to 3 dBA are below the threshold of human perception, although a change in the spectral distribution (changes in the tonality of perceived sound) may result in audible tones or low frequency hums. Intermittent events such as blasting may create increased noise levels and be audible on short-term basis.

Table 5.20-16: Alternative E – Increases in Noise above Existing Levels due to Construction and Drilling

Monitoring Location	Existing Noise Level, Leq dBA	Construction + Drilling Noise Level, Leq dBA[e]	Existing + Construction + Drilling Noise Level, Leq dBA	Increase Over Existing, dBA[f]
Winter				
Brownlow Spit	35	38	40	5
Canning River West Bank	48	29	48	0
Coastal Plain	32	29	34	2
Mary Sachs Island	37	39	41	4
Sea Coast	35[a]	57	57	22
Flaxman Island	37[b]	40	42	5
Summer				
Brownlow Spit	43[c]	21	43	0
Canning River West Bank	51	8	51	0
Coastal Plain	31	10	31	0
Mary Sachs Island	44[d]	47	49	5
Sea Coast	43	47	48	5
Flaxman Island	44	28	44	0

[a] The Sea Coast monitoring location (2.8 miles E of the Central Pad) was not used during initial data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Brownlow Spit (8.3 miles E of the Central Pad).

[b] The Flaxman Island monitoring location (6.3 miles NE of the Central Pad) was not used during the winter monitoring season, so the existing noise levels were estimated based on a representative noise monitoring location, Mary Sachs Island (1.7 mi NE of the Central Pad).

[c] The Brownlow Spit monitoring location (8.3 miles E of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Sea Coast (2.8 miles E of the Central Pad).

[d] The Mary Sachs Island monitoring location (1.7 mi NE of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Flaxman Island (6.3 miles NE of the Central Pad).

[e] The levels in this column are mapped, for winter, on Figure 5.20-4.

[f] The magnitude of impact for this alternative was based on the predicted increases in this column.

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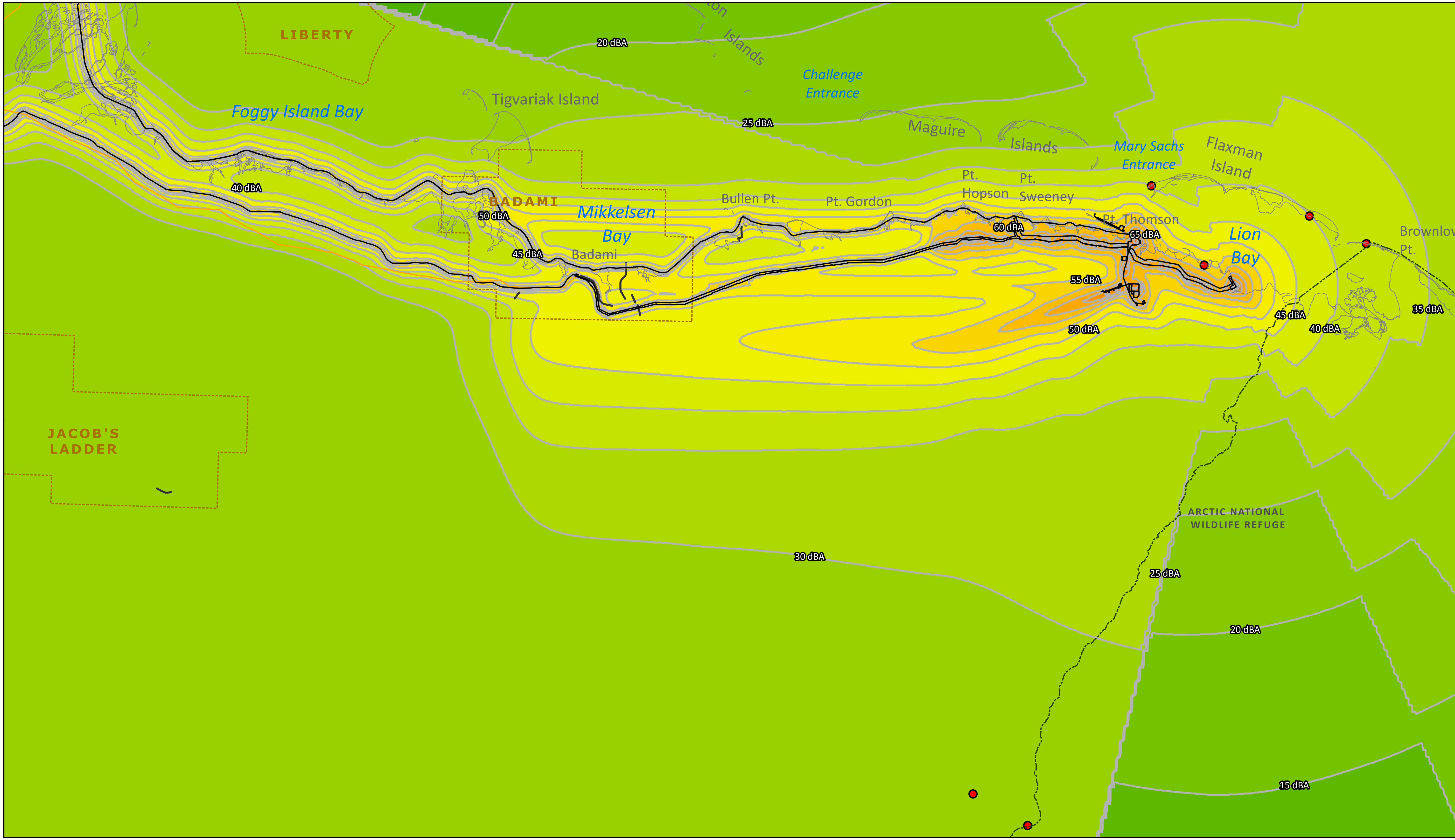

POINT THOMSON PROJECT EIS

Legend

- Arctic National Wildlife Refuge
- Upland
- Existing Pipeline

Proposed Layout - Noise Contour Data

- Noise Receptors
- Contours (5 dBA)
- Alternative E Features

Noise Contours (dBA)

0-5	25-30	50-55	75-80
5-10	30-35	55-60	80-85
10-15	35-40	60-65	85-90
15-20	40-45	65-70	90-95
20-25	45-50	70-75	95-100

The data displayed is concept level and has not been engineered.

N

0 2 4 Miles

Figure 5.20-4

Alternative E - Construction Winter Noise Contours

Date: 24 October 2011
Map Author: HDR Alaska Inc.
Source: See References chapter for map source information

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5.20.7.2 Alternative E: Operations

Operational noise modeling results for Alternative E are expressed in Table 5.20-17 and also graphically in Appendix O, Noise Technical Report. Airplane and helicopter flights, noise from barge and other water-based activities (in summer), snow removal (during winter), and noise from activities closer to the proposed pads, including the Central Pad, are the dominant noise sources in Alternative E. In lieu of infield roadways, Alternative E relies upon helicopter flights for transporting people, equipment, and supplies during construction and operation. Alternative E's long-term reliance on helicopters for daily construction and operations is dramatically different from the other build alternatives.

Operations associated with Alternative E would increase noise levels in the project area from 0 to 12 dBA depending on distance from the source and environmental conditions (Table 5.20-17). Noise levels in areas close to the CPF (e.g. within 3 miles at the Sea Coast site) would increase between 4 and 9 dBA during the occasional snow removal activities near the East Pad. Generally a 4 dBA increase is considered noticeable to the human ear. The resulting noise level would be less than a typical office. This does not account for the change in the spectral distribution of the noise, which even at less than 2 dBA can result in audible low-frequency tones and hums. Noise from operations would be lower than existing noise levels, and likely not audible, during the summer and in distant portions of the project area, represented by the Caning River West Bank and Coastal Plain monitoring locations (Table 5.20-17).

Table 5.20-17: Alternative E – Increases in Noise above Existing Levels due to Operations

Monitoring location	Existing Noise Level, Leq dBA	Operations Noise Level, dBA[e]	Existing + Operations Noise Level, dBA	Increase Over Existing, dBA
Winter				
Brownlow Spit	35	20	35	0
Canning River West Bank	48	8	48	0
Coastal Plain	32	14	32	0
Mary Sachs Island	37	32	38	1
Sea Coast	35[a]	47	47	12
Flaxman Island	37[b]	23	37	0
Summer				
Brownlow Spit	43[c]	21	43	0
Canning River West Bank	51	10	51	0
Coastal Plain	31	11	31	0
Mary Sachs Island	44[d]	35	45	1
Sea Coast	43	45	47	4
Flaxman Island	44	23	44	0

[a] The Sea Coast monitoring location (2.8 miles E of the Central Pad) was not used during initial data collection in 2010, so the existing noise levels were estimated based on a representative monitoring location, Brownlow Spit (8.3 miles E of the Central Pad).

[b] The Flaxman Island monitoring location (6.3 miles NE of the Central Pad) was not used during the winter monitoring season, so the existing noise levels were estimated based on a representative noise monitoring location, Mary Sachs Island (1.7 miles NE of the Central Pad).

[c] The Brownlow Spit monitoring location (8.3 miles E of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Sea Coast (2.8 miles E of the Central Pad).

[d] The Mary Sachs Island monitoring location (1.7 mi NE of the Central Pad) was not used during the summer data collection in 2010, so the existing noise levels were estimated based on a representative noise monitoring location, Flaxman Island (6.3 miles NE of the Central Pad).

[e] The levels in this column are shown graphically in Appendix O, Noise Technical Report.

The dominant sources of noise from operations would vary depending on the season, proximity to the Central Pad, and the presence of any other noise. The dominant sources from operations in Alternative E would be from the CPF and aircraft overflight (Table 5.20-18). Other activities that may create seasonally elevated noise levels include road maintenance and snow removal (Table 5.20-18).

Noise from the CPF and roadway transportation would occur frequently or continuously during operations. Noise from aircraft overflight, road maintenance, and snow removal would be intermittent, but would dominate the soundscape when occurring. Other intermittent noise sources not included in the operations noise assessment include PA announcements and backup beepers. These activities would occur occasionally during operations and would increase noise in the immediate vicinity (within 0.5 miles).

Table 5.20-18: Alternative E – Dominant Noise Sources from Operations

Monitoring location	CPF	Aircraft Overflight	Roadway Transportation	Road Maintenance Activities	Snow Removal Activities
Winter[a]					
Brownlow Spit	X	X	—	—	—
Canning River West Bank	—	X	X	—	X
Coastal Plain	X	X	X	—	X
Mary Sachs Island	X	X	—	—	—
Sea Coast	—	X	—	—	—
Flaxman Island	X	X	—	—	—
Summer					
Brownlow Spit	—	X	—	—	—
Canning River West Bank	X	X	X	X	—
Coastal Plain	X	X	X	—	—
Mary Sachs Island	X	X	—	—	—
Sea Coast	—	X	—	X	—
Flaxman Island	—	X	—	X	—

[a] Data used to represent winter noise conditions were collected from late April to early June. Temperatures remained cold during this period and snow cover was 100%. The assumptions used to represent both winter and summer seasonal conditions are presented in Appendix O, Table 4.

Analysis results indicate that operational noise associated with Alternative E is expected to be noticeably more than operational noise from Alternatives B, C, and D at the Sea Coast monitoring sites due to proximity and extensive reliance upon helicopters under Alternative E. The increase would likely be perceivable. This alternative is also expected to produce project-related noise levels at Mary Sachs Island that are commensurate with Alternative B. At other noise monitoring locations, estimates of operational noise are the same as under Alternatives B, C, and D.

Visitors to the western-most portions of Arctic Refuge may experience project-related noise when winds are very still. When winds are not still, there is potential that wind-induced noise may mask project-related noise; this is particularly true of winds above 11 mph from any direction. In summer, the acoustically absorptive tundra may help reduce project-related noise levels at locations inside the Refuge. In winter, denser (colder) air and nonabsorptive ground cover may contribute to sound propagation. However, audibility is very hard to predict. In some cases winds from the west may transport noise farther eastward than would otherwise occur. It is very difficult to estimate where, or the extent to which project-related noise would be audible under various wind speeds and directions. However it is likely that project-related noise would be lower in the eastern portions of the study area when the winds blow from the east.

5.20.7.3 Alternative E: Impact Evaluation

Table 5.20-19 provides the impact evaluation for noise under Alternative E. Noise from construction and drilling is predicted to dominate the ambient landscape in the immediate vicinity (within 0.5 miles) of the noise sources, having a major magnitude impact. Noise would only occasionally punctuate the ambient soundscape at locations farther away (greater than 3 miles) including distant areas like the Canning River West Bank and Coastal Plain monitoring locations (19 to 20 miles south) due to aviation activities and shipping, having a moderate magnitude impact. The construction and drilling noise effects would have a temporary duration with probable potential to occur. The geographic extent of those effects would be local; however noise from aviation and tug boat use would have a greater geographic extent. While the magnitude of construction noise effects is considered major, the magnitude reduces when drilling is complete, and its overall duration is temporary (Table 5.20-1and Table 5.20-19).

Noise from operations is predicted to dominate the ambient soundscape in the immediate vicinity of the noise sources (within 0.5 miles of the Central Pad), but would only occasionally punctuate the ambient soundscape at places like Mary Sachs Island and beyond (more than 3 miles from the CPF). These noise effects have a probable potential to occur over a geographic range that extends beyond the project area (due to aviation routes extending farther west than Badami), but have only a medium-term duration (for the life of the project; Table 5.20-1 and Table 5.20-19).

Table 5.20-19: Alternative E—Impact Evaluation for Noise[a]

Phase	Magnitude	Duration	Potential	Extent
Construction and Drilling activities on land	Major	Temporary	Probable	Local
Aviation to support construction and drilling	Moderate	Temporary	Probable	Extensive
Sea-based shipping to support construction and drilling	Moderate	Temporary	Probable	Extensive
Operational activities on land	Major	Medium term	Probable	Local
Aviation to support operations	Moderate	Medium term	Probable	Extensive
Sea-based shipping to support operations	Minor	Medium term	Probable	Extensive

[a] All four categories must have the highest intensity type in order for the noise impact to be considered significant. Definitions of the intensity types are shown in Table 5.20-1.

5.20.8 Existing Sound Levels and Project-Related Noise in the Arctic Refuge

During project scoping and development of the Final EIS, USFWS and other resource agencies voiced concerns regarding the noise effects of the proposed project to the sensitive soundscape of the Arctic Refuge. In addition, cooperating agencies and project stakeholders raised concerns regarding the potential for project-related noise to disturb polar bears, caribou, bowhead whale, and other animals in the area. As a result of these concerns, HDR performed additional analysis using the natural ambient sound level, a noise metric used by the NPS Natural Sound Program, to assess noise propagation from the project area into the Arctic Refuge.

The NPS uses the natural ambient sound level, L_{nat}, to document periods of natural quiet, as part of their efforts to preserve the natural soundscape in National Parks. The study area does not include any national park lands; however, USFWS relies on NPS expertise in the field of environmental acoustics. NPS recommended to USFWS that the study area soundscape be documented using NPS methods and metrics. Due to the unique natural soundscapes in the Arctic Refuge, and concerns over noise-related disturbances to refuge wildlife, the USFWS accepted the NPS recommendation and requested that the NPS Natural Sounds Program, "Acoustics and Soundscape Studies in National Parks," be used for soundscape monitoring (NPS 2005). This methodology was subsequently adopted by the Corps for the project noise assessment within the Arctic Refuge.

As discussed in Chapter 3, the study area was divided into four representative soundscapes in order to estimate existing noise levels both inside and outside of the Arctic Refuge. At each monitoring location (representative of a unique soundscape), noise monitoring data was processed to identify the natural ambient sound level, or L_{nat}. Eight days of valid data (wind speeds greater than 5 meters per second for less than 25 percent of the hour) were selected for audio review. The first 10 seconds from every 2 minutes of recording were used for analysis. The audible sounds in each 10-second audio clip and any human-caused sounds were identified and documented. This selective audio review was performed in accordance with NPS Natural Sounds methodologies.

The L_{nat} is the median measured noise level excluding human-caused noise and noise from high wind speeds. Because it eliminates both human-caused noise and noise from high wind speeds, it is an artificial descriptor that is intended to represent noise levels during periods of naturally-occurring quiet outdoor noise levels. Under certain circumstances, the NPS Natural Sounds methodology allows use of the L_{90} to determine the L_{nat}; however, it was not used for that purpose in this analysis except where audio recordings were unavailable. In summary, the L_{nat} measured at each monitoring location outside of the Arctic Refuge represents the L_{nat} at locations in similar soundscapes inside the Arctic Refuge.

5.20.8.1 Existing Sound Levels in the Arctic Refuge

Sound data was collected at six sites, representing four different soundscapes, outside of the Arctic Refuge to characterize the baseline winter and summer acoustic environment in the project area. This analysis assumes that each monitoring location is a soundscape that is representative of similar areas in the study area, both inside and outside of the Arctic Refuge.

Canning River West Bank

Measurements performed at the Canning River West bank are representative of upland coastal plains near surface water features within the Refuge. Figure 5.20-5 below depicts the hourly natural ambient sound level (L_{nat}) by hour during winter and summer. Hourly natural ambient noise levels at the Canning River site (L_{90} or L_{nat}) during the winter ranged from 21 to 23 dBA. During the summer, hourly natural ambient sound levels ranged from 33 to 42 dBA.

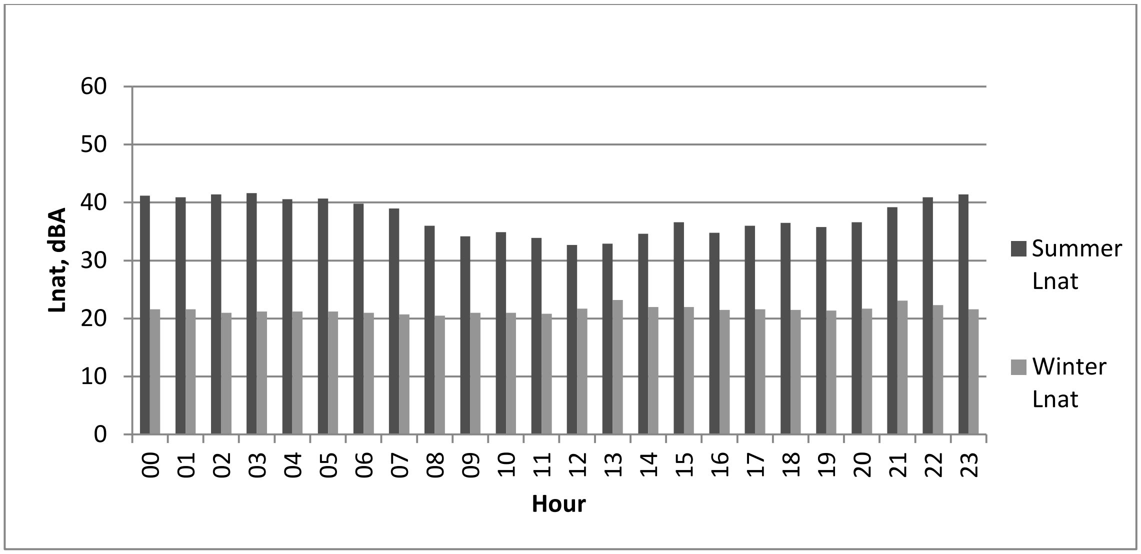


Figure 5.20-5: Canning River Natural Ambient Sound Level By Hour

(Hourly averages of broadband sound levels during winter and summer conditions)

The audible noise environment in the coastal plains during the summer is dominated by natural sources such as wind and wildlife. Human-caused noise identified through audio review (i.e., aircraft overflight) ranged from 0 to 3 events per hour. Noises from current Central Pad operations were not audible during selective audio review, likely due to the distance from the pad. There were no audio recordings to document human-caused sounds in the winter due to equipment failure. Instead, L_{90} was used to conservatively estimate the natural ambient sound level (L_{nat}), in accordance with NPS methods. Due to possible instrumentation noise, actual L_{nat} levels may have been lower than 20 dBA.

Upland Coastal Plain (Coastal Plain)

Measurements performed at the Coastal Plain monitoring location are representative of upland coastal plains. Hourly natural ambient sound levels (L_{nat}) in the Coastal Plain during the winter ranged from 23 to 28 dBA (Figure 5.20-6). During the summer season L_{nat} levels at the Coastal Plain site ranged from 24 to 26 dBA. The measured L_{nat} is representative of the upland coastal plain soundscape inside the Arctic Refuge in areas that are not influenced by human-caused noise. Noise levels in this range are potentially influenced by instrument noise; therefore, it is possible that L_{50} and L_{nat} levels at the Canning River site could have been lower than those depicted (Figure 5.20-6).

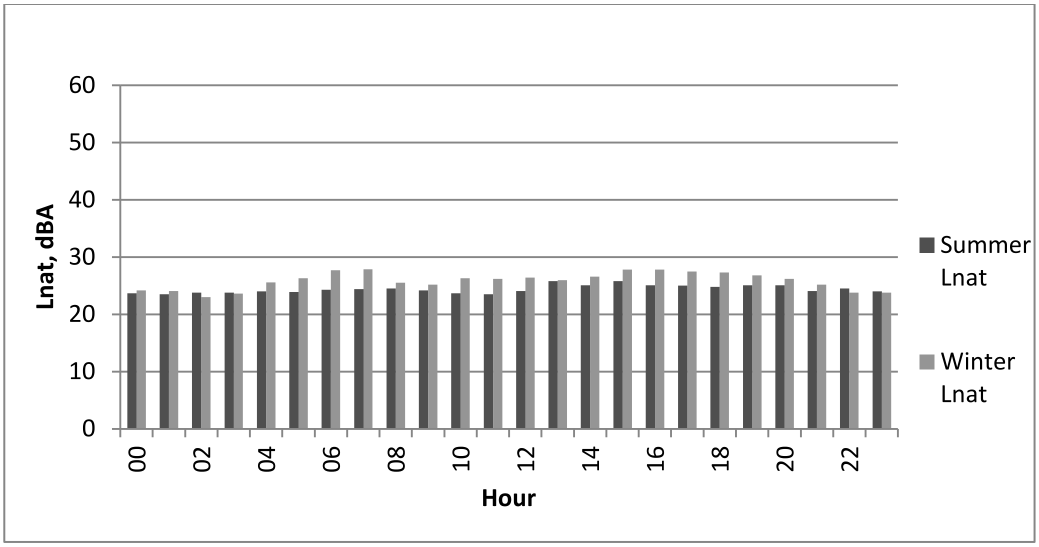


Figure 5.20-6: Coastal Plains Natural Ambient Sound Level By Hour
(Hourly averages of broadband sound levels during winter and summer conditions)

Natural ambient sound levels among all hours and seasons were fairly consistent, indicating that few loud events occurred during the measurement period. The audible noise environment in the coastal plains during the winter is dominated by natural sources such as wind and wildlife. Human-caused noise identified through audio review (i.e., aircraft overflight) ranged from 0 to 1 event per hour in the winter and 0 to 4 events per hour in the summer. Noises from current Central Pad operations were not audible during selective audio review, likely due to the distance from the pad (approximately 20 miles).

Mary Sachs Island and Flaxman Island

Measurements performed at Mary Sachs Island and Flaxman Island are representative of the offshore island soundscape. Hourly natural ambient sound levels (L_{nat}) at Mary Sachs Island during the winter ranged from 24 to 27 dBA (Figure 5.20-7). During the summer, hourly natural ambient sound levels ranged from 33 to 37 dBA. Natural ambient sound levels in the island soundscape are comparable to a quiet unoccupied room and occupied room during the winter and summer respectively.

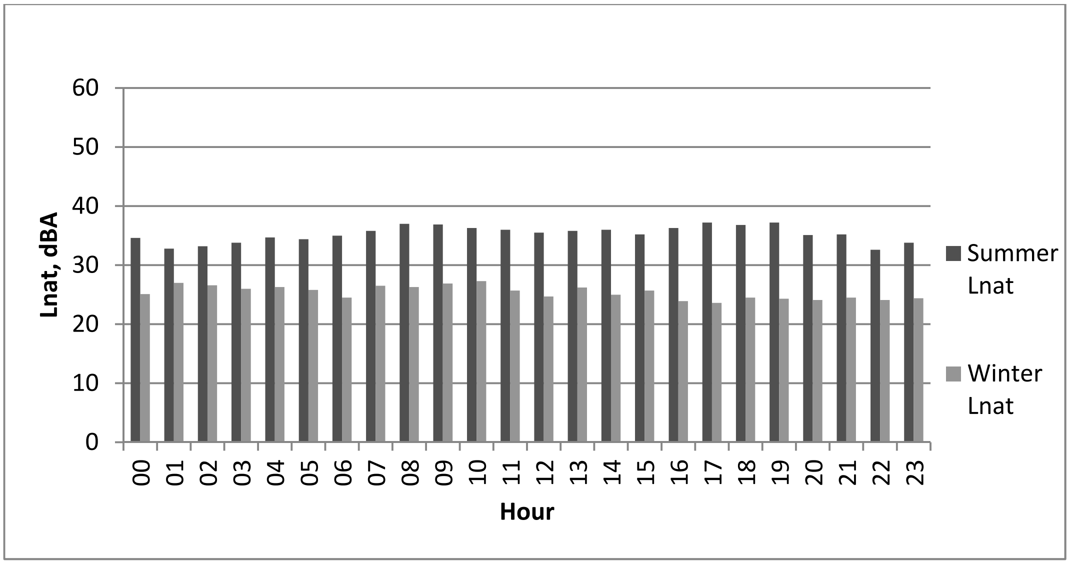


Figure 5.20-7: Offshore Island Soundscape Natural Ambient Sound Level By Hour

(Hourly averages of broadband sound levels during winter and summer conditions)

As shown in Figure 5.20-7 above, natural ambient sound levels for the island soundscape are generally louder in the summer. The acoustic environment at Mary Sachs Island and Flaxman Island is influenced by both natural and human-caused sounds, including industrial activities at the Central Pad (more than 2 miles away). Human-caused noises during the winter and summer included aircraft overflights, public address announcements, equipment backup alarms, and other industrial noises associated with the Central Pad. During selective audio review, these human-caused noises were audible between 0 and 100 percent of any particular hour.

Review of spectrograms for the Mary Sachs Island and Flaxman Island monitoring location revealed the presence of continuous noise sources creating elevated background levels, which were not recognized as human-caused noise events during audio review. While the audio review identified infrequent, discrete audible noise events from activities at the Central Pad, there was also a constant hum in the audio records (potentially associated with generators in use on the Central Pad). Consequently, the sound level, excluding all human-caused noise (the true L_{nat}) could not be calculated for the island soundscape due to consistent noise from the Central Pad. On average, discrete audible noise events (like beepers, horns, or other nonconstant noise events) were present between 7 and 42 percent of the time.

Brownlow Spit and Sea Coast

Measurements performed at the Brownlow Spit and Sea Coast monitoring locations are representative of the coastal shoreline soundscape within the Arctic Refuge (Figure 5.20-8). Hourly natural ambient sound levels (L_{nat}) at Brownlow Spit during the winter ranged from 21 to 23 dBA (Figure 5.20-8). During the summer, hourly natural ambient sound levels ranged from 32 to 42 dBA.

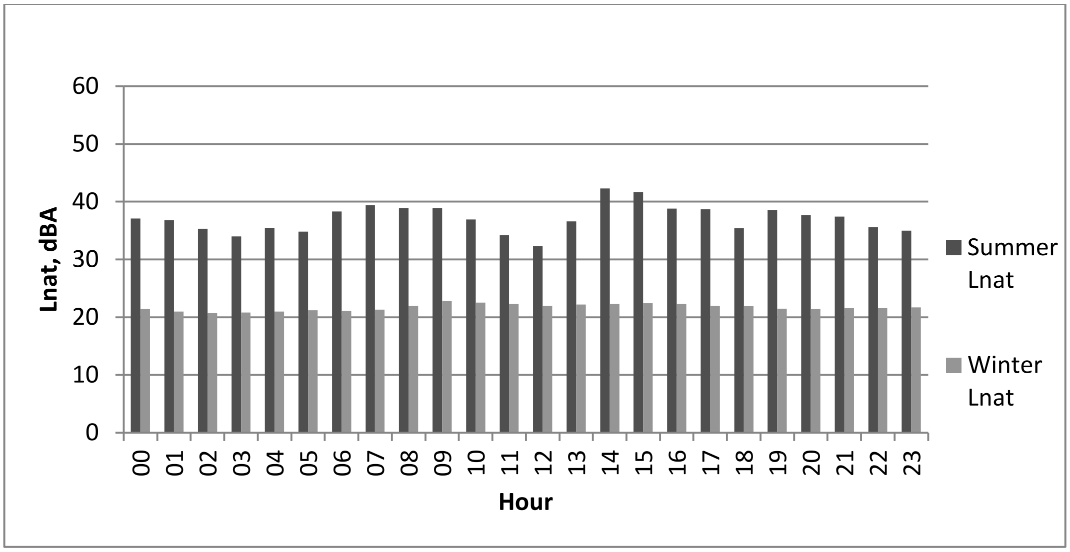


Figure 5.20-8: Coastal Shoreline Soundscape Natural Ambient Sound Level By Hour

(Hourly averages of broadband sound levels during winter and summer conditions)

Natural ambient sound levels in the island soundscape vary greatly during the winter and summer due to natural sources and the proximity of the Central Pad. Review of spectrograms for the Sea Coast monitoring location revealed the presence of continuous noise sources creating elevated background levels, which were not recognized as human-caused noise events during audio review. While the audio review identified infrequent, discrete, audible noise events from activities at the Central Pad, there was also a constant hum in the audio records (potentially associated with generators in use on the Central Pad). Consequently, the sound level, excluding all human-caused noise (the true L_{nat}) could not be calculated for the Sea Coast monitoring location due to consistent noise from the Central Pad.

Human-caused noise identified through audio review ranged from 0 to 26 events per hour. On average, human-caused sounds were audible between 0 and 30 percent each hour. The natural ambient noise environment is dominated by sources such as wind and wildlife. Human-caused, discrete, audible events included infrequent aircraft overflights.

5.20.8.2 Comparisons Among Monitoring Locations

Median sound levels for the Canning River, Coastal Plains, and Brownlow Spit sites, excluding human-caused noise, ranged from 21 to 39 dBA (Figure 5.20-9). Data in the figure represent all data collected during this study. Sound levels at these three sites are lower than typical residential noise environments and quieter than most unoccupied buildings. Sound levels approaching 20 dBA were potentially influenced by instrumentation noise; therefore it is possible that sound levels are sometimes lower than shown. Natural noise levels were greater in the summer season due to the influence of water features such as the Canning River.

Sound levels excluding all human-caused noise (a true L_{nat}) could not be calculated for the island and coastal shoreline soundscapes due to consistent noise from the Central Pad.

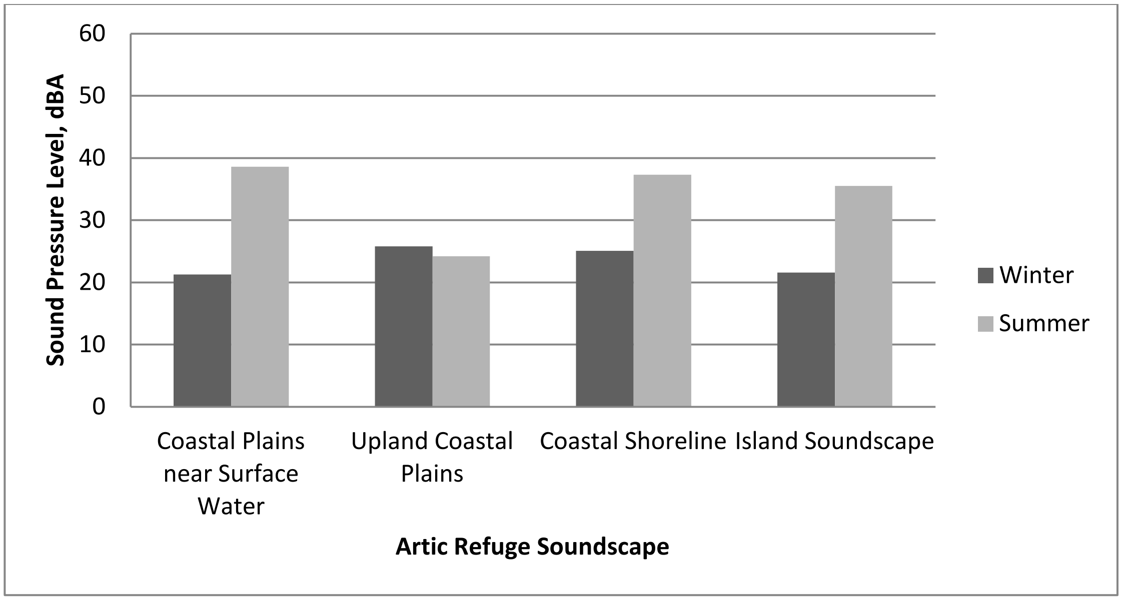


Figure 5.20-9: Natural Ambient Sound Level Comparison

(L_{nat} averages at four soundscapes recorded during summer and winter conditions)

The amount of human-caused noise in the coastal plains, and coastal plains near surface water feature soundscapes, was very low (occurring less than 1 percent of the time) compared to the coastal shoreline and island soundscapes. The audible anthropogenic noise events at the island monitoring locations and coastal shoreline soundscapes are much more frequent than the surrounding project area, with discrete noise events occurring between 10 and 40 percent of the time. Discrete, audible noise events heard during audio review include aircraft overflights, PA systems, backup alarms, and other equipment.[1]

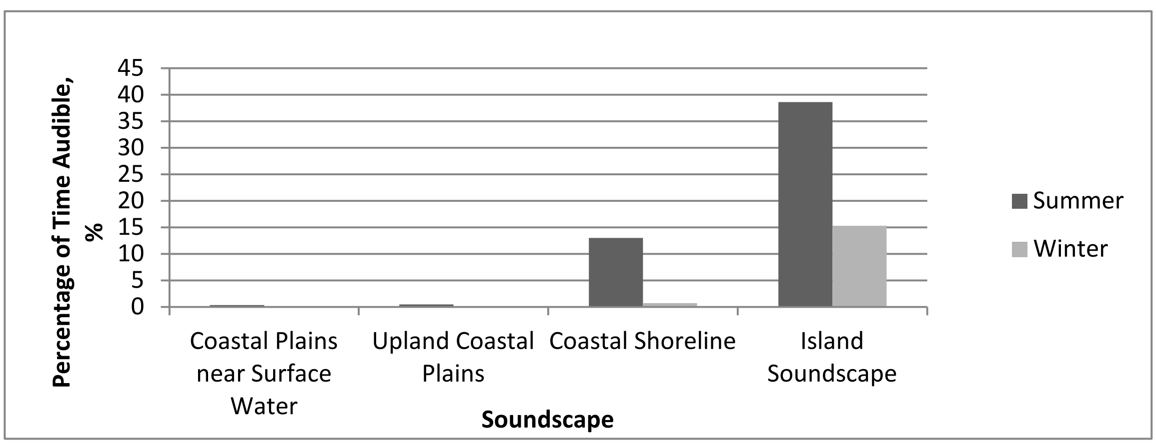


Figure 5.20-10: Audible Anthropogenic Noise

(Human-caused noise recorded during summer and winter conditions.)

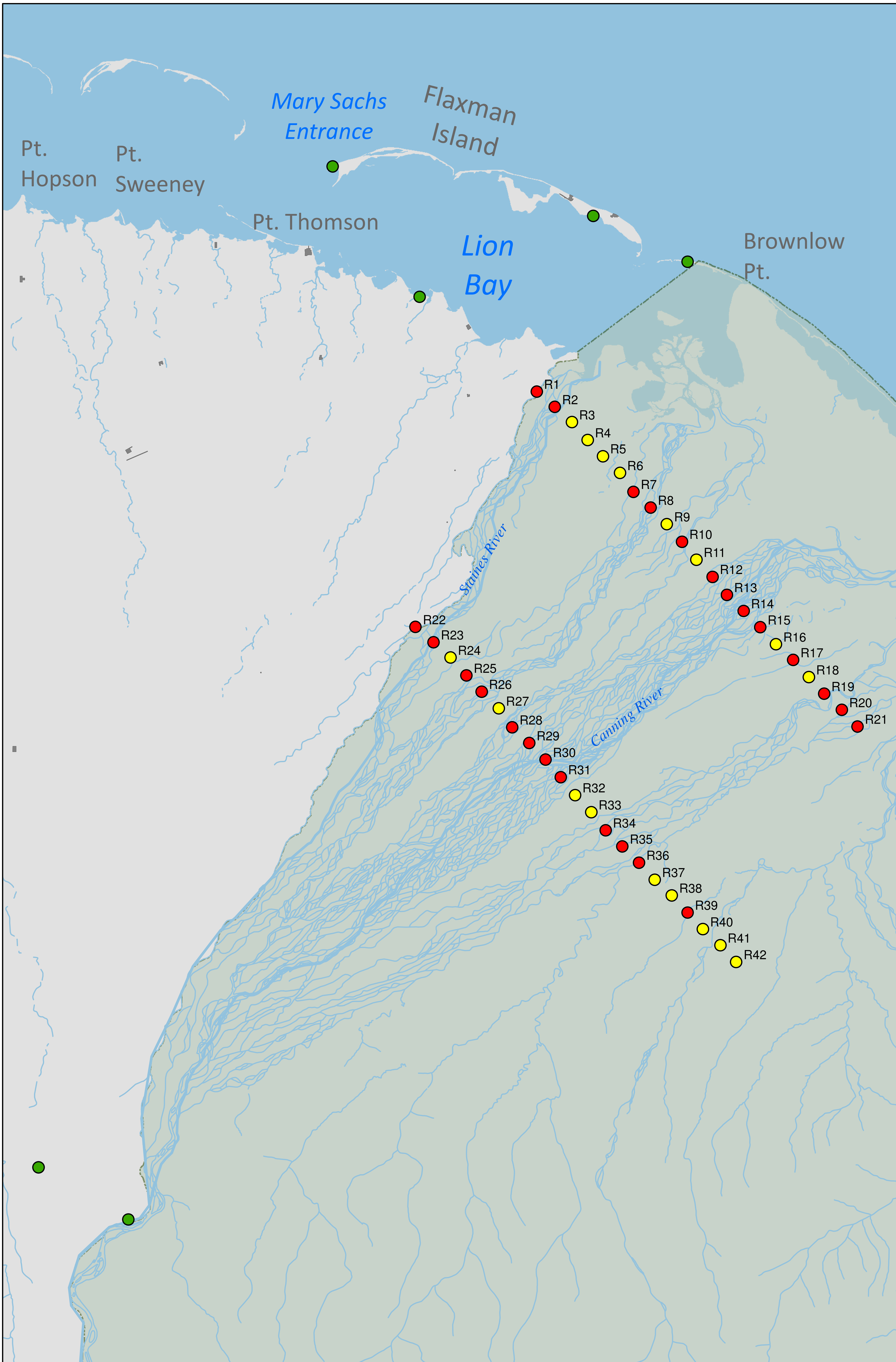
[1] Review of spectrograms for the Mary Sachs Island, Flaxman Island, and Sea Coast monitoring locations revealed the presence of continuous noise sources creating elevated background levels that would not have been recognized as human created noise events during audio review.

5.20.8.3 Potential for Project-Related Noise in the Arctic Refuge

The analysis evaluated project-related construction noise when winds blow from the west and northwest, and during winter. These conditions have the potential to result in the highest project-related noise levels inside the Arctic Refuge. The natural ambient sound level, L_{nat}, was used as a baseline inside the Arctic Refuge.

The modeling analysis included forty-two receptors (locations where the model calculates project-related noise) within the Arctic Refuge. Receptor locations were assigned at half-mile increments starting at two locations, both extending from the western boundary of the Arctic Refuge eastward for 10 miles. Receptors 1 through 21 (R1 through R21) commenced at approximately 5 miles south of the Beaufort seashore receptor. Receptors 22 through 42 commenced at approximately 5 miles north of the Canning River takeout receptor.

Figure 5.20-11 shows the noise receptors modeled inside of the Arctic Refuge. The modeling results generally showed little difference between the alternatives and various wind speeds, but project-related noise levels in winter were generally higher than in summer, reflecting the combined effects of colder, denser air and changes in ground absorption characteristics. Analysis results also show that project-related construction noise levels were generally higher than operations noise levels.



POINT THOMSON PROJECT EIS

Legend

Arctic National Wildlife Refuge

Noise Receptors

Noise Monitoring Locations

Soundscape

Surface Water Features

Upland Coastal Plain

0 1 2 Miles

Figure 5.20-11

Noise Receptors within the Arctic National Wildlife Refuge

Date: 24 October 2011
Map Author: HDR Alaska Inc.
Source: See References chapter for map source information

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Figure 5.20-12 shows the predicted project-related noise increase above the L_{nat} for R1-21, referring to the first or northern-most row of modeled receptors. The modeling results generally showed little difference between the various wind speeds modeled, therefore the predicted increase over L_{nat} represents the average over 10 , 15 , and 20 meter per second wind speeds. The common trends between winter and summer, operations and construction, and the northern and southern row of receptors is the reason for grouping the alternatives together in these results. Additional graphs are available in the noise assessment technical report (Appendix O).

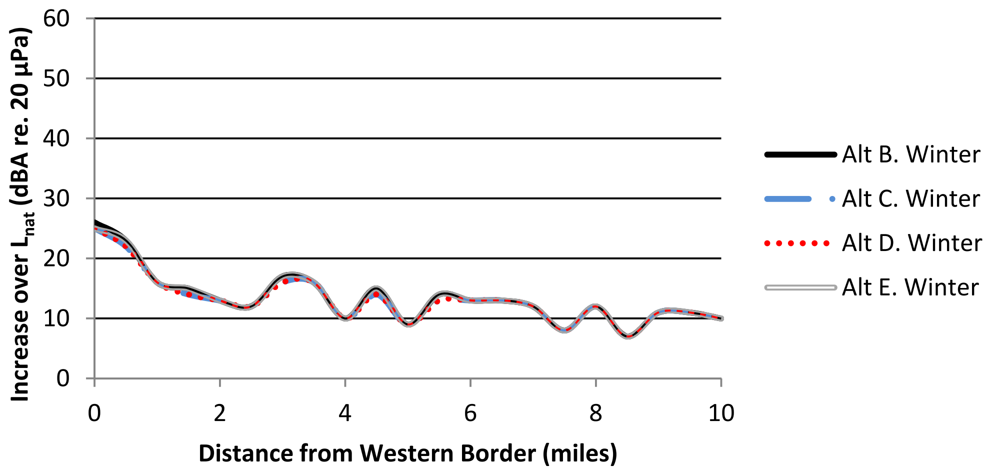


Figure 5.20-12: Winter Construction Noise in Arctic Refuge – R1 through R21 Increase Over L_{nat}

The figure above shows the predicted increases above the L_{nat}, and that the noise increase decays with increasing distance from Point Thomson. The slight noise increases/fluctuations in the graph occur because different receptors were assigned different L_{nat} values based on their proximity to surface waters (ie. they are located in different soundscapes). The general trend shows that the increase over existing noise levels is predicted to be in the 10 dBA range at a distance of 10 miles from the western border of the Refuge, for the northern row of receivers modeled inside the Refuge.

Figure 5.20-13 shows the predicted project-related increase above the L_{nat} at the northern row of receptors inside the Arctic Refuge. In the figure, R22-41 refers to the second or southern-most row of receptors.

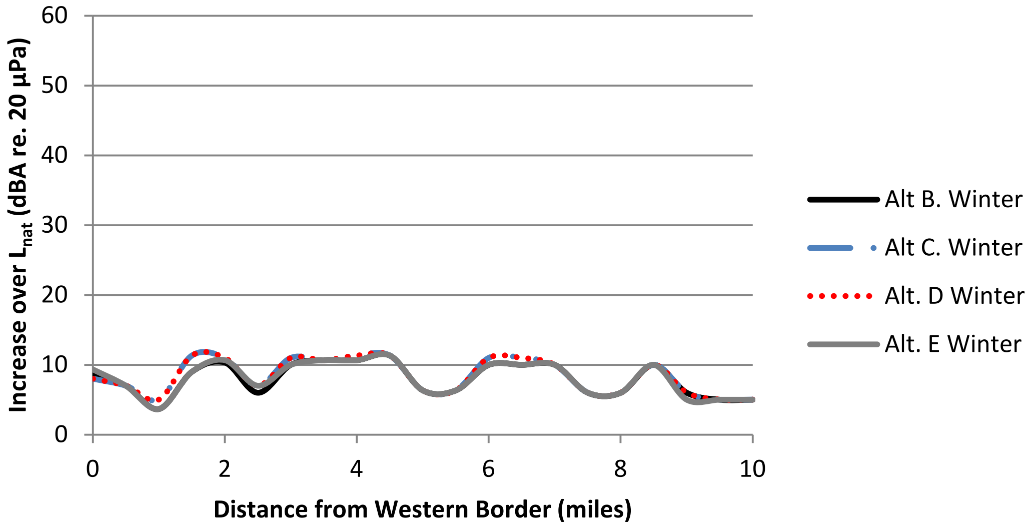


Figure 5.20-13: Winter Construction Noise in Arctic Refuge – R22 through R42 Increase Over L_{nat}

Figure 5.20-13 shows the predicted increases above the L_{nat}, and that the noise increase decays with increasing distance from Point Thomson. The slight noise increases/fluctuations in the graph occur because different receptors were assigned different L_{nat} values based on their proximity to surface waters (i.e. they are located in different soundscapes). The general trend shows that the increase over existing noise levels is predicted to be less than 10 dBA at a distance of 10 miles from the western border of the Refuge, for the southern row of receivers modeled inside the Refuge. These receivers are farther away from the Central Pad than the northern-most row of receivers modeled inside the Refuge.

The analysis focussed on construction noise during winter because that is when the most efficient noise propagation conditions occur (frozen tundra is less acoustically absorptive than living tundra). In summer, the potential increase above L_{nat} would be less than analysis results show for winter. Ground absorption provided by the acoustically soft tundra would contribute to the lower project-related noise levels inside the Arctic Refuge.

5.20.9 Mitigative Measures

The Applicant has included the following Design Measures as part of the project to avoid or minimize noise impacts.

- Installing turbine exhaust silencers of necessary length to provide calculated sound mitigation
- Installing silencers on turbine combustion air inlet filters
- Installing low-noise electrical generators for power generation package
- Installing low-noise design for cooling medium air cooler
- Installing acoustic panels on some module interior walls
- Installing noise enclosures around the instrument air compressors
- Installing noise enclosures around turbines
- Installing hospital grade silencers on the diesel engines driving the camp standby power generation packages and the emergency fire suppression packages

- Performing major construction activities in the winter to minimize impacts on sensitive receptors

The Corps is considering the following measures to avoid or minimize impacts from noise:

- Prepare and implement a noise mitigation plan that includes:
  - noise monitoring thresholds that would trigger mitigation requirements
  - the latest technology to muffle the compressors
  - minimization of noise-causing activities such as using outdoor public address systems and roadway maintenance and snow removal activities when winds are calm (less than 11 mph).

  This plan should be reviewed and approved by the Corps, in consultation with others, prior to start of construction.

5.20.10 Climate Change and Cumulative Impacts

5.20.10.1 Climate Change

Earlier thaws and later winter freezing have already been observed in the Arctic and are expected to be exacerbated by continued changes in global climate. As discussed in Section 4.3, Climate Change, longer seasons of open water are anticipated in the Beaufort Sea, as well as a lengthening of the frost-free season on land. These changes could impact the action alternatives' modes of transportation in the future. For Alternatives B and E, cargo currently planned to be transported via ice road or aircraft could be shipped by barge. This would not necessarily reduce the amount of man-made noise produced by the project, but could result in reduced noise impacts from winter overland sources and increased marine noise in the late summer and fall. However, because Alternatives C and D would not include barging facilities, those alternatives would not benefit from an expanded open-water season. Additionally, a potentially shortened ice road season could increase the volume and frequency of traffic along the ice access road in Alternative D, potentially increasing noise impacts over a shorter period of time. A similar traffic noise increase would be expected, though to a lesser extent, in Alternative E, which would need to accommodate a year's traffic to the East and West Pads in a shortened travel window. (See Section 5.17, Transportation, for additional detail regarding traffic patterns in the project alternatives.)

5.20.10.2 Cumulative Impacts

Noise impacts from this project, when combined with the noise effects of past, present, and RFFAs could cumulatively impact the local soundscape. Past and present actions in the project area include military operations; oil and gas exploration, seismic investigations, and drilling; construction and operations at the Badami Development, currently approved drilling operations at Point Thomson; scientific research and surveys conducted in the area; remediation in the project area (air and vessel traffic and noise from heavy equipment); and subsistence and commercial hunting. Noise from past actions, however, does not influence current or future noise levels as impacts from noise are limited to the period of time when those actions were actually occurring and thus are not expected to have long term impacts. Present actions may have cumulative effects with noise impacts from the Point Thomson Project. However, present actions have resulted in only minor noise-related effects on human receptors due primarily to the remoteness of the region and temporary nature of most noise events. Potential cumulative impacts from noise to terrestrial and marine mammals are presented in Sections 5.10 and 5.11, respectively.

RFFAs that could result in noise effects within the project area include on- and offshore oil and gas exploration, development, and transportation (See Section 4.2 Cumulative Impacts Methodology). Activities identified include the restart of Badami and Beaufort Sea offshore exploration. Associated actions and effects due to noise for future actions are likely to be similar to those described above for the Point Thomson Project, and could individually result in incremental increases in localized noise. Sensitive receptors, including residents of and visitors to the North Slope who transit the area or recreate in the Refuge, may experience noticeable changes to ambient noise levels as a result of localized and/or temporary, low to medium intensity noise. Visits to the Arctic Refuge, which occur primarily during the summer, generally occur within 21 miles of the East Pad at the Canning River take-out site, and some visits may also occur closer to the eastern project boundary (the western boundary of the Arctic Refuge). Kaktovik is the community nearest to the site; it is located approximately 60 miles to the east. Residents of the village regularly travel through the project area. Therefore, it is reasonable to assume that noise levels are likely to increase along with the increase in industrial activity on the North Slope, particularly in areas that are outside of the western boundary of the Arctic Refuge.

Transportation of workers, equipment, and supplies via aircraft, marine vessels, and, to a lesser degree, terrestrial vehicles associated with additional facilities could also incrementally increase noise in areas located along travel routes. Visitors to the Arctic Refuge and residents traveling through the area could be affected to varying degrees depending on the implementation schedule of future actions and associated travel routes. Changes in noise levels throughout the project area due to these activities are not expected to be noticeable over existing conditions; however, the frequency of occurrence may increase.

Cumulative impacts would be similar for all action alternatives. Alternatives C and D may have fewer impacts in costal areas than Alternative B because of the movement of facilities and activity away from the coast. Cumulative effects on noise could occur farther west in Alternative C, due to the construction and use of the gravel access road. Alternative E would have the highest cumulative impacts because of the extensive use of helicopters throughout construction, drilling, and operations.

Incremental increases in localized noise are possible as a result of the Point Thomson Project and other RFFAs. However, it is unlikely that the Point Thomson Project would contribute to cumulative impacts past the operations phase of the project, so these impacts would be of medium term duration and may not overlap temporally with impacts resulting from future actions. As a result, no concerns related to adverse cumulative impacts have been identified at this time.

5.20.11 Alternatives Comparison and Environmental Consequences

Under all action alternatives, project-related noise effects during construction are predicted to be moderate to major, probable, local to extensive in extent, but temporary in duration. During operations, project-related noise effects are predicted to be minor to major, medium term, probable, and extensive. Project-related noise effects are likely to be greater during the winter than during the summer. This is because the existing noise levels measured during the winter are lower than those measured during summer because sound travels more readily due to the cold, dense air and frozen, nonabsorptive ground; and because drilling activities that occur during the winter are louder than summer activities. Noise effects are greatest in the areas closest to the project pads and roadways (Sea Coast at less than 3 miles) and are minimal at sites more than 19 miles from the Central Pad (Canning River West Bank and Coastal Plain). Impacts at intermediate distances (less than 9 miles), including Brownlow Spit, Mary Sachs Island, and Flaxman Island, vary by alternative. Additional modeling showed minimal differences in the potential project-related noise effects in the Arctic Refuge between alternatives and various wind speeds.

Project-related noise effects are slightly greater in Alternatives B and E due to the use of tug boats and barges for transportation. In addition, the extensive use of helicopters and aircraft in Alternative E also results in an increase in noise during both construction and operations.

5.21 CULTURAL RESOURCES

The key findings for Cultural Resources are summarized below with a brief summary of the differentiating effects.

Key Impact Findings and Differentiators Among Alternatives

Key Findings:

Alternatives B, C, D, and E: There are between 12 and 44 recorded cultural resources across the alternatives project areas. One cultural resource may potentially experience direct effects from project construction. An additional 5 to 31 sites may experience additional indirect effects; 12 to 43 sites may experience visual or audible effects.

Alternative A: No impacts to cultural resources

Differentiators:

- Alternatives B, D, and E would not directly impact any cultural resource sites.
- Alternative C has the potential to directly and/or indirectly impact one cultural resource site in the project area as a result of the construction of the gravel access road.
- Alternative B has the greatest number of cultural resource sites that may be potentially affected by visual or audible effects; Alternative D has the fewest.
- The movement of Alternative C and D infrastructure away from the coast reduces the potential for visual and/or audible effects and impacts to undocumented cultural resources
- The inclusion of the optional sea ice road in Alternatives C, D, and E would increase the number of cultural resources included within the project area, therefore increasing the number of cultural resources that are potentially indirectly affected.

As described in Section 3.21, Cultural Resources, there are 60 recorded cultural resources within the Point Thomson cultural resource study area. In addition to these, the *Duchess of Bedford* shipwreck is located in the study area off of Flaxman Island. The 60 AHRS and TLUI sites located in the study area are listed in Table 3.14-2. Although the exact location of these sites is confidential, a majority of sites are located along the coastline or on the barrier islands (Figure 3.14-1).

5.21.1 Methodology

The following six assumptions guided the analysis of assessing project effects on cultural resources:

- The determination of whether the proposed action would adversely affect cultural resources is based on whether the action would affect the eligibility of a cultural resource for listing in the NRHP.
- All cultural resources in the study area are assumed to be National Register eligible (i.e., historic properties) unless otherwise specified.
- All unsurveyed areas of the proposed project could contain cultural resources eligible for listing in the NRHP. Unidentified potentially eligible cultural resources may be buried in surveyed areas.
- Cultural resources within project component footprints could experience both direct and indirect effects.
- Cultural resources within an additional 1-mile buffer of the project component footprints could also experience indirect effects (e.g., through potential ancillary staging or access areas needed during construction. Note: Specific buffers for visual and audible indirect effects are identified separately, as described below.
- Visual and audible effects to cultural resources would be most noticeable within a 3-mile buffer of the operation phase of project components, particularly for those sites with above ground built components such as sod houses, DEW Line buildings, camps, and graves. Temporary project components within the construction and drilling phases of the project (e.g., one season heavy-duty sea ice road) were not included in the visual and audible analysis because one season of visual/audible impacts would not permanently affect a cultural resource site's eligibility.

An adverse effect occurs when an undertaking may alter, directly or indirectly, any of the NRHP-qualifying characteristics of a cultural resource in a manner that would diminish the property's integrity (i.e., location, design, setting, materials, workmanship, feeling, association), and/or significance (i.e., association with an important event or patterns of history [Criterion A], association with an important historical person [Criterion B], style of architecture [Criterion C], or information potential [Criterion D]), thus potentially altering a site's eligibility. Direct effects, which are caused by the action and occur at the same time and place, are impacts to the characteristics of a cultural resource that qualify it for inclusion in the NRHP (36 CFR Part 800.5; 40 CFR 1508.8). Indirect effects to cultural resources include those impacts that result from the action later in time or further removed in distance but still reasonably foreseeable, such as increased access to and close proximity of project components to culturally sensitive areas (40 CFR 1508.8).

Examples of direct effects to cultural resources from ongoing or proposed activities could include: physical destruction of or damage to all or part of the resource, removal of the resource from its original location, change of the character of the resource's use or of physical features within the resource's setting that contribute to its historic significance (as defined under NRHP), change in access to traditional use sites by traditional users, or loss of cultural identification with a resource. Indirect effects could include: introduction of vibration, visual, noise, or atmospheric elements; vulnerability to erosion; neglect of a property that causes its deterioration; transfer, lease, or sale out of federal ownership without proper restrictions; increased industrial growth as a result of a project; and increased access to and proximity of project components to culturally sensitive areas. Increased access could result in a greater vulnerability of cultural resources to looting by onsite personnel, or damage caused by equipment during construction, drilling, and operation phases of the project.

The impact analysis identified the number of cultural resources that overlap within the project component footprints (for direct and indirect effects). There is a 1-mile buffer of project components for indirect effects, and a 3-mile buffer of project components for visual and audible indirect effects. For a quantitative analysis of cultural resources potentially affected by each alternative, AHRS and TLUI sites were counted independently unless it could be determined they were associated, in which case they were counted as a single site. Sites previously determined ineligible or listed as destroyed were not counted in the analysis of the number of sites potentially affected by each alternative.

5.21.2 Cultural Resources Impact Assessment

Primary direct effects to documented and unidentified cultural resources from the project alternatives include those associated with sea and/or tundra ice road construction, gravel road construction, and pipeline and VSM installation. Though no documented cultural resources are located within the footprint of other project components (e.g., gravel mine, airstrip, pads), direct effects could potentially affect unidentified cultural resources within these areas. The likelihood of impacting unidentified resources, however, would be low given the number of previous surveys conducted in the study area, the relatively few number of cultural resources documented in nearby areas, and the low potential of these other construction footprint areas for containing cultural resources (CCRS and NLUR 2010).

There is a low probability for discovering unidentified cultural resources in the Point Thomson area because the coastal areas and barrier islands have experienced continuous alteration due to strong storm surges, and because wet meadows and areas of extensive surface water are located throughout the area in the form of lakes, ponds, and aquatic sedges and grasses (Lobdell and Lobdell 2000).

Indirect effects to documented and unidentified cultural resources from the project alternatives include those related primarily to increased access and introduction of visual and/or audible effects. Increased access could allow for potential looting or inadvertent trampling or damage to cultural resources by the public during construction activities, use of the ice and/or gravel road, or during a potential oil spill cleanup activity. If setting, association, and feeling are identified elements that contribute to a cultural resource's integrity and subsequent eligibility for listing in the NRHP, visual and/or audible indirect effects could occur from the operation of equipment, the installation of the communication tower, and pipeline. Given the flat topography of the study area, it would be likely that many of the project components may be visible from cultural resources within the study area, and may also produce noise that could be heard at these cultural resources.

As described in Section 3.21, Cultural Resources, and Section 3.22, Subsistence and Traditional Land Use Patterns, a number of cultural resources, as well as the study area itself, have traditional cultural importance to local Iñupiat and their way of life. Changes in access to traditional and current hunting, fishing, and gathering areas, which are important components to Iñupiat culture, would occur due to the introduction of the pipeline and other project components. Local animal, fish, and plant resources that are harvested may also be affected during operations. Iñupiat subsistence harvest practices form the central organizing point of Iñupiat cultural and social life. Subsistence harvest activities conducted on the landscape in customary locations at appropriate times with unimpeded use of landscape features suited to those practices are the underlying reason for the existence and significance of the cultural resources that document the history of these practices. The effects to Iñupiat subsistence culture resulting from changes in access or availability of traditional local resources are discussed in greater detail in Section 5.22, Subsistence and Traditional Land-Use Patterns.

5.21.3 Alternative A: No Action

No impacts to cultural resources would be expected to occur under Alternative A as no activity, other than occasional well monitoring via helicopter, would occur at the site.

5.21.4 Alternative B: Applicant's Proposed Action

A majority of the documented cultural resources in the study area are located along the coast and barrier islands. Impacts from this alternative to cultural resources would primarily occur during the construction phase. Of all project components, the construction of the sea ice road has the greatest potential to directly affect the greatest number of undocumented cultural resources for this alternative. The total number of cultural resources impacted directly, indirectly, or from visual or audible effects of Alternative B are shown in Table 5.21-1. All of these areas have been surveyed and any cultural resources found have been identified and incorporated into a draft Programmatic Agreement (CCRS and NLUR 2010).

Table 5.21-1: Alternative B—Documented Cultural Resources Potentially Affected

Total Within Project Area	Directly and/or Indirectly Affected	Additional Indirect	Visual or Audible Effects[a] during Operations
43	0	31	43

[a] Temporary project components within the construction and drilling phases of the project (e.g., one season heavy-duty sea ice road) were not included in the visual and audible analysis.

5.21.4.1 Alternative B: Construction

No documented cultural resources are located within the proposed location of the sea ice road for Alternative B (Table 5.21-1) and thus direct effects to documented cultural resources are unlikely under this alternative. However, indirect effects, such as looting, inadvertent trampling, or damage to cultural resources by project personnel, could occur. These impacts are less likely for buried or surface cultural resources, as the construction of the sea ice road would occur in the winter over a layer of snow, which would cover the cultural resources. However, cultural resources with above-surface remains, such as Mikkelson Bay Village (AHRS Site XBP-00028), Point Gordon (XFI-00004), and Bullen Point (XFI-00001) could be subject to indirect effects during the winter construction months. Indirect effects may include potential looting or damage as the snow does not completely cover all buildings (such as DEW Line sites), and the sea ice road could provide continued winter access to such sites.

Thirty-one cultural resources are located within 1 mile of construction areas and could be indirectly affected.

Undocumented and/or buried cultural resources may be inadvertently destroyed or disturbed through project construction activities. Sea floor dredging for the barge off-loading facilities could disturb submerged cultural resources should any be present. Indirect effects, such as potential looting, inadvertent trampling, or damage to cultural resources resulting from increased public access could also occur.

Given the number of previous surveys conducted in the study area, the relatively few number of cultural resources documented, and the low probability of the construction footprint areas for containing cultural resources, impacts to inland cultural resources are less likely to occur under Alternative B. If a sea ice road were located outside an area that has been previously surveyed for cultural resources, direct impacts to undocumented cultural resources could occur. The likelihood for the sea ice road to affect unidentified cultural resources would be higher compared to a tundra ice road (see Alternatives C, D, and E) as the coast has a greater likelihood for containing cultural resources.

5.21.4.2 Alternative B: Drilling

Drilling activities at the East and Central Pads would occur within the existing gravel pads; thus, no direct effects to cultural resources are expected from this activity. Any direct and indirect effects to undocumented and/or buried cultural resources from drilling activities at the West Pad would be associated with those identified for the construction phase (outlined above). Other components of the drilling phase for Alternative B (e.g., mobilization, moving, and demobilization of drilling equipment) are not expected to affect cultural resources as they are temporary in duration and occur within areas that have been previously disturbed during construction.

5.21.4.3 Alternative B: Operations

No major ground-disturbing activities are associated with the operation phase of Alternative B, though the potential for spills would exist. During operations, spills of hydrocarbons or toxic materials could disturb or contaminate surface or shallow buried cultural resources. Potential impacts from spills are further discussed in Section 5.24, Spill Risk and Impact Assessment. Visual and/or audible indirect effects could occur from equipment operation, communication tower installation, and pipeline operation. A total of 43 documented cultural resources are located within an area where visual and audible effects would be most noticeable under Alternative B (Table 5.21-1). If setting, association, and feeling are identified elements that contribute to the 43 cultural resource's integrity and subsequent eligibility for listing in the NRHP, visual and/or audible indirect effects could occur from the operation of equipment, the installation of the communication tower, and pipeline. Of the 43 sites within the area where visual and audible effects would be most noticeable, 33 are associated with above ground/ built components such as sod houses, graves, and DEW Line buildings and would be the most likely to be effected by potential visual and audible project elements. Impacts to local Iñupiat culture and their traditional way of life are the same as those described under the cultural resources impact assessment (see Section 5.21.2).

5.21.5 Alternative C: Inland Pads with Gravel Access Road

The majority of impacts from this alternative would occur during construction of the gravel access road, tundra ice road, and optional heavy-duty sea ice road. Because a majority of the cultural resources under Alternative C are located along the coast, the optional heavy-duty sea ice road has the potential to indirectly affect a large number of cultural resources within the Point Thomson Project area. The total number of cultural resources impacted directly, indirectly, or from visual or audible effects of Alternative C are shown in Table 5.21-2.

Table 5.21-2: Alternative C—Documented Cultural Resources Potentially Affected

	Total Within Project Area	Directly and/or Indirectly Affected	Additional Indirect	Visual or Audible Effects[a] During Operations
Without optional sea ice road	12	1	5	12
With optional sea ice road	44	1	30	12

[a] Temporary project components within the construction and drilling phases of the project (e.g., one season heavy-duty sea ice road) were not included in the visual and audible analysis.

5.21.5.1 Alternative C: Construction

Only one of the documented cultural resources in the Point Thomson area is located within the construction footprint area for Alternative C (Table 5.21-2) and could experience a direct effect.

The gravel access road and export pipeline route could potentially affect this cultural resource through compaction associated with road construction and through vehicle and equipment staging.

With the optional sea ice road, an additional 30 cultural resources are within 1 mile of proposed construction action areas and may experience indirect effects such as inadvertent trampling or damage by project personnel during construction (see discussion under Section 5.21.2). Without the sea ice road, only five additional cultural resources would be located in an area that may experience indirect effects. Types of direct and indirect effects to cultural resources during construction are identified above under Section 5.21.2, Cultural Resource Impact Summary and would be the same for Alternative C.

Undiscovered and/or buried cultural resources may be inadvertently disturbed through project construction activities. For inland project components, given the number of previous surveys conducted in the study area, the relatively few number of cultural resources documented, and the low probability of the construction footprint areas for containing cultural resources, impacts would be less likely to occur than for coastal components.

5.21.5.2 Alternative C: Drilling

Drilling at the Central Well Pad would occur within the existing gravel pad; thus, no direct effects to cultural resources would be expected from this activity under Alternative C. Direct and indirect effects from drilling at the Central Processing Pad, West Pad, and East Pad to undiscovered and/or buried cultural resources would be similar to those identified for construction. Other components of the drilling phase for Alternative C (e.g., mobilization, moving, and demobilization of drilling equipment) would not affect cultural resources as they are temporary in duration and occur within areas that have been previously disturbed during construction.

5.21.5.3 Alternative C: Operations

As in Alternative B, no major ground-disturbing activities are associated with the operation phase of Alternative C, though the potential for spills and their impacts would exist.

The gravel access road would be located near one documented cultural resource, which has the potential to cause indirect effects by increasing public access along the road during operations.

Visual and/or audible indirect effects would be similar to those in Alternative B, and 12 documented cultural resources are located within the project area where visual and audible effects would be most noticeable (Table 5.21-2). However, because the operation components of this alternative are located farther inland than Alternative B and the location of most of these cultural resources are along the coastline, the potential for visual and/or audible effects would be less under Alternative C. Of the 12 sites within the area where visual and audible effects would be most noticeable, five are associated with above ground/ built components and would be the most likely to be potentially affected by visual or audible project elements. Impacts to local Iñupiat culture and their traditional way of life are the same as those described under the cultural resources impact assessment (see Section 5.21.2).

5.21.6 Alternative D: Inland Pads with Seasonal Ice Access Road

The majority of impacts from this alternative would occur during construction of the tundra ice road and optional heavy-duty sea ice road. Because a majority of the documented cultural resources are located along the coast, the optional heavy-duty sea ice road has the potential to indirectly affect a large number of cultural resources within the Point Thomson Project area. The total number of cultural resources impacted directly, indirectly, or from visual or audible effects of Alternative D are shown in Table 5.21-3.

Table 5.21-3: Alternative D—Documented Cultural Resources Potentially Affected				
	Total Within Project Area	Directly and/or Indirectly Affected	Additional Indirect	Visual or Audible Effects[a] During Operations
Without optional sea ice road	27	0	8	27
With optional sea ice road	42	0	31	27

[a] Temporary project components within the construction and drilling phases of the project (e.g., one season heavy-duty sea ice road) were not included in the visual and audible analysis.

5.21.6.1 Alternative D: Construction

No documented cultural resources identified in the Point Thomson area (see Section 3.21, Cultural Resources) are located within the proposed location of the sea ice road or other construction footprints for Alternative D (Table 5.21-3) and thus direct effects to documented cultural resources are unlikely under this alternative. An additional 31 cultural resources are within 1 mile of proposed construction action areas if the optional sea ice road was constructed. Without the optional sea ice road, only eight cultural resources could experience indirect effects (Table 5.21-3).

Similar to Alternative C, construction of the inland tundra ice road would affect fewer documented cultural resources and have less potential to affect unidentified cultural resources than a sea ice road in coastal areas. Compared to the 50 mile export pipeline construction route to Endicott under Alternative C, the construction of the 23-mile export pipeline route to Badami under Alternative D would have the potential to impact fewer undocumented cultural resources due to a smaller construction footprint. Like Alternatives B and C, Alternative D would be unlikely to inadvertently impact unidentified cultural resources, though the potential for such impacts exists.

5.21.6.2 Alternative D: Drilling

Impacts to cultural resources from drilling activities under Alternative D would be the same as those described for Alternative C.

5.21.6.3 Alternative D: Operation

Impacts to cultural resources from operation activities under Alternative D would be similar to those described for Alternative C. Indirect effects from increased access via the gravel road under Alternative C would not exist for Alternative D. Additionally, audible and visual effects would potentially increase from 12 cultural resources affected under Alternative C, to 27 cultural resources affected under Alternative D due to the proximity of the tundra ice road and pipeline to the coast. Of the 27 sites within the area where visual and audible effects would be most noticeable, 18 are associated with above ground/ built components and would be the most likely to be potentially affected by visual or audible project elements. Impacts to local Iñupiat culture and their traditional way of life are the same as those described in the cultural resources impact assessment (see Section 5.21.2).

5.21.7 Alternative E: Coastal Pads with Seasonal Ice Roads

Due to its reduced development footprint, Alternative E has a low potential to impact undocumented cultural resources. However, the footprint of the tundra ice road and sea ice road for Alternative E are similar to the other alternatives; thus, the number of documented cultural resources potentially affected would be similar to the other alternatives. The total number of cultural resources impacted directly, indirectly, or from visual or audible effects of Alternative E are shown in Table 5.21-4.

Table 5.21-4: Alternative E—Documented Cultural Resources Potentially Affected				
	Total Within Project Area	Directly and/or Indirectly Affected	Additional Indirect	Visual or Audible Effects[a] during Operations
Without optional sea ice road	37	0	8	37
With optional sea ice road	43	0	31	37

[a] Temporary project components within the construction and drilling phases of the project (e.g., one season heavy-duty sea ice road) were not included in the visual and audible analysis.

5.21.7.1 Alternative E: Construction

Potential impacts to documented cultural resources during construction would be the same as those identified under Alternative D, as both alternatives impact the same number of cultural resources (Table 5.21-4). Like Alternative B, dredging and construction activities could disturb unidentified cultural resources, though the probability of such impacts would be low.

5.21.7.2 Alternative E: Drilling

Direct and indirect effects from drilling at the West Pad and expanded Central and East Pads to unidentified and/or buried cultural resources would be similar to those for construction. Other components of the drilling phase for Alternative E would not affect cultural resources as they are temporary in duration, and occur within areas that would have already been disturbed during construction.

5.21.7.3 Alternative E: Operation

As with the other alternatives, no major ground-disturbing activities are associated with operation of Alternative E, though spill risks exist. Visual and/or audible indirect effects could occur, and 37 documented cultural resources are located within an area where visual and audible effects would be most noticeable. Of the 37 sites within the area where visual and audible effects would be most noticeable, 28 are associated with above ground/ built components and would be the most likely to be potentially affected by visual or audible project elements. Impacts to local Iñupiat culture and their traditional way of life are the same as those described under the cultural resources impact assessment (see Section 5.21.2).

5.21.8 Mitigative Measures

The Applicant has included the following design measures as part of the project design to avoid or minimize impacts on cultural resources:

- Conducting field and literature surveys to identify all cultural resources in the project area.
- Conducting interviews with local elders and others knowledgeable about potential resources.
- Developing protocols to protect sites that are known or discovered during project construction or operations.
- Conducting effective training for the workforce on the importance of protecting cultural sites and proper procedures to do so.

The Corps is considering the following measures to avoid or minimize impacts to cultural resources:

- Prepare and implement an unanticipated discovery plan describing the protocols that would be followed should cultural resources be discovered during project construction or operations. This plan should include a stop-work protocol, reporting, documentation, and assessment of eligibility for listing in the NRHP. This plan should be reviewed and approved by the Corps, in consultation with others, prior to start of construction.

5.21.9 Climate Change and Cumulative Impacts

5.21.9.1 Climate Change

Climate change has the potential to create impacts to cultural resources primarily through rising sea levels and coastal erosion. More frequent and powerful storms are predicted to occur; these storms will likely have higher waves due to increased fetch. In conjunction with rising sea level, storms could erode or inundate coastal cultural resources (see Section 5.5, Physical Oceanography and Coastal Processes).

Increases in temperature could cause permafrost to thaw (see Section 5.2, Soils and Permafrost), which could destabilize sediment, expose artifacts, and reduce the chance for cultural resource preservation. Additionally, climate change-influenced changes in wildlife and plant distribution and habitat similar to those described in Sections 5.8 through 5.12 could impact the continuity of cultural aspects of subsistence hunting (see Section 5.22).

5.21.9.2 Cumulative Impacts

Past and present actions and events that have potentially affected cultural resources in the project area include historic and continuing exploration and extraction of oil reserves, development of military sites for communications, scientific research and surveys, and recreation and tourism activities. Cultural resources are not ubiquitous across the North Slope, and their presence and location is predictable only to a limited degree (BLM 2004). Because of the potential existence of many unidentified cultural resources on the North Slope, it is difficult to quantify the extent to which cultural resources have been impacted by past and present activities. However, the potential for impacts increases with increased ground disturbance, including activities such as gravel mining, ice and gravel road construction, and VSM and pipeline construction. In addition, by bringing construction activities and/or more people to the region, these past and present actions have also provided the potential for disruption or destruction to cultural resource sites.

Any new development, research, or recreation activities, in conjunction with the proposed action, increase the possibility for future identification, disruption, or destruction of these resources (see Section 4.2 for a list of RFFAs). Therefore the action alternatives, in combination with other oil and gas exploration and/or other proposed development or recreation activities on the North Slope, have the potential to create cumulative effects on cultural resources. These effects include, but are not limited to: destruction or possible disturbance of unidentified cultural resources; added noise and visual effects to cultural resources and traditional use areas; and fragmentation of culturally important areas through reduction in access and changes in local resource availability. To reduce these impacts, measures can be taken to protect those sites that have been identified. While, undocumented sites are susceptible to adverse effects in direct correlation to the extent of ground disturbance, number of construction activities, and people in the region, the Point Thomson Project has a low likelihood of impacting unidentified resources because of the relatively few number of cultural resources documented in nearby areas, and the low potential of these other construction footprint areas for containing cultural resources (CCRS and NLUR 2010). Adverse cumulative impacts to known cultural resources are not anticipated. It is possible that cumulative impacts to unknown cultural resources could be adverse; however, as discussed, it is difficult to identify impacts to unknown resources.

5.21.10 Alternatives Comparison and Environmental Consequences

Alternative C is the only project alternative that could directly impact a documented cultural resource; one documented site is located directly within a construction footprint. All other alternatives do not have any documented cultural resources within construction footprints. Alternative B could potentially indirectly impact the greatest number of documented cultural resources, due to the proximity of project components to the coast, where a majority of cultural resources are located (Table 5.21-1). Potential visual and/or audible effects would also be the highest under Alternative B. However, if the optional sea ice road were included under Alternatives C, D, and E, then these alternatives would have the potential to indirectly impact the same number of documented cultural resources as Alternative B. Without the sea ice road option, Alternatives D and E would indirectly impact the fewest documented cultural resources; however, Alternative C would visually and audibly impact the fewest cultural resources.

Alternatives B and C would have the potential to impact the greatest number of undocumented cultural resources. Alternative C has a larger construction footprint (e.g., 50 mile versus 22 mile export pipeline, and 44-mile gravel road versus 45 mile ice road) than Alternative B. However, Alternative B has more components located near the coast, where the potential for encountering undocumented cultural resources would be greater. Alternatives D and E would have less potential to impact undocumented cultural resources.

If previously unidentified archaeological and/or historic-built environment resources are encountered during activities related to the project, the contractor should cease work immediately at that location and take all reasonable steps to secure the location until management of the resource can be resolved. In the event that human remains are discovered, excavations shall continue only to the extent necessary to verify that the remains are human. After verification, excavations in the vicinity should cease and the contracting agency notified. Following notification of the existence of cultural material and/or human remains, a qualified professional archaeologist should provide an evaluation of the nature of the findings and assist ExxonMobil and the contractor for the proper treatment and management of those resources, in consultation with tribal governments, NSB IHLC, the Corps, and SHPO.

A PA is being developed to specifically address identification, documentation, and mitigation of historic properties once a preferred alternative is selected, in accordance with Section 106 of the NHPA. The PA will further detail agreed-upon measures, developed in consultation with identified Section 106 consulting parties, for specific management of cultural resources throughout the life of the project, including plans for mitigation, resolution, and management of inadvertent discoveries during project activities.

5.22 SUBSISTENCE AND TRADITIONAL LAND-USE PATTERNS

This section provides an analysis of the potential impacts of the proposed project on Kaktovik and Nuiqsut subsistence and traditional land use patterns and activities addressed in Section 3.22, including potential impacts that may affect sharing of resources from Kaktovik and Nuiqsut with Anaktuvuk. The key findings for Subsistence and Traditional Land-Use Patterns are summarized below with a brief summary of the differentiating effects.

Key Impact Findings and Differentiators Among Alternatives

Key Findings:

Alternatives B and E: Minor impacts to the harvest amount of caribou for Kaktovik and bowhead whale for Nuiqsut are probable and would last for two years or more. Impacts would be localized to the study area. Impacts to fish and seal harvests for Kaktovik would be possible but limited in geographic extent. Impacts to other resources would not be likely and if they occurred would be limited in geographic extent. Applicant-proposed mitigation (e.g., conflict avoidance agreements between the Applicant and the AEWC restricting barge activities during the bowhead whale hunting season and employing marine mammal observers) would reduce potential impacts on bowhead whales adequately to ensure no loss of bowhead whale harvests for the community of Nuiqsut.

Alternatives C and D: Minor impacts to the harvest amount of caribou for Kaktovik are probable and would last for two years or more. Impacts would be localized to the study area. Impacts to fish harvest for Kaktovik would be possible but limited in geographic extent. Impacts to all other resources for Kaktovik and all resources in Nuiqsut are not likely and if they occurred and would be limited in geographic extent.

Alternative A: Minor impacts to the harvest amount of caribou are likely and would last for two years or longer. Impacts would be limited in geographic extent.

Differentiators:

- User avoidance would likely be higher in Alternatives B and E due to coastal infrastructure and barging activity. Increased disturbance to caribou may result from increased helicopter activity in Alternative E.
- Impacts to Kaktovik caribou harvests would likely be higher in Alternative C due to more widespread disruption, increased caribou displacement, and decreased hunter success as a result of the gravel access road.
- Alternatives C and D would be unlikely to have any impacts to marine resource harvest due to movement of project infrastructure away from the shoreline and the absence of barging activity.

5.22.1 Methodology

The subsistence environmental consequences analysis considers potential impacts for each alternative based on how each phase of development (construction, drilling, and operation) could affect subsistence uses for Kaktovik and Nuiqsut. The following subsistence impact categories are used to address impacts to subsistence uses.

5.22.1.1 Subsistence Use Areas

If a portion of a community's subsistence use area were within the project footprint, then a direct effect on subsistence use would occur. With the exception of downstream effects, the farther a community's subsistence use area is from the project area, the less the potential exists for a direct impact on residents' subsistence uses.

5.22.1.2 Resource Availability

Successful subsistence harvests depend on continued resource availability in adequate numbers and health in traditional use areas. Subsistence availability is affected by resource mortality or health changes, displacement from traditional harvest locations, or contamination (including actual and/or perceived contamination of resources and habitat or habituation of resources to development activities). When possible, impacts to resource availability are based on identified impacts in Section 5.9, Birds; Section 5.10, Terrestrial Mammals; Section 5.11, Marine Mammals; and Section 5.12, Fish, Essential Fish Habitat, and Invertebrates.

5.22.1.3 User Access

Successful subsistence harvests depend on continued access to subsistence resources without physical, regulatory, or social barriers. Access could be negatively affected or enhanced with a project.

5.22.1.4 Competition

Changes in access can result in changes in competition for resources. Increased access to an area may result in more competition for resources from outsiders and/or from community or nearby community residents who did not previously use the area. A decrease in access may decrease competition in the potentially affected area and introduce additional competition in new areas because harvesters can no longer access previously used hunting or fishing areas. A decrease in resource availability may result in increased competition among harvesters as they try to meet their harvest needs from a depleted or displaced resource stock.

5.22.1.5 Costs and Time

Displacement of resources, resource population decline, competition, and economic changes can affect costs of subsistence harvest activities. Harvest activity costs are likely to be directly related to distance traveled. Increased travel distances or time required to harvest subsistence resources could result in increased safety risks. Job opportunities from a development activity could result in increased income to support subsistence activities. Time available for subsistence activities can be affected by a development activity; new local job opportunities and/or rising local costs of living may cause harvesters to work for lower wages and/or work longer hours, affording less time for subsistence activities. Time for subsistence can also be affected by leave policies associated with available jobs.

5.22.1.6 Culture

Harvests of local resources are dependent on subsistence skills. Such skills are transmitted between generations largely through multigenerational harvesting, processing, and sharing activities. Disruption of harvest activities can also disrupt learning and transmission of subsistence skills. Harvesting activities, including distribution of harvest products, foster and maintain social ties that are also important to overall wellbeing. Disruption of harvest activities can weaken social ties by reducing social interactions.

5.22.1.7 Impact Evaluation Criteria

Impacts to subsistence and traditional land use were evaluated as a function of their severity. Impacts were considered more severe to the extent that they were large in magnitude, long in duration, likely to occur, and geographically extensive. Table 5.22-1 depicts the subsistence and traditional land use impact evaluation criteria. This table was used in the analysis to determine the magnitude, duration, potential, and geographic extent of impacts of each project alternative on subsistence uses. Under each alternative, impacts were analyzed for each subsistence resource of concern (caribou hunting, bowhead whale hunting, seal hunting, fish harvesting, and waterfowl harvesting; see Section 3.22.1) and for each study community (Kaktovik and Nuiqsut).

Table 5.22-1: Impact Criteria—Subsistence and Traditional Land Use Impact[a]

Impact Category	Intensity Type	Specific Definition for Subsistence
Magnitude – Resource Importance	Major	Impact affects subsistence uses of resources, contributing a high amount to either material or cultural measures (see Table 5.22-5).
	Moderate	Impact affects subsistence uses of resources, contributing a moderate amount to either material or cultural measures (see Table 5.22-5).
	Minor	Impact affects subsistence uses of resources, contributing a minor amount to either material or cultural measures (see Table 5.22-5).
Magnitude – Harvest Amounts	Major	Potentially affected area provides >50% of average annual harvests for a single resource.
	Moderate	Potentially affected area provides 25—50% of average annual harvests for a single resource.
	Minor	Potentially affected area provides <25% of average annual harvests for a single resource.
Duration	Long term	Impact lasts >2 years.
	Medium term	Impact lasts for 1 to 2 years.
	Temporary	Impact lasts <1 year.
Potential to Occur	Probable	Impact occurs under typical operating conditions.
	Possible	Impact may occur under typical operating conditions.
	Unlikely	Impact would be unlikely to occur.
Geographic Extent	Extensive	> 50% of harvester respondents[b] reported use areas within the project area (i.e., affects user access and subsistence use areas)
	Local	25% to 50% of harvester respondents[b] reported use areas within the project area (i.e., affects user access and subsistence use areas)
	Limited	<25% percent of harvester respondents[b] reported use areas within the project area (i.e., affects user access and subsistence use areas)

[a] SRB&A developed the impact evaluation criteria based on impact criteria developed by MMS (2003), other resource analyses in this Final EIS, and SRB&A for this and other impact analyses.

[b] Number of respondents derived from data collected for SRB&A 2010a.

Evaluation Criteria—Magnitude

The magnitude of an impact was measured by the average percentage of annual harvest amounts occurring in the potentially affected area, as well as by the material and cultural importance of the potentially affected resource, using methods discussed in the following section (Impact Evaluation—Magnitude). As discussed in Wolfe et al.(2000), the mean annual harvest variability for all subsistence resources in Kaktovik and Nuiqsut is 41 percent; specific resources have higher or lower rates of variability (27 percent for caribou and 74 percent for marine mammals). For the harvest amount magnitude, a major impact was considered to occur if affected harvest areas represented an annual average harvest of >50 percent for a single resource, a moderate impact if they represented 25 percent-50 percent of the average annual harvest, and a minor impact if they represented less than 25 percent of the average annual harvest. These data were calculated using harvest number by place name location data available from NSB Department of Wildlife (2003, 2006, 2010b) and ADF&G Division of Subsistence (2003a). These data are only available for caribou for the community of Kaktovik and bowhead whales for Nuiqsut and Kaktovik. The methods used to determine impact magnitude are discussed in further detail below (Impact Evaluation—Magnitude).

Evaluation Criteria—Geographic Extent

The subsistence impact analysis measures geographic extent in terms of the percentage of harvesters potentially affected rather than by the percentage of overall use areas affected because the size of an affected area is irrelevant if the area provides high harvest amounts, if subsistence users have a traditional or cultural connection to the use area, or if residents travel to the use area to harvest resources not available elsewhere. The extent of an impact was measured by the number of respondents who reported use areas for the potentially affected resource in the project area (see below under Impact Evaluation—Extent) during fieldwork conducted by SRB&A (2010a).For this analysis, impacts potentially affecting less than 25 percent of harvesters are considered limited in extent; impacts affecting between 25 percent and 50 percent of harvesters are considered local in geographic extent; and impacts affecting more than 50 percent of harvesters are considered extensive in extent (Table 5.22-1). The methods used to determine the extent of impacts related to the Point Thomson Project are discussed below.

Evaluation Criteria—Duration

Duration impact categories were based on impact criteria developed by MMS (2003, 2007). Under the subsistence impact analyses, impacts would be temporary if they last less than 1 year, medium term if they last between 1 and 2 years, and long term if they last more than 2 years. Because impacts on subsistence are generally ongoing and the nature of impacts (e.g., traffic, noise, infrastructure, regulations) are similar over the different phases of a project (i.e., construction, drilling, and operation), the impact evaluation criteria apply to all phases of the project under each alternative, rather than individual phases.

Evaluation Criteria—Potential to Occur

In the subsistence impact analyses, potential to occur applies to the subsistence impact in general and not to the ranges of potential effects indicated under the extent or magnitude categories (i.e., impacts on Kaktovik caribou hunting, not impacts on 39 percent of caribou harvesters, would be probable). The potential for an alternative to affect a higher or lower percentage of harvests (magnitude) or harvesters (extent) is discussed in the text under each alternative.

Biological impacts on subsistence resources are relevant to and incorporated into the subsistence impact evaluation; however, impacts on subsistence resources and subsistence harvesters would not be identical. While potential impacts to subsistence resources may be identified as minimal from a biological standpoint, localized changes in resource access and availability, including perceived changes in resource health due to development, can have larger effects on subsistence uses. Harvesters rely on subsistence resources being in community use areas at the expected times of year; even a small change in resource distribution, while not detrimental to overall resource health and abundance, can result in reduced harvest success for local hunters and therefore have greater impacts on subsistence.

The subsistence impact evaluation analysis considered exceptions to these criteria (i.e., magnitude, duration, potential, and extent) where impacts did not relate to a particular subsistence resource, or where additional factors contributed to a resource's or a use area's importance. The detailed approaches taken to categorize the material and cultural importance of subsistence resources in each community and percentage of harvest amounts (for determination of impact magnitude) and the percentage of harvesters (to determine impact extent) are discussed in the following two sections.

Impact Evaluation—Magnitude

The subsistence analysis measures the magnitude of an impact on subsistence uses using two indicators: harvest amounts and resource importance. The two magnitude indicators are equally important and should be considered together when analyzing overall magnitude of an impact (i.e., the magnitude of an impact on a subsistence use may be major in terms of potential effects on harvest amounts, but minor in terms of resource importance, and vice versa).

Harvest Amounts

In the case of the Point Thomson Project, the primary resource of concern for impacts on harvest amounts is Kaktovik caribou. Harvest amount by location data are only available for caribou (in Kaktovik) and bowhead whales (in Kaktovik and Nuiqsut). Because documented Nuiqsut and Kaktovik uses of the project area for harvests of resources other than caribou (for Kaktovik) and bowhead whales (for Nuiqsut) are relatively minor (see Section 3.22), this analysis assumes that the magnitude of impacts on harvest amounts for resources other than caribou and bowhead whales resulting from the Point Thomson Project would be limited (e.g., less than 25 percent). In addition, it is assumed that the Applicant-proposed mitigation (e.g., conflict avoidance agreements between the Applicant and the AEWC restricting barge activities during the bowhead whale hunting season and employing marine mammal observers) would reduce potential impacts on bowhead whales adequately to ensure no loss of bowhead whale harvests for the community of Nuiqsut, and therefore average annual harvest amounts for bowhead whales in potentially affected areas were not calculated.

This subsistence impact analysis determines the magnitude of impacts on caribou harvest amounts associated with the Point Thomson Project based on two potential avoidance and displacement areas. The first possible area of avoidance and displacement would be in the area west of Brownlow Point to Bullen Point and could affect caribou harvests associated with the Point Thomson and Bullen Point harvest place name locations. The second possible area of avoidance and displacement includes the area around Brownlow Point and Canning River delta to Bullen Point and could affect harvests associated with the Point Thomson, Bullen Point, Brownlow Point, and Canning River delta place name locations. Because it is not possible to determine the exact level of potential caribou displacement or user avoidance, the analysis provides the average annual harvest amounts (in terms of percentage of total harvests) for these two areas rather than analyzing impacts based on a projected maximum potential harvest loss.

As shown in Section 3.22.4.1, the two harvest place name locations in the project area (Point Thomson and Bullen Point) represent a small percentage of total caribou harvests over all study years (between 2 and

6 percent annually during successful harvest years, or an average of .8 percent over all study years) accounting for 16 harvested caribou (Figures 3.22-5 and 3.22-6). Harvests at these locations were reported during 4 of the 18 available study years. Two harvest place name locations just east of the project area (Brownlow Point and Canning River delta) have accounted for a greater percentage of reported caribou harvests over the years (between 1 and 67 percent annually, or an average of 10 percent over all study years), with residents reporting harvests of 118 caribou at these locations during all available study years (Figures 3.22-5 and 3.22-6). These harvest data are based on reported harvests that have not been extrapolated to represent community-wide harvest estimates; therefore, the actual number of caribou harvested in the above-mentioned areas is likely higher than the numbers reported. Furthermore, the harvest place name locations depicted on Figures 3.22-4 through 3.22-8 are not exact harvest sites and may represent a larger area; it is possible that a portion of the Brownlow Point or Canning River delta harvests may have occurred in areas to the west (or east) of those locations. Thus, disturbances in the eastern portion of the project area (e.g., around the East Pad) could have a greater potential to affect caribou harvests than those in the western portion of the project area, especially if those disturbances caused more than localized displacement of caribou.

Based on available harvest place name location data, hunter avoidance or reduced caribou availability in the first potential area of displacement and avoidance (Bullen Point and Point Thomson) could affect an average of 0.8 percent of the annual caribou harvest (average percentage of harvests at the Point Thomson and Bullen Point). During successful harvest years (4 of 18), these locations provided between 2 and 6 percent of the total harvest (Figures 3.22-7 and 3.22-8); therefore impacts on harvest amounts in the first potential area of displacement and avoidance may not occur on a yearly basis but could potentially affect greater than 0.8 percent (up to 6 percent) of the caribou harvest in any given year. Assuming an average annual harvest of 150 caribou, and an average per capita harvest of 123 edible pounds of caribou annually (see Section 3.22.4.1), impacts in the first potential area of displacement and avoidance could affect harvests of an average of 1.2 caribou annually, or 1 pound of caribou per capita per year.

If caribou displacement extends beyond the project vicinity and results in displacement from or hunter avoidance of coastal areas in the second area of potential avoidance and displacement (Brownlow Point and Canning River west to Bullen Point), then these impacts could affect an average of 10.8 percent of the annual caribou harvest. During successful harvest years (16 of 18), the Brownlow Point and Canning River delta locations provided between 1 and 67 percent of the total harvest; therefore harvest losses in the second potential area of displacement and avoidance may not occur on a yearly basis and may not approach the average annual harvest of 10 percent but could potentially affect a much higher percentage of the caribou harvest during certain years when caribou are not available elsewhere. Assuming an average annual caribou harvest of 150 caribou, and an average per capita harvest of 123 edible pounds of caribou (see Section 3.22.4.1), impacts related to reduced caribou availability or user avoidance could affect total harvests of 16 caribou annually, or 13.3 pounds of caribou per capita per year.

It would be unlikely that any alternative would result in total user avoidance of the project area or total displacement of caribou from the coast during the entirety of the hunting season. In addition, the above calculations do not take in to account that hunters would likely compensate, at least partially, for reduced harvests in the project area by harvesting additional caribou elsewhere. Therefore, impacts on harvest amounts would not be expected to approach 0.8 percent or 10.8 percent on an annual basis.

Effects on harvest amounts related to user avoidance are most likely to occur under Alternatives B and E, because of the proximity of project infrastructure to the coast and use of barges under this alternative increasing the likelihood of user avoidance; impacts related to resource availability are most likely to occur under Alternative C, because disruption of caribou would be expected to be most widespread under this alternative

(Section 5.10, Terrestrial Mammals). The specific impacts and the potentially affected harvest amounts under each project alternative vary depending on alternative design (see individual alternative discussions starting with Section 5.22.1.9).

Resource Importance

The purpose of this discussion is to establish the material and cultural importance of subsistence resources in Kaktovik and Nuiqsut based on available quantitative measures. In the subsistence impact evaluation analysis, the material and cultural importance of subsistence resources, in addition to potentially affected harvest amounts, informed the magnitude of an impact. While all subsistence activities and resources are of high importance to a community, the importance of individual resources relative to one another varies according to material and cultural measures. The ADF&G, Division of Subsistence, has collected community harvest data in the study region since the 1980s. These data allow for the quantitative measurement of certain aspects of cultural and material importance of subsistence resources used in this analysis. This analysis is only one method of quantitatively measuring the importance of subsistence resources and does not take into account a multitude of factors for which quantitative data do not exist. Rankings of resources under high, medium, and low importance should be viewed only in terms of the indicators presented here, and not in terms of overall importance. Subsistence harvesters in Kaktovik and Nuiqsut likely view all of the resources discussed in this section as important to their community and/or individual health and identity.

Material Importance

In this analysis, material importance was measured in terms of a resource's contribution toward each community's total subsistence harvest (i.e., edible pounds for each resource divided by the total edible pounds for all resources). This analysis uses averages based on ADF&G harvest data for comprehensive (i.e., all resources) study years; additional more recent harvest data are available from the NSB and are provided in Section 3.22. For Kaktovik, comprehensive ADF&G study years are available for 1985, 1986, and 1992; for Nuiqsut, comprehensive ADF&G study years are available for 1985 and 1993. Table 5.22-2 shows the average percentage that each resource category contributed to total subsistence harvests (in terms of pounds of usable weight) harvested by residents of each community for all available ADF&G study years. The majority of community subsistence harvests come from a relatively small number of resources. Table 5.22-2 breaks subsistence resources into categories of major, moderate, and minor based on their contributions toward the total harvest. All resources contributing less than one percent to the total harvest are not included in the table and are considered minor in terms of material importance. Resources that are considered major (e.g., contributing over 9 percent each of the total harvest) in terms of material importance for Kaktovik are bowhead whales, caribou, Dolly Varden, and seals; for Nuiqsut, these resources are caribou, whitefish (including arctic cisco), and bowhead whales.

Table 5.22-2: Average Resource Contribution Over All Available Study Years			
Kaktovik		Nuiqsut	
Resource	% of Total Harvest	Resource	% of Total Harvest
Major Resources (in terms of % of pounds of usable weight)			
Bowhead Whale[a]	38	Caribou	35
Caribou	27	Whitefish[b]	33
Dolly Varden	10	Bowhead Whale[a]	17
Seal	9		
Moderate Resources (in terms of % of pounds of usable weight)			
Whitefish[b]	3	Seal	3
Geese	3	Geese	3
Moose	2	Moose	3
Dall Sheep	2	Burbot	2
Muskox	2	Dolly Varden	2
Grayling	2		
Minor Resources (in terms of % of pounds of usable weight)			
Upland Birds	1	Upland birds	1
Polar Bear	1		

Sources: ADF&G 2011b (ADF&G study years 1985, 1986, and 1992 for Kaktovik; 1985 and 1993 for Nuiqsut)

Note: Table only includes resources that contribute one percent or more toward the total harvest for at least one study community. All other resources contributed an average of less than one percent and are categorized as “minor.”

[a] Averages include unsuccessful bowhead whale harvest years in Kaktovik and Nuiqsut.

[b] Includes arctic cisco.

Cultural Importance

ADF&G data that can be used to quantitatively measure the cultural importance of subsistence resources include data related to participation (percent of households attempting harvests of each resource) and sharing (percent of households receiving each resource). These measures were chosen as informing the cultural importance of subsistence resources because participation in subsistence activities promotes the transmission of skills from generation to generation, and sharing of subsistence resources between households strengthens cohesion in the community and region. Cultural importance of resources includes a multitude of other factors, including harvesting and processing activities, transfer of knowledge, satisfaction of eating traditional food, continuity of harvesting in traditional places, and harvesting resources unique to an area. Kaktovik, for example, is unique among coastal North Slope communities for their regular harvests of Dall sheep. While quantitative data have not been collected systematically for these measures, they are still considered in assessing potential impacts in this environmental consequences analysis.

Table 5.22-3 shows the average percentage of households attempting harvests of each resource for all available study years, and Table 5.22-4 shows the average percentage of households receiving resources in each community for all available study years. The tables break subsistence resources into categories of major, moderate, and minor, based on their contributions toward participation and sharing. Resources considered to contribute highly to cultural importance were those with the majority (50 percent or more) of households either sharing or participating in the harvests of that resource. For Kaktovik, these resources were caribou, Dall sheep, muskoxen, Dolly Varden, bowhead whales, seals, whitefish, geese, ducks, upland game birds, and wood; for Nuiqsut, these resources were caribou, bowhead whales, seals, whitefish, arctic grayling, burbot, geese, upland game birds, and berries. Resources of moderate (11 percent to 49 percent of households) and minor (10 percent or less of households) cultural importance are also shown in Table 5.22-3 and Table 5.22-4.

Table 5.22-3: Average Percentage of Households Attempting Harvests, All Available Study Years

Kaktovik		Nuiqsut	
Resource	% of Households	Resource	% of Households
Major Resources			
Dolly Varden	81	Caribou	82
Caribou	71	Geese	82
Upland Game Birds	65	Whitefish	74
Wood	64	Grayling	67
Whitefish	62	Upland Game Birds	66
Geese	59	Burbot	61
Bowhead Whale	54	Wood	50
Seal	53	Berries	50
Ducks	50		
Moderate Resources			
Squirrel	33	Dolly Varden	48
Dall Sheep	27	Salmon	44
Fox	21	Moose	43
Berries	18	Seal	42
Cod	14	Ducks	37
Wolverine	14	Fox	35
Wolf	12	Squirrel	31
Grayling	11	Bowhead Whale	30
Plants/Greens/Mushrooms	11	Wolverine	26
Muskox	10	Bird Eggs	23
		Wolf	20
		Brown Bear	19
		Smelt	14
		Plants/Greens/Mushrooms	12
Minor Resources			
Bird Eggs	9	Polar Bear	9
Moose	7	Swan	8
Beluga Whale	6	Walrus	7
Polar Bear	5	Cod	7
Walrus	4	Beluga Whale	5
Salmon	4	Weasel	5
Marmot	4	Marmot	2
Brown Bear	3	Dall Sheep	0
Flounder	3	Muskox	0

Table 5.22-3: Average Percentage of Households Attempting Harvests, All Available Study Years

Kaktovik		Nuiqsut	
Resource	% of Households	Resource	% of Households
Swan	2	Mink	0
Land Otter	2		
Mink	2		
Burbot	1		
Weasel	1		

Sources: ADF&G 2011 (ADF&G study years 1985, 1986, and 1992 for Kaktovik; 1985 and 1993 for Nuiqsut).
Note: Blank cells indicate data not available.

Table 5.22-4: Average Percentage of Households Receiving Resource, All Study Years			
Kaktovik		Nuiqsut	
Resource	% of Households	Resource	% of Households
Major Resources			
Bowhead whale	87	Bowhead Whale	98
Caribou	85	Whitefish	82
Dall Sheep	69	Caribou	70
Whitefish	67	Seal	56
Seal	66		
Geese	58		
Muskox	53		
Moderate Resources			
Dolly Varden	49	Walrus	49
Upland Game Birds	49	Geese	48
Ducks	45	Moose	44
Walrus	36	Burbot	44
Berries	29	Polar Bear	41
Moose	28	Ducks	37
Beluga Whale	26	Salmon	35
Wood	21	Beluga Whale	32
Squirrel	19	Grayling	31
Grayling	17	Berries	29
Polar Bear	16	Brown Bear	27
Salmon	11	Dolly Varden	26
		Smelt	24
		Bird Eggs	23
		Upland Game Birds	19
		Dall Sheep	13
Minor Resources			
Cod	9	Muskox	8
Bird Eggs	9	Cod	7
Plants/Greens/Mushrooms	6	Wolf	6
Burbot	5	Plants/Greens/Mushrooms	6
Brown Bear	4	Squirrel	5
Marmot	4	Wolverine	5
Greenling	2	Fox	4
Lingcod	2	Sheefish	3
Pike	2	Swan	3
Sculpin	2	Wood	3
Wolverine	2	Marmot	2

Table 5.22-4: Average Percentage of Households Receiving Resource, All Study Years			
Kaktovik		Nuiqsut	
Resource	% of Households	Resource	% of Households
Fox	2	Weasel	0
Wolf	1		
Weasel	1		
Swan	0		

Sources: ADF&G 2011 (ADF&G study years 1985, 1986, and 1992 for Kaktovik; 1985 and 1993 for Nuiqsut)

Combining Material and Cultural Measures of Importance

Table 5.22-5 integrates the results of the material and cultural importance analyses, and organizes subsistence resources for each community into categories of major, moderate, and minor importance. Those resources that were identified as major resources in terms of material or cultural importance were considered to be major resources overall. In both Kaktovik and Nuiqsut, caribou, bowhead whales, seals, whitefish, geese, and upland birds all rank high in terms of material and cultural contributions. In addition, Dall sheep, muskoxen, Dolly Varden, ducks, and wood are major resources in Kaktovik, and arctic grayling, burbot, and berries are major resources in Nuiqsut.

Table 5.22-5: Material and Cultural Importance of Subsistence Resources, All Study Years					
Major Resources		Moderate Resources		Minor Resources	
Kaktovik	Nuiqsut	Kaktovik	Nuiqsut	Kaktovik	Nuiqsut
Caribou	Caribou	Moose	Dall Sheep	Brown bear	Muskox
Dall Sheep	Bowhead Whale	Beluga	Moose	Burbot	Cod
Muskox	Seal	Polar Bear	Brown Bear	Flounder	Sheefish
Bowhead Whale	Whitefish	Walrus	Beluga	Greenling	Swan
Seal	Grayling	Grayling	Polar Bear	Lingcod	Marmot
Whitefish	Burbot	Salmon	Walrus	Pike	Mink
Dolly Varden	Geese	Cod	Dolly Varden	Sculpin	Weasel
Geese	Upland Game Birds	Fox	Salmon	Bird eggs	
Upland Game Birds	Berries	Squirrel	Smelt	Swan	
Ducks		Wolf	Ducks	Marmot	
Wood		Wolverine	Bird Eggs	Mink	
		Berries	Fox	Weasel	
		Plants/Greens/ Mushrooms	Squirrel	Land otter	
			Wolf		
			Wolverine		
			Wood		
			Plants/Greens/ Mushrooms		

Sources: ADF&G 2011b (ADF&G study years 1985, 1986, and 1992 for Kaktovik; 1985 and 1993 for Nuiqsut)

Impact Evaluation—Geographic Extent

As discussed in Section 5.22.1.8, the primary subsistence impacts of the proposed project would be related to project infrastructure, noise/traffic, contamination, and hunting regulations. These development activities could result in impacts on subsistence use areas, resource availability, and user access, and could cause effects on competition for subsistence resources, costs and time required to harvest subsistence resources, and culture. Ultimately, these impacts could result in impacts on local harvesters. For the subsistence impact analyses, the geographic extent of an impact was based on the percentage of harvesters reporting use areas in the project area during one or more years between 1996 and 2006. The method to determine geographic extent is discussed below.

Percentage of Harvesters

The geographic extent of an impact is measured as the percentage of harvesters reporting use areas in the project area during one or more years between 1996 and 2006. Extensive impacts occur if greater than 50 percent of harvesters reported subsistence use areas in the project area; local impacts occur if 25 percent to 50 percent of local harvesters reported subsistence use areas in the project area vicinity, and limited impacts occur if less than 25 percent of harvesters reported subsistence use areas in the project area. The percentage of harvesters potentially affected was determined by measuring the number of harvesters who reported use areas within the Point Thomson Project area during SRB&A's Kaktovik and Nuiqsut mapping interviews in 2004, 2005, and 2006 (SRB&A 2010a). The Point Thomson Project area is the coastal area west of Brownlow Point to the western end of the project footprint and, in the case of Alternatives B and E, also includes the proposed coastal barging route buffered by 4 km on either side (see Figure 5.22-1).

Under Point Thomson Project Alternatives B and E, barge traffic would follow a coastal route between Point Thomson and Prudhoe Bay. The barges would navigate within the bounds of the favorable draft and sea conditions along the proposed route, avoiding any potential encounters with other ships, boats, or watercraft. In order to determine the percentage of marine mammals harvesters potentially affected by barging activities, the proposed barge route was buffered at a distance of 4 km (2.48 miles) on either side. The buffer was to account for any variation in barge traffic from the proposed route, potential deflection of bowhead whales from barge traffic (see Section 5.22.1.8, Noise/Traffic, Resource Availability), and potential avoidance of hunters around barges (see Section 5.22.1.8, Noise/Traffic, User Access).

Because the primary impacts on subsistence would be expected to occur during coastal or offshore summer hunting, rather than overland winter hunting, the coastal project area extends from the coast inland 5 miles, the maximum distance residents have reported hiking or traveling inland from the coast to hunt summer caribou (SRB&A 2003c, 2010a; Figure 5.22-1).

Table 5.22-6 indicates the percentage of respondents who reported subsistence use areas in the project area, by subsistence resource. The project area for Alternatives C and D includes the coastal area west of Brownlow Point but does not include the buffered coastal barging route, while the project area for Alternatives B and E includes both the coastal hunting area and the buffered coastal barging route.

Table 5.22-6: Percentage of Harvesters Reporting 1995-2006 Use Areas[a] in the Project Area Vicinity, by Resource and Project Alternative

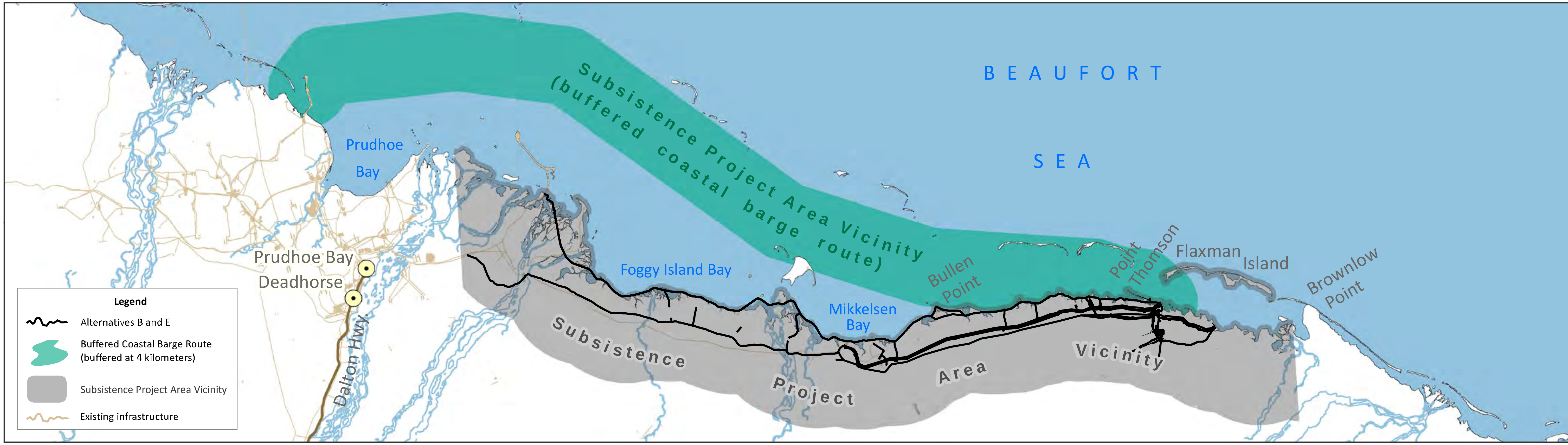
	Alternatives B and E[b] Project Area Vicinity (%)		Alternatives C and D[c] Project Area Vicinity (%)	
	Kaktovik	Nuiqsut	Kaktovik	Nuiqsut
Caribou	39	0	39	0
Bowhead Whales	0	42	0	0
Seals	5	15	3	0
Walrus	3	0	3	0
Waterfowl	5	6	5	0
Fish	8	0	8	0

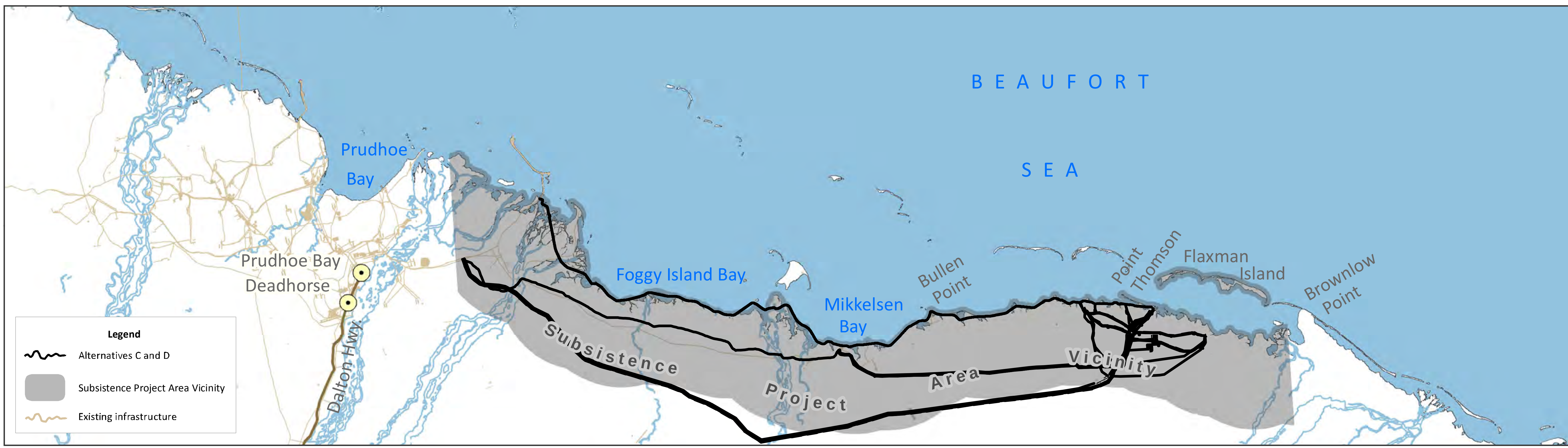
[a] The percentage of harvesters was determined based on data collected for SRB&A (2010a). The percentage represents the number of individuals who reported hunting or harvesting in the project area at least once during the study period (1995—2006).

[b] Alternatives B and E project area includes the coastal area west of Brownlow Point to the western end of the Point Thomson Project footprint and the coastal barging route buffered by 4 km on either side.

[c] Alternatives C and D project area includes the coastal area west of Brownlow Point to the western end of the Point Thomson Project footprint. It does not include the buffered coastal barging route.

As shown in Table 5.22-6, 39 percent of Kaktovik harvesters reported 1995 to 2006 caribou use areas in the project area for all alternatives and therefore impacts on caribou hunting related to the percentage of affected harvesters would be local in geographic extent. As reported in Section 3.22 and discussed in greater detail below (Section 5.22.1.8), a smaller percentage of Kaktovik hunters reported caribou use areas west of Brownlow Point during a 12-month time frame, and therefore the project would likely not affect the maximum percentage of harvesters on a yearly basis, but would occur over a longer time frame. A small percentage (less than 10 percent each) of Kaktovik harvesters reported subsistence use areas for seals, walrus, waterfowl, and fish in the project area for all alternatives.





POINT THOMSON PROJECT EIS

Figure 5.22-1
Point Thomson Subsistence Project Area Vicinity

Date: 10 August 2011
Map Author: Stephen R. Braund & Associates

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Nuiqsut bowhead whale use areas and GPS hunting tracks occur within the 4 km buffered area proposed for the Point Thomson coastal barging route (proposed under Alternatives B and E). Forty-two percent of Nuiqsut harvesters reported 1995-to-2006 bowhead whale use areas in the project area (buffered coastal barging route) under Alternatives B and E (Table 5.22-6). Bowhead whale hunting activities in the barging area occur only during certain years; 2010 bowhead whale hunting activities, for example, occurred north and east of Cross Island (Galginaitis 2011) and did not extend into or approach the project barging area. Nuiqsut whale hunters have reported that during a "normal" year, bowhead whales can be found within 15 to 20 miles of Cross Island and are generally northeast of the island (Galginaitis 2009a). Conditions during certain years (e.g., 2001, 2005, 2006, 2009) have resulted in a greater concentration of hunting activities south and east of Cross Island, sometimes extending within a couple of miles of the coast or east to Flaxman Island. In 2001, hunters reported traveling farther to scout for whales due to the whales acting "spooky," ice conditions in 2005 and 2006 constrained hunters to traveling primarily inside the barrier islands (Galginaitis 2009a). Thus, the barging route would likely overlap with Nuiqsut bowhead whale hunting activities only during years when environmental conditions or resource availability preclude hunting activities in residents' "usual" hunting areas north and east of Cross Island. If active barging occurred within 4 km of Nuiqsut residents' bowhead whale hunting efforts, then hunters could experience reduced success due to temporary changes in bowhead whale behavior and availability. Because the Applicant indicates that barge traffic would be restricted under a conflict avoidance agreement during the bowhead whaling season, impacts on bowhead whale harvesters resulting from the Point Thomson Project would be unlikely. If the conflict avoidance agreement were not in place under Alternatives B and E and these impacts did occur, they could affect 42 percent of harvesters, would be local in geographic extent, and would not be expected to occur on a yearly basis. No Nuiqsut harvesters reported subsistence use areas in the Alternative C and D project areas.

For all resources besides caribou (in Kaktovik) and bowhead whales (in Nuiqsut), less than 25 percent of harvesters reported use areas in the project area; therefore any impacts on subsistence uses of those resources would be expected to be limited in geographic extent.

5.22.1.8 Subsistence Impact Summary

The purpose of this discussion is to provide a description of the primary potential impacts of the proposed Point Thomson Project on subsistence uses. As noted in Section 3.22.1, the primary resources of concern for impact from the development of the Point Thomson Project are caribou hunting, bowhead whale hunting, seal hunting, waterfowl hunting, and fish harvesting. This analysis focuses on impacts on caribou and bowhead whale hunting because these are the most common subsistence activities in or offshore from the project area; however, this discussion includes references to potential impacts on other subsistence activities where relevant. Not all potential impacts discussed in this section are probable or expected to occur under all alternatives. In addition, the probability or magnitude of many of the impacts discussed in this section would likely be reduced through the implementation of mitigation measures. These instances are noted throughout the discussion where relevant.

Specific impacts on subsistence uses vary between alternatives; these differences are discussed individually under each alternative discussion. The following sources informed the impact analysis and discussion (for additional discussion of the data sources for this Final EIS, see Section 3.22.2 and Table H-22 in Appendix H, Data Adequacy Tables):

- Scientific research regarding the effects of development on subsistence resources and uses (Haynes and Pedersen 1989, MBC 1997, Pedersen et al. 2000, NRC 2003a, BLM 2004, EPA 2009a)

- The conclusions of the wildlife sections provided in this chapter
- The observations of North Slope subsistence users regarding development-related impacts (Kaleak 1996; Long 1996; SRB&A 2009, 2010b, 2011)

SRB&A (2009) includes the results of 215 systematic interviews with Barrow, Nuiqsut, Atqasuk, and Wainwright harvesters regarding the impacts and benefits of oil and gas development; it also includes a review of scoping testimony from 1975 to 2006 for all North Slope communities (including Kaktovik). Kaleak (1996) and Long (1996) provide histories of whaling in Kaktovik and Nuiqsut, respectively, with an emphasis on factors affecting bowhead whale hunting success. SRB&A (2010b, 2011) summarized the observations of Nuiqsut caribou hunters regarding impacts related to ConocoPhillips' CD4 and other Alpine Satellite developments.

As noted above, while potential impacts to subsistence resources may be identified as minimal from a biological standpoint, localized changes in resource access and availability, including perceived changes in resource health due to development, can have larger effects on subsistence uses. This is because subsistence users rely on healthy subsistence resources being present in traditionally used areas, and harvesters are often limited in their ability to access resources if they are not present in traditional use areas at the expected time of year. Nuiqsut hunters, for example, have noted that despite caribou being present in the Colville River delta area at expected times in the summer, helicopter and other disturbances have caused localized displacement and resulted in the caribou moving farther inland from the riversides, where residents wait for them (SRB&A 2010b, 2011). This has resulted in reduced harvest success for some hunters or has required greater effort (e.g., more frequent or longer trips) to ensure a successful harvest (SRB&A 2010b, 2011). Thus, the inclusion of subsistence harvester observations and knowledge is a necessary source of information about the impacts of development on subsistence. The local knowledge included in this Final EIS was derived primarily from individual interviews conducted by SRB&A with Kaktovik harvesters in March 2003 in association with previous Point Thomson efforts. The time frame for those interviews represented "current" subsistence use and knowledge, focusing on the last 10-year, or 1994-to-2003, time period. Comments regarding the Point Thomson Project during those interviews were related to a previous Point Thomson Project with a different project design. Therefore, certain aspects of these comments may no longer be relevant due to differences in the current project design (e.g., smaller facilities, elimination of a gravel causeway and extensive dredging). Other recent sources of local knowledge relevant to this Final EIS include a previous Point Thomson EIS meeting on caribou held in December 2002; the Nuiqsut Subsistence Caribou Monitoring Study (SRB&A 2010b, 2011); a North Slope Borough-funded study entitled *Impacts and Benefits of Oil and Gas Development to Barrow, Nuiqsut, Wainwright, and Atqasuk Harvesters* (SRB&A 2009); *Subsistence Mapping of Nuiqsut, Kaktovik, and Barrow* (SRB&A 2010a); scoping testimony provided at 2010 Point Thomson Project EIS public scoping meetings in Kaktovik and Nuiqsut (Appendix E); and statements made by Joseph Kaleak (Kaktovik) and Jeffrey Long (Nuiqsut) during the 1995 Arctic Synthesis Meeting (MBC 1997).

Impacts on subsistence uses resulting from the proposed project would include impacts on subsistence use areas, resource availability, and user access; these effects are discussed in further detail in the following five alternatives sections. If an alternative causes impacts on subsistence use areas (e.g., a project is built on top of an area traditionally used for subsistence), user access (e.g., a road, pipeline, regulation or policy restricts access or the project results in user avoidance), and resource availability (e.g., project activities divert or cause perceptions of unhealthy resources), additional impacts related to competition, costs and time, and culture could occur (see Section 5.22.1.1). If residents stop traveling to areas previously used for subsistence due to changes in access or resource availability, competition for subsistence resources may increase in other areas among local residents.

Furthermore, if project activities and infrastructure affect resource distribution such that residents have to travel farther to harvest the resource, then subsistence users may experience increased costs and time associated with certain subsistence activities. Overall, impacts on subsistence have the potential to decrease residents' opportunities to engage in subsistence activities (including harvesting, processing, distribution, and consumption of subsistence foods). The opportunity to engage in subsistence activities in traditional areas allows for the transmission of subsistence skills and knowledge about the environment. Disruption of harvest activities can reduce these opportunities and interactions, thus causing potential impacts on culture.

Potential sources of impacts on subsistence uses include the footprint of project infrastructure; noise and human presence related to construction and industrial activity and traffic, including ground, air, and barge traffic; contamination or perceived contamination; and regulations governing access to traditional subsistence use areas. A detailed discussion of potential impacts (subsistence use areas, resource availability, and user access) as they relate to the proposed project is provided in the following five sections by impact source, then by impact category. The subsistence impact summary discussion is organized as follows:

- Project infrastructure
    - Subsistence use areas
    - Resource availability
    - User access
- Noise/traffic
    - Resource availability
    - User access
- Contamination
    - Resource availability
    - User access
- Hunting regulations
    - Subsistence use areas
    - User access

The subsistence impact summary concludes with a summary of primary impacts and a discussion of the potential affected harvests resulting from the previously discussed impacts.

Project Infrastructure

Project infrastructure such as well pads, pipelines, and roads (both gravel and ice) have the potential to affect subsistence use areas, resource availability, and user access. However, compared to project components with linear or large footprints (e.g., roads and pipelines), construction of pads for stockpiling, storage, and water access could have less impact because they have a smaller footprint.

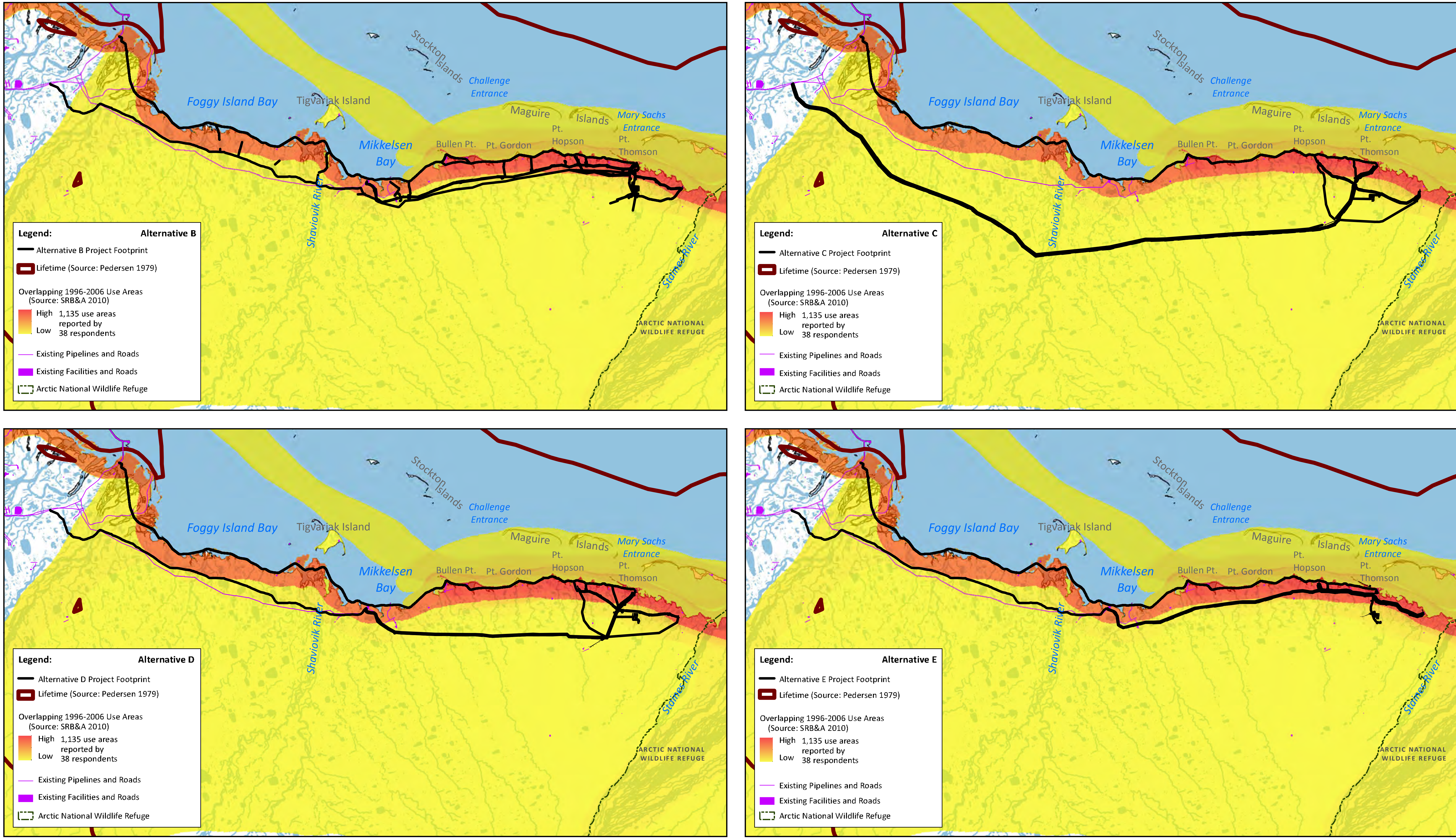
Subsistence Use Areas

The infrastructure footprint for the proposed project occurs within subsistence use areas for Kaktovik and, to a lesser extent, Nuiqsut, and therefore would result in a direct effect on subsistence use areas for those communities. Even the loss of a small percentage of a community's use area can have large effects if the use area is particularly productive for subsistence users, if subsistence users have a traditional or cultural connection to the use area, or if residents travel to the use area to harvest resources not available elsewhere. Therefore, analyzing the size of an affected area in comparison to a community's overall use area is not the most accurate way to measure the extent of an impact on subsistence use areas.

Figure 5.22-2 and Figure 5.22-3 depict Kaktovik and Nuiqsut all resources subsistence use areas with footprints for each project alternative. Project footprints for each alternative overlap with Kaktovik current (1996 to 2006) and lifetime use areas for all resources. Lifetime use areas encompass the entire project footprint under each alternative. Alternative B and E footprints would be closer to and more concentrated within Kaktovik areas of high overlapping use, whereas Alternatives C and D would be located farther from and would be less concentrated within Kaktovik areas of high overlapping use. In general, recent (1995 to 2006 and 1994 to 2003) Nuiqsut use areas are located offshore from the project and do not overlap directly with the project footprint. Lifetime (Pedersen 1979) and 1973 to 1985 (Pedersen 1986) occur along the coast and inland around the project alternative footprints, with inland overlaps occurring only west of Point Gordon.

Table 5.22-7 shows whether pre-1990 (Pedersen 1979, 1986) and post-1990 (SRB&A 2003b, 2010a; Pedersen and Linn 2005) Kaktovik and Nuiqsut use areas intersect with the Point Thomson Project footprint, by project alternative. The data vary little by alternative. All of the project alternative footprints overlap directly with Kaktovik Post-1990 subsistence use areas for caribou, fish, and wildfowl; in addition, the Alternative E footprint (specifically, the winter ice airstrip) overlaps slightly with offshore use areas for seal and walrus. Pre-1990 (lifetime to 1979) Kaktovik use area overlaps include caribou, seal (limited), polar bear, wildfowl, furbearers, and vegetation. Post-1990 Nuiqsut subsistence use areas do not overlap directly with any of the project alternative footprints (Table 5.22-7). However, pre-1990 (lifetime to 1979 and 1973 to 1986) data show each alternative overlapping with Nuiqsut use areas for caribou, bowhead (limited), seal (limited), fish, wildfowl, polar bear (limited), and furbearers.

The data presented in Table 5.22-7 and Figure 5.22-2 and Figure 5.22-3 indicate that the primary direct infrastructure overlap with subsistence use areas would be for Kaktovik caribou, fish, and wildfowl use areas; in terms of subsistence users, the primary potential impacts would be on Kaktovik caribou hunting and Nuiqsut bowhead whale hunting (see above, Impact Evaluation—Extent). Direct overlaps with subsistence use areas would be more prevalent under Alternatives B and E, which would be more concentrated within and closer to areas with high overlapping use for Kaktovik. In addition to overlaps with recent (post-1990) subsistence use areas, project infrastructure would also overlap with traditional or historic use areas for both communities for the above-listed resources as well as marine mammals (bowhead whales, polar bear, seals, and walrus), furbearers, and vegetation.



POINT THOMSON PROJECT EIS

Figure 5.22-2

Alternative Footprints with Kaktovik Subsistence Use Areas, All Resources

Date: 10 August 2011
Map Author: Stephen R. Braund & Associates

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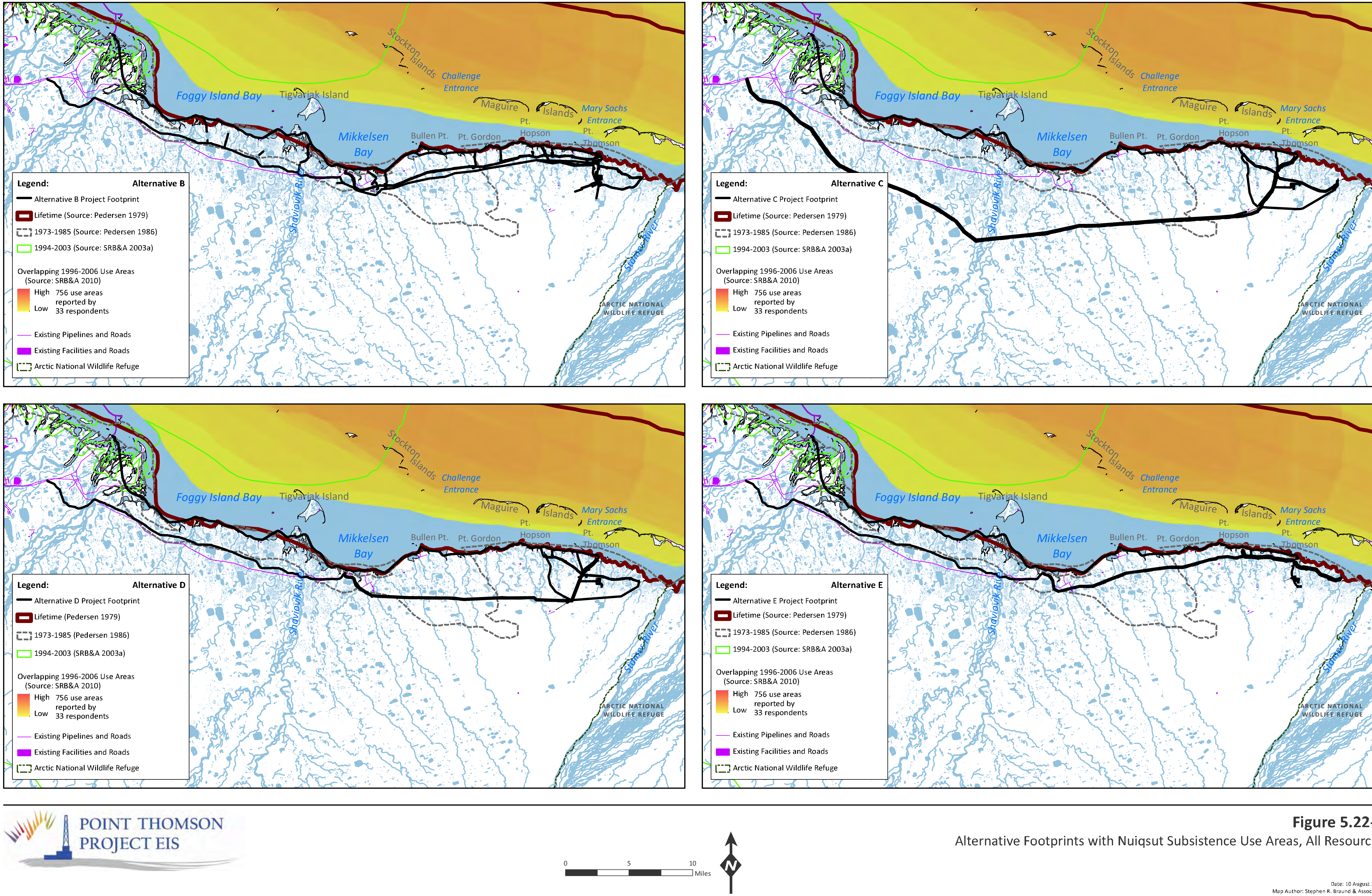

POINT THOMSON PROJECT EIS

Figure 5.22-3

Alternative Footprints with Nuiqsut Subsistence Use Areas, All Resources

Date: 10 August 2011

Map Author: Stephen R. Braund & Associates

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Table 5.22-7: Project Footprint Overlaps with Subsistence Use Areas by Alternative and Subsistence Resource, All Study Years

	Alternative B		Alternative C		Alternative D		Alternative E	
	Pre-1990	Post 1990	Pre-1990	Post 1990	Pre-1990	Post 1990	Pre-1990	Post 1990
Kaktovik								
All Resources	X	X	X	X	X	X	X	X
Caribou	X	X	X	X	X	X	X	X
Bowhead	/	/	/	/	/	/	/	/
Seal[a]	X	/	X	/	X	/	X	X
Walrus [a]	/	/	/	/	/	/	/	X
Polar Bear	X	—	X	—	X	—	X	—
Fish	—	X	—	X	—	X	—	X
Wildfowl	X	X	X	X	X	X	X	X
Furbearer	X	/	X	/	X	/	X	/
Moose	/	/	/	/	/	/	/	/
Dall sheep	/	—	/	—	/	—	/	—
Vegetation	X	—	X	—	X	—	X	—
Nuiqsut								
All resources	X	/	X	/	X	/	X	/
Caribou	X	/	X	/	X	/	X	/
Bowhead a	X	/	X	/	X	/	X	/
Seal a	X	/	X	/	X	/	X	/
Fish	X	/	X	/	X	/	X	/
Wildfowl	X	/	X[b]	/	X	/	X	/
Moose	/	/	/	/	/	/	/	/
Brown bear	/	—	/	—	/	—	/	—
Polar bear a	X	—	X	—	X	—	X	—
Furbearer	X	/	X	/	X	/	X	/
Vegetation	/	/	/	/	/	/	/	/

Sources: Pedersen 1979, 1986 (Nuiqsut only); SRB&A 2003b (Nuiqsut only), 2010a; Pedersen and Linn 2005 (Kaktovik fish only)

X Use area intersects with alternative footprint

/ Use area does not intersect with alternative footprint

— Subsistence use area data not available

[a] When use areas for these resources intersect with the alternative footprint, the amount of overlap is minimal. For Kaktovik seals and walrus, use areas only overlap with a small portion of the ice airstrip.

[b] For this alternative, the amount of overlap with the wildfowl use areas is minimal.

In the case of the proposed Point Thomson Project, subsistence harvesters from Kaktovik could be more directly affected than subsistence harvesters from Nuiqsut as they have a greater amount of current subsistence use documented within the project area (Figure 5.22-2 and Figure 5.22-3). The project area is used by Kaktovik residents primarily for the harvests of caribou and fish (additional resources harvested in the project area are discussed under the individual alternative discussions below). Kaktovik residents have reported traveling to Bullen Point specifically for the harvests of fish such as Dolly Varden, noting that it is an especially productive fishing location. Traditional uses of this area for fishing are documented in a number of sources (Jacobson and Wentworth 1982, IAI 1990a, Pedersen and Linn 2005); however, this location is not currently within Kaktovik's "usual or most productive" fishing sites (Pedersen and Linn 2005; see Appendix Q). Kaktovik caribou harvests occur along the coast to Brownlow Point and, when caribou are not available closer to the community, to Bullen Point (Section 3.22). Residents have reported a high number of overlapping caribou use areas along the coast to Bullen Point, with 39 percent of 38 Kaktovik harvester respondents interviewed in 2005 and 2006 indicating that they hunted in the coastal or offshore area between Bullen Point and Brownlow Point during one or more years during the 10 years prior to their interviews (Section 3.22, Table 3.22-4). The area is important for Kaktovik harvests of caribou because, based on existing information (SRB&A 2003c), it represents one of residents' last opportunities to locate and harvest caribou along the coast before returning to the community. However, the contribution of the project area to Kaktovik's caribou harvests, according to available data, has been somewhat limited. Over 18 study years, households reported harvests in the Bullen Point and Point Thomson locations during 4 of those years for a total of 16 harvested caribou (an average of approximately four caribou every 4 years); these data represent only reported harvests and are not community-wide estimates, and therefore the actual number of caribou harvested in those areas is likely higher than 16. The area just east of the Point Thomson Project area (Canning River delta/Brownlow Point) has provided a more substantial portion of residents' coastal caribou harvests during certain years, and a portion of those harvests may have occurred west of Brownlow Point closer to the project area (Section 3.22).

While the Point Thomson Project area is outside Nuiqsut's core subsistence use area for many key resources (e.g., caribou, arctic cisco, and moose), Nuiqsut whaling crews' bowhead whale hunting activities (see Appendix Q, Figure 30) occur from Cross Island, and bowhead whale subsistence use areas extend offshore from Point Thomson. Seal and eider hunting also occur in these areas during bowhead whale hunting, and could therefore be affected (see Appendix Q, Figures 32 and 35).

Resource Availability

In addition to resulting in a direct loss of subsistence use areas, project infrastructure has the potential to affect resource availability by causing localized displacement of caribou and fish through physical obstruction or resource avoidance. Infrastructure may cause displacement of other subsistence resources such as waterfowl and seal; however, use of the project area for harvests of these resources is relatively limited, and impacts on these resources in terms of infrastructure displacement would be expected to occur within relatively limited geographic areas (Sections 5.9, Birds, and 5.11, Marine Mammals). Impacts on subsistence uses for other resources would likely only occur if infrastructure caused widespread displacement or migratory changes. According to Section 5.12, Fish, Essential Fish Habitat, and Invertebrates, construction of ice roads, ice pads, and an ice airstrip, as well as infrastructure associated with the barge landing would not result in impacts to fish populations, including those for whitefish and Dolly Varden. Displacement of fish from temporary structures such as barges would be expected to be a temporary effect. Furthermore, use of the area by Kaktovik residents for fishing purposes is relatively limited and likely provides a small percentage of yearly fish harvests. Therefore, the resource availability for fish would not be expected to incur major impacts to subsistence due to project infrastructure, and only the potential effects to caribou are discussed below. Due to the large amount of existing infrastructure and development between Point Thomson and Nuiqsut, effects on the availability of migratory resources (such as caribou) to Nuiqsut harvesters would likely be cumulative, rather than directly causing impacts. Barge infrastructure would not be expected to cause major disruptions to fish migrations (Section 5.12, Fish, Essential Fish Habitat, and Invertebrates) and therefore should not affect Nuiqsut's harvest of arctic cisco, which migrate offshore from the Point Thomson area on their way to the Colville River delta each year.

Studies on the North Slope have shown that caribou distribution, especially among female caribou, changes around transportation corridors, with the density of females and calves increasing with distance from roads (NRC 2003a). Avoidance is especially high during the spring and early summer, and may persist through the summer (NRC 2003a). Studies in Denali National Park indicate that while caribou do not avoid the Denali Park road corridor, they do exhibit "uneasy" behavior in the immediate vicinity of the road (Yost and Wright 2001). Effects on caribou related to the Red Dog Mine road (DeLong Mountain Transportation System [DMTS]) have also been observed, with traffic on the road reportedly blocking caribou movements and unusually low numbers of caribou reported west of the DMTS (EPA 2009a). The Point Thomson development includes construction of roads and pipelines that could act as a barrier or deterrent to caribou as they travel to the coast.

Proposed Point Thomson Project export pipelines would be approximately 7 feet tall. Residents of Kaktovik and Nuiqsut have reported observing caribou unable to cross under pipelines at 7 feet due to heavy snow drifts (see Appendix Q); furthermore, infield water lines (under Alternative E only) would be placed lower to the ground. During interviews with Kaktovik harvesters in 2003, residents suggested pipeline heights of 8 to 10 feet to accommodate caribou crossing. According to Section 5.10, Terrestrial Mammals, pipelines associated with the Point Thomson Project may deflect caribou movements, especially in areas where pipelines are located less than 500 feet apart from other pipelines or roads. The placement of pipelines near roads, as proposed under some alternatives, could further impede caribou movements according to both biological studies (see Section 5.10, Terrestrial Mammals) and Nuiqsut residents' observations (Appendix Q). According to Section 5.10, Terrestrial Mammals, certain alternatives have a higher incidence of caribou movement combined with pipelines crossing or near (i.e., less than 500 feet from) roads. Alternatives C and D have higher numbers of potential "blockage areas" associated with pipelines crossing or close to roads, and a higher number of potential blockage areas in the eastern portion of the project where caribou displacement would be more likely to affect hunters.

Subsistence users have observed that the physical presence of pipelines and glare from pipelines cause caribou to change their migratory routes, thus reducing their availability to local residents (SRB&A 2009). The Applicant is proposing to use nonglare coatings on all export pipelines to help mitigate these impacts (ExxonMobil 2009a).

In addition to pipelines, gravel roads and pads could also cause caribou avoidance or displacement and may alter caribou distribution (Section 5.10, Terrestrial Mammals). Both the physical presence of roads and traffic associated with roads has the potential to displace caribou. The NRC's study on the cumulative effects of North Slope oil and gas activities reported that "the presence of a road or pipeline alone, without vehicular or human activity, can elicit avoidance" of caribou (NRC 2003a). The final supplemental environmental impact statement for the Red Dog Mine Extension–Aqqaluk Project found that despite a healthy population of caribou, studies reflect declining harvests for residents of nearby communities. Residents of Kivalina have attributed the declining harvests to the mine road (DMTS), which diverts caribou away from traditional hunting areas. Hunters indicated that the caribou sometimes follow the road rather than cross it directly (EPA 2009a).

Residents of Kaktovik have noted that caribou often congregate along the coast near Konganevik Point and Brownlow Point during the summer months, and stressed that their ability to access the coast for insect relief during the summer is important to their health and availability to coastal hunters at that time of year. Displacement of caribou from the coastline during the summer, when Kaktovik residents harvest the majority of their yearly caribou, could result in reduced caribou hunting success.

User Access

In addition to overlapping directly with community use areas, the presence of project infrastructure may affect subsistence user access either through physical obstruction or by causing user avoidance. The proposed pipelines for the Point Thomson Project have a 7-foot clearance and should allow for crossing by hunters on snowmachines; however, if snow drifts reduce the clearance between the pipeline and ground, then residents may have difficulty navigating areas with pipelines and may have to travel farther to reach subsistence hunting destinations. Physical obstruction of user access would be more likely to occur during the winter, when residents travel overland by snowmachine and would be more likely to encounter infrastructure such as pipelines and roads. However, winter use of the project area by subsistence users is relatively limited (with Kaktovik residents reporting periodic use of the area for caribou and furbearers); therefore, impacts related to user access during the winter months would likely be lower.

While the actual footprint of the Point Thomson Project overlaps with only a small portion of Kaktovik residents' highly-used subsistence areas, avoidance of the area could be at a greater distance than the footprint (e.g., the coastal area to the west of Brownlow Point); therefore, the loss of subsistence use area could be larger than the direct overlap of the project with documented use areas (Haynes and Pedersen 1989, Pedersen et al. 2000, NRC 2003a, BLM 2004, MMS 2007). Subsistence harvesters often avoid areas of development due to concerns about contamination and because of residents' discomfort about hunting near human or industrial activity (BLM 2004). Concerns about shooting near or toward pipelines could cause residents to avoid hunting along the coast past Point Thomson, even if caribou were present in those areas. Developing the Point Thomson area could result in Kaktovik hunters traveling less frequently beyond Brownlow Point due to avoidance of development, even if residents were otherwise unsuccessful harvesting caribou closer to the community. Residents' summer caribou hunting activities along the shoreline could be affected by presence of pipelines and other infrastructure, as hunters may avoid shooting toward a pipeline, and to the extent that pipelines divert caribou from coming to the coast. Other activities that occur during residents' summer caribou hunting activities, such as fishing, seal hunting, and waterfowl hunting, may also be affected if residents no longer travel to the area for caribou hunting. The following discussion includes references to studies concerning the impacts of oil and gas development on subsistence, including hunter avoidance, in other North Slope communities or during previous decades. In some respects, circumstances surrounding the current Point Thomson Project and Kaktovik may differ from those of other projects and communities. In particular, a number of studies cite hunter avoidance in Nuiqsut, where development has occurred much closer to the community and primarily affects overland travel. Thus, comparisons to other communities for the purposes of predicting potential avoidance behaviors should be viewed with these differences in mind.

The shifting of subsistence use areas away from areas of development at a distance greater than the development footprint has been documented for the community of Nuiqsut (RFSUNY 1984, IAI 1990b, Pedersen et al. 2000, MMS 2007). Pedersen et al. (2000) provides the most detailed analysis of this impact, noting that harvest location information for Nuiqsut from 1993 and 1994 “provide support for the claim of displacement from traditional hunting areas.” The report notes that 80 percent of the community’s 1993 harvest came from areas more than 16 miles from any development, and a similar pattern was noted during the following year from NSB research. According to MMS (2007), oil and gas development has the potential to divert subsistence users a distance of 5 to greater than 25 miles from facilities. Another report (IAI 1990a) describes the typical Kaktovik summer caribou hunting area as the area from the Canadian border to Tigvariak Island but noted that some hunters referred to the Canning River as their “Berlin Wall” because of oil exploration and drilling activities to the west of it. The presence of the Point Thomson Project could cause more hunters to avoid the area beyond Canning River or Brownlow Point or, for some hunters who may already avoid the area, could increase the area of avoidance. Pedersen and Coffing (1984) also noted possible avoidance of the area west of Canning River either due to increasing industrialization of the area or confusion about harvesting regulations in that area.

Hunter avoidance does not only apply to overland travel. Nuiqsut hunters have reported increased industry oversight and activity while conducting activities offshore and whalers have reported a reluctance to approach coastal or offshore developments due to security measures (Pedersen et al. 2000). Despite a lessening of security pressures, hunter avoidance of traditional safe harbors and coastal use areas (e.g., Oliktok Point, West Dock) persisted (Pedersen et al. 2000).

SRB&A (2009) summarizes the results of interviews with 215 active harvesters in Barrow, Nuiqsut, Atqasuk, and Wainwright regarding the impacts and benefits of oil and gas development. Respondents both volunteered concerns (i.e., without prompting) related to oil and gas development and identified concerns from a cued list that was developed through a review of North Slope scoping testimony, and then provided descriptions of personal experiences with the impacts and benefits of oil and gas development. Seventy-two percent of active harvester respondents in 2007 volunteered concerns about difficulties in hunting related to oil and gas development, and 68 percent (79 percent in Nuiqsut) cited personal experiences with this impact. Under the “difficulty hunting” category, respondents reported concerns related to physical and social barriers to hunting, hunting safety, increased effort required, and competition. Specifically, respondents reported social barriers to hunting (21 volunteered impacts and 112 cued impacts), including uncomfortable hunting environments due to development (14 volunteered impacts) and uncomfortable hunting environments due to nonlocals observing resident hunting activities (7 volunteered impacts; SRB&A 2009).

In addition, 61 percent of Nuiqsut respondents volunteered concerns about the impacts of oil and gas development on their ability to hunt, and 55 percent cited personal experiences with oil and gas impacts on their ability to hunt (SRB&A 2009). The most commonly volunteered impact was the loss of traditional hunting areas due to pipelines, roads, and other structures (37 volunteered impacts, 124 cued impacts), followed by difficulty finding caribou due to oil and gas activities (31 volunteered impacts), restrictions on hunting in NPRA areas (25 volunteered impacts), and loss of traditional hunting areas along the coast due to pipelines (18 volunteered impacts). In addition, 35 individuals reported personal experiences with the loss of traditional hunting areas due to pipelines, roads, and other structures, and 16 individuals reported personal experiences with the loss of traditional hunting areas along the coast due to pipelines (SRB&A 2009).

The exact extent of potential avoidance is not possible to determine; however, the likelihood of avoidance would increase with the proximity to project infrastructure and activities. Therefore, alternatives with project infrastructure closer to the coast (i.e., Alternatives B and E) may result in greater avoidance than alternatives located farther inland. Brownlow Point is the last location associated with caribou harvests before reaching the project area and therefore hunter avoidance could occur at locations west of Brownlow Point. Beyond Brownlow Point, hunting locations include the Point Thomson and Bullen Point areas. Hunting in these areas would require travel directly offshore from the Point Thomson Project area and therefore it is possible that certain hunters who customarily travel beyond Brownlow Point would avoid doing so in the future. Avoidance of Brownlow Point itself would be less likely unless disturbances related to traffic or other activities extend beyond the immediate vicinity of project components.

Inland hunting by Kaktovik residents is difficult in the summer because most area rivers are not navigable by boat. Thus, coastal hunting is the primary method of harvesting caribou during the open-water season. During the summer, residents generally travel west or east of the community until they find caribou; hunters tend to travel west of Barter Island more frequently than traveling east (Appendix Q). When traveling west, residents frequently travel as far as Brownlow Point and Flaxman Island; when they do not find caribou at those locations, then they travel farther west to Bullen Point and beyond; residents' use of the coast beyond Bullen Point for caribou hunting is relatively limited. Regular use of the coast east of the community for caribou hunting extends to Demarcation Point. Therefore, Kaktovik's high use area for coastal caribou hunting extends from Bullen Point in the west to Demarcation Point in the east. If Kaktovik hunters no longer traveled to the area past Brownlow Point to Bullen Point due to avoidance of the project area, reduced caribou availability, or hunting regulations, then approximately 17 percent of their "high use" coastal hunting area could be removed from use (72 miles of coastline). The likelihood of user avoidance of the area west of Brownlow Point varies depending on alternative design (e.g., distance of pads and pipelines from the coast); the project would not be expected to result in total avoidance of the area by all hunters.

Noise/Traffic

Noise from development activities, including construction, drilling, and traffic may result in effects on resource availability and user access.

Resource Availability

Impacts on resource availability related to noise and traffic have been frequently observed and reported by North Slope harvesters (SRB&A 2009). Noise and traffic associated with the Point Thomson development could affect the availability of caribou and marine mammals by causing resource displacement from customary subsistence use areas. Noise and traffic could cause limited displacement of other subsistence resources such as waterfowl; however, use of the project area for harvests of other resources is relatively limited. Impacts on subsistence uses of other resources would likely only occur if noise and traffic caused widespread displacement or migratory changes for those resources. Section 5.9, Birds; Section 5.11, Marine Mammals; and Section 5.12, Fish, Essential Fish Habitat, and Invertebrates, indicate that this level of potential effects would be unlikely.

Caribou

Potential impacts on caribou availability include displacement of caribou from coastal hunting areas due to noise from air, ground, and barge traffic, as well as noise from construction and drilling activities. In particular, harvesters have observed that helicopter and plane traffic tends to divert caribou or cause skittish behavior, resulting in reduced harvest opportunities (SRB&A 2009). During interviews with Nuiqsut caribou hunters in 2009 and 2010, helicopter traffic was the most commonly cited impact on caribou hunting related to CD4 and other Alpine Satellite Developments, followed by plane traffic and human-made structures (i.e., pipelines blocking caribou movement; SRB&A 2010b, 2011). Impacts from ground traffic (e.g., trucks) or barge traffic could also affect caribou distribution. Caribou, especially cows with calves, tend to avoid areas of human activity and have been found to shift calving areas farther from developed areas (NRC 2003a). Research indicates their avoidance zone may extend to 1.2 miles from the activity (NRC 2003a). Drilling activities may also result in reduced caribou availability. As reported in the NRC's *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope*, studies show that caribou, especially females with calves, generally avoid drilling sites and those caribou that do approach drilling sites spend less time feeding and lying down (2003a).

According to Section 5.10, Terrestrial Mammals, caribou may exhibit avoidance of project components within a "limited" (0 to 2.5 miles) range of the components, except for Alternative C, where avoidance behaviors could be expected in a wider "local" (Deadhorse to the Arctic Refuge) range. Even localized or "limited" changes in caribou distribution resulting from traffic displacement can affect the availability of caribou to harvesters because of residents' limited means to access caribou at different times of the year. Residents rely on caribou to be present in certain areas (e.g., along the coast) at certain times of the year (e.g., in July and August). Kaktovik subsistence users travel along the coast in the project area in the summer to spot caribou; overland travel in the summer months, when the majority of caribou hunting occurs, is limited to foot. During interviews with caribou hunters in 2005 and 2006, a number of hunters indicated that they only hike inland during years when they are having limited success, and that they generally try to harvest caribou as close to the beach as possible. Those residents who do hike inland indicated that generally they would hike no farther than one or two miles inland to access caribou (SRB&A 2010a). Some hunters have reported bringing all-terrain vehicles in their boats to travel inland from waterways or coastal camps (Pedersen and Coffing 1984, SRB&A 2010a) and traveling up to 5 miles from the coast when hunting (SRB&A 2003c, 2010a). If caribou were diverted inland in the summer such that residents cannot access them easily from the coast, then they could experience reduced harvest success.

Marine Mammals

Noise associated with barge and air traffic may affect subsistence harvests of marine mammals such as bowhead whales and seals offshore from the project area due to disturbance of these resources. Nuiqsut residents hunt bowhead whales and seals from Cross Island, and sometimes travel along the coast beyond Point Thomson when hunting these resources; however, no harvests of bowhead whales by Nuiqsut residents have been reported east of Bullen Point (NSB 2010b). Kaktovik bowhead whale hunting occurs east of the project area and the westernmost bowhead whale harvest during the 1988-to-2008 time period occurred offshore from Anderson Point (see Appendix Q, Figure 17). A small number of Kaktovik use areas for seal have been reported offshore from Point Thomson. North Slope hunters have reported having difficulty harvesting seals and bowhead whales during times of heavy activity such as aircraft and boat traffic (SRB&A 2009). Individuals have reported that noise from industrial activity, including seismic exploration, drilling, and helicopter and barge traffic, can divert marine mammals farther from shore, resulting in hunters traveling farther and experiencing increased risks to safety. Subsistence harvesters report that marine mammals, especially bowhead whales, are especially sensitive to noise and can act skittish or aggressive when disturbed (SRB&A 2009).

Research shows that industrial noise (particularly seismic activity) diverts bowhead whales and causes changes in bowhead whale behavior (e.g., reduced surface or diving times; MBC 1997, NRC 2003a). According to Richardson and Malme (1993), bowhead whales have been observed exhibiting reactions to approaching marine vessels (e.g., ships and boats) at a distance of up to 4 km, with statistically substantial avoidance occurring when vessels came within 1 to 4 km. A few whales reacted at greater distances from moving vessels (5 to 7 km) while others did not react until vessels were closer (less than 1 km). Reactions include flight responses (i.e., swimming away quickly from the direction of the vessel), and altered surface and diving patterns. Responses generally subsided once the vessel was several miles away, and at least some bowhead whales returned to their original locations prior to the disturbance. Bowhead whale reactions were most conspicuous when the vessels were moving at fast speeds directly toward the whales.

A more recent study monitoring industrial noises, bowhead whales, and seals related to BP's Northstar Development used acoustic localization techniques to determine displacement of marine mammals related to industrial noise (Moulton et al. 2003). The study found that, between 2001 and 2002, a small number of bowhead whales were deflected in the southern part of their migration due to sounds produced from maneuvering vessels. These bowheads were deflected by greater than or equal to 2 km (1.2 miles). The deflection occurred for only a small percentage (less than 0.2 percent) of the bowhead whale population.

The Applicant and the AEWC have a conflict avoidance agreement that limits barge traffic during Kaktovik and Nuiqsut bowhead whale hunting seasons. In addition, the Applicant has proposed that all offshore activities such as barge traffic would be coordinated with local communities, and the Applicant would hire a local Iñupiat marine mammal observer and subsistence monitors to help minimize potential conflicts. Therefore, direct impacts on bowhead whale resource availability due to barge traffic during the bowhead whale hunt would be unlikely.

User Access

User access could be impacted as residents may avoid the project area due to noise and human presence, especially if subsistence users associate noise from development with reduced resource availability. Avoidance of construction activities and development areas has been documented for the community of Nuiqsut in regard to their caribou harvests (RFSUNY 1984, IAI 1990b, Pedersen et al. 2000, BLM 2004), and could also occur for the community of Kaktovik.

The Applicant has proposed that vessel traffic would be routed inside the barrier islands to minimize disturbance to offshore subsistence activities. While this could reduce impacts on offshore marine mammal hunting activities, coastal hunting activities such as coastal caribou hunting may be affected if hunters alter their travel routes or hunting areas to avoid barges.

Contamination

Contamination or perceived contamination of subsistence resources related to the Point Thomson development may result in impacts on resource availability and user access.

Resource Availability

Contamination or perceived contamination associated with the proposed project could result in reduced resource availability to subsistence users. The availability of subsistence resources not only depends on their abundance in traditional use areas, but on their health or quality (either actual or perceived). A major concern to North Slope subsistence users is the potential effects of contamination and air pollution on subsistence resources related to development (SRB&A 2009). Possible sources of contamination related to the proposed Point Thomson Project include oil or diesel spills, dust from gravel roads and pads, discharges (including human waste, drilling muds, and toxic materials), flares, and incinerators. North Slope harvesters, particularly those from Nuiqsut, have reported harvesting caribou, fish, and other resources that appear unhealthy or have abnormalities (SRB&A 2009); these abnormalities are often associated with contamination from development and residents usually consider resources that appear unhealthy to be unfit for consumption. In addition, residents may avoid harvesting resources that behave abnormally (e.g., lingering around development areas) because they are perceived to be less healthy. Contamination or perceived contamination of subsistence resources could result in reduced availability of subsistence resources considered healthy enough for consumption. If contamination of subsistence resources occurs, consumption of these resources by Nuiqsut and Kaktovik subsistence users could potentially affect human health.

Changes in resource availability due to contamination of subsistence resources would most likely affect Kaktovik subsistence harvests of caribou and fish, as these are the resources most commonly harvested in the project area. However, any widespread contamination or contamination of waterways or marine waters could result in reduced availability of additional migratory resources such as waterfowl and marine mammals and could affect Nuiqsut subsistence uses.

User Access

Contamination may affect user access due to user avoidance of the project area for subsistence purposes. Concerns related to contamination from discharges (including human waste, drilling mud, and toxic materials), flares, incinerators, and oil spills may cause residents to avoid using the project area for subsistence.

Hunting Regulations Related to Project Development

Hunting regulations associated with the Point Thomson Project have the potential to affect subsistence use areas, resource availability, and user access.

Subsistence Use Areas

Potential hunting regulations in the project area may result in a loss of subsistence use areas to the extent that they include hunting buffers around project infrastructure. In their project description, the Applicant states that area hunters would be able to transit and conduct subsistence activities in the project area and notes that residents of Nuiqsut and Kaktovik would be consulted to implement guidelines for hunting around pipelines and other infrastructure. During interviews with Kaktovik hunters in 2003 (see Appendix Q), residents believed that a hunting buffer around the pipeline was likely; no hunting buffer has been proposed by the Applicant at this time. However, any limits on hunting around the pipeline or project infrastructure could result in impacts on hunters if the limitations result in exclusions of the coastal area for hunting.

Resource Availability

Hunting regulations to address new development may affect resource availability if nonlocal hunters were allowed access to the gravel access road proposed under Alternative C. In this case, Kaktovik residents hunting along the coast may experience reduced caribou harvest success due to an increase in competition for subsistence resources.

User Access

As noted above, the Applicant has indicated that local hunters would have access to the project area, including ice roads and gravel roads. However, given the distance of the road system from residents' usual winter hunting area and potential difficulty accessing the road system during snow-free months, it would be unlikely that residents would use project roads regularly unless wildlife were unavailable elsewhere. If nonlocal hunters use project roads to access the project area, then local hunters may experience reduced harvest success for caribou along the coast due to an increase in competition for those resources. Proposed mitigation related to project pipelines includes a measure to ensure that pipeline walls would be resistant to damage from accidental bullet strikes from coastal subsistence hunting. Avoidance of the area due to hunter concerns about hitting the pipeline or confusion about hunting regulations may persist despite measures taken to mitigate these impacts.

5.22.1.9 Alternative A: No Action

Because no production would occur under Alternative A and because existing equipment and structures have already been demobilized, this alternative has the lowest potential to affect subsistence uses for residents of Kaktovik and Nuiqsut. Noise/traffic associated with monitoring activities would be the only source of potential impacts on subsistence uses and could result in limited effects on resource availability or user access due to user avoidance (see Section 5.22.1.8). Although subsistence uses of several major subsistence resources (caribou, Dolly Varden, and bowhead whale) could be affected by Alternative A (major magnitude— resource importance) and the impacts could be long term (more than 2 years), effects on harvest amounts would be limited (minor magnitude—harvest amounts), most impacts would be limited in extent, and the impacts would be unlikely.

Potential sources of impacts related to monitoring under Alternative A would be as follows:

- Noise/Traffic:
    - Noise and traffic associated with monitoring activities could affect resource availability of caribou, and user access to caribou, marine mammal, and fish use areas (see Section 5.22.1.8).

Noise and traffic associated with monitoring activities could affect resource availability of caribou and user access to the project area through avoidance; however, these activities would likely only affect a small number of harvesters and would occur only periodically during monitoring. The likelihood of these impacts would depend on the timing and frequency of monitoring activities.

Impact Summary

As illustrated in Table 5.22-8, Alternative A could result in impacts on major resources (major magnitude—resource importance) that would be of long-term duration; however, impacts on harvest amounts would be minimal (minor magnitude—harvest amounts), the majority of these impacts would be limited in geographic extent and all would not be likely. In the case of caribou, a major resource, impacts would be of minor magnitude in terms of harvest amounts, long-term, unlikely, and local in geographic extent (i.e., affects between 25 and 50 percent of harvesters). Impacts would not result in measurable effects on harvests of other subsistence resources (minor magnitude—harvest amounts).

Table 5.22-8: Alternative A—Impact Evaluation for Subsistence[a]

Subsistence Activity/Use	Impact Type	Community	Magnitude – Resource Importance	Magnitude – Harvest Amounts	Duration	Potential to Occur	Geographic Extent[b]
Caribou Hunting	Subsistence Use Area, User Access, Resource Availability	Kaktovik	Caribou contributes highly to material and cultural importance (Major)	Average annual harvest 0.8 percent (Minor)	>2 years (Long term)	Unlikely	39 percent of caribou harvesters reported use areas in project vicinity (Local)
	Subsistence Use Area, User Access, Resource Availability	Nuiqsut	Caribou contributes highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported use areas in project vicinity (Limited)
Bowhead Whale Hunting	Resource Availability	Kaktovik	Bowhead whale contributes highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Kaktovik harvesters reported use areas in project vicinity (Limited)
	User Access, Resource Availability	Nuiqsut	Bowhead whale contributes highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported use areas in project vicinity (Limited)
Seal Hunting	User Access, Resource Availability	Kaktovik	Seals contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	3 percent of harvesters reported seal use areas in project vicinity (Limited)
	User Access, Resource Availability	Nuiqsut	Seals contribute moderately to material and cultural importance (Moderate)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut reported seal use areas in project vicinity (Limited)
Fish Harvesting	Subsistence Use Areas, User Access	Kaktovik	Fish (Dolly Varden and whitefish) contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	8 percent of Kaktovik harvesters reported fish use areas in project vicinity (Limited)
	Resource Availability	Nuiqsut	Fish (Whitefish/arctic cisco) contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported use areas in project vicinity (Limited)
Waterfowl Hunting	User Access	Kaktovik	Waterfowl (geese and ducks) contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	5 percent of harvesters reported waterfowl use areas in project vicinity (Limited)
	User Access	Nuiqsut	Waterfowl (ducks) contribute moderately to material and cultural importance (Moderate)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported waterfowl use areas in project vicinity (Limited)

[a] The impact summary table only includes subsistence and traditional land use resources of concern for the Point Thomson Project (see Table 3.22-1).

[b] Extent determinations are based on the analysis in Section 5.22.1.7, Impact Evaluation—Extent.

5.22.1.10 Alternative B: Applicant's Proposed Action

Potential sources of impacts on subsistence uses resulting from Alternative B include project infrastructure associated with drilling and operation; noise/traffic associated with construction, drilling, and operation; contamination associated with drilling and operation; and hunting regulations associated with drilling and operation.

As discussed in Section 5.22.1.8, Project Infrastructure, Subsistence Use Areas, the Alternative B footprint overlaps directly with recent (1995/96 to 2006) Kaktovik subsistence use areas for caribou, fish, and wildfowl, including areas of high overlapping use (Figure 5.22-2). Recent Nuiqsut subsistence areas do not overlap directly with the Alternative B footprint (Figure 5.22-3). The footprint overlaps with historic use areas for both communities. In addition, recent (1995/96 to 2006) bowhead whale (Nuiqsut), seal (Kaktovik and Nuiqsut), and waterfowl (Nuiqsut) subsistence use areas occur offshore from the Point Thomson Project area.

Under Alternative B, primary potential impacts could include the loss of high-use Kaktovik subsistence use areas for caribou due to project infrastructure (West, East, and Central Pads; gathering pipelines; gravel road; and a small percentage of the export pipeline); reduced resource availability to Kaktovik hunters for caribou due to displacement from infrastructure (e.g., pipelines) and noise/traffic; reduced resource availability and access to Nuiqsut hunters for bowhead whales due to noise/traffic; and reduced user access due to avoidance of coastal hunting areas in the project vicinity for caribou and fish (Dolly Varden and whitefish) resulting from project infrastructure, noise/traffic, contamination, and hunting regulations. These impacts would affect resources of major importance including caribou, fish (Dolly Varden and whitefish), and bowhead whale (major in magnitude—resource importance; see Table 5.22-5); impacts on harvest amounts would be minor (minor magnitude—harvest amounts); duration of impacts would be long term and expected to occur over the life of the project; the potential for impacts would be probable and likely to occur under normal operating conditions for caribou hunting, and possible or unlikely for other subsistence activities; and impacts would be limited to local in geographic extent. Local geographic extent impacts (affecting between 25 and 50 percent of harvesters) could occur for caribou hunting (in Kaktovik) and bowhead hunting (in Nuiqsut), potentially affecting up to 39 percent (Kaktovik) and 42 percent (Nuiqsut) of resource harvesters. All other subsistence impacts would be limited in geographic extent. Alternative B could affect caribou harvests associated with the Bullen Point and Point Thomson place name locations, which represent an average of 0.8 percent of the annual caribou harvest.

Construction

Potential sources of impacts related to construction under Alternative B would be as follows:

- Infrastructure: Construction of a winter ice road during the construction phase could affect subsistence use areas for caribou, furbearers, polar bears, and fish; and resource availability for caribou (see Section 5.22.1.8).
- Noise/Traffic: Noise and traffic associated with construction, especially summer barge and helicopter traffic, could affect resource availability for caribou and marine mammals, and user access (see Section 5.22.1.8).

Construction of the winter ice road for demobilization would affect winter subsistence use areas. A portion of Kaktovik's westernmost winter caribou and lifetime furbearer subsistence use areas would be located in the Point Thomson area. Lifetime polar bear and contemporary fish use areas also overlap with the project area. Harvests of polar bear and fish in the Point Thomson area during the winter most likely occur while participating in other subsistence activities such as furbearer or caribou hunting. As noted in the affected environment (Section 3.22), Kaktovik's more recent wolf- and wolverine-use areas would not be located near the proposed project, and Section 5.22.1.8 does not identify any impacts to wolf and wolverine from the construction phase under this alternative. As discussed in Section 5.22.1.8, construction of a winter ice road could cause local displacement of caribou.

Noise and traffic associated with construction of an ice road through residents' subsistence use areas could affect resource availability of caribou and user access to the project area through avoidance. Effects on resource availability resulting from ice road construction would likely be localized to the Point Thomson Project area and would occur only during the winter months. Subsistence uses of the project area during the winter are limited. Kaktovik's winter caribou harvests have primarily been reported east of the project area, with the majority of winter harvests coming from the Konganevik, POW-D, mainland south of Barter Island, and Jago areas (see Section 3.22).

Noise and traffic related to summer construction activities under Alternative B would be limited primarily to mobilization of construction equipment via barges and helicopters. These activities could result in impacts on resource availability for caribou and marine mammals; and user access (Section 5.22.1.8). Two coastal barges would make an average of 80 to 100 round trips to Point Thomson during each construction season. Barge traffic would generally be limited to the months of July and August and may affect subsistence resource availability if it displaces offshore and onshore resources in the vicinity of the Point Thomson Project. The barging season under Alternative B would coincide with the peak of residents' coastal caribou hunting activities and could result in displacement of caribou from coastal areas. Fishing generally occurs concurrently with summer caribou hunting; however, barge activities would not be expected to result in measurable effects on fish distribution or abundance (see Section 5.22.1.8). Barge traffic would also coincide with summer marine mammal harvests and could result in reduced marine mammal availability (see Section 5.22.1.8); however, as discussed above, the Applicant and AEWC have a conflict avoidance agreement that limits barge traffic during the bowhead whale hunting season and therefore impacts on bowhead whale harvests related to barge traffic would not be expected to occur. Residents of Anaktuvuk Pass may be indirectly affected if harvests of marine resources usually shared with Anaktuvuk Pass residents become less available.

In addition to barge traffic, summer helicopter traffic could affect resource availability for Kaktovik subsistence users. Use of helicopters under Alternative B construction would be limited to the months of

August and September, when barging would be restricted due to the bowhead whale hunting season. Helicopter traffic during these months would coincide with Kaktovik residents' summer caribou hunting and fishing activities along the coast, which peak in July and August. Helicopter traffic could also affect the availability of bowhead whales traveling close to shore. See Section 5.22.1.8 for a description of the effects of helicopter and barge traffic on resource availability.

In addition to impacts on resource availability, construction activities under Alternative B may also result in impacts on user access. These impacts would be the same as those discussed under Alternative A, but could occur both during the winter and summer and could include hunter avoidance due to summer barge and helicopter traffic. The majority of impacts on subsistence user access would likely occur during the summer months and would be related to construction traffic.

Drilling

Under Alternative B, drilling operations would occur at all three pads over approximately 2.5 years. Potential sources of impacts related to drilling under Alternative B would be as follows:

- Noise/Traffic: Noise and traffic associated with drilling activities, especially summer barge and helicopter traffic, could affect resource availability for caribou and marine mammals, and user access (see Section 5.22.1.8).
- Contamination: Concerns about contamination related to drilling could affect resource availability of caribou and fish, and user access (see Section 5.22.1.8).

Traffic during the drilling phase would include road, airplane and helicopter, and barge traffic. Effects on subsistence related to Alternative B noise and traffic would be similar to those discussed above under construction, although disturbance related to construction activities such as blasting and equipment would be less of an issue during the drilling phase, as the majority of construction would be complete. Barge activities would be reduced from 80 to 100 barges per year to 4 to 10 barges per year; therefore, impacts related to barge traffic would be less during the drilling phase. Increased air and ground traffic during the drilling phase may cause further disturbances for subsistence resources such as caribou, birds, and furbearers. Under Alternative B, a gravel airstrip would be located 3 miles inland from the coast south of Central Pad and would be used year-round. Disturbances from air traffic near the coast could affect resource availability of caribou to Kaktovik hunters during the summer months (see Section 5.22.1.8).

Operations

Effects on subsistence during the operation phase related to noise/traffic and contamination would be the same as those discussed above under drilling, but would occur over the life of the project. Additional effects on subsistence during the operation phase would be as follows:

- Infrastructure: Pipelines, ice roads, gravel roads and pads, barge facilities, and airstrips would affect Kaktovik subsistence use areas for caribou, fish, waterfowl, and seal (Figure 5.22-2), resource availability of caribou, and user access (see Section 5.22.1.8).
- Hunting Regulations: Regulations about hunting around the pipeline could affect subsistence use areas for caribou and user access (see Section 5.22.1.8).

Alternative B infrastructure, including pipelines, ice roads, gravel roads and pads, barge facilities, and airstrips would be in place during the operation phase. In particular, under Alternative B, the West, East, and Central Pads would be within residents' highly-used caribou hunting areas and would be close to shore; also within these highly used areas would be the infield gathering lines, gravel roads, and a small portion of the export pipeline (Figure 5.22-2). As the majority of caribou hunting occurs during the summer months, the ice road would not directly affect caribou subsistence use areas.

Potential impacts of infrastructure such as pipelines, roads, and barge facilities on subsistence use areas, resource availability, and user access are discussed in Section 5.22.1.8. Infrastructure associated with Alternative B overlaps with recent subsistence use areas for caribou, fish, and wildfowl. A high number of overlapping caribou use areas extend as far as Bullen Point with 39 percent of caribou harvest respondents reporting use areas in the area between Bullen Point and Brownlow Point; subsistence harvests of other resources generally coincide with the summer caribou hunt. Under Alternative B, the export pipeline would be located between 1 and 2 miles inland from the coast. Although only a small percentage of the export pipeline overlaps with highly used caribou subsistence use areas, the location of the pipeline within 1 to 2 miles of the coast could result in user avoidance of previously highly used areas along the coast between the East Pad and Bullen Point. Residents' summer caribou hunting activities along the shoreline could be affected by the relatively close presence of the pipeline not only by reducing the availability of caribou (see Section 5.22.1.8), but by causing user avoidance due to concerns about shooting toward the pipeline.

Hunting restrictions around pipelines may affect subsistence use areas for caribou and user access by causing residents to avoid hunting along the coast past Point Thomson, even if caribou were present in those areas (see Section 5.22.1.8). This impact would be especially likely to occur under Alternative B because of the placement of the pipeline within 1 or 2 miles of the coast. The potential effects of the Point Thomson Project on contamination or perceived contamination on resource availability and user access are discussed in Section 5.22.1.8.

Impact Summary

As illustrated in Table 5.22-9, the majority of impacts of Alternative B to Kaktovik would affect major resources (major in magnitude—resource importance), would occur in areas representing less than 25 percent of average resource harvests (minor in magnitude—harvest amounts), and would be long-term, unlikely to possible, and limited in geographic extent. Impacts on Kaktovik caribou hunting, a major magnitude resource, would be probable and local in geographic extent due to the percentage of harvesters (39 percent) reporting use areas in the project area and therefore potentially affected; the magnitude of impacts on caribou harvests would be minor in magnitude (0.8 percent average annual harvests associated with Bullen Point and Point Thomson). Impacts on Nuiqsut caribou hunting would be unlikely and limited in geographic extent. Impacts on Nuiqsut bowhead whale hunting, a major magnitude resource, would be local in geographic extent under Alternatives B and E due to the percentage of harvesters (42 percent) reporting use areas in the project area (i.e., the buffered coastal barging route), but would be unlikely due to the Applicant's conflict avoidance agreement with the AEWC. Impacts on Kaktovik and Nuiqsut seal hunting and Kaktovik fish harvesting would be possible but limited in geographic extent (less than 25 percent of harvesters reporting use areas in the project area). Impacts on Kaktovik bowhead whale hunting, Kaktovik and Nuiqsut waterfowl hunting, and Nuiqsut fish harvesting would be unlikely.

The average annual percentage of caribou harvests associated with the Point Thomson Project is between 0.8 percent (Bullen Point and Point Thomson) and 10.8 percent (Bullen Point to Brownlow Point/Canning River delta) annually (between 1 and 13.3 pounds per capita; Section 5.22.1.7, Impact Evaluation—Magnitude). Impacts on these harvests could occur due to user avoidance of the project area, or due to possible displacement of caribou from within one or two miles of shore. The likelihood of harvester avoidance under Alternative B would be higher than other alternatives (except Alternative E) because of the proximity of project facilities to shore and because of the presence of barge operations and therefore would be more likely to affect a higher percentage of harvesters who currently use the area. Based on Section 5.10, Terrestrial Mammals, impacts on caribou related to disruption would be expected to occur within 0 to 2.5 miles of project components and would therefore not be expected to affect caribou harvests at Brownlow Point or Canning River. Thus, with the exception of unknown hunter avoidance of Brownlow Point and Canning River delta associated with Point Thomson development, Alternative B impacts on harvest amounts would be limited to harvests associated with Bullen Point and Point Thomson (an average of 0.8 percent annually).

Assuming that the Applicant’s conflict avoidance agreement with the AEWC restricts barge traffic during the Nuiqsut bowhead whaling season, Alternative B would not be expected to result in reduced harvests of bowhead whales (minor magnitude—harvest amounts); potential impacts on bowhead whale hunters could be local in geographic extent but would only occur if the conflict avoidance agreement were not in place and barging occurred at the same time as bowhead whale hunting. Impacts on fish harvesting would be unlikely to occur for Nuiqsut, but would be possible for Kaktovik and primarily related to impacts from user avoidance; these impacts would be limited in geographic extent. Waterfowl hunting impacts would be unlikely.

Table 5.22-9: Alternative B—Impact Evaluation for Subsistence[a]							
Subsistence Activity/Use	Impact Type	Community	Magnitude – Resource Importance	Magnitude – Harvest Amounts	Duration	Potential to Occur	Geographic Extent[b]
Caribou Hunting	Subsistence Use Area, User Access, Resource Availability	Kaktovik	Caribou contributes highly to material and cultural importance (Major)	Average annual harvest .8 percent (Minor)	>2 years (Long term)	Probable	39 percent of caribou harvesters reported use areas in project vicinity (Local).
	Subsistence Use Area, User Access, Resource Availability	Nuiqsut	Caribou contributes highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported use areas in project vicinity (**Limited**).
Bowhead Whale Hunting	Resource Availability	Kaktovik	Bowhead whale contributes highly to material and cultural importance (**Major**)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Kaktovik harvesters reported use areas in project vicinity (**Limited**)
	User Access, Resource Availability	Nuiqsut	Bowhead whale contributes highly to material and cultural importance (**Major**)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	42 percent of Nuiqsut harvesters reported use areas in project vicinity (Local).
Seal Hunting	User Access, Resource Availability	Kaktovik	Seals contribute highly to material and cultural importance (**Major**)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	5 percent of harvesters reported seal use areas in project vicinity (**Limited**)
	User Access, Resource Availability	Nuiqsut	Seals contribute moderately to material and cultural importance (Moderate)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	15 percent of harvesters reported seal use areas in project vicinity (**Limited**)
Fish Harvesting	Subsistence Use Areas, User Access	Kaktovik	Fish (Dolly Varden and whitefish) contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Possible	8 percent of Kaktovik harvesters reported fish use areas in project vicinity (**Limited**)
	Resource Availability	Nuiqsut	Fish (Whitefish and arctic cisco) contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported use areas in project vicinity (**Limited**)

Table 5.22-9: Alternative B—Impact Evaluation for Subsistence[a]							
Subsistence Activity/Use	Impact Type	Community	Magnitude – Resource Importance	Magnitude – Harvest Amounts	Duration	Potential to Occur	Geographic Extent[b]
Waterfowl Hunting	User Access	Kaktovik	Waterfowl (geese and ducks) contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	5 percent of harvesters reported waterfowl use areas in project vicinity (Limited)
	User Access	Nuiqsut	Waterfowl (ducks) contribute moderately to material and cultural importance (Moderate)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	6 percent of harvesters reported waterfowl use areas in project vicinity (Limited)

[a] The impact summary table only includes subsistence and traditional land use resources of concern for the Point Thomson Project (see Table 3.22-1).

[b] Extent determinations are based on the analysis in Section 5.22.1.7, Impact Evaluation—Extent.

5.22.1.11 Alternative C: Inland Pads with Gravel Access Road

Potential sources of impacts on subsistence uses resulting from development of Alternative C include project infrastructure associated with drilling and operation; noise/traffic associated with construction, drilling, and operation; contamination associated with drilling and operation; and hunting regulations associated with drilling and operation.

As discussed in Section 5.22.1.8, Project Infrastructure, Subsistence Use Areas, the Alternative C footprint overlaps directly with recent (1995/96 to 2006) Kaktovik subsistence use areas for caribou, fish, and wildfowl, including areas of high overlapping use. Compared to Alternative B, the Alternative C footprint would be less concentrated in and located farther from areas of high overlapping use. Recent Nuiqsut subsistence areas do not overlap directly with the Alternative C footprint. The footprint overlaps with historic (lifetime to 1979 and 1973 to 1986) use areas for both communities. In addition, recent (1995/96 to 2006) bowhead whale (Nuiqsut), seal (Kaktovik and Nuiqsut), and waterfowl (Nuiqsut) subsistence use areas occur offshore from the Point Thomson Project area.

Impacts under Alternative C include the loss of Kaktovik subsistence use areas for caribou due to infrastructure, reduced resource availability of caribou for Kaktovik hunters due to displacement from infrastructure (e.g., pipelines) and noise/traffic, and reduced user access for Kaktovik due to avoidance of coastal hunting areas in the project vicinity for caribou resulting from project infrastructure, noise/traffic, contamination, and hunting regulations (see Section 5.22.1.8). Because Alternative C does not include the use of barges, and construction activities would be removed farther inland, impacts on harvests of marine mammal resources would be unlikely. Impacts on Kaktovik subsistence uses of caribou (related to user access and resource availability) would be probable, and impacts on subsistence uses of fish (related to user access) would be possible. Because caribou and fish are high contributors to material and cultural measures, the magnitude of those impacts in terms of resource importance would be major (see Table 5.22-10); the magnitude of Alternative C impacts would be minor in terms of effects on harvest amounts; duration impacts would be long term and expected to occur over the life of the project; and impacts would be local in geographic extent for caribou and limited in extent for fish (see Table 5.22-10 for a summary of potential impacts under Alternative C). Impacts on caribou in terms of disturbance would be expected to be more widespread under Alternative C (see Section 5.10, Terrestrial Mammals). Thus, impacts could affect harvests associated with the second potential area of displacement or avoidance (Bullen Point to Brownlow Point/Canning River delta harvests; see Section 5.22.1.7, Impact Evaluation Criteria), which accounts for an average of 10.8 percent (an average of 13.3 pounds per capita) of annual caribou harvests. Impacts may not occur during all years but could exceed the average annual percentage during certain years if caribou would be unavailable elsewhere.

Construction

Potential sources of impacts related to construction under Alternative C would be as follows:

- Infrastructure: Construction of a winter ice road and ice air strip during the construction phase could affect subsistence use areas for caribou, furbearers, polar bears, and fish, and resource availability for caribou (see Section 5.22.1.8).
- Noise/Traffic: Noise and traffic associated with construction could affect resource availability for caribou and user access (see Section 5.22.1.8).

The primary Alternative C construction activities that have the potential to affect subsistence uses and resources include the construction of the 50-mile elevated pipeline, 18 miles of infield gravel road, 44 miles of gravel access road to Endicott, 11 miles of infield pipelines, ice roads, pads, gravel airstrip, and mine site. Under Alternative C, construction would occur over three seasons. The majority of construction activities would occur during the winter months and would be conducted via ice roads and ice airstrips. Construction impacts on subsistence under Alternative C would be similar to those discussed under Alternative B and include effects on subsistence use areas and resource availability due to construction of a winter ice road, and effects on resource availability and user access due to construction-related noise and traffic. The elimination of barge traffic under Alternative C reduces potential impacts to summer subsistence harvests for caribou and marine mammals during the construction phase. Many of the potential effects of barge traffic under other alternatives would already be reduced through mitigation actions proposed by the Applicant to avoid conflicts with subsistence whaling activities (ExxonMobil 2009a).

Drilling

Potential sources of impacts related to drilling under Alternative C would be as follows:

- Noise/Traffic: Noise and traffic associated with drilling could affect resource availability for caribou and marine mammals, and user access (see Section 5.22.1.8).
- Contamination: Concerns about contamination related to drilling could affect resource availability of caribou and fish, and user access (see Section 5.22.1.8).

Subsistence impacts during the drilling phase would be similar to those discussed under Alternative B, drilling. However, impacts to coastal and marine subsistence activities (including resource availability and user access) would be reduced because of the elimination of barge activities under Alternative C.

Operations

Effects on subsistence during the operation phase related to noise/traffic and contamination would be the same as those discussed above under drilling, but would occur over the life of the project. Additional impacts under the operation phase would be as follows:

- Infrastructure: Pipelines, ice roads, gravel roads and pads, and airstrips would affect Kaktovik subsistence use areas for caribou, fish, and waterfowl (Figure 5.22-2), resource availability of caribou, and user access (see Section 5.22.1.8).
- Hunting Regulations: Regulations about hunting around the pipeline could affect subsistence use areas for caribou and user access (see Section 5.22.1.8).

Under Alternative C, the Central Pad would be within Kaktovik residents' coastal caribou hunting area and would be close to shore; the West and East Pads would be farther from shore and on the edge of residents' coastal hunting area. A small portion of an infield gathering line and gravel road between the Central Pad and CPF would be located within residents' coastal caribou hunting area. Impacts on subsistence user access related to infrastructure would be less than those under Alternative B because the pipeline, East and West Pads, and processing facility would be located farther inland, and the Central Pad would be located on a smaller footprint, causing fewer concerns and less visibility for local residents hunting caribou along the coast. Thus, user avoidance of the project area under Alternative C would likely be less than under Alternative B. However, caribou displacement could still occur under Alternative C due to the presence of pipelines, roads, and other infrastructure in the project area. According to Section 5.22.1.8, caribou displacement under Alternative C would most likely occur in areas near the Central Processing Pad, Central Well Pad, and East Pad, where Kaktovik residents have reported a relatively high number of overlapping caribou use areas along the coast (see Figure 5.22-2). Furthermore, according to Section 5.10, Terrestrial

Mammals, displacement of caribou could be more widespread under Alternative C than under other alternatives. If caribou were deflected away from coastal areas during the summer caribou hunting season, then local hunters could be affected.

Because Alternative C includes a gravel access road between the Point Thomson area and Endicott, and because the export pipeline extends to Endicott rather than ending at Badami, year-round impacts on caribou travel to the coast beyond the immediate project area would be more likely and more extensive under Alternative C than under Alternative B. Residents traveling along the coast to hunt caribou between the Point Thomson area and the Endicott area, especially between Point Thomson and Bullen Point where caribou hunting is more common, may experience reduced caribou availability. In addition, increased helicopter traffic under Alternative C compared to Alternative B could affect local caribou behavior and distribution and result in additional effects on hunter success or increased user avoidance during periods of helicopter activity.

Hunting regulations may affect resource availability if nonlocal hunters were allowed access to the gravel access road for hunting activities. In this case, Kaktovik residents hunting along the coast may experience reduced caribou harvest success due to an increase in competition for subsistence resources.

Impact Summary

As illustrated in Table 5.22-10, the impacts of Alternative C to Kaktovik caribou hunting activities would be major in terms of resource importance, minor in terms of effects on harvest amounts, long-term, probable, and local in geographic extent. The average annual percentage of reported caribou harvests associated with the Point Thomson Project is between 0.8 percent (Bullen Point and Point Thomson) and 10.8 percent (Bullen Point to Brownlow Point/Canning River delta) annually (between 1 and 13.3 pounds per capita; Section 5.22.1.8, Summary). Because Alternative C would be expected to cause more widespread disruption of caribou (i.e., disruption in the area between Deadhorse to the western edge of the Arctic Refuge), displacement of caribou and reduced hunter success could be higher and may affect a greater percentage of Kaktovik caribou harvests (e.g., harvests associated with the Brownlow Point and Canning River delta to Bullen Point harvest location place names, which account for an average of 10.8 percent annually [15 caribou, or 13.3 pounds per capita]) compared to other alternatives. This level of effects would not be expected to occur every year; however, during certain years when caribou were unavailable elsewhere, impacts could affect greater than 10.8 percent of the caribou harvest.

Due to the lack of barge activity under Alternative C and the moving of construction activities further inland, impacts on Nuiqsut and Kaktovik marine mammal hunting would be unlikely to occur (Table 5.22-10). Impacts on fish would be expected to be greater under Alternative C because of the fish streams crossed by the gravel access road (Section 5.12.4); these potential impacts on fish would not be expected to result in a measurable reduction in fish harvests for the communities of Kaktovik or Nuiqsut. Impacts on Kaktovik fish harvesting related to user avoidance would be possible but would be limited in geographic extent. Impacts on waterfowl harvesting would be unlikely.

5.22.1.12 Alternative D: Inland Pads with Seasonal Ice Access Road

Alternative D is similar to Alternative C, except that a seasonal ice road, rather than a gravel access road, would be the primary method of transportation between the Point Thomson Project and Endicott. Furthermore, the export pipeline would extend 22 miles to Badami rather than 45 miles to Endicott, and would be located more than 4 miles inland in most areas. As with Alternative C, project components would be located farther inland than under the Applicant's preferred alternative (Alternative B) to reduce impacts to coastal resources.

Potential sources of impacts on subsistence uses resulting from Alternative D development of the Point Thomson reservoir include project infrastructure associated with drilling and operation; noise/traffic associated with construction, drilling, and operation; contamination associated with drilling and operation; and hunting regulations associated with drilling and operation.

As discussed in Section 5.22.1.8, Project Infrastructure, Subsistence Use Areas, the Alternative D footprint overlaps directly with recent (1995/96 to 2006) Kaktovik subsistence use areas for caribou, fish, and wildfowl, including areas of high overlapping use. Compared to Alternatives B and E, the Alternative D footprint would be less concentrated in and located farther from areas of high overlapping use. Recent Nuiqsut subsistence areas do not overlap directly with the Alternative D footprint. The footprint overlaps with historic (lifetime to 1979 and 1973 to 1986) use areas for both communities. In addition, recent (1995/96 to 2006) bowhead whale (Nuiqsut), seal (Kaktovik and Nuiqsut), and waterfowl (Nuiqsut) subsistence use areas occur offshore from the Point Thomson Project area.

Under Alternative D, primary potential impacts include the loss of use areas for caribou due to infrastructure, reduced resource availability for caribou due to displacement from infrastructure (e.g., pipelines) and traffic, and reduced user access due to avoidance of coastal hunting areas in the project vicinity for caribou and fish (Dolly Varden and whitefish) project infrastructure, noise/traffic, contamination, and hunting regulations (see Section 5.22.1.8). Because caribou and fish (Dolly Varden and whitefish) are high contributors to material and cultural measures magnitude impacts would be major in terms of resource importance (see Table 5.22-10), duration impacts would be long term and expected to occur over the life of the project, and the potential for impacts would be probable for caribou and possible for fish. Magnitude impacts would be minor in terms of harvest amounts. Impacts would be limited for fish, affecting less than 25 percent of subsistence harvesters, and moderate for caribou, potentially affecting 39 percent of Kaktovik harvesters. These impacts would be expected to occur for the community of Kaktovik (see Table 5.22-11 for a summary of impacts under Alternative D). Because this alternative would be expected to cause limited displacement of caribou (between 0 and 2.5 miles from project components), effects on harvests related to displacement would likely be limited to first area of potential avoidance and displacement (west of Brownlow Point to Bullen Point; see Section 5.22.1.7, Impact Evaluation—Magnitude), representing an average of .8 percent of the annual harvest. Because project infrastructure such as pads and pipelines would be located farther inland than under Alternative B, Alternative D would be expected to affect a smaller (but unknown) percentage of harvesters and reduce the likelihood of user avoidance.

Construction

The primary construction activities that have the potential to affect subsistence uses and resources include the construction of the 22-mile elevated pipeline, 17 miles of gravel road, 11 miles of infield pipelines, ice roads, pads, gravel airstrip, and mine site. Impacts to subsistence during the construction phase under Alternative D would be the same as those discussed under Alternative C, with the exception of additional construction activities associated with the gravel access road proposed under Alternative C. Construction activities under Alternative C would occur over a greater area, thus increasing potential effects on resource availability of caribou. Construction under Alternative D would occur over three winter seasons.

Drilling

Potential impacts to subsistence during the drilling phase under Alternative D would be the same as those discussed under Alternative C.

Table 5.22-10: Alternative C—Impact Evaluation for Subsistence[a]

Subsistence Activity/Use	Impact Type	Community	Magnitude – Resource Importance	Magnitude – Harvest Amounts	Duration	Potential to Occur	Geographic Extent[b]
Caribou Hunting	Subsistence Use Area, User Access, Resource Availability	Kaktovik	Caribou contributes highly to material and cultural importance (Major)	Average annual harvest 10.8 percent (Minor)	>2 years (Long term)	Probable	39 percent of caribou harvesters reported use areas in project vicinity (Local)
	Subsistence Use Area, User Access, Resource Availability	Nuiqsut	Caribou contributes highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported use areas in project vicinity (Limited)
Bowhead Whale Hunting	Resource Availability	Kaktovik	Bowhead whale contributes highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Kaktovik harvesters reported use areas in project vicinity (Limited)
	User Access, Resource Availability	Nuiqsut	Bowhead whale contributes highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported use areas in project vicinity (Limited)
Seal Hunting	User Access, Resource Availability	Kaktovik	Seals contribute highly to material and cultural importance (Major).	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	3 percent of harvesters reported seal use areas in project vicinity (Limited)
	User Access, Resource Availability	Nuiqsut	Seals contribute moderately to material and cultural importance (Moderate)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported seal use areas in project vicinity (Limited)
Fish Harvesting	Subsistence Use Areas, User Access	Kaktovik	Fish (Dolly Varden and whitefish) contribute highly to material and cultural importance (Major).	Minimal average annual harvest (Minor)	>2 years (Long term)	Possible	8 percent of Kaktovik harvesters reported fish use areas in project vicinity (Limited)
	Resource Availability	Nuiqsut	Fish (Whitefish and arctic cisco) contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported use areas in project vicinity (Limited)

Table 5.22-10: Alternative C—Impact Evaluation for Subsistence[a]							
Subsistence Activity/Use	Impact Type	Community	Magnitude – Resource Importance	Magnitude – Harvest Amounts	Duration	Potential to Occur	Geographic Extent[b]
Waterfowl Hunting	User Access	Kaktovik	Waterfowl (geese and ducks) contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	5 percent of harvesters reported waterfowl use areas in project vicinity (Limited)
	User Access	Nuiqsut	Waterfowl (ducks) contribute moderately to material and cultural importance (Moderate)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported waterfowl use areas in project vicinity (Limited)

[a] The impact summary table only includes subsistence and traditional land use resources of concern for the Point Thomson Project (see Table 3.22-1).

[b] Extent determinations are based on the analysis in Section 5.22.1.7, Impact Evaluation—Extent.

Operations

Effects on subsistence during the operation phase would be the same as those discussed under Alternative C, although impacts related to the gravel access road under Alternative C would not apply under this alternative. As noted in Section 5.10, Terrestrial Mammals, Alternative C disturbance impacts on caribou would be moderate to major and local (between Deadhorse to the western edge of the Arctic Refuge), whereas Alternative D disturbance impacts on caribou would be expected to be minor to moderate and limited (within 2.5 miles of project components). A seasonal tundra ice road could reduce the likelihood of nonlocal hunters accessing Kaktovik residents' traditional hunting areas, as well as the likelihood of caribou displacement during residents' summer coastal caribou hunting activities. Furthermore, pipeline disturbances would extend only to Badami under Alternative D rather than to Endicott.

Impact Summary

As illustrated in Table 5.22-11, the impacts of Alternative D to Kaktovik caribou hunting activities would be major in terms of resource importance, minor in terms of impacts on harvest amounts, long-term, probable, and local in geographic extent. The potential for displacement of caribou and reduced hunter success would be lower than Alternative C because Alternative D does not include a year-round gravel road; however, impacts related to helicopter traffic would remain. Like Alternative C, Alternative D infrastructure would be located farther from shore and could therefore also result in a reduced likelihood of hunter avoidance compared to Alternative B. Because Alternative D would be less likely to result in hunter avoidance of the Brownlow Point/Canning River areas and because caribou displacement would not expected to extend to the Brownlow Point/Canning River area, the average annual percentage of harvests potentially affected under Alternative D would likely be closer to the lower range associated with the Bullen Point and Point Thomson areas (0.8 percent [1 pound per capita]). Greater than 0.8 percent of the caribou harvest could be affected during certain years if caribou were unavailable elsewhere.

Due to the lack of barge activity under Alternative D and the moving of construction activities further inland, impacts on Nuiqsut and Kaktovik marine mammal hunting would be unlikely to occur (Table 5.22-11). Impacts on Kaktovik fish harvesting related to user avoidance would be possible but would be limited in geographic extent. Impacts on waterfowl harvesting would be unlikely.

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Table 5.22-11: Alternative D—Impact Evaluation for Subsistence[a]

Subsistence Activity/Use	Impact Type	Community	Magnitude – Resource Importance	Magnitude – Harvest Amounts	Duration	Potential to Occur	Geographic Extent[b]
Caribou Hunting	Subsistence Use Area, User Access, Resource Availability	Kaktovik	Caribou contributes highly to material and cultural importance (Major)	Average annual harvest .8 percent (Minor)	>2 years (Long term)	Probable	39 percent of caribou harvesters reported use areas in project vicinity (Local)
	Subsistence Use Area, User Access, Resource Availability	Nuiqsut	Caribou contributes highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported use areas in project vicinity (Limited)
Bowhead Whale Hunting	Resource Availability	Kaktovik	Bowhead whale contributes highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Kaktovik harvesters reported use areas in project vicinity (Limited)
	User Access, Resource Availability	Nuiqsut	Bowhead whale contributes highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported use areas in project vicinity (Limited)
Seal Hunting	User Access, Resource Availability	Kaktovik	Seals contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	3 percent of harvesters reported seal use areas in project vicinity (Limited)
	User Access, Resource Availability	Nuiqsut	Seals contribute moderately to material and cultural importance (Moderate)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported seal use areas in project vicinity (Limited)
Fish Harvesting	Subsistence Use Areas, User Access	Kaktovik	Fish (Dolly Varden and whitefish) contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Possible	8 percent of Kaktovik harvesters reported fish use areas in project vicinity (Limited)
	Resource Availability	Nuiqsut	Fish (Whitefish and arctic cisco) contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported use areas in project vicinity (Limited)

Table 5.22-11: Alternative D—Impact Evaluation for Subsistence[a]							
Subsistence Activity/Use	Impact Type	Community	Magnitude – Resource Importance	Magnitude – Harvest Amounts	Duration	Potential to Occur	Geographic Extent[b]
Waterfowl Hunting	User Access	Kaktovik	Waterfowl (geese and ducks) contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	5 percent of harvesters reported waterfowl use areas in project vicinity (Limited)
	User Access	Nuiqsut	Waterfowl (ducks) contribute moderately to material and cultural importance (Moderate)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported waterfowl use areas in project vicinity (Limited)

[a] The impact summary table only includes subsistence and traditional land use resources of concern for the Point Thomson Project (see Table 3.22-1).

[b] Extent determinations are based on the analysis in Section 5.22.1.7, Impact Evaluation—Extent.

5.22.1.13 Alternative E: Coastal Pads with Seasonal Ice Roads

Alternative E is similar to Alternative B in terms of proximity of infrastructure to the coastline, and modes of transportation to and from the field. Alternative E would require greater amounts of air transport between pads during the ice-free season, as well as the use of tundra-safe, low-pressure vehicles when helicopter travel would not be possible due to weather.

Potential sources of impacts on subsistence uses resulting from development of the Point Thomson reservoir under Alternative E include construction, drilling, and operation activities and infrastructure (including pipelines, roads, traffic, and noise). Alternative E may result in impacts on subsistence use areas, user access, resource availability, competition, and costs and time for residents of Kaktovik and Nuiqsut.

As discussed in Section 5.22.1.8, Project Infrastructure, Subsistence Use Areas, the Alternative E footprint overlaps directly with recent (1995/96 to 2006) Kaktovik subsistence use areas for caribou, fish, and wildfowl, including caribou areas of high overlapping use. Recent Nuiqsut subsistence areas do not overlap directly with the Alternative E footprint. The footprint overlaps with historic (lifetime to 1979 and 1973 to 1986) use areas for both communities. In addition, recent (1995/96 to 2006) bowhead whale (Nuiqsut), seal (Kaktovik and Nuiqsut), and waterfowl (Nuiqsut) subsistence use areas occur offshore from the Point Thomson Project area.

Under Alternative E, primary potential impacts include the loss of Kaktovik use areas for caribou; reduced resource availability for caribou due to displacement from infrastructure (e.g., pipelines) and traffic; and reduced user access due to avoidance of coastal hunting areas in the project vicinity for caribou and fish (Dolly Varden and whitefish). Because caribou and fish (Dolly Varden and whitefish) are high contributors in material and cultural measures, impacts on those resources would be major in resource importance magnitude (see Table 5.22-12); however, magnitude in terms of impacts on harvest amounts would be minor (less than 25 percent of harvests are associated with the potentially affected area). Duration impacts would be long term and expected to occur over the life of the project. Impacts on Kaktovik caribou subsistence uses would be probable and likely to occur under normal operating conditions, and impacts would be local in geographic extent, because 39 percent of Kaktovik harvesters reported caribou use areas in the project vicinity. Because, according to Section 5.10, Terrestrial Mammals, impacts on caribou would be expected to be limited in extent (within 2.5 miles of project components) under Alternative E, potentially affected harvests under Alternative E would likely be limited to the area west of Brownlow Point to Bullen Point, which represent an average of 0.8 percent of the total annual caribou harvest, accounting for less than 1 pound of caribou per capita per year. Effects on harvester success due to changes in the behavior or distribution of individual caribou resulting from helicopter traffic could potentially increase the impacts on harvest amounts during certain years. Effects on fish harvests resulting from Alternative E would be expected to be minimal. Impacts on caribou and fish harvesting activities would be expected to occur for the community of Kaktovik (see Table 5.22-12 for a summary of impacts under Alternative E). Potential impacts on Nuiqsut harvesters would be related to bowhead whale hunting activities and would be major in terms of resource importance, minor in terms of impacts on harvest amounts, unlikely, long-term, and local in geographic extent, as 42 percent of harvesters reported bowhead whale use areas in the project vicinity; effects on bowhead whale harvests would be minimal assuming restrictions on barge traffic during the bowhead whaling season. If the conflict avoidance agreement restricting barge activity was not in place, impacts on harvesters would only occur during years when bowhead whale hunters travel offshore from the Point Thomson Project area and would not be expected to occur on an annual basis.

Construction

Potential impacts to subsistence during the construction phase under Alternative E would be the same as those discussed under Alternative B. Increased air traffic and tundra-safe, low-pressure vehicle traffic under Alternative E may cause further disturbances for subsistence resources such as caribou and marine mammals, thus reducing the availability of these resources to subsistence harvesters (see Section 5.22.1.8).

Drilling

Potential impacts to subsistence during the drilling phase under Alternative E would be the same as those discussed under Alternative B. Increased air traffic and tundra-safe, low-pressure vehicle traffic under Alternative E may cause further disturbances for subsistence resources such as caribou and marine mammals, thus reducing the availability of these resources to subsistence harvesters. Residents of Anaktuvuk Pass may be indirectly affected if harvests of marine resources usually shared with Anaktuvuk Pass residents become less available.

Operations

Potential impacts to subsistence during the operation phase under Alternative E would be the same as those discussed above under Alternative B, although increased air and tundra-safe, low-pressure vehicle traffic under Alternative E may result in additional disturbances to subsistence resources. Residents of Anaktuvuk Pass may be indirectly affected if harvests of marine resources usually shared with Anaktuvuk Pass residents become less available.

Impact Summary

As illustrated in Table 5.22-12, the majority of impacts of Alternative E to Kaktovik would affect major resources and would be long-term, unlikely or possible, and limited in geographic extent. Impacts on caribou hunting, a major resource (major magnitude—resource importance), would affect a minor percentage of caribou harvests (minor magnitude—harvest amounts), would be probable and would be local in geographic extent due to the percentage of harvesters (39 percent) reporting caribou use areas in the project vicinity and therefore potentially affected by the project. Impacts on Nuiqsut bowhead whale hunting, a major resource (major magnitude), would be unlikely but would be local in geographic extent due to the percentage of harvesters (42 percent) reporting bowhead whale use areas in the project vicinity.

The likelihood of harvester avoidance of the coastal area west of Brownlow Point under Alternative E would be higher than other alternatives because of the proximity of project facilities to shore and because of the presence of barge operations; increased air traffic associated with Alternative E could also increase the potential for user avoidance and impacts on caribou availability along the coast. According to Section 5.10, Terrestrial Mammals, caribou disturbance would likely occur within 0 to 2.5 miles of Alternative E infrastructure and should not affect caribou distribution or availability at the Brownlow Point and Canning River delta areas. Thus, with the exception of unknown hunter avoidance of Brownlow Point and Canning River delta associated with Point Thomson development, impacts on caribou harvests would likely be limited to harvests associated with Bullen Point and Point Thomson, which account for .8 percent of the total annual caribou harvest. Effects on harvester success due to changes in the behavior or distribution of individual caribou resulting from helicopter and airplane traffic could potentially result in increased impacts on caribou harvests during certain years.

Table 5.22-12: Alternative E—Impact Evaluation for Subsistence[a]

Subsistence Activity/Use	Impact Type	Community	Magnitude – Resource Importance	Magnitude – Harvest Amounts	Duration	Potential to Occur	Geographic Extent[b]
Caribou Hunting	Subsistence Use Area, User Access, Resource Availability	Kaktovik	Caribou contributes highly to material and cultural importance (Major)	Average annual harvest .8 percent (Minor)	>2 years (Long term)	Probable	39 percent of caribou harvesters reported use areas in project vicinity (Local)
	Subsistence Use Area, User Access, Resource Availability	Nuiqsut	Caribou contributes highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported current use areas in project vicinity (Limited)
Bowhead Whale Hunting	Resource Availability	Kaktovik	Bowhead whale contributes highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Kaktovik harvesters reported use areas in project vicinity (Limited)
	User Access, Resource Availability	Nuiqsut	Bowhead whale contributes highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	42 percent of Nuiqsut harvesters reported use areas in project vicinity (Local)
Seal Hunting	User Access, Resource Availability	Kaktovik	Seals contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Possible	5 percent of harvesters reported seal use areas in project vicinity (Limited)
	User Access, Resource Availability	Nuiqsut	Seals contribute moderately to material and cultural importance (Moderate)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	15 percent of harvesters reported seal use areas in project vicinity (Limited)
Fish Harvesting	Subsistence Use Areas, User Access	Kaktovik	Fish (Dolly Varden and whitefish) contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Possible	8 percent of Kaktovik harvesters reported fish use areas in project vicinity (Limited)
	Resource Availability	Nuiqsut	Fish (Whitefish and arctic cisco) contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	No Nuiqsut harvesters reported current use areas in project vicinity (Limited)

Table 5.22-12: Alternative E—Impact Evaluation for Subsistence[a]

Subsistence Activity/Use	Impact Type	Community	Magnitude – Resource Importance	Magnitude – Harvest Amounts	Duration	Potential to Occur	Geographic Extent[b]
Waterfowl Hunting	User Access	Kaktovik	Waterfowl (geese and ducks) contribute highly to material and cultural importance (Major)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	5 percent of harvesters reported waterfowl use areas in project vicinity (Limited)
	User Access	Nuiqsut	Waterfowl (ducks) contribute moderately to material and cultural importance (Moderate)	Minimal average annual harvest (Minor)	>2 years (Long term)	Unlikely	6 percent of harvesters reported waterfowl use areas in project vicinity (Limited)

[a] The impact summary table only includes subsistence and traditional land use resources of concern for the Point Thomson Project (see Table 3.22-1).

[b] Extent determinations are based on the analysis in Section 5.22.1.7, Impact Evaluation—Extent.

Assuming that the Applicant's conflict avoidance agreement with the AEWC restricts barge traffic during the Nuiqsut bowhead whaling season, Alternative E would not be expected to result in reduced harvests of bowhead whales; however, limited effects on seal harvesting (for Kaktovik) could possibly occur due to nearshore or coastal noise and traffic associated with the Point Thomson Project. If the conflict avoidance agreement were not in place, barging activities could potentially affect 42 percent of Nuiqsut bowhead whale harvesters. Impacts on fish harvesting would be unlikely to occur for Nuiqsut, but would be possible for Kaktovik and primarily related to impacts from user avoidance; these impacts would be limited in geographic extent. Waterfowl hunting impacts would be unlikely.

5.22.2 Mitigative Measures

The Applicant has included the following design measures as part of the project design to avoid or minimize impacts on subsidence and traditional land use.

- Routinely consulting with subsistence users to understand current and changing subsistence activities and patterns, identifying impacts that may have occurred, and ways to prevent reoccurrence
- Employing local Subsistence Representatives during active construction and drilling.
- Continuing to inform nearby Native Allotment owners/heirs, AEWC, and tribal organizations of project activities that may affect subsistence use or access to subsistence resources or traditional use sites
- Implementing applicable protective measures of the conflict avoidance agreement with the AEWC and Kaktovik and Nuiqsut Whaling Captains' Associations, which include support of Communications Centers (Com Centers) for improved communications and safety during periods of marine activity
- Avoiding interference with bowhead whales during the fall migration period by designating preferred routes inside the barrier islands for coastal barging and planning to complete sealift barging prior to the fall migration
- Conducting marine activities prior to or after the Kaktovik and Nuiqsut fall bowhead whale subsistence hunts, unless other arrangements are made with the Whaling Captains and the AEWC
- Using MMOs for marine vessels as provided in the conflict avoidance agreement
- Developing protocols and designing pipelines to facilitate the continuation of current hunting patterns
- Supporting subsistence access to the project area
- Requiring routine aircraft flights (e.g., transportation of personnel and cargo) to generally fly at a 1,500-foot altitude following a path inland from the coast to avoid disturbance to wildlife and subsistence activities, except as required for takeoffs and landings, safety, weather, and operational needs, or as directed by air traffic control
- Providing emergency assistance to subsistence hunters and other community residents traveling through the Project area, in cooperation with Kaktovik Search and Rescue or by NSB Search and Rescue
- Developing guidelines in cooperation with the community on safe hunting in proximity to oilfields
- Designing the Point Thomson export pipeline to withstand accidental bullet strikes from coastal hunters
- Making subsistence-related training mandatory for the North Slope-based project workforce, including protection of subsistence resources, lands, wildlife, and cultural and archaeological awareness as part of Arctic Pass training
- Prohibiting hunting and fishing by the Applicant's employees and contractors while personnel are assigned to, and working in, the Point Thomson area

- Designing project features (e.g., color, lighting schemes, and buried/suspended cables) to minimize visual impact to subsistence users and resources (see also Section 5.19, Visual Aesthetics)
- Implementing dust control BMPs to minimize impacts of dust fallout onto terrestrial and aquatic habitat
- Implementing the Applicant's Point Thomson Project Oil Spill Contingency Mitigation Agreement (Mitigation Agreement), with $25 million in funding currently in place to provide immediate assistance to subsistence communities and users in the event of a spill preventing access to subsistence resources
- Implementing spill prevention and response programs, as detailed in Section 5.24.

The Corps is considering the following measures to avoid or minimize impacts to subsistence and traditional land-use patterns:

- As part of the Air Traffic Plan, limit helicopter traffic during the primary caribou hunting season (July and August) or consult with local hunters regarding modification of helicopter routes during that time.
- Maintain close communication and coordination with subsistence harvesters as project activities progress.
- Develop formal hunting policies and communication of policies to local hunters to help avoid confusion about hunting access.

5.22.3 Climate Change and Cumulative Impacts

5.22.3.1 Climate Change

Climate change has the potential to affect subsistence uses by affecting the availability of subsistence resources, access to hunting and harvesting areas, and harvester safety. The success of subsistence activities in the Arctic relies on the predictability of weather conditions such as the timing of freeze-up and breakup, precipitation amounts, storms and winds, prevailing winds, ice conditions, and temperatures; as well as the presence of an adequate number of healthy subsistence resources in traditional subsistence use areas at the expected time of year. North Slope hunters have already reported experiencing the effects of climate change on subsistence, including changes in species productivity and distribution, reduced habitat for marine mammals associated with decreased sea ice, changes in the timing of subsistence activities due to later freeze-up or earlier breakup, changes in the physical environment (e.g., lakes, rivers, and wetlands), and increased risks to hunters associated with changes in ice thickness, ice movements, and currents (SRB&A 2009).

Shrinking sea ice, thawing permafrost, and warmer temperatures could result in changes in the migration, distribution, health, and abundance of subsistence resources, thus affecting their availability to subsistence users who rely on the resources being present in their expected locations at certain times of the year. For example, in recent years, North Slope hunters have observed that the ice pack has retreated more quickly than it used to and is farther from shore. This has resulted in hunters having to travel farther from shore and with increased risks to safety in order to locate and harvest marine mammals, which tend to follow the ice pack (Callaway 1998, SRB&A 2009). Climate change is expected to result in changes to the abundance (i.e., survival rates) and distribution of terrestrial mammals (including caribou and muskoxen; see Section 5.10), marine mammals (including bowhead whales, seals, beluga, and polar bears; see Section 5.11), birds (including white-fronted geese, brants, and eiders; see Section 5.9), and fish (see Section 5.12; ACIA 2004). Effects on subsistence uses of these resources would depend on the nature of the changes and the degree to which these changes occur.

Further, the warming temperatures in the Arctic, and their potential impact to soils and permafrost (see Section 5.2) could affect subsistence users' ability to store food gathered by subsistence activities. Many subsistence users have underground cellars that use the frozen ground to keep perishables frozen. A 2009-to-2010 survey of four ice cellars in Barrow found evidence that one cellar maintained its functionality, but that each of the three other cellars showed evidence of thawing and that their internal temperatures were at or above freezing, despite outside temperatures as low as -13°F (Brubaker et al. 2010). Failure of ice cellars due to warming may cause subsistence food to spoil, and users may need to increase their harvest to offset loss due to spoilage, or increase their reliance on artificial (electric or gas) refrigeration.

5.22.3.2 Cumulative Impacts

The interaction of the project effects with those from past, present, and future projects could impact subsistence in the project area. Past and present oil and gas development and other activities such as military use on the North Slope have already caused impacts on subsistence activities and use areas in North Slope communities.

Development of the Point Thomson Project under all action alternatives could lead to future expansion of the Point Thomson development, resulting in increased impacts on subsistence use areas, reduced user access to traditional hunting areas, decreased resource availability, increased competition among subsistence users, and increased costs and time associated with harvesting subsistence resources. Other reasonably foreseeable future developments on the North Slope, including oil and gas exploration in the Eastern Beaufort Sea and Eastern North Slope areas as well as west of the Colville River delta (Alpine Satellite pads GMT 1 and GMT 2) and south of Nuiqsut in the Kuparuk River area (see Table 4.2-2, Cumulative Impacts Methodology), could add to these impacts by expanding further into existing subsistence use areas and increasing the incidence of potential impacts on user access and resource availability. SRB&A (2009) shows the majority of active harvester respondents in four North Slope communities (Barrow, Nuiqsut, Atqasuk, and Wainwright) reporting personal experiences with the impacts of oil and gas development, with 60 percent of all respondents reporting personal experiences with displacement of wildlife alone. Further development of oil and gas development on the North Slope could increase the severity of already existing impacts and affect subsistence harvest patterns in North Slope communities.

Reduced harvests of subsistence resources over time could result in reduced opportunities to participate in subsistence harvesting and associated activities, such as processing and sharing subsistence foods. Without these opportunities to transmit knowledge through the generations, long-term effects on culture could also occur.

The project could contribute to cumulative effects of development on subsistence resources and activities because it would increase the amount of land used for oil and gas and other development. Nuiqsut's subsistence use area has shifted west over time due to Prudhoe Bay development (RFSUNY 1984; IAI 1990b; Pedersen et al. 2000); similarly, the extent of Kaktovik's subsistence use area could shift farther east with the development of Point Thomson and with possible future developments east of Point Thomson. Development of Point Thomson could enlarge the area of avoidance by subsistence users based on patterns seen elsewhere with oil and gas development on the North Slope (NRC 2003a).

In addition to oil and gas development, other activities on the North Slope contribute to cumulative effects on subsistence. These include scientific research and surveys, which cause helicopter and other traffic disturbances on the North Slope, and result in user avoidance of resources considered abnormal due to tagging and radio collars. Increased recreational hunting and fishing activities could also occur, which could cause increased competition for subsistence resources and wildlife disturbance through air traffic. The potential construction of new roads such as the proposed Foothills West Transportation Corridor could bring increased access to the area for nonlocal hunters and tourists, resulting in increased competition for subsistence resources, as well as the potential expansion of areas accessible for development.

Under Alternative C, the contribution to cumulative impacts would be similar to those discussed for all action alternatives, although the construction of a gravel access road could encourage opening the area to further oil and gas development and depending on control of the road, recreation, and hunting use. This would increase the likelihood of subsistence impacts by increasing the amount of area removed as a subsistence use area; increasing the amount of infrastructure and noise/traffic that could affect resource availability and user access; increasing concerns about and opportunities for contamination of subsistence resources; and increasing impacts on subsistence use areas and user access due to new hunting regulations. Subsistence users on the North Slope, especially residents of Nuiqsut, have been found to shift their activities away from oil and gas development (BLM 2004). This could occur for the community of Kaktovik if oil development continued to grow eastward. As stated in the NRC's *Cumulative Environmental Impacts of Oil and Gas Activities on Alaska's North Slope*, "Even where access is possible, hunters are often reluctant to enter oil fields for personal, aesthetic, or safety reasons. There is thus a net reduction in the available area, and this reduction continues as the oilfields spread" (NRC 2003a). In summary, adverse cumulative impacts to subsistence and traditional land use resources are anticipated.

5.22.4 Summary and Comparison of Alternatives

The majority of documented Kaktovik and Nuiqsut subsistence uses in the Point Thomson area occur along the coast or offshore during the open-water season. Kaktovik residents report use areas for caribou in the project area, or along the coast near the project area, with 39 percent of Kaktovik harvester respondents reporting use areas for the 1996-to-2006 time period in the subsistence project area (Figure 5.22-1). Thus, user avoidance, loss of traditional hunting areas, and perceived effects in terms of contamination could occur for a moderate portion of Kaktovik harvesters.

A relatively high number of caribou harvests have also been reported adjacent to and east of the project area at sites such as Brownlow Point, Canning River delta, and Konganevik Point, although reported harvests associated with place name locations within the project area (i.e., Bullen Point and Point Thomson) are smaller. Harvests reported at the Brownlow Point and Canning River delta place name locations likely include harvests west of those locations, closer to the project area, or east of those locations. If the Point Thomson Project affects hunter success in the Bullen Point and Point Thomson areas, then up to 0.8 percent (or 1 pound of caribou per capita) of the average annual caribou harvest could be affected. If impacts extend to the Brownlow Point and Canning River delta place name locations (most likely under Alternative C), then up to 10.8 percent (or 13.3 pounds of caribou per capita) of the average annual caribou harvest could be affected. The contribution of these place name locations toward the total subsistence caribou harvest varies widely from year to year, and therefore while impacts on community caribou harvests would not be expected to occur on a yearly basis, they may exceed the average annual percentage of harvest during certain years when caribou were unavailable elsewhere.

Fishing by Kaktovik residents also occurs along the coast in the project area, although these activities are limited to a small portion of residents (8 percent of SRB&A [2010a] harvester respondents) and it is assumed the area does not provide a major portion of yearly fish harvests for the community of Kaktovik. While the Point Thomson Project alternatives would not be expected to affect fish abundance or distribution (Section 5.12), impacts on fish harvesting related to user avoidance could occur.

The project area is not within Nuiqsut's subsistence use area for most subsistence resources; however, Nuiqsut bowhead whale use areas occur offshore from the project area, with 42 percent of SRB&A (2010a) active harvester respondents reporting bowhead whale use areas in the buffered coastal barging route under Alternatives B and E. No reported Nuiqsut bowhead whale harvests have occurred east of Bullen Point. Furthermore, Figure 32 in Appendix Q shows Nuiqsut bowhead whaling GPS tracks from 2001 to 2009 located offshore from the project area within the buffered coastal barging route, but only during certain years. If disturbances related to traffic occur during the Nuiqsut bowhead whale hunting season, then resource availability of this major resource could be affected, causing- impacts for subsistence users. The Applicant's conflict avoidance agreement with the AEWC restricting barge traffic during the bowhead whaling season should mitigate potential impacts on bowhead whale hunting related to barge operations, and therefore impacts on Nuiqsut bowhead whale hunting would be unlikely.

Nuiqsut and Kaktovik harvests of animals that migrate through the project area could also be reduced if the migration patterns, health, or abundance of those animals were affected. While Sections 5.9 (Birds), 5.10 (Terrestrial Mammals), 5.11 (Marine Mammals), and 5.12 (Fish, Essential Fish Habitat, and Invertebrates) do not indicate this potential level of impacts, local residents have voiced concerns about the potential for more widespread impacts on their subsistence uses. Therefore, avoidance of the project area or avoidance of certain resources (e.g., arctic cisco, caribou) may occur if residents from Nuiqsut and Kaktovik perceive these resources to be absent near the Point Thomson Project area, or if they perceive that these resources would be contaminated.

Alternatives B and E, which include barge traffic and nearshore infrastructure, would likely have the greatest impacts on residents' subsistence activities resulting from changes in user access (either through regulations or hunter avoidance) due to pipelines and infrastructure being located within 1 to 2 miles of residents' coastal hunting areas. Alternative E would rely more heavily on air transport, including helicopter and airplane traffic, and therefore may increase the likelihood of hunter avoidance or reduced availability of caribou due to localized changes in caribou behavior or distribution. Alternatives C and D would have the least direct impact on coastal or offshore subsistence uses related to hunter avoidance or user access due to the elimination of barge activity and the placement of infrastructure farther inland from residents' coastal and offshore hunting areas. However, the gravel access road proposed under Alternative C may cause greater disruption to caribou movement than other alternatives and greater cumulative impacts by opening the area to further oil and gas development. In terms of caribou disturbance, Section 5.10 notes that Alternative C could cause the greatest geographic extent of caribou disturbance; therefore this alternative may have the greatest impact on Kaktovik caribou harvests if the disturbance affects harvests associated with Brownlow Point and Canning River delta.

5.22.5 Environmental Consequences of Subsistence Impacts

The primary impacts on subsistence uses resulting from the proposed project alternatives include impacts on subsistence use areas, resource availability, and user access for caribou. These impacts, in turn, could also result in increased competition and increased costs and time for caribou hunters. Ultimately, effects on subsistence related to the proposed project could result in reduced harvests of caribou and reduced opportunities to participate in subsistence harvesting and associated activities. When subsistence users' opportunities to engage in subsistence activities are limited, then their opportunities to transmit knowledge about those activities, which are learned through participation, are also limited.

If residents stop using the project area for subsistence purposes, either due to avoidance of development activities, hunting regulations, or reduced availability of subsistence resources in that area, the opportunity to teach younger generations about that traditional use area would be lost. The loss of that knowledge could result in a permanent reduction of the community of Kaktovik's subsistence use area. If harvests of subsistence resources (particularly caribou) decline because of the effects of infrastructure, noise/traffic, or contamination on resource availability, then there would be fewer opportunities to teach younger generations the skills necessary to hunt, harvest, and process subsistence resources. There would also be fewer opportunities for residents to participate in the distribution and consumption of subsistence resources.

Any changes to residents' ability to participate in subsistence activities, to harvest subsistence resources in traditional places at the appropriate times, and to eat subsistence foods could have long-term or permanent effects on culture by diminishing social ties within the community (which are strengthened through shared harvesting, processing, and distribution of subsistence resources) and weakening overall community well-being.

5.23 HUMAN HEALTH

This section provides a summary of the environmental consequences for human health, and is based on the State of Alaska's technical report, *Health Impact Assessment: Point Thomson Project* (Appendix R). The key findings for human health are summarized below with a brief summary of the differentiating effects.

Key Impact Findings and Differentiators Among Alternatives

Key Findings:

Alternatives B, C, D, and E:

- High positive impacts for improved health care delivery and infrastructure.
- Medium negative impacts on depression/anxiety prevalence in communities associated with low-level but persistent fear of a catastrophic event during operations.

Alternatives C and D:

- Medium negative impacts on amount of dietary consumption of subsistence resources related to reduction in subsistence harvest.
- High negative impacts on roadway accidents and injuries, and associated local emergency and medical response, during construction and drilling.

Alternatives B and E:

- Low negative impacts on amount of dietary consumption of subsistence resources, composition of diet, food security, and accidents and injuries (negative).

Alternative A: No impacts

Differentiators:

- Increased truck traffic associated with gravel access road and seasonal tundra ice-road for Alternatives C and D, respectively, could lead to increased traffic accidents and injuries involving local residents as well as potential impacts on subsistence diet.

The Health Impact Assessment (HIA) was led by State of Alaska public health professionals (Alaska State HIA Team). The methods used in the HIA to evaluate potential impacts of the Point Thomson Project on human health are described below.

5.23.1 Methodology

The Alaska State HIA Team, led by the Alaska Department of Health and Social Services (ADHSS), evaluated the human health impacts by drawing on:

5. Available health baseline data from the literature review (see Section 3.23, Human Health).
6. Review of the project context, alternatives, and developments.
7. Review of pertinent resource sections of this EIS, particularly the Socioeconomic, Environmental Justice, Subsistence and Traditional Land-Use Patterns, and Transportation sections.
8. Information and recommendations generated by a panel of Alaskan public health professionals who are familiar with the Alaskan context and who have no vested interest in the project.

The Point Thomson HIA used a semiquantitative risk assessment technique (Winkler et al. 2010) to rate the level of identified health impacts, allowing health planners to prioritize management actions. The rating method is based on a modified Delphi (Rowe and Wright 1999), a technique used in judgment and forecasting situations where pure model-based statistical methods are not practicable. The HIA was executed in the presence of data gaps, particularly related to human consumption of subsistence resources.

5.23.1.1 Health Effects Categories

The impacts were analyzed according to eight Alaska-specific Health Effects Categories (HECs) and specific health issues relevant to the Point Thomson Project (see Table 5.23-1). These HECs were developed for the *State of Alaska HIA Toolkit* (ADHSS 2011). For a more detailed description on the HECs, see Table 5.23-1 in Chapter 3, Affected Environment, and the HIA (Appendix R).

Table 5.23-1: Health Effect Category and Specific Health Issues

Health Effects Category	Specific Health Issue
Water and Sanitation	Change in potable water access.
	Change in water quantity.
	Change in water quality.
	Change in sanitation effectiveness, adequate settling pools, discharge.
Accidents and Injuries	Change in unintentional injury (e.g., drowning, falls, snowmachine injury) rates.
	Change in roadway incidents and injuries due to service road access for hunters / increased traffic from Prudhoe Bay.
	Changes to safety during subsistence activities.
Exposure to Hazardous Materials	Changes in physiologic contaminant levels such as lead, methyl mercury, PCB, Dioxins, $PM_{2.5}$ from incineration, drilling mud, or gas flaring.
	Changed levels of the same substances in subsistence resources.
Food, Nutrition, and Subsistence	Change in amount of dietary consumption of subsistence resources.
	Change in composition of diet.
	Change in food security.
Health Infrastructure/Delivery	Change in number of clinics and staff.
	Change in quality of clinics and staff.
	Change in services offered (e.g., prenatal checks, x-ray, lab services).
	Change in accessibility of health care.

Table 5.23-1: Health Effect Category and Specific Health Issues	
Health Effects Category	Specific Health Issue
	Change in utilization/clinic burden from nonresident influx.
Infectious Disease	Change in pediatric acute respiratory disease rates (respiratory syncytial virus, pneumonias, asthma, bronchiectasis).
	Change in acute adult respiratory disease rates (tuberculosis, bronchitis, influenza).
	Change in sexually transmitted disease rates (especially chlamydia, gonorrhea, human immunodeficiency virus [HIV]).
	Change in gastrointestinal disorder outbreaks.
Noncommunicable Disease	Change in obesity prevalence.
	Change in average body mass index.
	Change in type 2 diabetes mellitus rates.
	Change in hypertension.
	Change in lung cancer rates.
	Change in chronic obstructive pulmonary disease rates.
Social Determinants of Health	Change in maternal child health status.
	Change in depression/anxiety prevalence.
	Change in substance abuse rate.
	Change in suicide rate.
	Change in teen pregnancy rates.
	Change in domestic violence.

5.23.1.2 Impact Evaluation Criteria

Using a modified Winkler et al. 2010 risk assessment matrix method, the Alaska State HIA Team determined and rated the level of the human health impacts based on the impact assessment criteria for human health presented in Table 5.23-2. In addition to the impact categories defined for this EIS (magnitude, duration, potential to occur, and geographic extent), the HIA also considered the intensity of the health effect. The HIA assessed the level of impacts of the project on human health based on the stepwise process described below. Table 5.23-2 defines the level of impact assessed in Step 1 shown on the following page. This step is similar to the impact criteria definitions used to assess impacts for other resources discussed in the EIS.

Table 5.23-2: Impact Criteria—Human Health

Impact Category*	HIA Intensity Type (Score for Step 1)*	Specific Definition for Human Health
Magnitude	Very high (3)	Those impacted would not be able to adapt to the health impact or to maintain pre-impact level of health.
	High (2)	Those impacted would be able to adapt to the health impact with some difficulty and would maintain pre-impact level of health with support.
	Medium (1)	Those impacted would be able to adapt to the impact with ease and maintain pre-impact level of health.
	Low (0)	Minor intensity.
Duration	Long term (3)	Long term: more than 6 years/life of project and beyond.
	Medium term (2)	Medium term: 1 to 6 years.
	Short term (1)	Short term: 1 month to 1 year.
	Less than 1 month (0)	Less than 1 month.
Potential to Occur (Likelihood)	Virtually certain	Greater than 99% probability.
	Very likely	90 to 99% probability.
	Likely	66 to 90% probability.
	About as likely as not	33 to 66% probability.
	Unlikely	10 to 33% probability.
	Very unlikely	1 to 10% probability.
	Extremely unlikely	Less than 1% probability.
Geographic Extent	State, Nation, Global (3)	Rest of State of Alaska (including Zone 3), U.S. and global.
	Regional (2)	Zone 2: Anaktuvuk Pass, Prudhoe Bay/Deadhorse, Barrow.
	Local (1)	Zone 1: Kaktovik and Nuiqsut.
	Project area (0)	Point Thomson Project area.
Health Effect	Very high (3)	Effect would result in loss of life, severe injuries, or chronic illness that requires intervention.
	High (2)	Effect would result in moderate injury or illness that may require intervention.
	Medium (1)	Effect would result in annoyance, minor injuries, or illnesses that do not require intervention.
	Low (0)	Effect would not be perceptible.

* Impact categories were developed based on CEQ NEPA regulations as described in Section 4.1, Impact Determination Methodology.

The Alaska State HIA Team convened an expert panel review of scientists and health professionals with HIA expertise and knowledge of North Slope oil field operations and the Point Thomson Project on October 29, 2010, to rank and rate the impacts by using the following four-step semi-quantitative risk assessment procedure:

Step 1. Score the level of each consequence (magnitude, duration, geographic extent, and health effect) on a four-point scale: low (0), medium (1), high (2), and very high (3), as described in Table 5.23-2, above.

Step 2. Rate the severity of the health impact (low, medium, high, or very high) based on the sum of the scores of the consequences.

Step 3. Rate the potential (or likelihood) of the impact to occur based on professional judgment on the percent probability of the impact occurring.

Step 4. Rate the identified health impacts (low, medium, high, or very high) based on the intersection of the level of severity and potential (or likelihood) as shown in Figure 5.23-1. Health issues anticipated to have negligible or zero impacts were identified as having no impacts.

For further details on the risk assessment procedure for human health, including the scoring results from Step 1, see the HIA (Appendix R). Risk assessment terminology was modified for the EIS for clarity within the NEPA context. Figure 5.23-1 presents the Impact Rating Matrix, referred to as Significance Rating in the HIA Technical Report, which was used in Step 4. The primary reason for changing the nomenclature was to clarify that what was being rated by this scale was the level of impact, not significance, in the NEPA context.

Step 2	**Step 3**						
Severity Rating (Magnitude + Duration + Geographic Extent + Health Effect)	**Likelihood Rating**						
	Extremely unlikely < 1%	Very unlikely 1-10%	Unlikely 10-33%	About as likely as not 33-66%	Likely 66-90%	Very likely 90-99%	Virtually certain > 99%
Low (0-3)	◆	◆	◆	◆	◆◆	◆◆	◆◆
Medium (4-6)	◆	◆	◆	◆◆	◆◆	◆◆	◆◆◆
High (7-9)	◆◆	◆◆	◆◆	◆◆◆	◆◆◆	◆◆◆	◆◆◆◆
Very high (10-12)	◆◆◆	◆◆◆	◆◆◆	◆◆◆◆	◆◆◆◆	◆◆◆◆	◆◆◆◆
Step 4	**Impact Rating**						
	Key: Low ◆ Medium ◆◆ High ◆◆◆ Very High ◆◆◆◆						

Figure 5.23-1: Visual Representation of the Impact Rating Matrix

A low impact rating would indicate that while a negative effect to health may occur from the proposed activity, the impact magnitude would be small (with or without mitigation) and well within accepted levels, and/or the receptor has low sensitivity to the effect. Low impacts may be low in intensity but have long duration as found in the operations phase or medium in intensity but of very short duration as is common during the construction or drilling phases.

Impacts classified with a medium impact rating and above would require action so that predicted negative health effects could be mitigated to as low as reasonably practicable (Winkler et al. 2010). An impact given a high or very high rating would affect the proposed activity, and without mitigation, may present an unacceptable risk. Mitigation requirements would be determined by the Corps.

In addition, impacts were assessed for whether they may worsen (indicated by a "-") or improve (indicated by a "+") human health compared to the baseline condition. An example of an improvement to human health would be an increase in healthcare resources.

5.23.2 Alternative A: No Action

Under Alternative A, the proposed project would not obtain a permit from the Corps for gravel fill and other regulated construction activities. Protective wellhead covers approximately 16 feet tall and 8 feet in diameter installed on PTU-15 and PTU-16 and rig mats would remain onsite. Occasional helicopter operations for site monitoring would occur.

Under Alternative A, no construction or drilling activity would occur, and therefore there would be no associated impact to human health. The wells would continue to be monitored in accordance with AOGCC regulations and prudent operator practices until the time that they are closed or brought into production in a future project. This monitoring activity would likely have no impacts on human health.

5.23.3 Alternative B: Applicant's Proposed Action

Alternative B would initiate the development of the Thomson Sand reservoir and hydrocarbon production facility. Under Alternative B, year-round access to the project site would occur by using seasonal modes of travel, including barge access in the summer, ice roads in the winter, and helicopters and fixed-wing aircraft as weather permits. The construction and drilling phases in Alternative B overlap, with construction beginning in Year 1 and drilling beginning in Year 3 following receipt of the ROD. Drilling would conclude in Year 6. Facilities, including the pipeline and barging facilities, would be located near the coast.

5.23.3.1 Alternative B: Construction and Drilling

During construction and drilling, potential impacts to human health could occur as a result of exposure to hazardous materials, reduced consumption of subsistence resources, and changes in SDH (e.g., income and community cohesiveness).

Exposure to Hazardous Materials

The expert panel ranked exposure to hazardous materials as medium, primarily because of the presence of incinerators with no documented plan for monitoring stack emissions. While emissions would be regulated through the air permitting process and emissions would likely be rapidly diffused over a wide area, the health expert panel could not deny that certain byproducts of incomplete combustion would escape the stack and some potential for exposure of wildlife and humans could exist.

Food, Nutrition, and Subsistence Activities

Changes to subsistence resource habitat and hunting areas cannot be directly converted into changes in human health status. Rather, changes to subsistence resource areas could negatively affect human health if considered in terms of several interrelated assumptions. First assuming that complete avoidance of the area does in fact occur, one must then assume that:

- Reduction in subsistence resource area equals a reduction in subsistence resource harvest.
- Reduction in subsistence harvest equals reduction in subsistence resource consumption.
- Residents choose to replace lost subsistence foods with less nutritious alternatives.

Under Alternative B, primary potential impacts to subsistence could include loss of high-use Kaktovik subsistence use areas for caribou; reduced resource availability to Kaktovik hunters for caribou; reduced resource availability and access to Nuiqsut hunters for bowhead whales; and reduced user access due to avoidance of coastal hunting areas in the project vicinity for caribou and fish (Dolly Varden and whitefish; see additional discussion in Section 5.22, Subsistence and Traditional Land-Use Patterns).

According to Section 5.22, the maximum potential harvest loss annually associated with the Point Thomson Project is estimated between 0.8 percent (Bullen Point and Point Thomson) and 10.8 percent (Bullen Point to

Brownlow Point/Canning River delta) or between 1 and 13.3 pounds of caribou per capita. Less than 1 percent of the total caribou harvest may be affected by the activities described under Alternative B or 1 pound of caribou per person per year (or approximately 600 calories of very lean meat).

When placed in the context of the overall subsistence harvest (including bowhead whale harvest), according to the subsistence technical data provided (Appendix Q, *Subsistence and Traditional Land-Use Technical Report*), this region (Bullen Point to Point Thomson) represents less than 1 percent of the overall harvest. It is possible that in some years residents could have successful hunts without accessing this remote region and that the actual harvest would not be materially affected. On the other hand, it is also the case that in some years, avoidance of this hunting ground may significantly challenge harvest efforts if herds are less common in other areas or if the whale harvest does not occur.

Second, the reductions in subsistence resource areas could affect human health if one further assumes that a reduction in harvest produces an equal reduction in consumption of subsistence resources. Due to factors such as resource sharing and variable subsistence food consumption for different community groups (e.g., men vs. women, elderly vs. youth) it is difficult to know precisely to what extent a reduction in the resource harvest affects consumption patterns in the community. Some individuals or household units with heavy reliance on traditional foods or subsistence consumption would be disproportionately burdened by the reduction in subsistence harvest. For others with different dietary habits, the reduction in harvest may have little impact.

Third, reduction in subsistence resource areas could affect human health if one also assumes that residents would replace subsistence foods with less healthy alternatives. According to Section 5.16, Environmental Justice, if the proposed project reduces the quantity of caribou harvested by residents of Kaktovik, they would likely purchase more food from outside the area. In addition to increasing the reliance on the cash economy and the cost of living, Kaktovik residents could experience a change in diet as caribou become a less dominant part of their diet, which may result in nutritional deficiencies.

While residents would obviously replace subsistence foods by using cash-purchased foods, some may choose healthy replacement foods and some may not. Without current nutritional survey information for these villages, it is difficult to say precisely how a predicted reduction in subsistence resource area would ultimately affect human health. If, however, one accepts the assumptions above and there is indeed a reduction in subsistence food consumption, this could lead to negative impacts on human health in the community. Based on the information provided in Section 5.22, Subsistence and Traditional Land-Use Patterns, the coastal region affected by the project yields a very small portion of the overall subsistence harvest for Kaktovik and would likely produce very small changes in consumption of traditional foods.

Subsistence activities are an important component of the Nuiqsut economy and Iñupiat culture and identity. As in Kaktovik, subsistence resource harvesting continues to be the focus of life in Nuiqsut. Caribou are an important migratory resource that consistently ranks as one of the top two resources harvested by Nuiqsut residents. Although Nuiqsut's most recent (1995 to 2006) caribou use areas do not extend as far east as Point Thomson, caribou that migrate through the Point Thomson area may later be harvested by Nuiqsut hunters.

According to Section 5.22, Subsistence and Traditional Land-Use Patterns, Alternative B is not expected to result in reduced harvests of bowhead whales given the Applicant's Conflict Avoidance Agreement with the AEWC, which restricts barge traffic during the Nuiqsut bowhead whaling season. Impacts on fish harvesting would be unlikely to occur for Nuiqsut, but are possible for Kaktovik and primarily related to impacts from user avoidance; these impacts would be limited in extent. In addition, waterfowl hunting impacts are unlikely.

As discussed above, Alternative B could present some potential health challenges for the residents of Kaktovik and Nuiqsut related to subsistence impacts. However, other sources of subsistence and manufactured food are available to make up for the potential loss of 1 pound of caribou per person. In addition, the Applicant has agreed to build the pipeline with a minimum clearance of 7 feet above the tundra in order to facilitate the movement of caribou and to conduct barging activities prior to or after the Kaktovik and Nuiqsut fall whaling season unless other arrangements are made with the community whaling captains and AEWC.

Given the assumptions involved and the relatively small amount of meat potentially lost per capita, the expert panel rated the potential health impacts related to the change in (1) the amount of dietary consumption of subsistence resources, (2) composition of diet, and (3) food security as low.

Social Determinants of Health

Constructing Alternative B would be a multiyear project that would generate employment within the NSB and the State of Alaska. Employment would peak in Years 4 and 5 when an estimate of 950 workers would be employed in construction and drilling (HDR 2011b). The Applicant anticipates hiring local NSB residents as part of its construction crew or as employees of subsidiaries of the Native Corporations of Kaktovik, Kaktovik Inupiat Corporation, and of Nuiqsut, Kuukpik Corporation. In 2009, 20 NSB residents were employed under these two contracts. Income in local NSB communities might also be positively impacted by the proposed seasonal hire of area residents for marine mammal observers, subsistence advisors, and polar bear monitors. In most cases, increased income is strongly associated with improved community health status (ExxonMobil 2009b; Appendix D, RFI 31).

According to Section 5.22, Subsistence and Traditional Land-Use Patterns, if harvests of subsistence resources (particularly caribou) decline because of the effects of infrastructure, noise/traffic, or contamination on resource availability, then there might be fewer opportunities to teach younger generations the skills necessary to hunt, harvest, and process subsistence resources, potentially weakening overall community well-being. The expert panel rated the negative impact to community cohesiveness, an aspect of social determinants of health, as low because the core subsistence areas near Kaktovik would be unaffected.

Construction and drilling employees would be housed in six construction camps with a maximum capacity of 520 workers. Before construction camp modules arrive, a pioneer camp would be located on existing gravel to house up to 160 personnel, and demobilized in late fall of Year 2. The temporary camp modules would be fully self-contained and workers would have no reason to travel to any of the NSB communities, other than Deadhorse. The lack of physical connection between Point Thomson and the other communities would also reduce interaction between the workers and the local community, thereby reducing the potential for adverse effects to community characteristics or culture.

5.23.3.2 Alternative B: Operations

During operations, potential impacts to human health could occur as a result of exposure to hazardous materials, reduced consumption of subsistence resources, changes in SDH (e.g., depression/anxiety prevalence), and improvements in health care infrastructure/delivery.

Exposure to Hazardous Materials

The expert panel ranked exposure to hazardous materials as medium, primarily because of the duration of the proposed project. While the amount of incinerated waste would decrease after construction, there would still be no requirement per current air quality regulations for stack monitoring, which would preclude knowing if persistent organic pollutants are entering the atmosphere. The EPA is currently reviewing stack monitoring regulations, which if enacted would change this rating.

Food, Nutrition, and Subsistence Activities

Although hunters may avoid the project facilities for the duration of project operation, the Alaska State HIA Team determined that the potential impact on consumption of subsistence foods would likely remain low for Alternative B. This is due to the remote nature of the affected area and the relatively small contribution it now makes to the subsistence caribou harvest for Kaktovik and Nuiqsut. See Section 5.23.3.1, Alternative B: Construction and Drilling, for more discussion.

Social Determinants of Health

A total of 160 permanent employees would be expected to work at the Point Thomson site during the 30-year operations phase. It is unclear how many of these positions could be filled by NSB residents because of the required job skills needed during operations. The Applicant has committed to continuing its local hiring program and encouraging independent contractors to “hire, train, and retain” Native residents (Appendix D, RFI 31). Given that the NSB does not have a sufficiently developed industrial base to supply materials or other project-related services, a direct-hire program would be the primary method by which the NSB could benefit economically from the proposed project.

According to Section 5.15, Socioeconomics, Deadhorse would experience a minor increase in activity during operation of the Point Thomson facility and this would generate some minor indirect employment and income during operations. Income in local NSB communities may be positively impacted by the proposed seasonal hire of area residents for marine mammal observers, subsistence advisors, and polar bear monitors. Increased income, increased educational attainment, and increased employment rates are strongly associated with improved health (ExxonMobil 2009b; Appendix D, RFI 31).

As with construction activities, operation of the Point Thomson facility would be fully self-contained and workers would have no reason to travel to any of the NSB communities, other than Deadhorse. The lack of physical connection between Point Thomson and the other communities would also reduce interaction between the workers and the local community, thereby reducing the potential for adverse effects to community characteristics or culture.

The expert panel determined that local residents, especially of Kaktovik, might experience a modest change in their prevalence of depression and anxiety due to a low-level but persistent fear of a catastrophic incident at the facility. Although not anticipated for this project, environmental disaster in the Arctic is a real concern for local residents as it would have profound implications for their communities. Thus, the HIA expert panel rated the health impact associated with a negative change in depression/anxiety prevalence as medium which is common to all action alternatives in the operations phase.

Health Infrastructure/Delivery

The development at Point Thomson is predicted to add approximately $1 billion to the actual and true property value of the NSB (ExxonMobil 2009b). This would represent an increase of about 8 percent relative to the total NSB actual and true property value of $12.9 billion reported in 2009 (see Section 5.15, Socioeconomics, for further discussion). According to Section 5.15, increasing the tax revenue of the NSB may have cascading effects across the borough. The NSB provides most of the services and employment in the borough; it also funds most of the capital improvement projects in the region, including health care facilities. This is a positive impact common to all action alternatives in the operations phase.

5.23.3.3 Alternative B: Impact Summary

Table 5.23-3 summarizes the health impacts rated as medium to high for Alternative B. The HIA (see Appendix R, Tables 15-22) determined that Alternative B would have no impacts to water and sanitation and infectious disease and low impacts to specific health issues related to accidents and injuries; food, nutrition, and subsistence; and noncommunicable chronic diseases. Impacts to off-site accidents and injuries are expected to be low, and the Applicant has existing procedures for safe driving.

Table 5.23-3: Alternative B—Impact Summary for Human Health

Health Effects Category	Specific Health Issue	Impact Rating
Construction and Drilling		
Exposure to Hazardous Materials	Changes in physiologic contaminant levels such as lead, methyl mercury, PCB, Dioxins, $PM_{2.5}$ from incineration, drilling mud, or gas flaring.	Medium (-)
	Changed levels of the same substances in subsistence resources.	Medium (-)
Operations		
Exposure to Hazardous Materials	Changes in physiologic contaminant levels such as lead, methyl mercury, PCB, Dioxins, PM2.5 from incineration, drilling mud, or gas flaring.	Medium (-)
	Changed levels of the same substances in subsistence resources.	Medium (-)
Social Determinants of Health	Change in depression/anxiety prevalence.	Medium (-)
Health Infrastructure/Delivery	Change in number of clinics and staff.	High (+)
	Change in quality of clinics and staff.	High (+)
	Change in services offered (e.g. prenatal checks, x-ray, lab services).	High (+)
	Change in accessibility of health care.	High (+)

(-) = Detrimental impact, (+) = Beneficial impact

5.23.4 Alternative C: Inland Pads with Gravel Access Road

Alternative C would move project components inland and as far away from the coast as feasible to minimize impacts to coastal resources such as marine mammals, marine fish, subsistence activities, coastal processes, and to avoid potential impacts to the proposed project from coastal erosion. To provide year-round access to Point Thomson, this alternative includes the construction of a gravel access road from Point Thomson to the Endicott Spur Road where it would connect to the Dalton Highway during construction and drilling. West Dock in Prudhoe Bay would be used for deliveries by barge; however, those materials would be transported to Point Thomson by truck. An airstrip would be built for air access. Alternative C would not include barging or associated facilities for sea access to Point Thomson.

5.23.4.1 Alternative C: Construction and Drilling

The construction and drilling phases in Alternative C would again overlap with construction beginning in Year 3 following receipt of the ROD and drilling beginning in Year 4. All construction, including the construction of the gravel access road would be complete by Year 6, while drilling would be completed by Year 8. Under Alternative C, materials and supplies would be barged into West Dock in Prudhoe Bay and then trucked to Point Thomson between 17,000 and 18,500 trips during the extended construction and drilling phases of the project.

During construction and drilling, potential impacts to human health could occur as a result of exposure to hazardous materials, reduced consumption of subsistence resources, changes in SDH (e.g., community cohesiveness), increased accidents and injuries, and demand on local emergency and medical response.

Exposure to Hazardous Materials

The expert panel ranked exposure to hazardous materials as medium, primarily because of the need to incinerate waste and the lack of stack monitoring, which would preclude knowing if persistent organic pollutants enter the atmosphere. This risk would be higher than for Alternative B because the construction period would be twice as long and because the amount of material for incineration would increase with the size of the construction workforce.

Food, Nutrition, and Subsistence Activities

Alternative C would place most facilities, including the export pipeline, inland from the Beaufort Sea. Materials and supplies, including the modules, would be delivered by barge to West Dock in Prudhoe Bay and trucked to the site on the Dalton Highway to Endicott Spur and to the site by a sea or tundra ice road. While the impact to marine mammals may be less intense under Alternative C than Alternative B, impacts to the quantity of caribou would be expected to be approximately the same as for Alternative B.

According to Section 5.22, Subsistence and Traditional Land-Use Patterns, construction and drilling activities under Alternative C would be expected to disrupt subsistence caribou hunting for the residents of Kaktovik because the herds congregate along the shoreline during the summer months and that the noise and traffic could disrupt the herd during the long (multiple years) construction period. The Subsistence section estimates that the maximum potential effects on caribou harvests may include the loss of up to 10.8 percent of annual caribou harvests, accounting for approximately 13.3 pounds per capita of caribou per year or approximately 15,000 calories of energy from very lean meat. Impacts may not occur during all years but could exceed the maximum expected annual loss during certain years if caribou are unavailable elsewhere. In addition, other sources of subsistence and manufactured food are available to replace the 13 pounds per year of caribou potentially lost.

According to Section 5.16, Environmental Justice, if the proposed project reduces the quantity of caribou harvested by residents of Kaktovik, they would likely purchase more food from outside the area. In addition to increasing the reliance on the cash economy and the cost of living, Kaktovik residents might experience a change in diet as caribou become a less dominant part of their diet, which may result in nutritional deficiencies.

Nuiqsut's most recent (1995 to 2006) caribou use areas extend to just east of Prudhoe Bay and cross the Dalton Highway, which would experience a substantial increase in traffic under Alternative C.

The expert panel rated the potential negative health impacts related to reduction in dietary consumption of subsistence resources to be medium, and changes in composition of diet and food security to be low.

Social Determinants of Health

Construction employment under Alternative C could be as much as 50 percent greater than employment under Alternative B due to additional workforce needed to construct the gravel access road and to transport and assemble the facility modules from Deadhorse (Section 5.15, Socioeconomics). The additional module assembly and commissioning would require between 8 and 10 months, rather than the 60-day to 120-day range estimated by the Applicant for Alternative B. Maximum total employment in Alternative C would peak in Years 5 and 6 with over 1,100 workers employed in construction and drilling. Alternative C would have a total of six camps, five of which would demobilize with the construction and drilling crews. Workforce hiring policies, security of work camps, and the ability to pass on traditional knowledge would remain the same as under Alternative B.

Similar to Alternative B, the lack of physical connection between Point Thomson and the other communities would reduce interaction between the workers and the local community, thereby reducing the potential for adverse effects to community characteristics or culture.

Accidents and Injuries/Health Infrastructure and Delivery

Alternative C was designed to mitigate the impact of coastal oriented facilities on subsistence resources by moving the facilities inland and eliminating the use of barges to the Point Thomson Project site. Alternative C would rely on trucking to transport supplies and materials to the Point Thomson site. A gravel access road would be built under Alternative C and start at Endicott Spur Road and end near Point Thomson.

Under Alternative C, 60 barges would go into West Dock in Prudhoe Bay and require over 10,000 truck trips on the gravel access road during the construction and drilling phases, plus an additional 6,850 to 8,200 truck trips needed for drilling activities.

The gravel access road would be used for the Point Thomson Project only, likely be closed to the public, and not be expected to impact other road facilities. The Applicant has proposed, however, supporting subsistence access to the project area, which could include access to major egress corridors to facilitate travel for hunting or other purposes. The combination of local resident travel and heavy truck traffic creates significant risk of increases in accidents and injuries.

The expert panel ranked the potential for increased roadway accidents and injuries as high, especially during the construction and drilling phases when traffic volumes are high. Consequently, Alternative C could have a negative impact on the ability of the local emergency response and clinics to respond to the increase in accidents and injuries.

5.23.4.2 Alternative C: Operations

Operation activities under Alternative C could have similar potential negative health impacts to Alternative B related to exposure to hazardous materials and increase in depression/anxiety prevalence, as well as positive impacts on health care services. In contrast to Alternative B, operation activities under Alternative C could have a medium health impact related to the reduction of dietary consumption of subsistence resources, and the increase in roadway accidents and injuries.

5.23.4.3 Alternative C: Impact Summary

Table 5.23-4 summarizes the health impacts (positive and negative) rated as medium to high for Alternative C. The HIA (Appendix R, Tables 15 through 22) determined that Alternative C would have no impacts to water and sanitation and infectious disease and low impacts to noncommunicable chronic diseases.

Table 5.23-4: Alternative C—Impact Summary for Human Health		
Health Effects Category	Specific Health Issue	Impact Rating
Construction and Drilling		
Exposure to Hazardous Materials	Changes in physiologic contaminant levels such as lead, methyl mercury, PCB, Dioxins, $PM_{2.5}$ from incineration, drilling mud, or gas flaring.	Medium (-)
	Changed levels of the same substances in subsistence resources.	Medium (-)
Food, Nutrition, and Subsistence	Change in amount of dietary consumption of subsistence resources.	Medium (-)
Accidents and Injuries	Change in roadway incidents and injuries due to service road access for hunters / increased traffic from Prudhoe Bay.	High (-)
Health Infrastructure and Delivery	Change in utilization/clinic burden from nonresident influx.	High (-)
Operations		
Exposure to Hazardous Materials	Changes in physiologic contaminant levels such as lead, methyl mercury, PCB, Dioxins, $PM_{2.5}$ from incineration, drilling mud, or gas flaring.	Medium (-)
	Changed levels of the same substances in subsistence resources.	Medium (-)
Food, Nutrition, and Subsistence	Change in amount of dietary consumption of subsistence resources.	Medium (-)
Social Determinants of Health	Change in depression/anxiety prevalence.	Medium (-)
Accidents and Injuries	Change in roadway incidents and injuries due to service road access for hunters / increased traffic from Prudhoe Bay and gravel access road.	Medium (-)
Health Infrastructure and Delivery	Change in number of clinics and staff.	High (+)
	Change in quality of clinics and staff.	High (+)
	Change in services offered (e.g. prenatal checks, x-ray, lab services).	High (+)
	Change in accessibility of health care.	High (+)

(-) = Detrimental impact, (+) = Beneficial impact

5.23.5 Alternative D: Inland Pads with Seasonal Ice Access Road

Alternative D was designed to minimize impacts to coastal resources such as marine mammals, marine fish, subsistence activities, coastal processes, and to reduce potential impacts to the proposed project from coastal erosion. Similar to Alternative C, the project components under Alternative D would be moved inland and as far away from the coast as feasible. However, instead of a gravel access road as designed for Alternative C, access to and from Point Thomson under Alternative D would primarily be via an inland seasonal tundra ice road, running east from the Endicott Spur Road (at its junction with the Dalton Highway) to the northern end of the Point Thomson Project area.

During construction and drilling, potential impacts to human health could occur as a result of exposure to hazardous materials, reduced consumption of subsistence resources, changes in SDH (e.g., community cohesiveness), increased accidents and injuries, and demand on local emergency and medical response.

5.23.5.1 Alternative D: Construction and Drilling

The impacts expected during construction and drilling under Alternative D would be similar to those discussed for construction under Alternative C, which include negative health impacts from exposure to hazardous materials, reduced dietary consumption of subsistence resources, increased roadway incidents and injuries, and an increase in utilizations/clinic burden from nonresident influx due to accidents and injuries; see the discussion in Alternative C for more information.

Alternative D has the following exceptions compared to Alternative C:

- Truck traffic during the construction phase on the road from Prudhoe Bay would be lower under Alternative D, theoretically decreasing the burden on local clinics and emergency services. Alternative D has an estimated 15,870 to 17,495 total truck trips to the Point Thomson site during an extended (8 year) construction/drilling phase, compared to an estimated 17,220 to 18,570 total truck trips needed during the 6-year construction/drilling phase under Alternative C. See Section 5.17, Transportation, for additional discussion.
- Fewer workers would be needed under Alternative D than Alternative C because no construction of a gravel access road would be required under Alternative D.

However, neither of these exceptions changes the rating of the impacts between Alternatives C and D. Workforce hiring policies, security of work camps, and the ability to pass on traditional knowledge would remain the same as under Alternative B.

5.23.5.2 Alternative D: Operations

The impacts related to operation under Alternative D would be similar to the impacts related to operations under Alternative C, which include potential negative impacts from exposure to hazardous materials, reduced consumption of subsistence resources, changes in SDH (e.g., depression/anxiety prevalence), increased roadway incidents and injuries, and improvements in health infrastructure/delivery.

5.23.5.3 Alternative D: Impact Summary

Table 5.23-5 summarizes the health impacts (positive and negative) rated as medium to high for Alternative D. The HIA (Appendix R, Tables 15 to 22) determined that Alternative D would have no impacts to water and sanitation and infectious disease and low impacts to specific health issues related to noncommunicable chronic diseases.

Table 5.23-5: Alternative D—Impact Summary for Human Health		
Health Effects Category	Specific Health Issue	Impact Rating
Construction and Drilling		
Exposure to Hazardous Materials	Changes in physiologic contaminant levels such as lead, methyl mercury, PCB, Dioxins, $PM_{2.5}$ from incineration, drilling mud, or gas flaring.	Medium (-)
	Changed levels of the same substances in subsistence resources.	Medium (-)
Food, Nutrition, and Subsistence	Change in amount of dietary consumption of subsistence resources.	Medium (-)
Accidents and Injuries	Change in roadway incidents and injuries due to service road access for hunters / increased traffic from Prudhoe Bay.	High (-)
Health Infrastructure and Delivery	Change in utilization/clinic burden from nonresident influx.	High (-)
Operations		
Exposure to Hazardous Materials	Changes in physiologic contaminant levels such as lead, methyl mercury, PCB, Dioxins, $PM_{2.5}$ from incineration, drilling mud, or gas flaring.	Medium (-)
	Changed levels of the same substances in subsistence resources.	Medium (-)
Food, Nutrition, and Subsistence	Change in amount of dietary consumption of subsistence resources.	Medium (-)
Social Determinants of Health	Change in depression/anxiety prevalence.	Medium (-)
Accidents and Injuries	Change in roadway incidents and injuries due to service road access for hunters / increased traffic from Prudhoe Bay.	Medium (-)
Health Infrastructure and Delivery	Change in number of clinics and staff.	High (+)
	Change in quality of clinics and staff.	High (+)
	Change in services offered (e.g. prenatal checks, x-ray, lab services).	High (+)
	Change in accessibility of health care.	High (+)

(-) = Detrimental impact, (+) = Beneficial impact

5.23.6 Alternative E: Coastal Pads with Seasonal Ice Roads

Alternative E was designed to minimize the development footprint to reduce impacts to wetlands and surrounding water resources. To minimize the development footprint, this alternative would reduce the amount of gravel fill needed for some of the project components. Land transport numbers in construction and drilling include the overland transportation of large fuel tanks, modules, and the drill rig by way of the access ice road before barging would be established. During drilling, the gravel pad footprint would be expanded by ice to support other associated facilities. Over the long term during operations, the ice pad footprint would be removed and only the gravel fill would remain to support the wellheads and associated required infrastructure.

Nine months of the year the site would be without ground transportation, except for a gravel road from the central production pad to the airport. Alternative E has direct barge access with new barge bridge landing, bulkheads, and mooring dolphins.

5.23.6.1 Alternative E: Construction and Drilling

Construction and drilling would take place over 9 years because of the use of seasonal tundra ice roads to access the East and West Pads. Construction in this alternative extends from Years 2 through 5 while drilling activities begin in Year 4 and extend through Year 9. Facilities, including the export pipeline and barging facilities, would be located near the coast.

Impacts to subsistence resources and activities could be greater than in Alternative B, as the increased use of helicopters has the potential to disturb wildlife in the project area. However, the expert panel ranked impacts to subsistence as low, similar to Alternative B. All construction and drilling impacts are expected to be lower to those experienced under Alternative C because of the lack of road transport. See discussion in Alternative B for more information. Workforce hiring policies, security of work camps, and the ability to pass on traditional knowledge would remain the same as under Alternative B.

5.23.6.2 Alternative E: Operations

Long-term employment during operations in Alternative E is expected to be higher than in the other alternatives because an additional construction crew would be needed each winter to construct an ice road to the Point Thomson facility. Other impacts would be similar to the operation under Alternative B, which include potential negative impacts from exposure to hazardous materials and changes in SDH (e.g., depression/anxiety prevalence); as well as improvements in health infrastructure/delivery. See discussion for Alternative B.

5.23.6.3 Alternative E: Impact Summary

Table 5.23-6 summarizes the health impacts (positive and negative) rated as medium to high for Alternative E. The HIA (Appendix R Tables 15 through 22) determined that Alternative E would have no impacts to water and sanitation and infectious disease; and low impacts to specific health issues related to accidents and injuries; food, nutrition, and subsistence; and noncommunicable chronic diseases.

Table 5.23-6: Alternative E—Impact Summary for Human Health		
Health Effects Category	Specific Health Issue	Impact Rating
Construction and Drilling		
Exposure to Hazardous Materials	Changes in physiologic contaminant levels such as lead, methyl mercury, PCB, Dioxins, $PM_{2.5}$ from incineration, drilling mud, or gas flaring.	Medium (-)
	Changed levels of the same substances in subsistence resources.	Medium (-)
Operations		
Exposure to Hazardous Materials	Changes in physiologic contaminant levels such as lead, methyl mercury, PCB, Dioxins, $PM_{2.5}$ from incineration, drilling mud, or gas flaring.	Medium (-)
	Changed levels of the same substances in subsistence resources.	Medium (-)
Social Determinants of Health	Change in depression/anxiety prevalence.	Medium (-)
Health Infrastructure and Delivery	Change in number of clinics and staff.	High (+)
	Change in quality of clinics and staff.	High (+)
	Change in services offered (e.g. prenatal checks, x-ray, lab services).	High (+)
	Change in accessibility of health care.	High (+)

(-) = Detrimental impact, (+) = Beneficial impact

5.23.7 Mitigative Measures

The Applicant has included design measures as part of the project design to avoid or minimize adverse effects to many resources that are related to human health. These measures are detailed in the following sections of the EIS:

- Water Quality (Section 5.7)
- Terrestrial Mammals (Section 5.10)
- Marine Mammals (Section 5.11)
- Fish, Essential Fish Habitat, and Invertebrates (Section 5.12)
- Socioeconomics (Section 5.15)
- Transportation (Section 5.17)
- Subsistence and Traditional Land-Use Patterns (Section 5.22)
- Spill Risk and Impact Assessment (Section 5.24)

The Corps has considering the following measures to avoid or minimize adverse effects to human health:

- Increase community education about safety measures for arctic projects.
- Restrict road access during project construction, increase security and safety patrols, and enforce speed limits.

5.23.8 Climate Change and Cumulative Impacts

5.23.8.1 Climate Change

Climate change could impact human health insofar as it affects human access to subsistence resources (see Section 5.22, Subsistence and Traditional Land-Use Patterns) and subsistence users' ability to store harvested foods. Traditionally, North Slope subsistence users have used the permafrost to store whale and caribou in deep cellars. Changes to the permafrost regime (see Section 5.2, Soils and Permafrost) due to climate change could reduce the effectiveness of these ice cellars, increasing the amount of spoiled food (Brubaker et al. 2010) and the incidence of food-borne illness.

5.23.8.2 Cumulative Impacts

In addition to the potential influence of climate change on human health, the addition of the Point Thomson Project in any of its action alternatives could compound the effects of past, present, and reasonably foreseeable future projects. Section 5.17, Transportation, notes that the construction of the gravel access road in Alternative C could potentially open the area up for additional oil and gas development which could maintain high levels of traffic in this area increasing the potential for accidents and injuries. Section 5.22, Subsistence and Traditional Land-Use Patterns, confirms this possible adverse cumulative effect and notes that by opening the area to further oil and gas development, the gravel access road proposed under Alternative C may cause greater disruption than under Alternative B to caribou movement, which could ultimately adversely affect subsistence harvest and dietary consumption patterns. Potential cumulative impacts related to oil spills are discussed in Section 5.24, Spills Risk and Impact Assessment.

5.23.9 Alternatives Comparison and Environmental Consequences

Under all of the action alternatives, the operation phase of the Point Thomson Project is anticipated to generate tax revenues collected by the North Slope Borough, which provides most of the services and employment in the borough and funds most of the capital improvement projects in the region, including health care facilities. The development of the Point Thomson Project can have positive health impacts related to improved health care delivery and infrastructure.

Under all the action alternatives, the Point Thomson facilities, including the temporary construction camps for workers, would be fully self-contained and workers would have no reason to travel to any of the NSB communities. Thus, the lack of physical connection between Point Thomson and the other communities would reduce worker-community interaction, thereby reducing the potential for spread of infectious diseases and adverse health effects to community characteristics or culture.

Under all action alternatives, the expert panel ranked exposure to hazardous materials during construction/drilling and operations as medium, primarily because of the presence of incinerators with no documented plan for monitoring stack emissions. While emissions would be regulated through the air permitting process and would likely be rapidly diffused over a wide area, the health expert panel could not deny that certain byproducts of incomplete combustion would escape the stack and some potential for exposure of wildlife and humans could exist.

During operations of the Point Thomson Project for all action alternatives, the expert panel determined that local residents, especially of Kaktovik, might experience a modest change in their prevalence of depression and anxiety due to a low-level but persistent fear of a catastrophic incident at the facility. Although not anticipated for this project, environmental disaster in the Arctic is a real concern for local residents as it would have profound implications for their communities.

Alternatives C and D are anticipated to have similar negative health impacts associated with their reliance on trucking along a constructed gravel access road and seasonal tundra ice-road, respectively, to transport supplies and materials to Point Thomson. Truck traffic for these alternatives are estimated to be higher than under Alternative B; thus, have the potential to increase the risk of roadway incidents and injuries associated with local resident travel, especially during the construction and drilling phase when traffic volumes are high. Consequently, Alternatives C and D could also have a negative impact on the ability of the local emergency response and clinics to respond to the increase in accidents and injuries.

Under Alternative B, potential negative health impacts related to (1) the amount of dietary consumption of subsistence resources, (2) composition of diet, and (3) food security were rated as low given the relatively small amount of meat potentially lost per capita (1 pound of caribou per person). Similar impacts are anticipated for Alternative E.

In contrast, activities under Alternative C could reduce caribou harvest by approximately 13.3 pounds per capita of caribou per year. In addition, caribou use areas under Alternative C as well as Alternative D would experience a substantial increase in traffic, causing greater disruption to caribou movement, which could ultimately alter subsistence harvest and dietary consumption patterns. Thus, Alternatives C and D were determined to have a medium health impact related to reduction in dietary consumption of subsistence resources. However, given the assumptions needed to make the link between change in subsistence resource habitat/hunting areas and human health status, the expert panel rated the impacts for changes in composition of diet and food security to be low under Alternatives C and D, similar for Alternatives B and E.

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5.24 SPILL RISK AND IMPACT ASSESSMENT

The key findings of spills effects are summarized below. The remainder of the section describes the methodology for assessing impacts and the full results of the assessment.

Key Impact Findings and Differentiators Among Alternatives

Key Findings:

All Action Alternatives: Small to medium spills would be likely to occur over the project life but would be restricted in geographic extent and would be unlikely to have measureable impacts on resources. Large or very large spills would be very unlikely to occur. In the very unlikely event that a large or very large spill were to occur, it could result in major to catastrophic impacts to wetlands and vegetation, birds, and marine mammals. Other resources could be impacted to lesser degrees and subsistence impacts could be magnified by perception.

Alternative A: No impacts.

Differentiators:

- Potential for more fuel-truck-related spills under Alternatives C and D.
- No barge-related spills under Alternatives C and D.
- Potentially more and larger pipeline spill volumes under Alternative C.

This section focuses primarily on the likelihood, rate, fate and behavior, and potential impacts to natural resources and human uses of these resources from spills of ***produced fluids*** and other hazardous materials in a variety of spill scenarios. In addition, information is provided on the management of hazardous and waste materials associated with the project.

A distinguishing factor of this project is that the majority of the anticipated produced fluids would be gas condensates (similar to kerosene) and natural gas with some saltwater. Other operations on the North Slope produce primarily crude oil with smaller and varying proportions of saltwater and natural gas. Because of this, the current information on North Slope spills is based on crude oil and hazardous materials associated with crude oil exploration, production, and transportation. Where practical, the distinctions between potential impacts of crude oil and condensate spills will be indicated in this section.

There is an additional consideration for the volume and rate of potential spills of produced fluids and saltwater for the Point Thomson Project. As described in Section 3.1, Geology and Geomorphology, the project's reservoir pressure is higher than the reservoir pressure in other producing fields on the North Slope. The flowing wellhead pressure is estimated to be over 6,500 psig (ExxonMobil 2009a). This condition relative to spills is further discussed in Section 5.24.3.5.

Long-reach directional drilling would be used for the Point Thomson Project to access the offshore reservoir without the impacts to offshore and coastal environments that would be posed by using offshore well pads. Long-reach directional drilling requires specialized drilling rigs and computer technology to steer the borehole to the desired location in the hydrocarbon reservoir. Directional drilling, while a safe and proven technology, introduces the risk of friction and increases the complexity of drilling in terms of controlling the pressure of the well. Increases in the horizontal drilling distance increase the complexity of well development and the level of concern about safety. Consequently, even in a directional drilling scenario the technically preferable approach is to be as close to the resource as possible to pursue the safest and most efficient drilling program possible.

Spills are not a planned activity for any alternative but they are a potential result of accidents, equipment failure, human error, and similar causes. Spills are generally unpredictable in cause, location, time, size, duration, and/or material type (Mach et al. 2000). In general, the type, likelihood of occurrence, or impacts of spills would not depend on the alternative chosen. However, Alternative A (the No Action Alternative) would not result in spills.

Also, the likelihood of a spill may be greater in specific areas in some alternatives (e.g., export pipeline spills are more likely in Alternative C because the export pipeline would be more than twice as long as in Alternatives B, D, and E). Similarly, the likelihood of a fuel spill (from fuel trucks and large storage tanks) would be greater for Alternatives C and D because the total onsite fuel storage volume would be about 2.5 times greater than Alternatives B and E.

Over the past 40 years, the combination of stricter agency regulations, improving industry operating practices, and advancements in spill control technology have likely resulted in a reduction of the likelihood of spills on the North Slope. Although historical records show that spills are both possible and likely to occur over the life of the project, the vast majority of the crude and refined oil, produced fluids, saltwater, and other material spills that have occurred have been very small (fewer than 10 gallons) and very few have been greater than 100,000 gallons (Mach et al. 2000, NRC 2003b, MMS 2007). Based on the record of spills in the ADEC (2010c) database, and consistent with the experience of oil field operations in the contiguous U.S., the likelihood of a large spill over 1,000 gallons would be low and the likelihood of a very large spill greater than 100,000 gallons would be extremely low. Furthermore, when spills have been detected, they have been met with a rapid response and were contained and cleaned up in adherence with state, federal, and borough regulations (NRC 2003b).

Most spills have been contained on gravel pads and roadbeds (NRC 2003a), and most of those that have reached the tundra have covered fewer than 5 acres (BLM 1998, ADEC 2008b). The largest crude oil spill at the BP GC-2 site was first reported at 267,000 gallons (rectified to 212,252 gallons in ADEC 2008b) and was reported to cover about 1.9 acres of snow-covered tundra. Impacts from most of these spills were judged as minor, and natural and/or anthropogenic-assisted restoration has generally occurred within a few months to years (NRC 2003a).

This analysis is conservative, meaning that the following spill scenarios (especially for larger spills) are likely an overestimation of the rate or probability of a spill and/or the potential impacts. Alternative A has a zero probability of a spill occurrence due to the fact that no action would be taken. Under the action alternatives, spills of produced fluids and other chemicals from the proposed project have a finite likelihood of occurrence, might affect the environment to varying degrees, and are of concern to all of the stakeholders.

The following analysis includes a description of several basic factors, assumptions, processes, and classifications related to the spills themselves and associated environmental variables. Several items should be noted (see also Section 5.24.4, Environmental Factors Affecting the Fate of Spilled Materials):

- The spill impact analyses are necessarily simplified and might not represent or encompass the entire spectrum of possible values and/or events that might be realized in actual spills.
- Not all combinations of events or values are applicable to all or even most spills.
- The projection provided is based on past spill experience on the North Slope plus environmental conditions as depicted in the resource descriptions (Chapter 3, Affected Environment).
- Many of the assumptions used in this analysis have been used in previous assessments and are based on the empirical experience of oil spill experts on the Alaska North Slope and elsewhere (e.g., Maxim and Niebo 2001a, b, c; MMS 2007).

5.24.1 Hazardous Material and Waste Management

Various produced liquids, fuels, and waste material would be generated and/or stored at the Point Thomson site. This material would be managed according to a number of plans that are required as part of various permits. The primary plans are described below.

Oil Discharge and Prevention Contingency Plan (ODPCP). An ODPCP describes the response actions, equipment, procedures, and other required elements necessary to rapidly respond to and manage an oil spill response. It is required by the ADEC under 18 AAC 75.425. The Applicant prepared an ODPCP prior to drilling the current wells at the PTU-3 pad that covered only drilling activities. This October 2008 plan was approved by the ADEC in March 2009 and is provided in Appendix U. It also provides relevant information for the current assessment of the risk of produced fluid spills for the proposed project. Because this existing ODPCP only addresses drilling operations, a plan amendment would be required under 18 AAC 75.415. The ODPCP for the proposed project would need to include all categories of activities at the facility under 18 AAC 75.430-440.

Spill Prevention Control and Countermeasure (SPCC) Plan. The SPCC Plan would be required as part of the NPDES permit for the facility. It would be prepared and provided to ADEC and EPA prior to initiation of the project. This plan would contain spill prevention measures such as fluid storage and transfer guidelines, secondary containment requirements, and cleanup procedures (including management of associated wastes) if a spill were to occur. Also included would be information on the potential sources of spills and the equipment and materials available onsite for cleanup. The October 2008 ODCPCP for the current wells at the PTU-3 pad (see Appendix U) included an SPCC Plan as an appendix. This plan would need to be updated for the current proposed project.

Facility Response Plans (FRP). The U.S. DOT would require a pipeline FRP, and EPA and the U.S. Coast Guard would require an FRP for the production facilities. These plans would be prepared and provided to the agencies prior to initiation of the project. FRPs include emergency response action plans, facility information, worst-case spill scenarios, and response training records.

Stormwater Pollution Prevention Plan (SWPPP). A site-specific SWPPP would be prepared to protect water quality by providing BMPs to manage snowmelt and stormwater runoff.

Waste Management Plan. The Applicant would prepare a comprehensive Waste Management Plan prior to the generation of wastes. This plan would include effective mitigation measures, including: avoiding waste generation where possible, waste minimization, product substitution, beneficial reuse, recycling, and proper disposal. The Waste Management Plan would address storage, transportation, and disposal of wastes generated during construction, drilling, and operations.

Development of the Point Thomson site would include construction of a garbage incinerator and a UIC well to minimize quantities of solid waste. Solid waste that cannot be recycled, reclaimed, incinerated, or injected would be transferred to the NSB-owned and operated Oxbow landfill located near Deadhorse and or to another appropriate facility. The landfill in Deadhorse exists to provide utilities to industrial customers in the Prudhoe Bay and Deadhorse areas (ADCCED 2011). Fees for these services would be paid to the NSB.

Activities associated with the project would produce waste materials, some potentially hazardous, that would require special handling and disposal. Waste products such as used antifreeze or oil would be containerized for proper disposal or recycling offsite. Wastes would be handled in accordance with the North Slope industry standard, Alaska Waste Disposal and Reuse Guide (Red Book) (ARCO and BPXA, 2000), in full compliance with federal, state, and NSB regulatory requirements. The Alaska Waste Disposal and Reuse Guide provides a set of best waste management practices for the majority of routine waste streams generated by oil and gas exploration and production operations in Alaska. The guide contains disposal/reuses tables for various waste streams and products. These tables are based on regulations and policy guidelines of the EPA, ADEC, and AOGCC.

Wastewater would be produced throughout the project life beginning with construction and continuing though the operation of the facility. Wastewater would be handled, treated, and discharged in accordance with applicable agency permits. All drilling and process wastes would be disposed to the Class 1 UIC well, as would most other wastewaters. APDES and/or NPDES permits would be obtained for use during construction and as a contingency for situations where the disposal well is unavailable. Table 5.24-1 summarizes the project activities that would produce wastewater and the proposed methods of disposal for each source of wastewater.

Table 5.24-1: Summary of Wastewater Discharges

Waste Stream	Phase	Discharge Method/Location	Estimated Discharge	Permit Required	Contingencies
Domestic[a]	Construction	Tundra/surface waters near Central Pad	~40,000 gpd maximum while export pipeline is being constructed, ~20,000 gpd during the rest of construction	ADEC GP AKG-57-000 OR AKG-57-1000	All water would go through secondary treatment as required by permit.
	Operations	Class I disposal well[b]	~18,240 gpd	EPA UIC Well Permit/ ADEC GP AKG-57-000 OR AKG-57-1000	If well is unavailable during equipment outages, the treated domestic wastewater would be discharged to the lake south of the Central Pad in accordance with the ADEC permit.
Hydrostatic testing[a]	Construction	Tundra	~16.200 barrels	EPA GP AKG-33-1000	Water would be filtered to meet NPDES discharge limitations. If permit requirements cannot be met, water would be injected. If UIC well is unavailable, then water could be hauled in tanker trucks on barges to a facility at Prudhoe Bay.

Table 5.24-1: Summary of Wastewater Discharges					
Waste Stream	Phase	Discharge Method/Location	Estimated Discharge	Permit Required	Contingencies
Drilling[c]	Operations	Class I disposal well[b]	Unknown	EPA UIC Well Permit	When there are equipment outages, the drilling waste stream would be housed in storage tanks with secondary containment until the injection well is back online or would be shipped to another facility for injection.

[a] Appendix D, RFI 41
[b] EPA would have authority under the SDWA for the Class I UIC well
[c] ExxonMobil 2009a

If the Class I disposal well becomes temporarily unavailable for drilling waste disposal, the Applicant could execute one of two possible scenarios. First, drilling wastes could be stored in tanks equipped with secondary containment until the disposal well is once again operating. Second, the drilling wastes could be put into tanker trucks with appropriate safeguards in place to prevent leaks and spills, and be transported by barge to another facility with a permitted Class I UIC well. Only drilling wastes that are non-hazardous or exempt exploration and production wastes can be injected into Class I UIC wells. Therefore, if transport of the waste is required, hazardous material transport regulations would not apply.

5.24.2 Qualitative Summary of Expected Spill Occurrence

Based on the spills database and literature review detailed in Section 3.24, Contaminated Sites and Spill History, this analysis used a qualitative rating system to estimate the likelihood of a range of sizes of future spills, from the main potential sources for project's oil and gas operations (Table 5.24-2).

Table 5.24-2: Expected Relative Rate of Occurrence for Spills from Main Project Sources						
Source	Material	Spill Size (gallons)				
		Very Small (<10)	Small (10-99.9)	Medium (100-999.9)	Large (1,000-100,000)	Very Large (>100,000)
Gathering Pipelines	Produced fluids	H	M	M	VL	0
Fuel Distribution Pipelines	Diesel	M	M	L	VL	0
Export Pipeline	Gas condensate and/or crude oil	M	M	L	VL	VL
Vessels, On-pad Bulk Storage Tanks, and Containers	Various	H	M	L	VL	VL
Tank Vehicles	Various	H	M	L	VL	0
Vehicle and Equipment O&M	Various	VH	H	M	VL	0
Other Routine Operations	Various	VH	H	M	L	0
Drilling Blowout	Produced fluids	VL	VL	VL	VL	VL
Production Uncontrolled Release	Produced fluids	VL	VL	VL	VL	VL

H = High rate
L = Low rate

Table 5.24-2: Expected Relative Rate of Occurrence for Spills from Main Project Sources						
Source	Material	Spill Size (gallons)				
		Very Small (<10)	Small (10-99.9)	Medium (100-999.9)	Large (1,000-100,000)	Very Large (>100,000)

M = Medium rate
0 = Would not occur
VH = Very high rate of occurrence (approaching 1)
VL = Very low rate of occurrence (approaching zero)

5.24.2.1 Size Classification

For this EIS, previous and potential spills are categorized as:

- Very small spills: less than 10 gallons (approximately 0.25 bbl)
- Small spills: 10 to 99.9 gallons
- Medium spills: 100 to 999.9 gallons
- Large spills: 1,000 to 100,000 gallons
- Very large spills: greater than 100,000 gallons

The ADEC, EPA, and spill response contractors generally categorize spills of oil and hazardous materials as small, medium, and large based on spill volumes shown above (BLM 2004a). For this analysis, the “very small” and “very large” spill categories were added to provide a realistic evaluation of the true distribution of spill volumes on the North Slope, especially in the very small spill category, which is the predominant one.

5.24.2.2 Types of Materials Spilled

For this EIS, possible spill materials are defined as follows:

- **Produced fluids** – Fluids directly from the formation reservoir and composed predominately of gas condensate and natural gas, but may also include crude oil, produced water, and formation sand. Most natural gas would be re-injected into the reservoir, and an unplanned release of natural gas would likely dissipate into the atmosphere, primarily as methane.
- **Produced water** – Brine, seawater, and formation water separated from the produced fluids and re-injected in a Class 1 disposal well at the Central Pad.
- **Export hydrocarbons** – Gas condensate and potentially crude oil transported to the TAPS for shipment to market.
- **Refined oil** – Arctic diesel, aviation fuel, unleaded gasoline, hydraulic fluid, transmission oil, lubricating oil, grease, waste oil, mineral oil, transformer oil, and other petroleum hydrocarbon products.
- **Other hazardous materials** – Methanol, antifreeze (ethylene and propylene glycol), water-soluble chemicals, chlorine, corrosion and scale inhibitors, drag-reducing and emulsion-breaking agents, biocides, and possibly a small amount of hydrogen sulfide associated with the produced fluids and gas. There may be additional materials required for the project, and they would be identified by the applicant in the appropriate hazardous material management plans.

The ADEC Spills Database (see Section 3.24) also includes spills of Halon, Freon, drilling muds, and bentonite. This analysis excludes Halon gas due to its rapid dissipation in air, limited impact to humans or natural resources, and its limited use on the North Slope since 2001. Newer facilities on the North Slope are designed to operate without the use of Halon (BPXA and ConocoPhillips 2005). Freon is a Dupont trade name that refers to a number of different compounds, including the now banned refrigerant Freon-12. Drilling muds, including bentonite, are primarily mineral oil, clay, and freshwater and most releases are on or adjacent to roads or drilling pads, with minor areal impacts. Two different types of drilling mud would be used for the Point Thomson wells. The surface interval would be drilled with a high viscosity, water-based mud consisting of a freshwater, bentonite, and polymer mixture. Nonaqueous fluid (NAF) drilling muds would be used for drilling below the surface casing (Appendix D, RFI 112). NAF drilling mud contains mineral oil and, unlike petroleum-based drilling muds, does not rely on diesel or other similar hydrocarbons to provide the base mud material. Sewage spills are not included in discussion due to: their absence from the ADEC Spills Database, tendency to be small in volume, limited impact area (gravel or ice roads and pads), and general composition of biodegradable organic materials.

The impact assessment is based primarily on spills of produced fluids (primarily gas condensate), refined products (primarily diesel and hydraulic oil), export hydrocarbons (primarily expected to be gas condensate which is similar to kerosene), and produced water (usually saltwater). These materials are the most likely to spill in sufficient volume and frequency at locations where environmental resources and services would be impacted. Spills upstream (in a processing context) of the Central Pad Facility could include natural gas liquids, oil, saltwater, and drilling mud, whereas downstream of the facility, spills from the export pipeline could include natural gas liquids and oil.

5.24.2.3 Phases of Oil Field Development

The potential spill sources and impacts (e.g., size) are linked to the development activities and would change as the project progresses. For example, during the construction phase, most potential spills would be relatively small and consist of materials associated with the vehicles and construction equipment (Mach et al. 2000, NRC 2003a). For most alternatives, the reduction in vehicle size and traffic volume during the operation phase compared to construction phase would reduce the potential for vehicle spills.

Construction

Most construction spills are very small to small and composed of refined products (e.g., gasoline, diesel, transmission oil, brake fluid, and lubricating and hydraulic fluids). Most occur during fueling and maintenance of vehicles ranging in size from ATVs to large trucks and construction equipment. Fueling operations are generally the main source of frequent but very small to small spills of diesel and gasoline. Construction staging areas may include portable fuel and oil storage tanks staged onsite. The capacities of such oil storage tanks vary, depending on the duration of work, quantity of equipment to be fueled, and proximity to the main fuel storage areas.

Tanker and fuel or maintenance truck accidents along the gravel and ice road ROW or fuel storage tank failures would be the most likely sources of larger spills during the construction phase. The potential maximum oil spill volume from these sources would be about 6,000 gallons for diesel or gasoline and about 330 gallons for lubricating or hydraulic fluid (i.e., six 55-gallon barrels on a pallet). As noted in the ODPCP (Appendix U), oil storage tanks at each staging area would have secondary containment (berms) for 110 percent of the capacity of the largest tank. Portable oil storage containers would also have berms that hold 110 percent of the total capacity of the container(s) inside the berm.

Specific design measures for avoiding or minimizing potential spills from construction activities are described in the Applicant's ODPCP (Appendix U) and Section 5.24.12, Mitigative Measures.

Drilling

Like construction spills, most drilling spills are small and composed of refined products (e.g., gasoline, diesel, and lubricating and hydraulic fluids). Fueling and equipment maintenance activities may also be a source of frequent but very small to small spills.

Well blowouts are an additional, but very low probability, potential source of spilled production fluids (NRC 2003b, ADEC 2010c). Blowouts could occur at any time during drilling in the production zone, which could be 30 to 50 percent of the total time required to drill a well. A well blowout could result in a potentially large to very large volume spill of produced fluids over an extended period, even with a rapid response and voluntary ignition of the released gas condensate. The Applicant's ODPCP for the current wells at the PTU-3 pad (Appendix U) describes a simulated 27,000 barrel-per-day (1,134,000 gallons per day) blowout scenario during drilling. With voluntary ignition of the gas condensate at the wellhead as the primary response tactic, it was estimated that less than 1,500 barrels (63,000 gallons) of gas condensate would be released into the environment over a 15-day period.

Operation

Spills associated with operation activities may occur anywhere along a pipeline and within the boundaries of the pads, roads, and other facilities. Pipeline leaks, drips, and spills could occur as a result of corrosion, equipment failure, human error, external forces due to weather, or other causes. Some small or pinhole leaks could potentially be undetectable by the leak detection system for an extended period of time (e.g., the BP GC-2 spill in March 2006; ADEC 2008b). Operational leaks at the pumping facilities on the pads can occur due to circumstances similar to pipeline operational leaks, with additional risks related to filter change and pig launching or receiving operations. Most of these spills are very small to medium in size. A large or very large spill would be rare.

A large spill would be most likely to occur as a result of a large break in a pipeline, failure of a large storage tank, or loss of containment in a fuel barge or tug in the marine area of Lion Bay or approaches to it. If a large break in a pipeline did occur, some of the released produced fluids or export hydrocarbons would be contained in the immediate vicinity of the release point as response actions of the project-specific ODPCP would be followed. The released fluids would, however, affect the environment adjacent to the spill source.

In some instances, the release point may be relatively remote and hard for responders to locate and access quickly. Pipeline leak detection technology may identify a leak and shut down flow quickly, but actual response with containment equipment and cleanup crews may be delayed due to one or more of the following factors:

- Difficulty in accessing location, which may inhibit visual leak detection and delay of deployment of equipment and personnel.
- Locating the leak may require significant time searching the area identified by the Supervisory Control and Data Acquisition (SCADA) system as the likely source.
- Snow cover, light conditions, or other natural factors that may hinder visual detection.
- Inaccessibility due to seasonal road access (ice roads not available in summer) or due to extensive wet tundra areas in summer.
- Extreme weather conditions and other natural events (e.g., sea ice freeze-up, extreme storm surge, flooded, tundra, excessive snow fall) may delay access to the spill location, especially for larger equipment and supply vehicles.

- Depending on spill volume, proximity, and season, the spilled material could reach a variety of environments, including wetlands, tundra ponds and lakes, streams, larger rivers, and/or the nearshore marine environments, the larger expanse thereby taxing the resources readily available to contain and clean the spilled material.

Likewise, a large or very large spill from a fuel barge or tug may be difficult to contain and clean if it occurs during a major storm and/or near the beginning of sea ice freeze-up or during breakup. Mobilization and utilization of the equipment and vessels may be hampered during the storms and the presence of sea ice may limit access to the oil.

5.24.3 Potential Sources of Spilled Material

The main sources of spilled material from the proposed project operations and facilities would include the gravel pads, infield gathering and the export pipelines, vehicles and construction equipment, and barges and vessels.

5.24.3.1 Pads

The development's storage tanks and containers, gas and wastewater injection facilities, and produced fluids pumping facilities would be housed on the gravel pads. Because the secondary containment around the storage tanks and containers would be designed to contain 110 percent of the tank capacity, it would be very unlikely that complete failure of one or more storage tanks would be a potential source of a spill large enough to leave the pad. In Alternatives C and D, the storage volume for fuel would be about 6 million gallons, about 2.5 times as much as would be stored in Alternatives B and E. Details regarding the size, contents, and secondary containment for the storage tanks and containers at drilling and production pads would be provided in the project-specific ODPCP. A worst-case scenario would be considered possible if the secondary containment were breached, especially for Alternatives C and D. Processing facilities also store numerous other chemicals such as methanol and antifreeze, some in large volumes and all of which have the potential to spill.

5.24.3.2 Infield Gathering Lines

The infield pipelines transport produced fluids (i.e., gas condensate, natural gas, produced water and, potentially, crude oil) from the wells to the process facilities. If released, natural gas would dissipate in the atmosphere and would not impact natural resources unless a fire would occur. Produced liquids could be sprayed under pressure as a mist and may impact resources and habitat downwind of the source (Appendix U).

5.24.3.3 Vehicles on Roads and Pads

The following vehicles and equipment are potential spill sources: light- and heavy-duty trucks and tanker trucks, fixed- and rotary-wing aircraft, snow machines, and heavy equipment. Fuels, oils, and antifreeze can spill or leak during routine refueling and maintenance, normal operations, or unexpected vehicle or equipment accidents. With the exception of an accident that would result in a vehicle leaving a pad or road, impacts from vehicle spills generally would be confined to small areas on airstrips, pads, and roads. These are areas where containment and cleanup would be easily accomplished. In addition, if a spill from a snowmobile or tundra-safe, low-pressure vehicle occurred on the snow-covered tundra, the volume would be small and the snow would generally contain the fluid. The likelihood of spills from tanker trucks is substantially greater in Alternatives C and D where the storage volume is about 2.5 times than in Alternatives B and E, and the fuel would be trucked from Deadhorse to the project storage tanks.

5.24.3.4 Vessels

Spills from most watercraft would probably occur at the barge offloading facility, emergency response boat launch, in Lion Bay, or along approaches from Beaufort Sea. Most of these spills would be composed of diesel, bunker fuel, gasoline, lubricating or hydraulic oil, and grease. Most spills would be very small to small and come from the small craft at the ramp, specifically the tugs that handle the barges with modules, fuel, and other supplies, and large vessels in the ice-free season. It would be possible, though highly unlikely, that a medium to large or even very large spill could occur if a tug or a barge carrying large volumes of fuel or other bulk hazardous material were to run aground, sink, or otherwise be compromised such that the one or more containment compartments were breached and the contents released to the marine environment.

Alternatives C and D would have no barge offloading facilities and no marine traffic with the exception of potential emergency response.

5.24.3.5 Well Blowouts and Uncontrolled Releases

Well blowouts could occur during drilling, and uncontrolled releases could occur during production. Although there is a very low probability of either occurring, this would be an additional potential source of spilled production fluids (NRC 2003a). A well blowout or uncontrolled release could result in a potentially large to very large volume spill of produced fluids lasting several days in the worst-case scenario provided in the ODPCP. Such a spill could extend beyond the limits of the gravel production pad and could potentially reach nearby tundra, tundra ponds, lakes, streams, rivers, and eventually enter Lion Bay. The volume of spilled fluid would be dependent upon the response time and actions taken.

As previously indicated, the Point Thomson Reservoir is under higher pressure than other North Slope reservoirs. The higher pressures (6.500 psig for the produced fluid) would be experienced at the wellhead and would be reduced to 2,700 psig before entering the gathering lines for delivery to the Central Pad for processing (ExxonMobil 2009a). Once the condensate has been separated from the gas, it would no longer be under high pressure. A blowout or uncontrolled release of produced fluids before the pressure is reduced may result in a larger discharge rate than might be experienced in a similar situation elsewhere on the North Slope where the reservoir pressures are lower. Combined with the relative remoteness of the project compared to other areas of the North Slope oil field, there is a chance that the total volume of fluids released and related potential environmental impacts would be larger than if the spill occurred from a well with lower reservoir pressure. However, the ODPCP prepared by the Applicant for the project and approved by the state and federal agencies would take this increased potential risk into account and provide appropriate response actions to control, contain, and clean up the released material.

As described in the ODPCP for the existing wells at the PTU-3 pad (Appendix U), ADEC has preapproved wellhead ignition as a response action for a condensate well blowout and the Applicant has delegated authority to the onsite drilling supervisor to make well ignition decisions. On this basis, it is estimated that a gas condensate well blowout could be ignited in 2 hours, which would significantly reduce the amount of condensate spilled to the land or water.

5.24.4 Environmental Factors Affecting the Fate of Spilled Materials

The environmental factors that affect the fate of the spilled materials, especially the petroleum hydrocarbons (e.g., gas condensate, crude oil, refined oil), include but are not necessarily limited to:

- Physical and chemical properties of the condensate and other petroleum hydrocarbons (generally referred to as oil in this section) itself
- Environmental degradation processes acting directly on the oil
- Season of the year
- Weather conditions at the time of the spill and for days to weeks thereafter
- Location relative to sensitive habitats and resources

Response actions (e.g., containment and cleanup) and response time (see Section 5.24.7.3, Response) would also affect the fate of spilled materials.

These environmental factors are often not mutually exclusive and their presence, intensity, and interaction may markedly affect the fate and behavior of the spilled material and its impacts on habitats, resources, and the services they provide. The majority of produced fluid encountered during any of the action alternatives would be expected to be gas condensate; however, in each of the alternatives the drill would penetrate the gas reservoir's oil rim, introducing the potential for oil spills even if the oil volume in the rim does not prove viable for production and export. For purposes of this EIS, the fate and impacts of gas condensate would be generally similar to those of crude oil, except that there are fewer heavy hydrocarbons and a larger proportion of volatile and semi-volatile hydrocarbon fractions in the gas condensate.

When an oil spill occurs, the main weathering processes that determine the fate of spilled oil are: spreading, evaporation, dispersion, dissolution, and emulsification. These primary processes have the highest impact during the first few days to weeks of a spill. Longer-term processes that occur include photo- and biodegradation, auto-oxidation, and sedimentation. These processes are more influential in the later stages of weathering and usually determine the ultimate fate of the spilled oil, including the persistence of heavy hydrocarbons, the composition and thus toxicity of the remaining hydrocarbon fractions, and the physical impacts of the remaining fractions. A more detailed description of these processes can be found in Payne et al. (1987), Boehm (1987), Boehm et al. (1987), Lehr (2001), and Leirvik et al. (2002). The processes are summarized in the rest of this section.

5.24.4.1 Weathering

Some petroleum hydrocarbons weather rapidly and undergo extensive changes in chemical and physical compositions, whereas others remain relatively unchanged over long periods of time. Evaporation weathering is generally rapid (one to a few days) for hydrocarbons with lower molecular weights (e.g., gasoline, aviation gas, gas condensate, and diesel). Degradation of the higher-weight hydrocarbons (e.g., crude oil, transmission and lube oil, hydraulic fluid) is slower and occurs primarily through microbial degradation and chemical oxidation.

The weathering of spilled oil and other organic materials, described in detail below, depends on the materials' properties and on environmental conditions, both of which can change over time.

Spreading: Spreading on the water or ground surface reduces the bulk quantity of oil in the vicinity of the spill, but increases the area over which adverse effects could occur. For example, oil spilled in flowing systems (e.g., rivers and streams, Lion Bay) rather than contained systems (e.g., tundra, wetlands, tundra ponds, and lakes) would be less concentrated in any given location, but could impact a larger area, albeit less severely. Spreading and thinning of spilled oil also increases the surface area of the slick, enhancing surface-dependent fate processes such as evaporation, biodegradation, photodegradation, and dissolution.

Adsorption: Crude, condensate, or refined oil dispersed in dry tundra soil may adhere to soil particles in a process called adsorption. Oil usually binds most strongly with organic soil particles and less strongly in sandy soils. In water, heavier molecular weight hydrocarbons may bind to suspended particulates, and this process can be significant in highly turbid or mineral- and organically-rich (eutrophic) waters. Organic particles in soils or suspended in water tend to be more effective at adsorbing oils than inorganic particles (e.g., clays). Adsorption and sedimentation reduce the quantity of heavier hydrocarbons present in the water column and available to aquatic organisms. However, these processes also make hydrocarbons less susceptible to degradation. Oil incorporated into oxygen-free sediment tends to be highly persistent and can cause chronic impacts.

Evaporation: Evaporation is the primary mechanism for loss of low-molecular-weight constituents and light oil products such as gasoline, diesel, and condensate. As lighter components evaporate, the remaining petroleum hydrocarbons become denser and more viscous. Evaporation tends to reduce oil toxicity but enhance persistence. Hydrocarbons that volatilize into the atmosphere are broken down by sunlight into smaller compounds. This process, referred to as ***photodegradation***, occurs rapidly in air, and the rate of photodegradation decreases as molecular weight increases. The gas condensate that is expected to dominate the produced hydrocarbons at Point Thomson would likely have a greater proportion of constituents that evaporate more rapidly than Endicott, Milne Point Unit, or Northstar crude oils (Leirvik et al. 2002). Evaporation would occur rapidly for refined products that may be spilled onsite, such as diesel and gasoline, but there would be little evaporation from the heavier refined products such as lubricating, transmission, or hydraulic oil, or greases.

Dispersion: Natural dispersion is a process which results in oil being dispersed into the water column, forming fine droplets stabilized by natural forces. This process is increased when surface turbulence increases due to wind, broken ice movement, gravity, or tidal currents. This dispersion increases the surface area of oil susceptible to dissolution and degradation processes and thereby limits the potential for physical impacts. Some of the oil dispersed into the water column may be deposited on the bottom as it adheres to particulate matter. The presence of particulates, including organic matter, silt and clay, and larger sediment particles, would likely be greatest during breakup, flood flows, and storms (especially in Lion Bay and offshore areas).

Dissolution: Because oil usually floats on water rather than dissolving into it, dissolution is not the primary process controlling the fate of the oil in the environment. To the extent dissolution does occur, especially with the lighter fractions of the gas condensate, it is one of the primary processes affecting the potentially toxic effects of a spill in confined water bodies such as tundra ponds. Dissolution increases with decreasing hydrocarbon molecular weight, increasing water temperature, decreasing salinity, and increasing concentration of dissolved organic matter. Components of gasoline (e.g., benzene, toluene, ethylbenzene, and xylenes) would dissolve more readily than the heavier fractions of condensate, crude oil, or hydraulic or lubricating oils under the same environmental conditions. Methanol is also highly soluble in water.

Emulsification: Emulsification is the incorporation of water into oil as small drops of water become surrounded by oil. It is the opposite of dispersion. External energy from wave or strong current action is needed to emulsify oil. In general, heavier oils such as crude and bunker from the tugs emulsify more readily than lighter oils such as diesel and gas condensate. The oil could remain in a slick, which could contain as much as 70 percent water by weight and could have a viscosity of a hundred to a thousand times greater than the original oil. Water-in-oil emulsions often are referred to as “mousse.”

Photodegradation: Oil photodegradation, or degradation by photon absorption, increases with solar intensity. It can be a substantial factor controlling the disappearance of a surface slick of condensate or oil, especially of lighter products and constituents, but it would be less important during cloudy days and would be nonexistent in winter months on the North Slope. Photodegraded petroleum product constituents tend to be more soluble and more toxic than parent compounds and extensive photodegradation, like dissolution, could increase the biological impacts of a spill.

Biodegradation: Biodegradation of oil by native microorganisms in the immediate aftermath of a spill may not be a major process controlling the fate of oil in water bodies previously unexposed to oil. Although oil-degrading microbial populations are ubiquitous at low densities, including on the North Slope, a sufficiently large population must become established before biodegradation can proceed at any appreciable rate. The addition of nutrients may also enhance the size and rate of establishment of the microbial populations and thus the biodegradation of oil.

5.24.4.2 Seasons

Season influences the fate, behavior, impacts, and the cleanup response actions for spills of condensate and other materials. This EIS considers spills in four seasons, based more on the weather and access conditions than on the calendar year:

Summer (Ice-free)

Summer is confined to the ice-free period when most of the rivers and streams are flowing; ponds, lakes, and Lion Bay are open water; tundra is snow-free; and biological use of tundra and water bodies is high. Currents, winds, and passive forces would spread spills that reach the water bodies. Spills to tundra would directly affect the vegetation.

The spreading of spills to the tundra would likely be impeded by the vegetation. Spills to wet tundra may float on the water or be spread over a larger area than would spills to dry tundra or to snow-covered tundra. Spills under pressure that spray into the air may be distributed downwind over substantial areas and impact tundra vegetation and water bodies.

Fall (Freeze-up)

Freeze-up is the period when water bodies are beginning to ice over but the ice cover might come and go depending on temperature, wind, currents, and river flow volume and velocities. Snow begins to cover the tundra and most of the migratory birds have left or are leaving the North Slope. Spilled material could disperse when it reaches flowing water but slow or stop when it reaches snow or surface ice. The spilled material could be contained by the snow or ice but spread and be dispersed if this ice breaks up and moves before it refreezes. The spilled material also could flow through ice cracks to the underlying water where it could collect.

Winter (Ice Cover)

In winter, water bodies (including Lion Bay and the tundra lakes and ponds) are covered with mostly unbroken ice, and snow covers the tundra. The snow cover would generally slow spreading of material spilled to the tundra, though such cover would not necessarily stop spreading. Depending on the depth of snow, temperature and volume of spilled material, the material may reach the underlying dormant vegetation or tundra ponds and lakes. Similarly, snow and ice on water bodies would generally restrict the areal distribution of spills to rivers and streams, compared to seasons during which there is little or no snow and ice cover. Spills under the ice to streams, rivers, and tundra ponds/lakes might spread and disperse slowly as the currents are generally slow to nonexistent in the winter.

Spring (Breakup)

Breakup is the short period in the spring when thawing begins and river and stream flows increase substantially and quickly, often to flood stages. These increased flows cause the river ice cover to break up and flow downriver, eventually to Lion Bay and hasten the breakup of the sea ice. The tundra snow cover begins to melt and many of the migratory species, especially birds, return to the tundra.

Spills to water bodies during breakup are likely to be widely spread and dispersed and difficult to contain or clean up, especially if the flooding overtops the stream banks and entrains the spilled material.

5.24.4.3 Weather, Water Level, and Winds

Rapid influx or runoff of water from snowmelt and/or heavy rainfall could result in flooding of the tundra lakes/ponds, wetlands, and major streams. This flooded area, especially with flowing waters, could facilitate the transport of spilled material to adjacent terrestrial and tundra-pond/lake habitats that are normally not exposed.

Water levels in the streams, Staines River delta, and Lion Bay may increase or decrease substantially over normal flow and tidal levels, depending on the duration, direction, and strength of wind storms. A spill occurring at high water levels may have distribution and impacts similar to that occurring from flooding described above. High wind velocity and the direction of the released spray (e.g., downward into the tundra, horizontal, or skyward) may result in widespread distribution of any material released under pressure, primarily from small holes in the pipelines or blowouts and uncontrolled releases. The pressurized material would spray out of the pipe and form a cloud of mist and fine particles that would be carried downwind.

Rough seas tend to spread and break up a hydrocarbon plume on the water surface, making it more difficult to clean up. Inclement weather, including fog, can impede spill response efforts.

5.24.4.4 Spill Location

Most spills would occur on or in close association with the oil field infrastructure. For this assessment, the location classifications are as follows:

- Gravel pads (Central, East, and West) for drilling, production and processing facilities
- Gravel and ice roads (including culverts)
- Gravel airstrip
- Overburden storage pad and gravel mine
- Temporary ice roads and ice pads
- Pipelines
- Bridges
- Bulkhead and marine facility at Central Pad shoreline (Alternatives B and E only)

Due to project activity, most nonpipeline spills would occur and be contained on or immediately adjacent to the ice or gravel pads, roads, and airstrips, and they would be promptly cleaned up as required by federal, state, and borough regulations before they reach the tundra or water bodies. Some vehicle spills, including fuel and other tank trucks running off the roads, may result in much or all of a load being spilled to the tundra, wetlands, tundra ponds and lakes, or flowing water bodies adjacent to the road or pad.

Most pipeline spills are likely to occur at some distance from the nearest road or pad. Spills from other sources (e.g., aircraft crash, or tugboat/barge grounding) are much less likely but would also tend to occur away from pads and roads. Additionally, material released under pressure from a pipeline during high winds could result in the spilled material being spread over a wide area of tundra and/to the nearshore habitats that are often remote from access roads.

5.24.5 Fate and Behavior of Spilled Materials

This section describes the behavior (e.g., trajectory, movement) of spilled material, with a focus on "oil" and saltwater, that is important to the evaluation of the potential effects that these spilled materials might have in the various environments in the project area. Much of this section is based on analyses from the Northwest NPR-A Draft IAP/EIS (BLM 2003a, b, 2004), the Alpine Satellite Development Plan FEIS (BLM 2004), and the Liberty Development and Production Plan EA (MMS 2007). The focus is spilled oil (broadly defined to include gas condensate), crude oil, produced water, natural gas, and refined products. Because the impacts are likely to be greater and more persistent from gas condensate and other petroleum hydrocarbons than from most other spilled materials (with the possible exception of saltwater), there are more data and analyses available. Also, oil spills generally cause more concern from stakeholders than saltwater or other chemical spills.

Saline, process, brine, or produced water all have varying concentrations of salt and might behave generally like oil when spilled in large volumes. However, these fluids, referred to generally as "saltwater" here, are usually less viscous than oil in warmer temperatures and could potentially spread farther than the same amount of oil might. Saltwater spilled into freshwater bodies would be completely miscible and the salt concentration would decrease as it is diluted in the freshwater. The rate of dilution depends primarily on the volume of the receiving water relative to the volume of spilled saltwater, as well as the dynamics of the receiving water body. For example, a saltwater spill during peak runoff of one of the larger of the 21 streams crossed by pipeline might be diluted very rapidly, whereas a saltwater spill to a small tundra lake on a calm summer day may remain at relatively high salinity for some time.

In the late fall-early spring period, saltwater may freeze, which would limit the areal extent of spreading on the tundra and frozen water surfaces. Response actions may include removal of the frozen saltwater. However, if it is not removed it would melt as temperatures rise and behave as described in the previous paragraph.

Ethylene glycol (antifreeze) is completely miscible in water. Other materials, such as methanol, acids and some chemicals, are highly to completely soluble in water. Because they are miscible or soluble, it is generally not practical to contain or clean up these materials before they are dispersed and diluted in the water or atmosphere. However, these materials may be toxic and harmful to aquatic invertebrates, plants, and fish and the birds and mammals that eat them until the materials are substantially diluted or neutralized (see Section 5.24.11, Summary of Impacts by Resource).

5.24.5.1 Tundra

The path of spilled oil and saltwater is dictated by the topography of the land. In general, a spill would flow until it reaches a surface water body or a depression; infiltrates the vegetation cover, soil, and/or snow prevents further movement; or its viscosity increases due to low temperatures, slowing its movement. The low relief of the tundra on the coastal plain of the North Slope limits the spread of oil spills. For example, the 2006 BP GC-2 spill of 212,252 gallons in winter only impacted approximately 2 acres of adjacent tundra (ADEC 2008b).

During summer, flat coastal tundra develops a dead-storage capacity averaging 0.5 to 2.3 inches deep (BLM 2004), which can retain 12,600 to 63,000 gallons of oil per acre. Even at high water levels, the tundra vegetation tends to act as a boom, with both vegetation and peat functioning as sorbents that allow water to filter through, trapping the more viscous oil. However, even small spills can spread over large areas if the spill event includes aerial, pressured discharge. With the high-velocity, bidirectional winds on the North Slope, oil can be misted substantial distances downwind of a leak. For example, in December 1993 an ARCO drill site line failed and 40 to 160 gallons of crude oil misted over an estimated 100 to 145 acres (BLM 2004).

The rate of oil movement and tundra penetration depth depend on a variety of factors. If released onto dry tundra, oil can penetrate the soil because of the effects of gravity and capillary action until an impervious layer of water, ice, or tight soils is encountered. The rate of penetration depends on the season, temperature, soil saturation, soil nature, and oil type. Spills in summer may penetrate the active layer and then spread laterally on the frozen subsurface, accumulating in local depressions. The oil then may penetrate into the permafrost layer through cracks in the permafrost (BLM 2004).

Also in summer, rain can increase the spread of spills over thawed soils (BLM 2004) and large areas of the tundra may be covered with a shallow layer of standing water. In these areas, the oil would likely float on the surface of the water until it reached dry ground or tundra vegetation, such as tussocks that are above the water. The oil may adhere to this vegetation, which would thereby serve as a barrier to further spreading. Oil and other chemicals may act as contact herbicides, which could result in barren patches of tundra potentially subject to thermokarsting.

In winter, the presence of snow cover or frozen soil could slow the spreading of oil, depending on the temperature of the oil, topographic relief, and the amount of snow cover. Snow cover may act as an absorbent, possibly reducing the amount of the spill that reaches the tundra surface. Penetration of oil into the soil is generally limited; however, pore space that is not filled with ice may allow spilled oil to move into the frozen soil (BLM 2004).

Saltwater spills on tundra generally behave in a similar fashion to oil spills. The primary difference is that saltwater may freeze (thereby minimizing spread) at temperatures just below 32°F, depending on the temperature and TDS concentration of the discharge. However, in warmer temperatures, saltwater may flow farther through the vegetation and penetrate farther into the soil and the permafrost than would the same volume of oil. Finally, the salts in saltwater do not weather as oil does and these salts would likely persist until they are diluted and/or transported from the area by freshwater flows from precipitation, floods, or flushing activities of the cleanup and restoration crews.

5.24.5.2 Fresh or Marine Water

Weathering processes in fresh or marine water are generally similar and mainly impacted by seasonal ice cover, which could greatly slow weathering in both systems (BLM 2004).

Due to the colder temperatures of the project waters and the increase in viscosity of oil at cold temperatures, oil spills in project area ponds, lakes, streams, rivers, and marine waters would spread less than in temperate fresh or marine waters. The exception to this would be a spill in a warmer water area, such as a shallow, marshy, or ponded tundra or flooded lake margins in summer (BLM 2004).

An oil spill in broken ice in the stream channels or Lion Bay would spread less than on an open lake and would spread between ice floes into any gaps greater than approximately 4 to 6 inches (BLM 2004).

The presence of currents could affect the spread of oil under the ice if the magnitude of those currents is large enough. A field study near Cape Parry in the Northwest Territories reported currents up to 0.2 knots. This current was insufficient to move oil from under the ice sheet after the oil had ceased to spread (BLM 2004). Laboratory tests have shown that currents in excess of 0.3 to 0.5 knots are required to move oil collected in under-ice depressions (BLM 2004). Current speeds in the nearshore Beaufort Sea, including Lion Bay, generally are less than 0.2 knots during the winter (BLM 2004). The area of contamination for oil under ice could increase if the ice were to move. For example, because the nearshore Beaufort Sea, including Lion Bay, is in the landfast ice area, the spread of oil from ice movement would not be anticipated until spring breakup; however, once breakup occurs the oil could move long distances rapidly.

For any oil that enters a stream, regardless of flow velocities or water levels, some of the oil would be deposited on the stream banks. During flood stage, the oil could be deposited on the tundra and in normally isolated tundra ponds. The amount of oil per unit area stranded on a stream bank or reach would depend on the following factors:

- Physical character of the oil, which would change over time as the spilled oil weathers
- Physical character of the stream bank material (i.e., sand, grass, peat, etc.), which would vary considerably even over short distances
- Speed at which the water flowed at the water-sediment interface
- Size of any wind-generated waves on the stream surface that would spread the oil over a band above the water level
- Changes in the water level and flow volume through the time that oil would pass through a reach; these changes would depend on both season and recent/ongoing storm events
- Direction, persistence, and magnitude of winds occurring during and after the oil spill event; strong persistent winds could strand oil against lee banks and/or create surface currents that could be stronger than the instream, near-surface velocities

Oil could persist in the following areas:

- Stable vegetated banks where the oil could coat branches, leaves, and grass
- Ponds or channels where the oil is left above the level of the stream by falling water levels
- Areas of quiet water or eddies at the inside of stream bends on a meandering channel
- Other pools or backwaters where velocities are slower

5.24.6 Likelihood of Spills

The likelihood of a spill is a qualitative assessment based on the rate or frequency of occurrence. The rate of occurrence is a function of several factors, including age of the infrastructure, operating procedures, personnel training and awareness, maintenance, and human error. Impact analyses typically are presented in various scenarios to span the range of likelihood of occurrence, which may be expressed in several ways; for example, “once in 1,000 years,” “once in 1 billion barrels (or gallons) of oil produced,” or “once per 10,000 wells drilled.” This EIS analyzes the potential impacts of a range of possible spills, including the very low likelihood of very large volume spills.

The relative ranks listed below are based on the experience of several personnel with extensive oil spill background, peer-reviewed and "gray" literature, USCG spill reports, the reports incorporated by reference earlier, the ADEC North Slope Spills Database (ADEC 2010c), and other spill reports for North Slope incidents. The assessment is a subjective evaluation and the categories are relative to each other in the context of North Slope oil field operations. Research referenced in Section 3.24, Contaminated Sites and Spill History (see BLM 1998b, 2003, 2004; Mach et al. 2000; NRC 2003b; MMS 2007), indicates that the likelihood of a spill decreases as the size of the spill increases. Specifically, that the probability of very small and small spills would be relatively high, with the probability being 1.0 over the life of the project (i.e., they would occur). The likelihood of large spills would be substantially less (i.e., there would be fewer large spills, but there would likely be at least one over the life of the project). Finally, based on past experience on the North Slope, the likelihood of a very large spill associated with the project would be very low and might approach 0.0 as the size of the potential spill increases. The qualitative assessment of potential likelihood of spills is summarized in Table 5.24-2.

The detailed statistical analysis conducted by Everest Consulting Associates (2007) and reported in the Liberty EA (MMS 2007) is generally applicable to the Point Thomson Project and is incorporated here by reference. Notable differences from the Point Thomson Project are they limited their analysis to include only oil (crude and refined products) and did not consider produced water, saltwater, or other substances in their analyses. They ranked oil spills as small (less than 200 bbl or 8,400 gallons) or large (greater than 200 bbl). Their analysis was based on a thoroughly vetted ADEC database with additional data and information from other sources for the North Slope of Alaska. They did not include oil spill data or statistics from other locations such as onshore and/or offshore of the Gulf of Mexico or international areas, primarily because the operating conditions and environment of these areas are not similar to or representative of the Alaska North Slope. They concluded that there was a less than 1 percent chance of a large spill (greater than 8,400 gallons) over the 25-year expected life of the Liberty Project and, though the chances of a small spill were essentially 100 percent, the total annual spill volume was estimated to be on the order of 100 gallons per year.

For this EIS, the likelihood of each type of material spill, regardless of the volume, was estimated using the ADEC 1995 to 2009 Spills Database (see Table 3.24-5). Based on cause of spill as listed in the database, line or equipment failures and human error together compose 45 percent of all spill records. Five other categories, including leak, seal failure, valve failure, gauge/site glass failure, and tank failure may be considered special cases of "equipment or line failure" and constitute approximately 27 percent of the recorded spills in the database.

The worst case spills, though a very unlikely event, could be from a complete loss of containment from a large fuel storage tank or a well blowout. In Alternatives C and D, there is onsite storage of up to 6 million gallons of fuel which would be surrounded by a berm with a storage capacity of 110 percent of the maximum spill. The details of the worst case spill and the appropriate response actions would be detailed in the new ODPCP for the project and would be modeled on the ODPCP for the existing wells (Appendix U). In the case of an "uncontrolled flow from wellbore" (commonly called a well blowout), the ODPCP (Table 2-1 of Appendix U) estimates the maximum spill over a 15-day period could be 3,570,000 gallons of crude oil (Bookian oil production scenario), or about 59,000 gallons of condensate from Thomson Sand assuming that the condensate is voluntarily ignited at the wellhead.

5.24.7 Spill Prevention, Detection, and Response

The combination of natural environmental factors affecting the fate, behavior, and potential impacts of spilled materials and the actions taken by the Applicant and its contractors, including oil spill response organizations (OSRO), ultimately influence the potential impacts of any spill to the human and natural environment. The Applicant has designed and committed to a comprehensive slate of processes, procedures, and systems to prevent, detect, and mitigate potential spills that may occur during drilling, as well as construction, maintenance, and operation of the proposed project (see the ODPCP in Appendix U and Section 5.24.12, Mitigative Measures). The new ODPCP for this project would contain further detail and would be required as a condition for the Applicant to construct and operate the proposed drilling, processing, and pipeline components of the project.

5.24.7.1 Prevention

The Applicant has developed safeguards and procedures to protect against potential threats to project facilities and operations, which may include but not be limited to:

- Human error in any phase of the project
- Incorrect drilling operations
- Incorrect pipeline operations (e.g., overpressure of the pipeline)
- Materials and construction damage (e.g., flaws such as defective welds, dents, cracks, nicks in the pipeline coating that are a result of transport or construction, and flaws in the seam of the pipeline created during the manufacturing process)
- Corrosion (e.g., internal, external, and stress-corrosion cracking)
- Stress defects that develop over time during operation
- Damage from external contact with the pipeline by vehicles and equipment
- Bullet holes from hunters and/or vandals
- Facility damage from natural hazards (e.g., storm surge)

Safeguards would be implemented during design, construction, development and production drilling, processing of produced fluids, and operations of the proposed pipeline. These include:

- Fabricating pipe and all other equipment such as valves, pumps, VSMs, etc. according to specifications that meet or exceed applicable regulations
- Installing an operational pipeline monitoring system (SCADA) that remotely measures changes in pressure and volume every 5 seconds on a constant basis. These data would be immediately analyzed via redundant computer programs to determine potential leaks anywhere on the gathering or export pipeline systems
- Instituting a regime of periodic pipeline integrity inspection and cleaning programs using pigs to detect pipeline diameter anomalies and loss of wall thickness from corrosion
- Conducting aboveground aerial and ground surveillance inspections on a regular basis to detect leaks and spills as early as practical, and to identify potential third-party activities (e.g., subsistence hunting) that could damage the pipeline and/or associated facilities.

The Applicant's SPCC Plan would contain spill prevention measures such as fluid storage and transfer guidelines, and secondary containment requirements. In addition, the U.S. DOT would require a pipeline FRP, and EPA and the U.S. Coast Guard would require an FRP for the production facilities. The implementation of these plans would minimize the likelihood of spills to occur, and in the unlikely event of a spill, would minimize the volume released.

5.24.7.2 Pipeline Leak Detection

The Applicant would utilize a comprehensive SCADA system to monitor and control the proposed pipeline for leaks. Data provided by the SCADA system would alert the Operations Control Center (OCC) operator to an abnormal operating condition, indicating a possible spill or leak. A second communication system would provide redundancy should SCADA communications fail between field locations and the OCC.

The SCADA system would monitor pipeline conditions continuously and update information provided to the command center operator. Data received via the SCADA system also would be directed to the dedicated leak detection system, capable of independently sending an alarm to the operator.

The Applicant would install two independent leak detection systems. The primary system would detect a leak as small as 1 percent of the daily flow rate, as required by 18 ACC 75.055(a)(3). This system would use meters on the inlet and outlet of the export pipeline, with a state-of-the-art computational system that would perform real-time monitoring for pipeline leaks and be continually updated via the SCADA system. A proprietary leak detection system using different technology would provide another level of protection. In the event that a volume imbalance is identified and warrants further investigation, the Applicant would use measures such as the following to identify the leak location:

- Shut-in pressure testing between isolation valves to identify pressure loss within a pipeline segment
- Aerial and ground patrols whenever practical to provide direct observation and identification of leak location
- Internal inspection surveys

Visual inspections of the export and infield pipelines would be conducted weekly during operations via aerial surveillance, unless precluded by safety or weather conditions. In addition, the FLIR thermal infrared survey methodology could be used for pipeline leak detection.

5.24.7.3 Response

Spill response procedures incorporated in the ODPCP, SPCC Plan, and the FRPs would be prepared or updated by the Applicant prior to the start of the project and strictly adhered to in the event of a spill. The Applicant's OCC operator would follow prescribed procedures in responding to possible abnormal conditions (including spills) that may be reported from sources such as:

- OCC operator observing abnormal pipeline conditions
- Leak detection system alarm (SCADA)
- Observation by on-site employees
- Observation by third parties (e.g., Native subsistence hunters, oil field service personnel, other service providers, security)

Upon receipt of an abnormal condition report, leak report, or leak alarm, the OCC operator would execute the following procedures:

- Follow prescribed operating and response procedures for abnormal pipeline condition or alarm response
- Dispatch First Responders to evaluate first-hand the situation with regard to location, type and size of leak, surrounding environmental conditions that impact response, types of habitats and resources at risk, and other relevant factors required to initiate a response action

- Shut down the pipeline within a predetermined time threshold if abnormal conditions or leak alarm cannot be positively ruled out as a leak
- Complete internal notifications

All Applicant employees would be authorized to communicate directly with the OCC should they observe conditions that may signify a possible spill.

Time

In the event of a potential pipeline leak or spill, the estimated time to complete an emergency pipeline shutdown and close remotely operated isolation valves would be 45 minutes. This includes 30 minutes for the leak detection system to indicate an alarm after the start of a significant leak (e.g., complete fracture of line) and 15 minutes to stop pumping units at all pump station locations.

Consistent with standard North Slope industry practice and in accordance with ADEC regulations, the Applicant's response time to transfer such additional resources to a potential leak site would follow an escalating or tier system. Dependent on the nature of site-specific conditions and resource requirements, the Applicant would meet or exceed the requirements along the entire length of the proposed pipeline system.

Tiered Response

The primary task of the Tier 1 response team is to stop the source of the spill and to minimize the spread of product on the ground surface or water. The goal is to protect ecological, historical, and archeological resources, and subsistence locations. The Emergency Site Manager (also known as the Person in Charge) would perform an initial assessment of the site for specific conditions, including the following:

- Actions required to stop the discharge and begin containment
- The nature and amount of the spilled material(s)
- The location, source, status, and release rate of the spill
- Direction(s) of spill migration
- Known or apparent impact on potentially affected environmental features and human uses
- Concentration of wildlife (e.g., birds, marine mammals) and nesting areas
- Presence of environmental hazards that could impact response actions (e.g., polar bears, high flows in rivers and streams, fire, toxic materials)

The Person in Charge would request additional resources in terms of personnel, equipment, and materials from the Tier 2 response teams (from the North Slope and other areas of Alaska) and if necessary, the Tier 3 response teams (national and international). The primary objective would be to spot the source of the spill followed by initiation of containment actions. Once containment activities have been successfully concluded, efforts would then be directed toward the recovery and transfer of free product. Site cleanup and restoration activities would then follow, all of which would be conducted in accordance with the authorities having jurisdiction, including development of a natural resource damage assessment in the event it is required.

Personnel and Training

The number of emergency responders comprising specific response teams would be determined on completion of the Applicant's ODPCP, FRPs, and SPCC Plan prior to implementation of the project. Emergency responders would meet or exceed the requirements of ADEC, and would typically be comprised of Hazardous Waste

Operations and Emergency Response trained personnel. The response organization would follow the Incident Command System (ICS), which is prescribed by the National Contingency Plan and is required to comply with the National Incident Management System. The response organization would typically consist of personnel both onsite and supplemented by Applicant staff and/or contractors from other North Slope locations as well as Anchorage. The Applicant is expected to contract the services of Alaska Clean Seas as the OSRO to support a Tier 2 and 3 (and possibly some Tier 1) responses. This would be determined and verified in the new ODPCP that the Applicant would prepare prior to implementing the project.

Exercises and Drills

The primary elements of the exercise program are notification exercises, tabletop exercises, Applicant-owned equipment deployment exercises, contractor exercises, unannounced exercises by government agencies, and area-wide exercises up to and including actual field drills conducted by industry and government agencies.

The Applicant would ensure that operating personnel participate in exercises or responses on a regular basis to ensure they remain trained and qualified to operate the equipment in the operating environment and to ensure that the ODPCP, SPCC Plan, and FRPs are effective. Alaska Clean Seas provides training and support in exercises and drills for the North Slope Operators, including the Applicant.

Communication

Internal and external notification procedures would be provided in the ODPCP along with a table of agency reporting requirements. The Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) includes certain requirements regarding emergency planning, emergency release notification, and "Community Right-to-Know" reporting on hazardous and toxic chemicals. The Applicant would be required to follow the applicable provisions of EPCRA.

5.24.7.4 Vehicle-related Spills

The Applicant would avoid or minimize vehicle-related spilled by implementing a number of measures. Storage and transfer locations for fuels and other fluids would be designed with appropriate secondary containment systems and site-specific procedures (e.g., drip pans/duck ponds and pads underneath equipment). Various BMPs, such as a Drips and Drops Program, would be implemented for road and pad maintenance. Before a vehicle would be allowed on an ice road, it would receive a complete inspection for leaks. Each vehicle would be equipped with a drip pan for stopping on the ice road. Alaska Clean Seas, an oil spill response service contractor, would perform a daily inspection of the ice roads and scrape up any spills. In addition, Alaska Clean Seas would record any observed drip by type and investigate its source.

5.24.8 Spill Scenarios

A range of spill scenarios is the basis for this impact assessment. It is impractical to evaluate all reasonably likely combinations of factors that influence a spill impact assessment. Spills that may result in significant environmental impacts are likely to be large condensate spills from the proposed export pipeline. For that reason and because a key criterion for the ADEC spill reporting system is volume of oil released, spill scenarios were based on the spill volumes discussed in Section 3.24.5. The volumes characterizing each of the five following categories are to be used as a guide and are not official or fixed. One or more of the factors influencing a spill could dramatically change the resulting impact. For example, a spill of 2,000 gallons into an interconnected tundra wetland system in late spring where thousands of migrating waterfowl are getting ready to nest could cause substantial impacts, whereas a spill of 210,000 gallons onto frozen, snow-covered dry tundra in winter may result in minimal impact on the natural or human use environment (for example the March 2006 BP GC-2 spill). The spill scenarios used in this EIS likely overestimate the potential spill impacts.

The most common scenarios would be the very small and small spills of material, usually diesel, hydraulic fluid, transmission oil, and antifreeze, on gravel or ice infrastructure. Rarely would these spilled materials reach the tundra or water bodies, but, if they did, the impact area would be adjacent to the road or pad and effects would be limited. Some of these small spills could result from slow and small (pin hole) leaks of produced fluids or export fluids from the proposed pipeline, and they could occur on the tundra or into water bodies remote from the roads and pads.

A similar scenario exists for medium-to-large spills although these occasionally reach the tundra or water bodies adjacent to the roads, pads, and airstrips and are much less common. These spills would be more likely to consist of produced fluids or condensate, although medium to large spills of antifreeze, diesel, and drilling muds may occur.

Medium spills would more likely:

- Relate to tanker truck accidents at or in transit to construction and operation/maintenance sites
- Be refined products
- Occur on or near roads, construction pads, facility sites, or along the pipeline ROW.

Large spills would more likely be composed of condensate or produced fluids released from gathering and export pipelines and would likely occur in the ROW. Both medium and large spills could result from tanker truck accidents (during construction), major failure of the fuel storage tanks at construction sites, or catastrophic failure of the pipeline. Due to the increase in fluid volume, medium and especially large spills would be more likely to reach natural tundra or water bodies adjacent to the ROW, roads, and pads and the impact area would generally be more extensive. Large spills that result from a pipeline rupture would likely be detected quickly by the SCADA system; both automatic and manual responses would be quickly activated to stop and isolate the leak within 45 minutes (Appendix D, RFI 91).

Very large (greater than 100,000 gallons) spills would be highly unlikely events and would probably only result from a major blowout or uncontrolled release at the drilling site (Appendix U), a complete failure of a containment berm around several fuel storage tanks (e.g., especially in Alternatives C and D where up to 6 million gallons of fuel would be stored onsite), or from a fuel barge delivering diesel fuel to the project in the open water season. These spills would likely reach tundra and adjacent water bodies, especially if the spill occurs in the ice-free seasons. The proximity of the drilling and production wells to streams near the pads may be the most important factor in spill scenarios. In general, if the spilled material flows to the limited amount of dry tundra, the material probably would not spread over a great distance. However, if a very large spill reaches a flowing stream, the distance that the material could spread substantially increases, including to downstream areas and into Lion Bay or adjacent marine waters. Flood flows could distribute spills over flooded natural tundra and into ponds as well as the streams and eventually to Lion Bay. Whether a very large spill would reach these streams would depend on several variables, including the spilled material type, ambient water and air as well as temperature and volume material released; the topographic relief and slope; presence of snow or vegetation; and response time and actions.

A very large spill from a tug/barge accident (Alternatives B and E) could result if some to all of the bulk tanks or compartments were breached in a severe storm or other accident. The material would likely be primarily diesel fuel but could include gasoline, aviation fuel or bunker oil, lubricating or hydraulic oil, or some combination of these materials.

The maximum volume that would be spilled from pipelines was estimated for each of the action alternatives assuming a worst-case large break flowing without controls for 45 minutes, followed by complete drainage of the pipeline during summer conditions (Appendix D, RFI 91). The maximum predicted spill in Alternative B would be 704,970 gallons for the export pipeline and 23,226 gallons from either the east or west gathering lines (Table 5.24-3). These would constitute very large and large spills, respectively, based on the classification system used in this EIS. As shown in Table 5.24-3, the maximum pipeline spills under the other action alternatives would be of similar volume with the exception of the export pipeline in Alternative C, which would have a spill volume more than twice as large.

Table 5.24-3: Action Alternatives—Potential Maximum Pipeline Spill Volumes

Alternative	Pipeline Component	Length (feet)[a]	Material Spilled	Diameter (inches)	Volume (gallons)[b]
Alternative B	Export pipeline	117,216	Export condensate and oil	12.75	704,970
	West Pad to Central Processing Facility (CPF)	25,344	Produced fluids	8.63	23,226
	East Pad to CPF	25,344	Produced fluids	8.63	23,226
Alternative C	Export pipeline	265,056	Export condensate and oil	12.75	1,574,244
	West Pad to Central Well Pad	16,896	Produced fluids	8.63	20,538
	East Pad to Central Well Pad	28,512	Produced fluids	8.63	24,234
	Production line (Central Well Pad to CPF)	11,088	Produced fluids	10.00	22,344
Alternative D	Export pipeline	118,272	Export condensate and oil	12.75	711,186
	West Pad to Central Well Pad	17,952	Produced fluids	8.63	20,874
	East Pad to Central Well Pad	24,288	Produced fluids	8.63	22,890
	Production line (Central Well Pad to CPF)	8,448	Produced fluids	10.00	20,622
Alternative E	Export pipeline	116,160	Export condensate and oil	12.75	698,754
	West Pad to CPF	25,344	Produced fluids	8.63	23,226
	East Pad to CPF	24,288	Produced fluids	8.63	22,890

a Length of longest segment that would drain with a guillotine break.

b Volumes calculated following methodology of Appendix D, RFI 91 and assuming 45 minutes from time of break to shutdown.

5.24.9 Impacts of Other Spilled Materials

As noted in Section 5.24.5, Fate and Behavior of Spilled Materials, the main focus of the spill impact assessment is on condensate, crude oil, refined hydrocarbon products and saltwater because these are the materials that may be spilled in large volumes in locations where the spilled material could reach natural habitats (e.g. wet and dry tundra, tundra ponds, lakes, streams and rivers, and the nearshore Beaufort Sea).

Table 3.24-5 lists several other materials that have been spilled on the North Slope and reported in the ADEC database (ADEC 2010c). Some of these materials would likely be used for the Point Thomson Project and include: antifreeze (ethylene glycol, propylene glycol and "glycol"), methanol, acids (primarily hydrochloric and sulfuric), drilling mud, corrosion inhibitor, and "others" which include drag reducing agents, emulsion breakers, biocides and unspecified chemicals.

Antifreeze (e.g., ethylene glycol, propylene glycol and "glycols") is completely miscible in water. It is toxic to animals when ingested in substantial quantities; mammals will eat/drink it because it tastes sweet. Waste antifreeze contains heavy metals such as lead, cadmium, and chromium in high enough levels to potentially make it a regulated hazardous waste. Because antifreeze is miscible, it is generally not practical to contain or clean up these materials before they are dispersed and diluted in the water. It undergoes rapid (1 to 2 days) biodegradation in aerobic and anaerobic environments and is not persistent in air, surface water, soil and groundwater Staples et al. (2001) and Polyscience (2010) also report that ethylene glycol acute toxicity values for fish and aquatic macroinvertebrates were generally >10,000 mg/l and does not bioaccumulate. Pillard (1995) reports even higher acute toxicity values ranging from about 7,000 to 73,000 mg/l for daphnia and fathead minnow. Based on past North Slope spills (see Table 3.24-5), antifreeze spills would likely be very small to small and occur on gravel pads or roads thus limiting potential impacts to natural habitats, wildlife, and aquatic species.

Methanol (also known as methyl alcohol) is completely soluble in water. Methanol is used for freeze protection on the North Slope and would also be used to prevent hydrate formation in the gathering lines at Point Thomson. Methanol biodegrades very rapidly in soil and water. It has high soil mobility and degrades from the ambient atmosphere by the reaction with photochemically produced hydroxyl radicals with an estimated half-life of 18 days. It does not bioaccumulate. Methanol acute toxicity to fish ranges from 13 to 68 mg/l up to 29,400 mg/l and values of 8,000 mg/l have been reported for rainbow trout. It is likely to be acutely toxic to aquatic life in high concentrations as might occur at the source of a spill or when a large volume is spilled to a small water body. Based on past North Slope spills (see Table 3.24-5), methanol spills would likely be very small to medium and occur on gravel pads or roads thus limiting potential impacts to natural habitats, wildlife, and aquatic species.

Acids, primarily hydrochloric and sulfuric, are completely miscible in water with the final concentration being a function of the relative volume of acid and receiving waters or water in wet soils. Acids will reduce the pH, potentially to levels that impact vegetation, fish, invertebrates, birds and/or mammals that come into contact with the acid or acidic water. Based on past North Slope spills (see Table 3.24-5), acid spills would likely be very small to small and occur on gravel pads or roads thus limiting potential impacts to natural habitats, wildlife, and aquatic species.

Drilling muds are generally not a hazardous material as they are composed mostly of bentonite and similar "mud" material and mineral oil. The main impacts of spilled drilling mud would likely be relatively short-term and would include: smothering of tundra and aquatic vegetation; benthic invertebrates, and potentially large increases in turbidity in water bodies, especially relatively small ponds, lakes, and streams. In the past, most of these spills have been small with a few large ones (10,000 to 19,000 gallons; see Table 3.24-5). Drilling mud spills would be likely to occur on gravel pads or along roads and have temporally and spatially limited impacts to habitats and species located adjacent to these gravel pads and roads.

A variety of "Other" materials are used in drilling and production operations (Table 3.24-5), including corrosion inhibitors, drag reducing agents, emulsion breakers, biocides and unspecified chemicals. Spills of these materials would most likely be small to very small (Table 3.24-5) and occur on a gravel pad or road. The impacts would likely be constrained to the habitats and species adjacent to the road and be both temporally and spatially limited.

The corrosion inhibitors, drag reducing agents, emulsion breakers, and biocides are injected into crude oil delivery lines and mixed at low concentrations with the oil. As such, they could also be spilled along with the oil in any crude oil spill but would not be separable from the oil physically or in the impacts on the environment.

5.24.10 Impact Assessment Criteria

Based on the worldwide extensive experience and literature accumulated over the past 50 years by environmental scientists, engineers, planners, natural resource economists, and a wide range of other stakeholders on spill impacts to ecosystems and human uses (NRC 2003b) the impact of a North Slope spill would be primarily a function of size and material type of the spill, season, and sensitivity of the receptors affected. Impacts can be generally described in the context of magnitude, duration, and geographic or spatial distribution. For each of these descriptors, there is a range of intensity that further influences the impact of the spill to the resources and/or services at risk. The impact categories and intensity for each category are defined in Table 5.24-4.

Table 5.24-4: Impact Criteria–Spills

Impact Category*	Intensity Type*	Specific Definition for Spills
Magnitude	Catastrophic	• Mostly continuous or nearly continuous and often heavy presence of spilled materials[a] on all habitats near and/or for substantial distances downgradient of the spill site. • Area may include extensive areas of tundra or wetlands, tundra ponds/lakes, and marine waters and shore zone, and/or several to numerous miles of river or streams. • May be both local and regional disruption of human uses. • May be both local and regional impacts to biological populations and communities.
	Major	• Patchy to continuous and often heavy presence of oil on terrestrial, aquatic, and/or marine habitats near the spill site and for substantial distances downgradient. • Area may include many acres of tundra or wetlands, tundra ponds/lakes, and marine waters and shore zone, and/or several to numerous miles of river or streams. • May have local biological community and population-level impacts on organisms and habitats, and disruption of human uses of local spill impacted areas.
	Moderate	• Patchy to continuous but generally not heavy presence of oil on terrestrial, aquatic, and/or marine habitats near the spill site and for substantial distances downgradient. • Area may include several acres of tundra or wetlands, tundra ponds/lakes, and marine waters and shore zone, and/or a few miles of river or streams. • May have local biological community and population-level impacts on organisms and habitats, and disruption of human uses of local spill impacted areas.

Table 5.24-4: Impact Criteria–Spills		
Impact Category*	Intensity Type*	Specific Definition for Spills
	Minor	• Area may include a few acres of tundra or wetlands, tundra ponds/lakes, and marine waters and shore zone, and/or short sections of river or streams. • May have local biological community and population-level effects on organisms and human uses of the area.
	Negligible	• Little to no detectable impact on most habitats, resources, or human uses; may be some visible presence of oil on land, vegetation, or water. • Zero to very few organisms apparently killed or injured. • Temporary (days) and spatial distribution localized to spill site.
Duration	Long term	Impact would be permanent or present for many years; active restoration not practical.
	Medium term	Impact would last from a few months to more than 1 year; active restoration practical.
	Temporary	Impact would last a few days to a few weeks; active restoration practical or not needed.
Potential for Impacts to Occur	Probable	Highly likely to occur (likelihood would approach 1.0).
	Possible	Moderately likely to occur (likelihood in the range of 0.4).
	Unlikely	Not likely to occur (likelihood less than 0.1).
	Highly unlikely	Very unlikely to occur (likelihood would be essentially zero).
Extent of Impacts to Resources	Extensive	Impacts from spill would extend over one of the below areas: • >100 acres on land, wetlands, or tundra ponds/lakes. • >2 miles of stream. • >5 mi^2 in marine waters and shore zone.
	Local	Impacts from spill would extend over one of the below areas: • <100 acres on land, wetlands, or tundra ponds/lakes. • <2 miles of stream. • <5 mi^2 in marine waters and shore zone.
	Limited	Impacts would be restricted to immediate area of the spill location and generally on the built environment (e.g., gravel pad and roads, ice road) or pipeline ROW.

* Impact categories and intensity types were developed based on CEQ NEPA regulations as described in Section 4.1, Impact Determination Methodology. Because the size of spills can vary widely, the intensity levels for magnitude have been expanded in this table to reflect the greater range in potential impacts.

[a] Produced fluids, petroleum hydrocarbons, and other hazardous materials.

5.24.11 Summary of Impacts by Resource

This section focuses on the potential impacts resulting from spills to most of the resource categories described in Sections 3.1 to 3.23. The impact assessment is based on the past 30 plus years of North Slope experience. As noted previously, very small and small spills are highly likely to occur several times a year. A medium spill would be likely to occur at some time in the lifetime of the project. A large spill has a low likelihood of occurring in the lifetime of the project and a very large spill has an extremely low likelihood of occurrence in the project lifetime. Therefore, the following assessments focus on the expected very small, small, and medium spills and indicate the possible impacts of the unlikely large to very large spills. The impact summary tables provide the results relative to the impacts to the resource, not relative to the spill. For example, the "Potential to Occur" is the potential for impacts to the resource for a given spill size category, not the potential for spills of that size to occur.

Each discussion summarizes impacts by resource category and spill size and draws heavily on the impact assessments from the Northwest NPR-A Draft IAP/EIS (BLM 2003b), as well as information in other recent North Slope EISs (BLM 1998b, 2002, 2004, 2007; TAPS 2001, MMS 2007). Impacts are not organized by alternative because the range of impacts would be about the same for each action alternative. As described in Section 5.24.4, Environmental Factors Affecting the Fate of Spilled Materials, the variables surrounding a possible spill are not predictable, especially for large and very large spills; therefore, it is very difficult to reliably predict any differences in impacts that would occur among the alternatives. It is possible that there may be a larger pipeline spill from Alternative C because of the much longer export pipeline or that there may be more very small to medium spills from Alternatives C and D because of the numerous fuel truck trips required to stockpile about 6 million gallons of fuel compared to 2.4 million for Alternatives B and E. However, the impact of any particular spill is not likely to be different between the alternatives.

The main criteria for the following resource- or service-specific impact assessment are the size of the spill (Section 5.24.8, Spill Scenarios) and the type of material spilled. For this EIS, the variations in spill size and receptor type are key variables for estimating the magnitude, duration, and extent of environmental impacts of spills from the project. Spill size can be measured or estimated within a reasonable margin of error in most cases. Receptor sensitivity is more subjective and is influenced by the training, perspectives, and biases of the evaluators, and the actual sensitivity of the receptors to the spilled material. For example, a subsistence hunter whose tundra hunting area is affected by a spill is likely to consider impacts to this area differently than spill-related impacts on a stream that supports recreational hunting and other recreational opportunities. The types of spilled material that are expected to have the greatest likelihood of detectable impacts are produced fluids from the gathering lines, condensate, and/or crude oil from the export pipeline, and diesel fuel from onshore or barge/tug tank ruptures.

In most cases, very small to medium spills would be contained on ice or gravel infrastructure (roads, pads, and airstrips). The primary exception would be spills from pipelines to tundra remote from infrastructure. If spilled material were to escape containment during very small to medium spills, the impacts to most resources addressed here would be negligible to minor, temporary, and limited to the area adjacent to the spill source, depending on the invasiveness of cleanup methods. This assessment assumes implementation of the required measures addressing prevention and response described in the ODPCP prepared by the Applicant for the existing wells at the PTU-3 pad (Appendix U). A similar but more comprehensive ODPCP would be prepared for the proposed project. The details of impacts to specific portions of each resource are included below, as are impacts from large to very large spills.

This section does not consider spill impacts on the following resource categories described in Chapter 3: Geology and Geomorphology, Meteorology and Climate, Physical Oceanography and Coastal Processes, Hydrology, and Environmental Justice. Spills may be influenced by these categories (especially Meteorology and Climate, Physical Oceanography and Coastal Processes, and Hydrology) but the converse would be not true.

Any specific spill is a unique and independent event that may result in impacts to the environment, natural resources, and/or the services those resources provide. As described previously in this section, the causes of the spill may be many and the likelihood of spills for a range of causes, types of materials, locations, etc. may also be many and varied, depending upon the operations, infrastructure, etc. However, once the spilled material is in the environment then the range and type of impacts to any particular resource are fairly well known and can be described, as presented in the following sections.

The impacts for each alternative are similar though the *likelihood* of a particular type of spill may vary depending upon the major differences in the alternatives. Alternative B is the Applicant’s Proposed Action and is the basis against which the relative likelihood of spills from Alternatives C, D, and E are compared. There may be more pipeline spills to the dry and wet tundra, associated lakes and ponds, and small streams from Alternative C because of the additional export pipeline distance from Badami to Endicott whereas the export pipeline in Alternatives B, D, and E stops at Badami. There may be fewer spills that reach the nearshore marine environments from Alternatives C and D than from B and E because the pipelines and pads with associated infrastructure are located further inland in the former alternatives. Any spilled material would have farther to be dispersed and transported, generally by flowing water, to the nearshore areas. In addition, Alternatives C and D do not have barging facilities so would not have the potential for marine spills associated with barges. However, Alternatives C and D may have more fuel transport-related spills because of the need to store 6 million gallons of fuel onsite compared to the 2.4 million gallons planned for onsite storage in Alternatives B and E.

5.24.11.1 Paleontology

Paleontological resources are present in the general project area. The locations of known resources would be avoided by the project facilities and activities thereby minimizing the likelihood of the spilled material and/or the response activities directly impacting the resources. Most paleontological resources are usually far enough below the surface that they probably would not be affected by either a spill or subsequent spill cleanup activities. If present at or near the surface, paleontological resources could be coated with some spilled material and stained, perhaps irreversibly.

Very small to medium and even most large spills would be unlikely to reach areas well outside the footprints of project structures and infrastructure, and thus are highly unlikely to have impacts to paleontological resources. Large or very large spills extending outside the project footprints are very unlikely, but if they occur, are more likely to reach paleontological resources. Potential impacts could include staining and possible physical damage if response actions are not managed appropriately. The impacts may be moderate, medium to long term and local to extensive, depending on the distribution of spilled material and the cleanup methods used. Table 5.24-5 summarizes the potential impacts of spills on paleontological resources.

Table 5.24-5: Spill Impact Evaluation for Paleontology

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small or Small Spills (less than 100 gallons)	Negligible	Temporary	Highly unlikely	Limited
Medium Spills (100 to 999.9 gallons)	Negligible—minor	Temporary—medium term	Highly unlikely	Limited—local
Large or very large spills (1,000 gallons or greater)	Minor—moderate	Medium—long term	Highly unlikely	Local

5.24.11.2 Soils and Permafrost

All spills that are not confined to ice or gravel infrastructure could affect the soils, especially where there is no barrier or sorbent such as vegetation or snow cover for the spilled material.

Crude oil in the produced fluids and export oil, lubricating oil, and similar heavy oils would be less likely to reach the surface soil layers than would gas condensate and refined oil (e.g., diesel), which could easily infiltrate through the vegetation. The penetration depth into the soil would depend on the soil porosity, the relative amount of clay and/or organic material, depth to permafrost, and the extent to which the soil is saturated with water. The area affected would be limited to that area immediately adjacent to and covered by the spill.

Spills could affect soils and permafrost indirectly by affecting the vegetation, which in turn could die and expose the soil to impacts such as thermokarst formation, and wind erosion. Spill cleanup would be more likely to affect the soils than the presence of the spilled material itself unless the cleanup response actions were well controlled, and heavy traffic and digging are minimized (especially for summer spills).

Saltwater would be likely to reach the soil especially in the warmer, snow-free seasons because its low viscosity would allow it to penetrate the vegetation and even thin snow layers. Depending on the porosity of the soil and the extent to which the pore spaces are filled with ice, the saltwater could penetrate to or below the tundra vegetation root zone. In locations such as the outer regions of the stream estuaries from Lion Bay to Mikkelsen Bay, where the vegetation includes ***halophytic*** (salt-tolerant) plants, the impacts of saltwater spills could be of smaller magnitude and duration than in most of the rest of the tundra where the plants are nonhalophytes. The soils affected by saltwater spills could take as little as 1 year and possibly up to several years to return to normal, depending on the initial salinity of the saltwater and the amount of flushing from precipitation and flooding (McKendrick 1996, 1997, 1999, 2000a,b,c, 2001, 2003a,b; McKendrick and Mitchell 1978).

Large or very large spills would be very unlikely but, if they occur, the impacts may be moderate to major, medium to long term and local to extensive, depending on the type and distribution of spilled material and the cleanup methods used. A very large spill could result in a thicker, continuous layer of spilled material over a large area and may result in more extensive loss of vegetation, soil overlying the permafrost, increased thermokarsting and potential incorporation of the spilled material into the soil and ice voids. Table 5.24-5 summarizes the potential impacts of spills on soils and permafrost.

Table 5.24-6: Spill Impact Evaluation for Soils and Permafrost

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very small or small spills (less than 100 gallons)	Negligible - minor	Temporary - medium term	Possible	Limited – local
Medium spills (100 to 999.9 gallons)	Minor	Temporary – medium term	Unlikely - possible	Limited - local
Large or very large spills (1,000 gallons or greater)	Moderate – major	Medium – long term	Highly unlikely	Local – extensive

5.24.11.3 Air Quality

Impacts on air quality from an condensate or oil spill would be localized and transient, even for very large spills. Evaporation of the lighter hydrocarbon fractions typically occurs within one to a few days, and the vapors are usually dissipated below risk levels within a short distance of the source. Hanna and Drivas (1993) showed that the majority of VOCs from crude oil spills (and presumably any petroleum VOCs regardless of source) likely would evaporate almost completely within a few hours after the spill occurred. This would be especially true during the late spring-early fall when the weather is warmest and windiest, and when most of the biological resources are present on the North Slope. Emissions of VOCs such as benzene, ethylbenzene, xylenes, and toluene would peak within the first several hours after the spill starts and drop by two orders of magnitude after a few hours to a day. The heavier compounds take longer to evaporate, particularly at the colder temperatures typical of the project area, and might not peak until more than 24 hours after the spill. In the event of a spill on land, the air quality effects would be less severe than those for a spill on water because some of the material could be absorbed by vegetation or into the ground.

Gas condensate, diesel fuel, kerosene, and similar hydrocarbons could be spilled during refueling, from a compromised pipeline, or from accidents involving vehicles or equipment. Produced fluids including the gas condensate spilled from a well blowout or failure of the pipeline and/or associated equipment in the gathering lines and processing facility may contribute a substantial amount of volatile and semi-volatile hydrocarbons to the local atmosphere for a few hours to days after the spill is stopped. Because most of these spills would probably be relatively small, any air quality effects likely would be lower than for large spills.

Gasoline and many of the solvents would evaporate and disperse very rapidly. Most of the volume released would evaporate, except for small amounts that may seep into the upper soil and vegetation layers from which it would be released over a day to days. Gasoline vapors are generally not toxic at the concentrations experienced in spills but they may be subject to fires and explosions.

In the event of a gas condensate well blowout, the wellhead may be ignited as a response action to minimize the spill of gas condensate to the ground. This would result in the emission of pollutants into the atmosphere. The Applicant has shown that the igniting of condensate blowout would not result in the exceedance of NAAQS (Appendix U).

Impacts on air quality related to oil spills would be negligible to minor, temporary, and limited in extent. The associated VOC air emissions would result in negligible, temporary, and limited impact on the biological or physical resources of the project area. Table 5.24-6 summarizes the potential impacts of spills on air quality.

Table 5.24-7: Spill Impact Evaluation for Air Quality

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very small or small spills (less than 100 gallons)	Negligible	Temporary	Possible	Limited
Medium spills (100 to 999.9 gallons)	Negligible	Temporary	Possible	Limited
Large or very large spills (1,000 gallons or greater)	Minor	Temporary	Highly unlikely	Limited

5.24.11.4 Water Quality

Freshwater

Spills could affect freshwater quality if the spilled material reaches water bodies either directly or from flowing over the tundra. During the fall to early summer, most spilled material would not reach freshwater bodies (e.g. tundra ponds and lakes or streams) unless it is spilled directly into them. Even then, most would be frozen and/or snow-covered so the spilled material would not reach the water. During the period of breakup through freeze-up, spills could reach and affect wet tundra and tundra ponds and lakes, as well as streams or the marine environment.

If the spilled material, especially gas condensate, other petroleum hydrocarbons and other organics, reached the freshwater bodies, there could be an impact to water quality in reduced dissolved oxygen concentrations and increased toxicity to aquatic organisms.

Dissolved oxygen concentrations in tundra waters could be affected by spilled hydrocarbons in summer. The NPR-A experiment provides an illustration of the potential impacts (Miller et al. 1978, Barsdate et al. 1980, Hobbie 1982). In the experiment, they released 210 gallons of Prudhoe Bay crude into a small tundra pond. Dissolved oxygen concentrations, 1 week after the spill, were reduced by approximately 4 mg/l below levels in a control pond. Some measurements just under the oil slick were less than 5 mg/l, which is the state standard for wildlife protection. At the 4-inch water depth (average pond depth [Miller et al. 1980]), outside the slick, oxygen concentration was within the expected normal range of 10.8 mg/l compared to 11.4 mg/l in the control pond. The oxygen deficit under the slick (and also in the shallower waters of the control pond) was attributable to decreased oxygen influx from the air because of the relative impermeability of the oil slick to oxygen and to the relatively high rate of natural sediment respiration in coastal tundra ponds. The oxygen deficit was not attributable to oil-enhanced respiration of oil-biodegrading microorganisms in the pond.

In winter, even under ice, a small spill would not be expected to cause an oxygen deficit in most waters because low biological abundance and activity means that sediment and water column respiration rates are low to negligible. During open water periods in the streams and nearshore marine habitats, there would be no detectable impacts on dissolved oxygen levels due to the spilled materials. The high water volume (relative to the volume of spilled material) and the high rate of water flow would disperse and dilute the spilled material before effects on dissolved oxygen concentrations were detectable.

An oil or condensate spill reaching the larger tundra lakes would result in a minimal effect on water quality. Dissolved oxygen levels would not be affected. Direct toxicity would be minimal because of the much greater dilution volume in these lakes than in the small ponds and lakes.

A saltwater spill to smaller freshwater bodies could exceed state freshwater quality standards, which prohibit TDS or salinity from exceeding 1.5 percent salinity. In a year with high rainfall, some of the salt would be diluted and flushed from the tundra ponds and lakes during summer (Miller et al. 1980, Prentki et al. 1980, Hobbie 1984, O'Brien et al. 1995).

Large or very large spills would be very unlikely but, if they occur, the impacts to water quality would be minor to catastrophic, medium to long term and local to extensive, depending on the type and distribution of spilled material and the cleanup methods used. Table 5.24-8 summarizes the potential impacts of spills on surface water quality.

Table 5.24-8: Spill Impact Evaluation for Surface Water Quality

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small or Small Spills (less than 100 gallons)	Negligible - minor	Temporary—medium term	Highly unlikely	Limited—local
Medium Spills (100 to 999.9 gallons)	Negligible—moderate	Temporary—medium term	Unlikely - possible	Limited— extensive
Large or Very Large Spills (1,000 gallons or greater)	Minor—catastrophic	Medium – long term	Highly unlikely	Local—extensive

Marine

Under any of the project alternatives, some very small to medium spills that occur near/in flowing waters or at the nearshore facilities are likely to reach marine waters of Lion Bay or the nearshore Beaufort Sea in measurable amounts. The volume of the material spilled to water bodies would be diluted before it reached the marine waters, where it would be further diluted rapidly to very low concentrations approaching ambient conditions. Very small to medium spills from the tugs, barges, work boats, and shoreline facilities at the proposed barge offloading area immediately adjacent to the marine coastal zone near the Central Pad (in Alternatives B and E) would be likely to reach the marine waters. However, the spilled material would be either contained within a boom or other oil containment equipment or be rapidly dispersed by waves and currents, and would have negligible impact to marine water quality or resources.

If a medium to large spill enters a stream in the breakup or summer seasons, the spilled material could be transported to the marine environment before it could be cleaned up. The flood flow volumes would dilute the material and disperse it over a large area of the shorefast sea ice (if it were still in place) where it would be further diluted as it mixes with the marine water and flood waters. If the spill occurred on the marine waters during the ice-free summer season, some to most of the spill would likely be contained by spill response actions and equipment. Any material not recovered would likely be dispersed rapidly by winds, waves, and currents until it is essentially undetectable in the marine waters.

The impact of a large to very large oil or condensate spill in the marine environment would likely be detectable over a large area of shoreline, barrier islands, and sea surface because the spilled material would spread rapidly in the large volume of marine water. However, most of the toxic components would evaporate rapidly or be diluted and dispersed below toxic levels. Any spill of saltwater that is eventually transported to the marine environment would have negligible impact on the marine water quality. The saltwater would be near to ambient salinity so that even if it could be discharged directly to the marine waters, the spilled saltwater would rapidly be diluted to ambient salinity. Spills directly into streams flowing to the Lion and Mikkelsen Bays could affect estuarine water quality at the mouths of these streams and could measurably degrade estuarine water quality of the project area. On some shoreline types (e.g., those with a substantial accumulation of peat), spilled oil or condensate could persist for several years, and possibly for more than a decade. On other shorelines, especially high energy, eroding ones such as are present at the project area, the stranded oil would likely not persist for more than a few months to a couple of years.

If a medium to large spill were to occur during the open water or broken-ice seasons from any of the pipelines, the spilled material could reach the estuarine waters of Mikkelsen or Lion Bays. The spilled material could be dispersed over and dissolved in the water column and could be incorporated into the sediments (BLM 2002) where it could measurably degrade estuarine water quality and contaminate shorelines. The Liberty EIS (MMS 2002; 2007) concluded that hydrocarbons dispersed in the nearshore, essentially estuarine, water column from a medium to large (greater than or equal to 21,000 gallon) oil spill could exceed the 1.5 parts per million (ppm) acute toxicity criterion during the first day in the immediate vicinity of the spill (BLM 2002b).

Large or very large spills would be very unlikely but, if they occur, the impacts may be moderate to catastrophic, medium to long term, and local to extensive, depending on the type and distribution of spilled material and the cleanup methods used. Though highly unlikely, a large to very large spill in the nearshore marine habitat during breakup or freeze-up could result in long-term, extensive, and possibly major to catastrophic impact to marine resources due to the difficulty of containing and cleaning up spilled oil in those conditions. Table 5.24-9 summarizes the potential impacts of spills on marine and estuarine water quality.

Table 5.24-9: Spill Impact Evaluation for Marine and Estuarine Water Quality				
Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small or Small Spills (less than 100 gallons)	Negligible	Temporary—medium	Highly unlikely—unlikely	Limited
Medium Spills (100 to 999.9 gallons)	Negligible—moderate	Temporary—medium	Unlikely—possible	Limited—local
Large or Very Large Spills (1,000 gallons or greater)	Moderate—catastrophic	Medium— long term	Highly unlikely	Local—extensive

5.24.11.5 Vegetation and Wetlands

Some medium-to-large or very large spills from a spill source such as a pressurized pipeline leak, well blowout, or uncontrolled release from a pipeline break could reach wetlands and associated dry tundra vegetation. Wetlands; including wet tundra, moist tundra, and vegetated shallow tundra ponds; comprise most (about 99 percent) of the vegetated habitat in the project area.

For approximately two-thirds of the year, there is sufficient snow cover to slow the flow of spilled material and allow cleanup efforts to occur before spilled materials spread substantial distances from the spill source (e.g., BP GC-2 crude oil spill, ADEC 2008b). Thus, there would be a limited impact to wetlands and associated vegetation from these spilled materials if no immediate response action were taken. However, cleanup operations, if not implemented carefully and with regard for minimal disturbance of the surface soils and vegetation, could have negative impacts on the system. During the remaining, warmer third of the year, there would be less or no snow cover and the spilled materials may flow farther on the tundra, depending on factors such as topographic relief; temperature; amount of moisture; material spilled; and vegetation type, density, and height.

Most condensate/oil spills would cover less than an acre but have the potential to spread up to several acres if the spill were a windblown mist. Overall, past spills on Alaska's North Slope have caused minor ecological damage, and ecosystems have shown a good potential for recovery with wetter areas recovering more quickly (Jorgenson and Martin 1997, McKendrick 2000b). Spills on wet tundra kill the moss layers and aboveground parts of vascular plants and sometimes kill all macroflora at the site (McKendrick and Mitchell 1978). Damage to oil-sensitive mosses could persist for several years if the site were not rehabilitated (McKendrick and Mitchell 1978). Spill persistence depends on soil moisture and the concentration of the product spilled. McKendrick (2000b) reported that complete vegetation recovery occurred within 20 years on a wet sedge meadow without any cleanup. A dry habitat exposed to the same application supported less than 5 percent vegetative cover after 24 years. For the most part, tundra oil spills would be very local (less than 1 acre) in their effects and would not be expected to contaminate or alter the quality of habitat outside this limited area.

A spill of saltwater has the potential to affect vegetation. The size of the area affected would depend on the terrain and vegetation cover at the spill site and would be proportional to the amount of saltwater spilled. If such a spill were to occur within a community of halophytic plant species, there would likely be little effect. Otherwise, depending on the specific situation under which the spill occurred, the result could vary from little impact to total plant death in the area affected, with eventual replacement of the vegetation community by halophytic species. According to McKendrick (1999, 2000b), brine (and other saltwater) spills kill plants on contact and increase soil salinity to the point that many species cannot survive. Unlike condensate and oil, salts are not biodegradable, and natural recovery occurs only after salts have leached from the soil. A spill would have adverse effects on salt-intolerant vegetation near the gathering pipelines, but the amount of tundra habitat affected would be small, likely no more than a few acres. Thus, potential saltwater spills are not likely to affect forage availability.

Large or very large spills would be very unlikely but, if they occur, the impacts may be moderate to catastrophic, medium to long term and local to extensive, depending on the type and distribution of spilled material and the cleanup methods used. A very large spill could result in a thicker, continuous layer of spilled material over a large area and result in the potential for extensive loss of vegetation in upland areas, dry and wet tundra, salt marshes, and the wetland vegetation of tundra ponds. Table 5.24-10 summarizes the potential impacts of spills on wetlands and vegetation.

Table 5.24-10: Spill Impact Evaluation for Wetlands and Vegetation

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small or Small Spills (less than 100 gallons)	Negligible—minor	Temporary—medium	Highly unlikely—unlikely	Limited—local
Medium Spills (100 to 999.9 gallons)	Minor—moderate	Medium—long term	Unlikely—possible	Limited—local
Large or Very Large Spills (1,000 gallons or greater)	Moderate—catastrophic	Medium—long term	Highly unlikely	Local—extensive

5.24.11.6 Birds

Species of some brood-rearing, molting, or staging waterfowl could come into contact with spilled condensate or oil in coastal and estuarine habitats. For example, a spill entering protected areas could be lethal for molting long-tailed ducks, a conservation species of concern that is vulnerable to oil or condensate spills and contaminants and is currently experiencing population declines (Larned 2009). In addition, several thousand shorebirds could encounter a spill in shoreline habitats (e.g., river deltas), and the rapid turnover of migrants during the migration period suggests many more could be exposed. A spill that enters open water off stream or river deltas in spring could impact migrant loons and eiders.

Birds with light to moderate exposure to spills can ingest condensate or oil material during preening or feeding. This could reduce future reproductive success as a result of pathological effects on liver or endocrine systems (Holmes 1985) that interfere with the reproductive process and can compound ordinary environmental stresses such as low temperatures and metabolic costs of migration. Lethal effects would be expected to result from moderate to heavy coating (or “oiling”) of any birds contacted (BLM 1998). Oiled individuals could lose the water repellency and insulative capacity of their feathers and subsequently die from hypothermia. Oiled females could transfer oil to their eggs, which could reduce hatching success, or possibly result in deformities in young.

Very small to medium spills on or near the roads, pads, or airstrips would have negligible impacts to birds on a population level, but a few individual shorebirds, waterfowl, raptors, and very few passerine birds could be exposed to the spilled material, especially condensate or oil.

A large spill onto the very limited “dry” tundra habitat in the project area could cause the mortality of small numbers of shorebirds and passerines from direct contact, especially with condensate or oil. If the spilled material were to enter local or inter-connected wetlands, small numbers of loons and waterfowl, plus additional shorebirds, could be exposed. The number of individuals exposed would depend primarily on wind conditions and numbers and location of birds following entry of the spill into the water. Impacts would not be detectable at the population level.

If the spill were to enter a stream, a variety of waterfowl and shorebird species could be present, particularly where the stream empties into the estuarine environment. Early-arriving birds may be exposed in any open water pools and cracks in the stream or river ice. A spill entering a stream in spring could contaminate overflow areas or open water where spring migrants of several waterfowl species concentrate before occupying nesting areas. Such losses are likely to cause negligible impacts at the regional population level.

A spill, especially a large or very large one, that occurred in the May to September period and impacted the tundra water bodies where many of the waterfowl, shorebirds, and other migratory birds breed, nest, and fledge their young could have a moderate to catastrophic impact on the local populations of those birds.

A large spill in the marine habitat could result in a substantial concentration of floating oil or condensate that might contact waterbirds staging before or stopping during migration in protected coastal habitats. A very large spill of oil or condensate would be likely to affect substantially more shorebirds, passerines, gyrfalcons, hawks, and other terrestrial birds than would a small to large spill. The areal extent and potential for direct or indirect exposure would increase with a very large spill. The number of individuals exposed and affected would not likely have a measurable effect on the regional population size. Bird species that spend much or most of their time on the water (resting, feeding, or molting or nesting immediately adjacent to the water) could experience a greater impact relative to number, depending on the spill distribution and behavior and density of the birds. If large volumes of surface oil reach the estuarine portions of the streams or Mikkelsen and/or Lion Bay during the summer season, large numbers of birds would likely be oiled and ultimately die. In addition to the expected mortality due to direct oiling of adult and fledged birds, impacts could also include mortality of eggs due to secondary exposure by oiled brooding adults; loss of ducklings, goslings, and other nonfledged birds due to direct exposure; and lethal or sublethal effects due to direct ingestion of condensate/oil or ingestion of contaminated foods (e.g., insect larvae, mollusks, other invertebrates, or fish).

Large or very large spills would be very unlikely but, if they occur, the impacts may be moderate, medium to long term and local to extensive, depending on the type and distribution of spilled material and the cleanup methods used. Though highly unlikely, a large to very large spill in the terrestrial habitat or nearshore habitats from a well blowout and aerial dispersal of the produced fluids could result in long-term, extensive and possibly major impact to the nesting, resting, molting, and/or feeding foraging habitats of some birds. Table 5.24-11 summarizes the potential impacts of spills on birds.

Table 5.24-11: Spill Impact Evaluation for Birds

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small or Small Spills (less than 100 gallons)	Negligible—minor	Temporary—medium term	Unlikely	Limited—local
Medium Spills (100 to 999.9 gallons)	Minor—moderate	Medium—long term	Possible	Local—extensive
Large or Very Large Spills (1,000 gallons or greater)	Moderate—catastrophic	Long term	Highly unlikely	Local—extensive

5.24.11.7 Terrestrial Mammals

Condensate or oil spills would have a limited impact on the terrestrial mammals found in the study area. The dominant terrestrial mammals are large herbivores (e.g., caribou and muskoxen), large predators (e.g., brown bear and fox) and several small species (e. g., arctic ground squirrels, lemmings, voles, and shrews). For the larger animals, the proportion of habitat impacted would be very small relative to the size of the habitat utilized. For example, the BP GC-2 crude spill of 212,252 gallons on March 2, 2006 only covered about 1.9 acres and that was not continuous heavy coverage (ADEC 2008b).

A large or very large spill, especially from a blowout, could affect terrestrial mammals across an area of several acres to tens of acres. They would tend to avoid spill-covered areas and thus lose a measurable (though small) proportion of total available forage habitat. The risk of direct contact with the spilled material and thus potential injury or death is greater than for small to medium spills. Most larger mammals could avoid the affected area. The loss of vegetation from oil, condensate or saltwater spills would be measurable but would not constitute a substantial portion of the available forage.

Caribou and muskoxen could become oiled by direct contact with coated vegetation or soil, or by ingesting contaminated vegetation from the areas impacted by the spilled material. Adult caribou and muskoxen that become oiled are not likely to suffer from a loss of thermal insulation during the summer, although toxic hydrocarbons could be absorbed through the skin or inhaled. Oiled caribou and muskoxen hair would be shed during the summer before the winter hair is grown. If caribou were oiled in the winter after shedding their summer coats, oiling would not be expected to substantially affect thermal insulation, because the outer guard hairs of caribou are hollow and thus retain their insulating properties even when coated with oil. Toxicity studies of crude-oil ingestion in cattle (Rowe et. al. 1973) suggest that weight loss and aspiration pneumonia leading to death are possible adverse effects for caribou and muskoxen exposed to unweathered oil and condensate.

A large spill would likely affect tundra vegetation, the principal food of the larger mammals. Caribou and muskoxen probably would not ingest impacted vegetation because they tend to be selective grazers and are particular about the plants they consume (Kuropat and Bryant 1980). For most spills, control and cleanup operations (ground traffic, air traffic, and personnel) at the spill site would frighten caribou and muskoxen away from the spill and reduce the possibility of these animals grazing on the impacted vegetation prior to cleanup. The spilled material could affect the vegetation and reduce its availability as food for several years, though this impact would be limited in area and would not affect the overall abundance of food for the grazing mammals.

Brown bears may forage along coastal streams, beaches, mudflats, and river mouths during the summer and fall for vegetation and carrion of varying types. If an oil or condensate spill were to contaminate beaches and tidal flats along the shore of Mikkelsen or Lion Bays, some brown bears could ingest contaminated food, such as oiled birds, seals, or other carrion (BLM 1998). Such ingestion could result in the loss of a few bears. For example, brown bears on the Shelikof Strait coast of Katmai National Park (an area contacted by the 1989 *Exxon Valdez* oil spill) were observed with oil on their fur and consuming oiled carcasses (Lewis and Sellers 1991). A study of the exposure of Katmai National Park brown bears to the *Exxon Valdez* oil spill through analysis of fecal samples indicated that some bears had consumed oil or were exposed to oil; one young bear that died had high concentrations of aromatic hydrocarbons in its bile and may have died from oil ingestion (Lewis and Sellers 1991).

Small mammals could be affected by spills due to oiling or ingestion of contaminated forage or prey items. These impacts would be localized around the spill area and would not have population level impacts.

A saltwater spill could kill plants on contact and increase soil salinity to the point that local vegetation could not survive (McKendrick 2000b). Unlike oil, salts are not biodegradable, and natural recovery occurs only after salts have leached from the soil. A saltwater spill would adversely affect halophytic vegetation near the spill, but the amount of tundra habitat affected would be small, usually no more than a few acres. Thus, potential saltwater spills are not likely to affect forage availability for caribou, muskoxen, or other terrestrial mammals in the project area.

A large or very large spill would be very unlikely but, if one occurred, the impacts would be moderate, medium to long term and local, depending on the type and distribution of spilled material and the cleanup methods used. Though highly unlikely, a large to very large spill in the terrestrial habitat from a well blowout and aerial spread of the produced fluids could result in long-term, extensive, and possibly major impact to the foraging habitat of some terrestrial mammals. Table 5.24-12 summarizes the potential impacts of spills on terrestrial mammals.

Table 5.24-12: Spill Impact Evaluation for Terrestrial Mammals

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small or Small Spills (less than 100 gallons)	Negligible	Temporary	Highly unlikely	Limited
Medium Spills (100 to 999.9 gallons)	Negligible	Temporary	Unlikely	Limited
Large or Very Large Spills (1,000 gallons or greater)	Negligible—moderate	Medium term	Highly unlikely	Local

5.24.11.8 Marine Mammals

Polar bears; bowhead, beluga, and gray whales; and spotted, ringed, and bearded seals regularly occur in marine or coastal habitats of the study area. Only polar bears and bearded and ringed seals are common inside the barrier islands (e.g., Lion Bay) and the seals primarily in the open water season. Very small to medium terrestrial spills would be unlikely to impact marine mammals. Polar bears are the only marine mammal that would potentially be affected by any spills to the tundra that do not reach a flowing stream. Large spills that directly or indirectly enter flowing water of the streams that discharge to Lion or Mikkelsen Bays could have limited impacts on some of the marine mammals, primarily the seals.

Negligible impacts would be anticipated for whales including bowhead whales, whose migration route typically is well offshore of the barrier islands and the immediately adjacent nearshore Beaufort Sea (see Section 3.11, Marine Mammals), and where low concentrations of oil from a large to very large spill from a barge or tug spill might occur during the open water season. Any spill reaching this marine environment would disperse to undetectable levels before it reaches migration routes and offshore habitats of whales.

Some seals could be exposed to condensate or oil if a spill were to reach the marine environment of Mikkelsen and Lion Bays or the areas they occupy in the adjacent nearshore Beaufort Sea during the open water season. Such an event could result in the oiling of those seals directly exposed. A condensate or oil spill could affect seals as follows:

- A seal could incidentally ingest condensate/oil or consume contaminated food (Geraci 1990, St. Aubin 1990, Bratton et al. 1993).
- Inhalation of toxic vapors released by fresh crude oil spills and other volatile distillates could irritate respiratory membranes, congest lungs, and cause pneumonia.

- Hydrocarbons absorbed in the blood stream might accumulate in the brain and liver and result in neurological disorders.
- Oil and condensate could coat the fur, possibly interfering with mobility, and oiling of the hair reduces its insulative properties (St. Aubin 1990, Lowry et al. 1994).

It would be possible, though unlikely, that a small number of exposed seals could die from ingestion or inhalation toxicity, but the population would experience a minor and temporary impact at most.

Anecdotal accounts of polar bears deliberately ingesting hydraulic and motor oil, antifreeze, and foreign objects from human garbage sites, suggest that they are vulnerable to ingesting oil directly, especially from oiled carrion and other contaminated food sources (Derocher and Stirling 1991, Amstrup et al. 1989). Oiled bears could suffer skin damage and temporary hair loss, with adverse effects on thermal insulation (Derocher and Stirling 1991). Polar bears would be most vulnerable to an oil spill if the spill were to reach the coastal habitats of Mikkelsen or Lion Bays. Spills to the tundra along the coast would have the most potential to affect polar bears in the fall when polar bears tend to come on shore (Schliebe et al. 2006a). The number of bears likely to be contaminated directly or indirectly through ingestion or contact with oiled seals probably would be small. However, polar bears may be attracted to oiled seals or other affected prey species (Schliebe et al. 2006a). Spills of produced fluids and oil that reaches the coastal denning areas for polar bears would likely cause them to leave the dens or not occupy the area in the first place, and this may have a local impact on the population.

A large or very large spill would be very unlikely but, if one occurred, the impacts would be minor to major, medium term, and local, depending on the type and spatial distribution of spilled material, season of the spill, and the cleanup methods used. Though highly unlikely, a large to very large spill in the nearshore habitats from a well blowout and aerial dispersal of the produced fluids could result in minor, temporary, and local impact to the denning or foraging habitats of some polar bears. In the case of polar bears, the response actions may cause them to leave the areas of most activity; however, the bears may also be attracted to the activity if they are hungry and view the response personnel as potential prey. Also, denning or recently emerged females may aggressively defend their den and/or cubs if response personnel approach the dens. Table 5.24-13 summarizes the potential impacts of spills on marine mammals.

Table 5.24-13: Spill Impact Evaluation for Marine Mammals

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small or Small Spills (less than 100 gallons)	Negligible	Temporary	Highly unlikely	Limited
Medium Spills (100 to 999.9 gallons)	Negligible	Temporary	Unlikely	Limited—local
Large or Very Large Spills (1,000 gallons or greater)	Minor—major	Temporary—medium term	Highly unlikely	Local

5.24.11.9 Fish and Invertebrates

Freshwater Fish

Spills could affect freshwater and diadromous fish while they are in freshwater (hereafter called freshwater fish in this section), if the spilled material reaches fish habitats either directly or from flowing over the tundra. However, the vast majority of all spills would be confined to a pad, road, or airstrip, to an adjacent area, or to the tundra area under a pipeline. Most spills would be very small to medium in volume (i.e., less than 1,000 gallons). Finally, spill response would remove almost all of most spills from frozen tundra or ice-covered water bodies prior to snowmelt for two-thirds of the year. During one-third of the year (late May through late September), spills could reach and affect tundra ponds and lakes, as well as streams and rivers, before spill response could be initiated or completed. Most oil or condensate spills would not be expected to have a measurable effect on arctic fish populations in the study area over the life of the project. Spills occurring in a small body of water containing fish with restricted water exchange could kill a small number of individual fish, but would not be expected to have a measurable effect on arctic fish populations.

The effects of oil spills on freshwater fish have been discussed in previous Beaufort Sea EISs and in numerous previous spill reports (Vandermulen et al. 1992; API 1992a,b, and 1997; Taylor and Stubblefield 1997; Corps 1999; BLM 2002), which are incorporated here by reference. Oil spills have been observed to have a range of effects on North Slope fish (Malins 1977, Hamilton et al. 1979, Starr et al. 1981). The specific effect depends on the concentration of petroleum present, the length of exposure, and the stage of fish development involved (i.e., larvae and juveniles are generally most sensitive). Mortality caused by a petroleum-related spill is seldom observed except in small, enclosed water bodies and in the laboratory environment. This is because contaminant concentrations in the water column generally remain low, even with a large spill. The concentrations in flowing rivers and streams of the project area also would be relatively low, even for medium to large oil spills.

However, if a spill of sufficient size were to occur in a small body of water with restricted water exchange (e.g., tundra ponds, small slow-flowing streams), lethal and sublethal effects could occur for fish and food resources in that water body. Toxic concentrations of condensate or oil in a confined area would have greater lethal impacts on larval fish, which are generally more sensitive than adults (Hose et al. 1996, Heintz et al. 1999). Sublethal effects include changes in overwintering and spawning behavior, reduction in food resources, consumption of contaminated prey, and temporary displacement. If a large to very large spill reached a slow-flowing, small to moderately-sized creek in summer, the impacts due to toxic exposures may be greater than in the same creek during breakup when flows are higher and water temperatures are cooler. Long-term toxicity (up to a decade) can result from a small spill, as shown in the NPR-A experimental pond spill (Miller et al. 1978, Barsdate et al. 1980, Hobbie 1982). Spilled oil can remain trapped in the sediments and/or aquatic vegetation resulting in localized long-term, low-level toxicity. Spills into the larger streams of the project area (see Table 3.3-3), especially during early open water periods, might have limited toxicity impacts because of the large and rapid dilution of the oil relative to the flow volumes. In the smaller streams, the lower relative volume and water flow rate could result in direct toxicity impacts in the water column and sediments.

Lethal effects to fish in streams and some lakes would be unlikely during high water events (such as breakup) because toxic concentrations of oil are unlikely to be reached. However, toxic levels may be reached in lakes that are normally not connected to the river/stream system except during the spring and maybe fall high-water periods. Fish may be transported to these lakes and become “landlocked” until the next high-water event. If the oil concentrations in the water column reach toxic levels, these fish could suffer mortalities or injury.

The effects of produced fluid spills containing substantial amounts of saltwater on freshwater fish populations would depend on the specific location, size, and timing of the spill. No effect would be expected during the winter period when ice would serve as a barrier. During the spring and summer, impacts from large quantities of saltwater entering a fish-bearing freshwater environment would range from no effect to lethal effects, depending on the specific water body involved, the size and concentration of the saltwater spill into that water body, and the rate of freshwater exchange within that water body. Migratory fish would be less likely to be affected by saltwater spills because of higher tolerance to saltwater and the likelihood that most would have already left the freshwater environment by spring in their migration to sea. In larger freshwater bodies, saltwater spills are expected to have from no effect to sublethal effects on freshwater fish because the saltwater would be rapidly diluted to ambient TDS concentrations. In small water bodies with restricted water exchange, lethal effects could result from a medium to large saltwater spill. Because of the small size of most of the saltwater spills anticipated, and the low diversity and abundance of freshwater fish in most of the study area freshwater bodies, saltwater spills are not expected to have a measurable effect on arctic fish populations in the project area over the production life of the field.

Large or very large spills would be very unlikely but, if they occur, the impacts may be minor to moderate, medium term and local, depending on the type and spatial distribution of spilled material, season of the spill, and the cleanup methods used. Though highly unlikely, a large to very large spill from a well blowout and aerial dispersal of the produced fluids could result in minor, temporary, and local impact to the nearby freshwater habitats and fish residing in them. Table 5.24-14 summarizes the potential impacts of spills on diadromous fish.

Table 5.24-14: Spill Impact Evaluation for Freshwater and Diadromous Fish

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small or Small Spills (less than 100 gallons)	Negligible	Temporary	Highly unlikely	Local
Medium Spills (100 to 999.9 gallons)	Negligible—minor	Temporary - Medium term	Highly unlikely—possible	Local
Large or Very Large Spills (1,000 gallons or greater)	Minor—moderate	Medium term	Highly unlikely	Local

Marine Fish

Spills could affect marine and diadromous fish while they are in marine and nearshore waters of Lion and Mikkelsen Bays or the nearshore Beaufort Sea. However, the vast majority of all spills would be confined to a pad, road, or airstrip, to an adjacent area, or to the tundra area under a pipeline. Most spills would be very small to medium in size and would be rapidly dispersed on the water surface or stranded on the shore zone due to the winds and currents of the area. Finally, spill response would remove most of the spilled material from the surface waters during the ice-free third of the year when marine spills are likely to occur.

Large spills from tug or barge accidents (Alternatives B and E) could occur in the shallow marine waters of Mikkelsen or Lion Bays at initial concentrations that could affect marine fish or their prey. A large or very large spill from one of the three pads or from a pipeline could reach the marine environment via the streams but probably would be diluted by the time the spill reached the much larger volume of marine water in Mikkelsen or Lion Bays.

Large or very large spills would be very unlikely but, if they were to occur, the impacts would likely be limited, depending on the type and spatial distribution of spilled material, season of the spill, and the cleanup methods used. Though highly unlikely, a large to very large spill from a well blowout and aerial dispersal of the produced fluids prior to voluntary ignition could result in minor, temporary, and local impact to the nearby marine habitats and fish residing in them. Table 5.24-15 summarizes the potential impacts of spills on marine fish. Also, marine fish do not usually suffer mortality as a result of oil spills unless they are trapped in bays or similar areas. Arctic cod, a keystone species in the region's food webs, move inshore to spawn during the winter (Morrow 1980). However, spills would be unlikely to reach marine waters during the winter due to the presence of sea ice. Further, due to the presence of bottom-fast ice to a depth of about 7 feet, the fish would not be able to access the nearshore areas in the vicinity of the pads. The benthic organisms could be exposed and some could die from the toxic effects of condensate or oil in the water or in the sediments. However the marine/estuarine benthic community is very species-poor and low in productivity, standing crop, and abundance in water depths less than about 6 to 8 feet due to the presence of landfast ice most of the year. The impacts from even a very large spill to marine water quality and thus to the marine benthic community would likely be limited.

Table 5.24-15: Spill Impact Evaluation for Marine Fish

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small or Small Spills (less than 100 gallons)	Negligible	Temporary	Highly unlikely	Limited—local
Medium Spills (100 to 999.9 gallons)	Negligible—minor	Temporary—medium term	Highly unlikely—unlikely	Limited—local
Large or Very Large Spills (1,000 gallons or greater)	Minor—moderate	Medium term	Highly unlikely	Local

Invertebrates

Benthic invertebrates in the marine, estuarine, and freshwater habitats may be a substantial part of the food web supporting fish, birds, and ultimately some marine mammals. Spills of produced fluids, oil, condensate, and saltwater (in freshwater habitats), may be acutely or chronically toxic and/or may coat the invertebrates to hinder their movements.

Most spills would be very small to medium in volume and the hydrocarbons would float on the water surface. The removal of the condensate or oil in the cleanup operations would further reduce the potential impacts, especially in the tundra ponds and lakes.

Large and very large spills could also cover large areas of wetlands, wet tundra, pond, and lake water surface and affect DO levels, resulting in adverse impacts to the invertebrates. Also, the condensate or oil may become spread throughout the water column and/or entrained into the bottom sediments by wave and current action, potentially causing acute or, more likely, a low level of chronic toxicity.

Large or very large spills would be very unlikely but, if they occur, the impacts may be minor to moderate, temporary to medium term, and local to extensive, depending on the type and spatial distribution of spilled material, season of the spill, extent to which the spilled material mixed into the benthic substrata, proportion of the habitat affected in any particular area, and the cleanup methods used. Though highly unlikely, a large to very large spill from a well blowout and aerial dispersal of the produced fluids could result in minor, temporary to medium term, and local to extensive impact to the nearby marine or freshwater habitats and macroinvertebrates residing in them. Table 5.24-16 summarizes the potential impacts of spills on invertebrates.

Table 5.24-16: Spill Impact Evaluation for Invertebrates

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small or Small Spills (less than 100 gallons)	Negligible	Temporary	Highly unlikely—unlikely	Limited
Medium Spills (100 to 999.9 gallons)	Negligible	Temporary	Unlikely—possible	Limited—local
Large or Very Large Spills (1,000 gallons or greater)	Minor—moderate	Temporary— medium term	Highly unlikely	Local—extensive

5.24.11.10 Land Ownership, Use, and Management

Most of the land use impacts of a spill would be associated with the subsistence and recreational uses of these lands. These impacts are addressed in Sections 5.24.11.14 and 5.24.11.18.

5.24.11.11 Arctic National Wildlife Refuge

Most spills would not have the potential to affect the Arctic Refuge. The exception would be large to very large spills that reach the marine environment and spread to the coastline of the Arctic Refuge. Such spills would be very unlikely but if they did occur, the resources of the Arctic Refuge most likely to be impacted include water quality; wetlands; marine mammals, fish, and invertebrates; recreation; visual aesthetics; cultural resources; subsistence; and human health. The individual assessments of impacts to these resources for a large or very large spill as presented in this section would apply to the Arctic Refuge.

5.24.11.12 Socioeconomics

Very small to medium spills on Point Thomson infrastructure would not affect the local economy. Large to very large condensate or oil spills and spill containment and cleanup could affect the socioeconomic systems of local communities.

Limited employment could be generated from cleanup of very small to medium spills on infrastructure or pipeline corridors. Even large spills might not generate many additional local jobs depending on where the spill occurs and what types of skills are required for the response operations. However, Alaska Clean Seas does include local natives as potential response contractors where the spill response requires more than a Tier 1 response. Onsite workers ordinarily assigned to other operations and other response personnel from the North Slope, as well as other locations in Alaska, would clean up most small to medium spills. A large or very large spill that enters flowing water, especially where the condensate/oil strands along a substantial stretch of shoreline or stream bank, would likely require the temporary employment of local village response teams and additional labor to clean up the oil.

Spill response and cleanup employment could disrupt, but would be unlikely to displace, subsistence-harvest activities for at least an entire season and could also disrupt some sociocultural systems. Cleanup would be unlikely to add population to the communities because administrators and workers would live in separate camps but it could abruptly introduce stressors, including inflation and displacement of Native residents from their normal subsistence-harvest activities and village service jobs if they are employed as spill workers. Large or very large spills would be very unlikely but, if they occur, the impacts may range from minor to major, medium to possibly long term, and local to extensive, depending on the type and spatial distribution of spilled material, season of the spill, and the cleanup methods used. Though very unlikely, a large to very large spill such as from a well blowout and spread of the produced fluids could result in minor to major, temporary to long term, and local impacts to the socioeconomics of the area. Table 5.24-17 summarizes the potential impacts of spills on socioeconomics.

Table 5.24-17: Spill Impact Evaluation for Socioeconomics

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small to Medium Spills (less than 999.9 gallons)	Negligible	Temporary	Highly unlikely—unlikely	Limited
Large or Very Large Spills (1,000 gallons or greater)	Minor—moderate	Medium—long term	Highly unlikely	Local—extensive

5.24.11.13 Transportation

A large to very large spill that occurs near a road, on a pad, or in the nearshore areas may have a limited impact to the vehicle or (under Alternatives B and E) barge transportation modes for project personnel. These spills, if they occur in or reach the marine environment in the open water season, may have a minor to moderate, temporary to medium-term, and local to extensive impact of marine traffic of the limited number of subsistence users and recreationists utilizing the protected areas of Lion and Mikkelsen Bays. Table 5.24-18 summarizes the potential impacts of spills on transportation.

Table 5.24-18: Spill Impact Evaluation for Transportation

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small or Small Spills (less than 100 gallons)	Negligible	Temporary	Highly unlikely	Limited
Medium Spills (100 to 999.9 gallons)	Negligible	Temporary	Unlikely	Limited - local
Large or Very Large Spills (1,000 gallons or greater)	Minor—moderate	Temporary—medium term	Highly unlikely	Local—extensive

5.24.11.14 Recreation

Fishing, hunting, kayaking, ocean boating, camping, recreational flying, backpacking, wildlife viewing, and other recreation pursuits could be affected as a result of a spill in an environment that is used by recreationists. The number of users is small (see Section 3.18) and includes some NSB local residents. A large to very large spill may reach recreation-use areas, most of which are not in the project area. The subsequent response and cleanup activities may be visible and thus could have an impact on recreation activities in the area. An obvious short-term effect would be condensate/oil residues in areas of use. Long-term effects would possibly be the reduction or loss of scenic value of the area, as residue could take a 1 to several years to weather to the point it would not be detectable.

A spill of saltwater and other miscible or soluble materials could have less short-term impact on recreational uses because it could be less visible. However, it could affect fish, birds, and, over a longer term, the vegetation, which could somewhat diminish the recreational value and use of these resources.

Very small to medium spills would not likely have detectable effects to recreational users or uses. Large or very large spills would be very unlikely but, if they occur, the impacts may be minor to moderate, medium and possibly long term, and local to extensive, depending on the type and spatial distribution of spilled material, season of the spill, and the cleanup methods used. Though highly unlikely, a large to very large spill such as from a well blowout, and spread of the produced fluids could result in minor to moderate, temporary to medium-term, and local to extensive impact to the recreation uses of the area. Table 5.24-19 summarizes the potential impacts of spills on recreation.

Table 5.24-19: Spill Impact Evaluation for Recreation

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small or Small Spills (less than 100 gallons)	Negligible	Temporary	Highly unlikely	Limited
Medium Spills (100 to 999.9 gallons)	Negligible—minor	Temporary—medium term	Unlikely	Limited - local
Large or Very Large Spills (1,000 gallons or greater)	Minor—moderate	Medium—long term	Highly unlikely	Local—extensive

5.24.11.15 Visual Aesthetics

A spill would not present more than a negligible visual impact for very small to medium spills. There would be negligible to minor, temporary, and limited impacts from large to very large spills except if there were a blowout or similar event that results in a plume of condensate or oil sprayed into the air or large amounts of material are spread on the water or tundra surface or stranded along the shoreline. In these cases, the visual impacts may be moderate, medium to long term, and local to extensive. Table 5.24-20 summarizes the potential impacts of spills on visual resources.

Table 5.24-20: Spill Impact Evaluation for Visual Aesthetics

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small to Medium Spills (less than 999.9 gallons)	Negligible—minor	Temporary	Highly unlikely—unlikely	Limited
Large or Very Large Spills (1,000 gallons or greater)	Minor—moderate	Medium—long term	Highly unlikely	Local—extensive

5.24.11.16 Noise

Very small to medium spills are unlikely to result in more than a negligible and temporary noise impact at most. A large to very large spill may result in a minor and temporary noise increase especially in a truck or equipment accident, or a well blowout. However, cleanup activities typically involve large amounts of equipment and numerous people, all of which may result in noise in the area of response operations. The noise impacts are likely to be negligible to minor, limited to the spill area, and temporary (for the duration of the response activity). Table 5.24-21 summarizes the potential impacts of spills on noise.

Table 5.24-21: Spill Impact Evaluation for Noise				
Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small to Medium Spills (less than 999.9 gallons)	Negligible	Temporary	Unlikely—possible	Limited
Large or Very Large Spills (1,000 gallons or greater)	Negligible—minor	Temporary—medium term	Highly unlikely	Limited—local

5.24.11.17 Cultural Resources

With the exception of Alternative C, which has one cultural resource site within the project footprint, the locations of known cultural resources would be avoided by the project facilities and activities thereby minimizing the likelihood of the spilled material and/or the response activities directly impacting the resources. Very small to medium and even most large spills are unlikely to reach areas well outside the footprints of project structures and infrastructure, and thus are highly unlikely to have impacts to paleontological resources.

In the construction stage, most spills would occur on an ice pad or ice road during winter conditions, where snow and ice would limit impacts to cultural resources and cleanup would be less invasive than in a summertime terrestrial spill. Cleanup from spills associated with drilling and production could be more invasive because of the nonfrozen surface environment.

Most of the documented cultural resource sites in the project area are located along the coast, therefore a large or very large spill (which would be very unlikely to occur) impacting the coast would have the most potential to affect cultural resources. Should such a spill occur, studies of impacts to cultural resources from the *Exxon Valdez* oil spill estimated that less than 3 percent of sites within the spill area suffered negative effects (Mobley et al. 1990, MMS 2002). Thus, the potential for adverse effects from possible spill contamination would remain low. Cultural resources could be damaged or disturbed during cleanup activities, similar to the *Exxon Valdez* spill. Specifically, direct effects noted from the *Exxon Valdez* Oil Spill were relocation of artifacts and features by cleaning operations, increased access leading to trampling and rarely vandalism and theft of artifacts, and chemical contamination of organic materials by volatile hydrocarbon fractions which could increase the apparent age of radiocarbon dates in permeable materials (Mobley et al. 1990, Bittner 1996).

Table 5.24-22 summarizes the potential impacts of spills on cultural resources.

Table 5.24-22: Spill Impact Evaluation for Cultural Resources				
Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small or Small Spills (less than 100 gallons)	Negligible	Temporary	Highly unlikely	Limited
Medium Spills (100 to 999.9 gallons)	Negligible—minor	Temporary—medium term	Highly unlikely	Limited—local
Large or Very Large Spills (1,000 gallons or greater)	Minor—moderate	Medium—long term	Highly unlikely	Local

5.24.11.18 Subsistence and Traditional Land-Use Patterns

Impacts to subsistence resources (e.g., caribou, birds, fish, bowhead whales, and seals), which were described above, would affect subsistence harvest. As previously mentioned, due to the small size and easy containment of most spills, there is usually minimal impact to tundra ponds, lakes, or small streams so these spills and their associated cleanup are not likely to affect subsistence resources or subsistence harvests and the potentially impacted areas would constitute a small proportion of the North Slope habitat utilized by the subsistence species and the subsistence users.

Large and very large spills, particularly those in remote sections of the pipelines or in the larger streams, could affect a limited proportion of the habitat for subsistence species such as caribou or waterfowl, or a proportion of the subsistence resource population itself. The direct and indirect ecological and physiological impacts to the resources may extend beyond the immediate area of the spill and could last up to 1 or 2 years after the spill because most of the subsistence species are mobile and move over areas much larger than a typical large spill (e.g., the BP spill of 212,252 gallons covered less than 2 acres of habitat).

A large or very large spill could result in a major response and cleanup effort, especially for a spill that is not easily accessible by ice or gravel structures. The response could include the presence of hundreds of humans, boats, and aircraft that would displace subsistence species and alter or reduce access to these species by subsistence hunters. This impact would last as long as the major response activity continues, probably no longer than two seasons and generally less than one.

For large spills, especially of oil or hazardous substances, most of the mobile subsistence resources may move to adjacent unaffected areas. Some of the subsistence users may follow the resources and other users may not utilize the resources because of concerns about contamination of the resources.

From a technical perspective, the resources may meet all government regulations protective of human health regarding safety for ingestion or dermal contact in a relatively short time after the spill has been cleaned up. These standards are typically based on physiological and toxicological (e.g., cancer health risk) criteria and not on cultural perceptions.

Traditional knowledge criteria and the perception of contamination contribute to the decision by subsistence users to harvest a resource. After harvest, traditional knowledge-based criteria are used to determine the fitness of the harvested resource for consumption and the appropriate or safest method for preparation, consumption, distribution, and storage. In the case of contamination that shows no outward symptom or sign, the perception of contamination is the basis for a behavioral response by subsistence users (Usher et al. 1995). This does not reflect a lack of sophistication on the part of subsistence hunters but rather a lack of the scientific tools and strategies (for example field test kits) for addressing a novel risk. Where the contamination event is undeniably evident, as in the *Exxon Valdez* oil spill, behavioral responses by subsistence users may be dictated by a number of other factors, such as resource availability, resource health, financial resources, and regulatory constraints (Fall and Utermohle 1999, Fall et al. 2001).

For all resources, the perception of contamination in the absence of testing (e.g., abscesses, pus spots, discoloration, anatomical deformity, and taste) or the tested presence of contaminants at levels deemed acceptable by the government may discourage resource users from harvesting and consuming the resource for multiple harvest seasons. If harvesters perceive the resource habitat or traditional harvest location to be contaminated, they may go farther from the community or traditional harvest location to harvest uncontaminated resources (Fall and Utermohle 1999). Possible results of this change may be shifts in species emphasis, the need to purchase some formerly-subsistence foods to reinforce perceptions of safety, and the need to expend more time, effort, and money pursuing resources at more distant locations with greater associated accident risks for some forms of travel (Fall and Utermohle 1999, Fall et al. 2001).

Large or very large spills would be very unlikely but, if they occur, the impacts may be minor to moderate, medium and possibly long term, and local to extensive, depending on the type and spatial distribution of spilled material, season of the spill, and the cleanup methods used. Though highly unlikely, a large to very large spill from a well blowout and aerial dispersal of the produced fluids could result in minor to moderate, temporary to medium-term, and local to extensive impact to the subsistence uses of the area. Table 5.24-23 summarizes the potential impacts of spills on subsistence harvest and uses.

Table 5.24-23: Spill Impact Evaluation for Subsistence Harvest and Uses

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small or Small Spills (less than 100 gallons)	Negligible	Temporary	Highly unlikely	Limited
Medium Spills (100 to 999.9 gallons)	Negligible—minor	Temporary	Unlikely—possible	Limited
Large or Very Large Spills (1,000 gallons or greater)	Minor— moderate	Medium—long term	Highly unlikely	Local—extensive

5.24.11.19 Human Health

People who are not employed or associated directly with the project are unlikely to be affected by very small to medium spills. For large to very large spills with extensive distribution, especially in subsistence use and recreation areas, there is a possibility of exposure to fumes, direct contact with contaminants, and/or indirect contact through ingestion of resources that have been affected by the spill. However, the ODPCP, SPCC, and FRP procedures (plus other actions by the agencies and the Applicant and/or its response contractors) would prevent or restrict access to the spill areas if they present a human health risk.

Overall, the impacts to the human health from very small to medium spills would be negligible, temporary, and limited in geographic extent. Large or very large spills are very unlikely but, if they occur, the impacts would be minor, medium term, and local to extensive, depending on the type and spatial distribution of spilled material, season of the spill, and the cleanup methods used. Though highly unlikely, a large to very large spill from a well blowout and aerial dispersal of the produced fluids could result in minor to moderate, temporary to medium-term, and local to extensive impact to human health in the area. Table 5.24-24 summarizes the potential impacts of spills on human health.

Table 5.24-24: Spill Impact Evaluation for Human Health

Spill Size	Magnitude	Duration	Potential to Occur	Geographic Extent
Very Small to Medium spills (less than 999.9 gallons)	Negligible	Temporary	Unlikely	Limited
Large or Very Large Spills (1,000 gallons or greater)	Negligible—moderate	Temporary—medium term	Highly unlikely	Limited—local

5.24.12 Mitigative Measures

This section describes measures to mitigate potential impacts related to waste management and spills. The Applicant has proposed design measures that would be included as part of the project; BMPs and permit requirements would be stipulated by federal, state, and local agencies, and the Corps has considered additional mitigation measures.

5.24.12.1 Applicant's Proposed Design Measures

The Applicant has included the following design measures as part of the project design to avoid or minimize impacts of project-related waste, and to prevent and respond to spills.

Waste Management

- Recycling/reusing drilling mud to the extent practicable, and spent drilling muds and cuttings will be injected into an onsite or offsite disposal well. Tanks or lined pits will be used for temporary storage of drilling muds and cuttings.
- Segregating and storing wastes using appropriate containers, including dumpsters, hoppers, bins, etc. for food waste, burnable (nonfood) waste, construction debris, oily waste, and scrap metal.
- Segregating and securing hazardous waste in a hazardous waste Central Accumulation Area. Satellite Accumulation Areas will be provided, as needed.
- Incinerating camp waste (including food waste).
- Identifying recyclable materials and associated proper handling and storage methods.
- Recyclable Accumulation Areas will be provided, as needed.
- Providing storage hoppers and bins for contaminated snow.
- Providing domestic wastewater treatment system(s).
- Providing Class I non-hazardous disposal well for approved liquid waste disposal.

Spill Prevention and Response

Spill Prevention and Response Plans: The Applicant has developed comprehensive prevention and response plans, including an ODPCP, Spill SPCC Plans, and FRPs. These plans provide the overall framework for prevention and response measures; they will be maintained and updated to reflect the evolving nature of the Project operations. Key requirements under the plans include:

- All facilities and pipelines will be designed to ensure safe containment of all hydrocarbons.
- North Slope-based Project workers will attend the Project-specific "Arctic Pass" training program and the North Slope Training Cooperative "Unescorted Course," covering environmental excellence (among other topics) to ensure best practices of spill prevention. Contractors may also attend additional training provided by their respective employers.
- Special prevention programs will be developed where a need is identified. Examples include:
    - A special Barging Spill Management Program: An element of this program is that every team member is considered to be a "spill champion." As such, each individual is expected to be a steward of the environment, looking out for leaks on equipment, or for any other environmental hazards present during work activities.
    - A targeted Ice Road Spill Management Program: This includes a "Drips and Drops" Program to identify the causes/sources of small drips and drops, and learn from these observations to both reduce their number and avoid potentially larger spills. This program also includes strict vehicle maintenance and inspection requirements, and limiting the use of older vehicles. Construction equipment is inspected to help identify/prevent leaks or other mechanical defects of vehicles prior to leaving Deadhorse or Point Thomson.

<u>Trained Response Teams:</u> To implement effective response plans, it will be necessary to have sufficient numbers of properly trained personnel. Personnel are trained in the ICS, Hazardous Waste Operations and Emergency Response, and other specialties as needed by position. The response drills and exercises to maintain readiness will include federal, state, and NSB personnel. There are currently estimated to be about 600 trained responders available within 24 to 48 hours, as summarized below (these numbers will vary over time):

- Point Thomson Spill Response Team (SRT); approximately 10 people who are part of the onsite workforce.
- An Anchorage-based Incident Management Team (IMT); approximately 60 people who are prepared to respond to any spill event.
- The Applicant's North American Regional Response Team is comprised of about 130 personnel. Approximately 45 personnel can be mobilized to Alaska in less than 24 hours in the event of a major spill response effort, as needed.
- The Applicant retains Alaska Clean Seas as its Oil Spill Removal Organization (OSRO). Alaska Clean Seas owns response equipment totaling over $50 million and has about 80 employees, all of whom are available to assist in an oil spill response at Point Thomson.
- The North Slope Operators North Slope Spill Response Team (NSSRT) mutual aid program maintains over 115 volunteers on the North Slope who are trained and qualified to assist in spill response.
- Through Alaska Clean Seas, the Applicant has access to over 250 qualified spill responders through contracts with the Auxiliary Contract Response Team.
- Alaska Clean Seas Village Response Teams currently have over 15 qualified spill responders, and are continually recruiting new members.

<u>Pipeline Design</u>: The Point Thomson pipelines (PTEP and in-field gathering lines) will be based on state-of-the art Arctic designs, specifically tailored for the Project. Prevention and leak detection measures common to both pipeline systems will include:

- Pigging facilities to allow running in-line inspection, maintenance, and cleaning tools:
    - The in-line inspection tools (smart pigs) will be used to monitor both internal and external corrosion.
    - The maintenance and cleaning pigs will remove sediment from the lines, thereby reducing the potential for corrosion.
- Internal corrosion will also be monitored through the use of corrosion coupons and Electrical Resistance (ER) probes that provide a measure of corrosion rate and activity. The ability to inject a corrosion inhibitor will be provided.
- A wall thickness to withstand damage from incidental bullet strikes from coastal subsistence hunters. Additional wall thickness will be added, where necessary, to meet this criterion.
- External corrosion prevention through use of shop-installed polyurethane foam insulation covered with a roll-formed, interlocked, and galvanized metal jacket. This insulation jacket system has a proven North Slope track record of preventing moisture ingress, which can lead to external corrosion. The pipeline will be shop fusion bonded epoxy (FBE) coated and field joints will be coated with field applied coating, insulation, sealing, and jacketing to coincide with best available North Slope practices.
- Pipeline hydrostatic testing to verify pipeline integrity in accordance with 49 CFR 195 (PTEP) and American Society of Mechanical Engineers B31.8 (gathering lines).

- Visual inspections of the pipelines will typically be conducted weekly during operations via aerial surveillance, unless precluded by safety or weather conditions.
- Spill prevention measures unique to the PTEP include:
    - Isolation valves at pipeline inlet at the Central Pad and at pipeline outlet at Badami to allow rapid shut-in in the event of a leak or rupture.
    - Use of vertical loops at the East Badami Creek to limit the amount of liquid hydrocarbon that could be spilled in the event of a pipeline leak or rupture. The vertical loops eliminate the need for valve pads on either side of the creeks, thus minimizing gravel placement and possible leak source (valve).
    - An additional wall-thickness for corrosion allowance.
    - Internal corrosion of the PTEP will be controlled by dehydration of the liquid hydrocarbon product and injection of corrosion inhibitors, when needed.
    - The use of two half-shell, pre-form weld pack field joints with small channel for water draining to minimize corrosion under insulation.
    - Two independent leak detection systems will be installed. The primary system will meet ADEC's requirement to detect a leak as small as 1 percent of the daily flow rate. This system will use meters on the inlet and outlet of the PTEP, with a state-of-the-art computational system that will perform real-time monitoring for pipeline leaks and will be continually updated via a SCADA system. An Applicant's proprietary leak detection system using different technology will provide another level of protection.
- Spill prevention measures unique to the infield gathering lines will include:
    - Use of corrosion resistant alloy (CRA) materials to reduce the potential for internal corrosion.
    - Design to contain full shut-in pressure of the wells, avoiding the need for pressure relief devices and vent systems to prevent over pressure and associated release to the environment.

<u>General Design, Construction and Operations Measures</u>:

- Well pad locations were chosen to allow development of offshore portions of the reservoir from onshore pads, thereby avoiding placement of drilling structures in marine waters. Small spills that might otherwise escape the pads and enter marine waters will be contained on the onshore pads or adjacent land.
- Formal Hazard and Operability for Process Hazard Analyses (HAZOPs), risk assessment, facility site reviews, design readiness review, independent project review, and constructability reviews will be used to identify potential spill risks and associated prevention or response measures.
- Storage tanks for oil and hazardous substances will be located within impermeable secondary containment areas. These storage tanks will not be stored within 100 feet of water bodies, unless otherwise approved by the appropriate regulatory agencies.
- Spill response equipment and materials will be readily available at designated locations throughout the facility.
- Hazardous waste storage will also be located within impermeable secondary containment areas.
- Fuel transfers will follow Best Management Practices, including using secondary containment devices. Refueling and transfer sites will be located away from the shoreline and river crossings and outside active floodplains.

Drilling-specific Prevention and Response Measures: Drilling operations at Point Thomson are unique to the North Slope and many special spill prevention and response measures are used. While some drilling mitigation measures are regulatory conditions (e.g., limiting drilling into hydrocarbon zones during certain seasons of the year or AOGCC drilling-related regulations), most of the following are based on the Applicant's drilling experience and practices. Measures implemented during drilling have included, and will continue to include as appropriate, the following:

- Training: Drilling personnel will complete key training programs to understand procedures for safely maintaining control of the wells. This will include training in blowout prevention technology, well control, and Training to Reduce Unexpected Events (TRUE). TRUE involves a multifunctional team made up of the rig contractor, service company, and operator personnel prior to commencing operations, and focuses on increasing knowledge and awareness to prevent and deal with potential hazards at Point Thomson. The training is based specifically on Point Thomson wells, and its goal is to provide site-specific solutions to potential problems before they occur. Potential hazards are defined by the team, including well control and lost returns. Action plans are developed to identify roles and responsibilities, warning signs, how to react to an event, and lines of communication. Special emphasis is placed on abnormal pressure detection and well control.
- Well Planning: The comprehensive well planning process for the Point Thomson PTU-15 and PTU-16 wells was the first step in preventing spills or releases and ensuring the safe drilling of the wells. This planning process will be applied to the drilling of future Point Thomson wells, and includes:
    - During well planning, the Applicant uses an Integrated Pore Pressure Prediction (IP3) Team consisting of reservoir engineers, geologists, drilling engineers, and computer modelers. The IP3 Team analyzes seismic data, data from exploration wells, and geologic models to predict pore pressure and fracture gradients, and to develop a detailed understanding of the reservoir. The use of advanced technology enables accurate prediction of formation behavior as wells are drilled, and allows the engineer to plan a well that minimizes the risk of a well control incident. In addition, bottom-hole pressure data from other wells in the area and seismic data are reviewed to ascertain the expected bottom-hole pressure at the proposed well location.
    - The bottom-hole pressure predictions are used to design a drilling mud program with sufficient hydrostatic head (determined by the mud density or "weight" and height of the mud column) to overbalance the formation pressures from surface to total well depth. Other factors influencing the mud weight design are shale conditions, fractures, lost circulation zones, under-pressured formations, and stuck-pipe prevention. The well casing program is designed to allow for containment and circulation of formation fluid influx out of the wellbore without fracturing open formations.
- Drilling Rig and Well Control/Blowout Prevention Equipment: More and higher pressure-rated blowout prevention equipment (BOPE) than other North Slope drilling will be used for Point Thomson. During drilling operations below the surface-hole, the Point Thomson BOPE will consist of:
    - A minimum of four, 13 5/8-inch, 10,000 pounds per square inch (psi) working pressure, ram-type preventers.
    - One 13 5/8-inch annular preventer (rated to 10,000 psi).
    - Choke and kill lines that provide circulating paths from/to the choke manifold.
    - A two-choke manifold that allows for safe circulation of well influx out of the wellbore.

    - A hydraulic control system with accumulator backup closing capability.
    - The addition of a fifth blowout preventer (BOP) was incorporated into the BOP stack arrangement to manage the risk at Point Thomson. (Most North Slope drilling operations use four BOPs – three ram-type and one annular type). A BOP stack with four sets of rams and one annular preventer will be used to drill below surface casing, providing one more preventer than required by AOGCC regulations. This arrangement allows two preventers to close on the casing and liners and, in the case of liners, permits two ram-type and one annular preventer to be used on the drill-pipe running-string without having to stop and change out rams. The extra ram preventer will also provide added redundancy.
    - Prior to acceptance of the drilling rig, comprehensive inspection and testing will be performed on the BOPE, including:
        - Test BOPE to the full rated working pressure (10,000 psi).
        - Test choke manifold equipment to the full rated working pressure.
        - Test the BOP accumulator unit to confirm that closing times meet American Petroleum Institute standards and meet or exceed AOGCC requirements.
        - Verify pre-charge pressure and total volume of the accumulator bottles.
        - Install new ring gaskets and seals between each BOP component.
        - Test pressure integrity of the high-pressure mud system.
        - Inspect drill string and bottom-hole assembly (BHA) components to the most stringent “T.H. Hill DS-1 Category 5 level.” (This refers to an inspection and qualification document written by T.H. Hill Associates, Inc., that is considered industry standard for drill string and BHA inspections, as well as quality control of the drill string equipment.) While operating, the BOPE will be tested according to AOGCC and Applicant requirements, which is typically every 7 or 14 days. AOGCC field inspectors may witness these pressure tests.
- Well Control While Drilling Below the Surface Hole: The following summarizes measures for well control while drilling below the surface hole:
    - Well Control Monitoring and Procedures: Each well will be drilled according to a detailed well plan. While drilling, the well will constantly be monitored for pressure control. The mud weight (the primary well control mechanism) will be monitored and adjusted to meet actual wellbore requirements. A range of mud weights will be used as the well is drilled to provide the proper well control for the formation conditions encountered. Automatic and manual monitoring equipment will be installed to detect abnormal variation in the mud system volumes and drilling parameters.
    - If an influx of formation fluid (kick) occurs, secondary well control methods will be employed. Constant monitoring of the total fluid circulating volume and other drilling parameters will ensure that a kick is quickly detected. The well annulus will be shut-in using the BOPE. The drill pipe will be shut-in by a downhole check valve near the bit and a surface-mounted valve. This will contain the influx and associated build-up of surface pressure and prevent further influx of formation fluid into the wellbore. After the well is stabilized, a well kill procedure will be developed and implemented to circulate kill-weight mud and safely remove formation fluids

from the hole. Mud-gas separators and degassers will be used to remove gas from the mud as it is circulated out of the hole. After this procedure is completed, the kill effectiveness will be confirmed and the well will be opened up and the fluid levels monitored. Drilling operations will not resume until conditions are normal.

- BOP drills will be performed on a frequent basis to ensure the drilling crews can quickly and properly shut-in the well. Certified training of Point Thomson personnel will include hands-on simulator practice at recognizing kicks, well shut-in, and circulating the kicks out of the wellbore.
- Bottom-Hole Pressure Measurements: The Applicant will measure bottom-hole pressure while drilling, with computer-assisted analysis of drilling fluids circulation. State-of-the-art technology will be used to enhance drilling performance and mitigate risk. Several of the technologies are known as logging while drilling (LWD) and pressure while drilling (PWD). The LWD system enhances early detection of over-pressured intervals or possible lost circulation zones. The PWD system directly monitors bottom-hole pressures to maintain sufficient overbalance without compromising the formation integrity. Early detection of overpressure and maintaining sufficient overbalance while drilling will minimize the chance of incurring a well control event.
- Overbalanced Drilling Confirmation Technique: The “10/10/10 Test” developed by the Applicant is an analytical technique to help evaluate whether an overbalanced situation exists in the wellbore. Testing using the 10/10/10 Test can provide accurate and early diagnostics of the formation pressure before the potential kick interval is reached. The 10/10/10 Test involves circulating the well for 10 minutes to establish background gas, discontinuing mud circulation for 10 minutes to reduce equivalent circulating density, and circulating the wellbore for an additional 10 minutes. Mud is then circulated from the bottom of the well, without further drilling, to the surface. Gas concentrations are measured, and an evaluation is done to determine whether the overbalance is sufficient.
- Computer-aided Management of Inspection, Maintenance, and Repair: The Applicant will use a computerized preventive maintenance program to help manage inspection, maintenance, and repair of the drilling rig and associated equipment. The drilling contractor’s preventive maintenance program will be reviewed, a gap analysis performed, and an agreed-upon computer-aided system will be followed. The contractor will have the responsibility to maintain the program, while the operator closely monitors the inspection, maintenance, and repair program.
- Well Control Blowout Contingency Plan: The Applicant has developed a Well Control Blowout Contingency Plan (BCP) to address controlling a potential blowout in the shortest possible time. The BCP relies upon well capping as the primary means of controlling a blowout. Well capping is proven and will normally control a blowout in far less time than a relief well. The BCP address critical logistical elements of bringing the well capping equipment to the location. A key element of the BCP is ignition of a Thomson Sand gas condensate blowout. This is an effective method of “source control.” Air quality modeling has demonstrated that such a blowout would burn cleanly and would not violate national ambient air quality standards. ADEC has granted pre-approval for wellhead ignition and the Applicant will be prepared to implement well ignition within 2 hours of a blowout occurring, if that is the chosen response measure.

5.24.12.2 BMPs and Permit Requirements

Management of wastes generated by the project would be addressed by a number of plans that are required as part of various permits and regulations. These plans are discussed in detail in Section 5.24.1 and include an ODPCP, SPCC Plan, FRPs, a SWPPP, and a Waste Management Plan. In addition to measures for preventing and minimizing spills, most of these plans provide spill response measures. BMPs for waste management are also contained in the Alaska Waste Disposal and Reuse Guide, which is based on regulations and policy guidelines of the EPA, ADEC, and AOGCC. In addition, a number of the DO&G's mitigation and lessee advisories that would be applied to the project cover waste management and spill prevention. Many of these BMPs and permit requirements are included in the Applicant's proposed design measures above.

5.24.12.3 Corps-considered Mitigation

In addition to the Applicant's proposed design measures and BMPs and permit requirements, the Corps, in consultation with others, is considering the following actions to avoid or minimize impacts related to waste management and spills:

- Require all contractors to review and follow permit conditions related to waste management and spill prevention.
- Where practicable, locate onshore pipelines on the upslope side of roadways and construction pads to facilitate the containment and cleanup of spilled fluids.

5.24.13 Climate Change and Cumulative Impacts

5.24.13.1 Climate Change

Changes in the environment as a result of climate change could exacerbate potential spills and result in greater logistical and technical challenges for cleanup. A longer ice-free season and greater extent of offshore open water would increase the potential for greater storm surge, which, when combined with projected sea level rise, could inundate well pads, barge facilities, and production infrastructure if they are not properly designed to account for these potential changes.

Decreased periods of ice or snow cover and increased seasons of open water would lengthen the time that a spill could reach open water or tundra. Spills to open water or tundra create greater logistical and technical challenges for cleanup over those onto continuous snow and ice.

Changes in surface air temperatures as described in Section 4.3, Climate Change, could result in areas of thermokarsting throughout the project area. This response to climate change could increase the risk of spills through the upheaval or subsidence of land areas beneath pipeline, transportation, and drilling or production infrastructure.

5.24.13.2 Cumulative Impacts

No cumulative impacts from very small to large spills are expected. The spilled material for most spills is not expected to leave the pads, roads, and other infrastructure of the project and therefore would have negligible to minor impacts at the local project site. In the few situations where very small to medium spills would impact a natural habitat (e.g. dry or wet tundra, tundra ponds or lakes, streams, or nearshore estuarine/marine), the impacts to the habitat would be negligible in the context of the ACP. Further, the medium to large spills have a low to very low likelihood of occurring during the project life; are not predictable in season or location; and would be generally expected to be minor to moderate in magnitude, local in extent, and temporary to medium term in duration at the local resource level, and negligible impacts at the population/community/ACP level.

The likelihood of a very large spill resulting from the proposed project is extremely low. The likelihood of a very large spill from any other existing or reasonably foreseeable future project or activity that is considered in Section 4.2, Cumulative Impacts Methodology is also extremely low. Therefore, while a very large spill may have more extensive impacts in terms of area of habitat impacted, number of individuals exposed (e.g., polar bears, birds), and persistence of the spilled material that may result in longer term impacts to some resources, the likelihood of cumulative impacts from very large spills on the ACP and adjacent Beaufort Sea is extremely small.

5.24.14 Alternatives Comparison and Consequences

Based on historical records for the North Slope, spills are both possible and likely to occur over the life of the project. The vast majority of the crude and refined oil, produced fluids, saltwater, and other material spills that have occurred have been very small (fewer than 10 gallons). A large or very large spill would be very unlikely to occur. However, if such a spill were to occur, the resources that would be most affected are wetlands and vegetation, birds, and marine mammals. Impacts on subsistence would be moderate, but could be magnified by the perception that subsistence resources are contaminated even if they are not.

The shorter airstrip under Alternative E would constrain the size of aircraft that could be accommodated. In the event of a large or very large spill, delivery of heavy equipment, supplies, and export support would be more difficult and could hinder spill response efforts.

The likelihood of a spill may be greater in specific areas under some alternatives; for example, export pipeline spills are more likely in Alternative C and could be of greater volume because the export pipeline would be more than twice as long as in Alternatives B, D, and E. Similarly, the likelihood of a fuel spill (from fuel trucks and large storage tanks) is greater for Alternatives C and D because the total onsite fuel storage volume would be about 2.5 times greater than Alternatives B and E. In addition, Alternatives C and D do not have barging facilities so would not have the potential for marine spills associated with barges. However, in general, the impact of any particular spill is not likely to be different between the alternatives.

5.25 UNAVOIDABLE ADVERSE EFFECTS, RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES AND LONG-TERM PRODUCTIVITY, AND IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Unavoidable adverse effects, the relationship between local short-term uses and long-term productivity, and irreversible and irretrievable commitments of resources issues are generally the same among all action alternatives. Where alternatives vary, distinctions among individual alternatives and their resource commitments have been identified and the rationale is explained below.

5.25.1 Unavoidable Adverse Effects

Unavoidable adverse effects are those effects that cannot be avoided, even with the implementation of mitigation measures. The following is a brief summary of those resource categories where there are unavoidable adverse effects. See the respective sections for more detail.

- **Hydrology:** For all action alternatives, there would be unavoidable adverse effects associated with gravel roads, infrastructure and development of the gravel mine(s).
- **Subsistence and Traditional Land-use Patterns:** For all action alternatives, unavoidable adverse effects are associated with proposed infrastructure in subsistence use areas, noise/traffic and infrastructure impacts on resource availability, and impacts to user access.
- **Recreation:** For all action alternatives, unavoidable adverse effects are associated with a reduction of potential recreation grounds and avoidance of the project site; loss of public use of the shoreline in the project vicinity; visible and audible impacts of project infrastructure on recreation opportunity, especially recreation opportunity with high wilderness qualities; and potential displacement of wildlife due to facilities and resulting loss of wildlife viewing and hunting opportunities.
- **Visual Aesthetics:** For all action alternatives, unavoidable adverse effects would occur in high-sensitivity areas where action alternatives would contrast strongly with the surrounding viewshed; project components would be visible during daytime and nighttime for a long time period; and the project would be visible (with strong contrast) within the coastal corridor and from the northwest corner of the Arctic Refuge.
- **Vegetation and Wetlands:** For all action alternatives, there would be unavoidable adverse effects associated with gravel roads, infrastructure, and development of the gravel mine(s). For Alternative C, unavoidable adverse effects are associated with fill placement and gravel mines resulting from the gravel access road.

5.25.2 Relationship Between Local Short-term Uses and Long-term Productivity

The short-term use of the environment versus preserving its long-term productivity is related to converting the natural productivity of the land, a renewable use, to a developed use that has a relatively short economic life. Generally, short-term refers to the useful life of the project. Long-term refers to the time beyond the lifetime of the project. Impacts that narrow the range of beneficial uses to the environment are usually of primary concern. Potential impacts include selecting a development option that reduces the ability to pursue other possibilities, or committing a piece of land or other resources to a particular use that limits additional uses being performed on that site.

The proposed project would be consistent with the land lease the Applicant has with the State of Alaska. The commitment of these resources is based on the premise that the project would help to meet the Nation's domestic energy demand, help offset declining production from other North Slope reservoirs that would help to maintain the efficiency of TAPS and get the product to market. At an unspecified future date and outside the scope of this analysis, the proposed project would be abandoned and the lands would be rehabilitated.

5.25.3 Irreversible and Irretrievable Commitment of Resources

Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the use of those resources have on future generations. Irreversible commitments of resources are those that cannot be reversed except over an extremely long period of time. These irreversible effects primarily result from the destruction of a specific resource (e.g., energy and soils) that cannot be replaced within a reasonable time frame. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action (e.g., extinction of a threatened or endangered species or the disturbance of a cultural site). Under the action alternatives, there would be irreversible and irretrievable commitments of resources.

The proposed project would result in the irretrievable commitment of fossil fuels and other energy sources needed to construct and operate the project. Fossil fuels (gasoline and diesel oil) would be used to power construction equipment and vehicles. The energy consumed for construction and operation represents a permanent and nonrenewable commitment of these resources. Materials for construction of the proposed facilities would be irretrievably committed for the life of the project. Use of these materials represents a further depletion of natural resources. Construction and operation activities are considered a long-term nonrenewable investment of these resources. The capital and labor required for construction would also be an irreversible and irretrievable commitment resources. Constructing the proposed project would also require a substantial expenditure of irretrievable funds.

Other particular irreversible and/or irretrievable impacts that would result are noted below:

- Production of petroleum hydrocarbons from subsurface reservoirs would constitute an irreversible impact to geological resources (hydrocarbons).
- Ground disturbances associated with installation of the export pipeline, VSMs, and gravel mining for project infrastructure would be irreversible. Soils would be displaced or permanently impacted by the construction and the development footprint of facilities. Improperly-mitigated disturbance may cause irreversible changes in the permafrost thermal regime.
- Vegetation would be permanently lost with fill placement and the installation of project infrastructure, particularly for the gravel access road under Alternative C.
- Water use associated with the development of the gravel mine reservoir(s) and ice infrastructure, such as ice roads and ice pads, and water diversion would be irretrievable.

Chapter 6. Consultation and Coordination

This section describes and summarizes the public involvement process, tribal government consultation, and the agency involvement process during the formal scoping period (January 11, 2010 – February 25, 2010) and the process the Corps has undergone to engage the stakeholders to develop the EIS.

The purpose of the coordination effort is to produce a document based on the best available information and reflective of input received from the interested parties.

6.1 NOTICE OF INTENT

In October 2009, the Applicant submitted a draft Section 404/10 application to the Corps for the proposed project.

The Corps published and filed an NOI in the Federal Register on December 4, 2009 announcing the preparation of an EIS for the Point Thomson Project. The NOI initiated the formal scoping period that occurred from January 11, 2010 to February 25, 2010 and therefore began to prepare the Draft EIS for the proposed project. The NOI described the project's proposed action and announced the public and agency scoping meetings scheduled for Fairbanks, Kaktovik, Nuiqsut, Barrow, and Anchorage.

The NOI was posted on the Point Thomson Project EIS project Web site (www.pointthomsonprojecteis.com) and the Federal Register on December 4, 2009.

6.2 PUBLIC INVOLVEMENT AND SCOPING

Scoping, a requirement under NEPA, occurs early in the process and is one of the first opportunities for the public, tribal governments, and state and federal agencies to be involved in the project. The goal of scoping is to provide opportunities for the public, tribal governments, and state and federal agencies to provide input and to identify potential issues and concerns to be addressed in the Draft EIS. The scoping process helps establish the framework for the environmental study and facilitates the development of the reasonable range of feasible alternatives to be evaluated.

More detailed information pertaining to the scoping activities for the Draft EIS is available in Appendix B of the Point Thomson Project EIS Scoping Summary Report (April 2010), which is provided as Appendix E of this EIS.

This section also describes the coordination, outreach efforts, and tools utilized to provide information and solicit feedback from the stakeholders during scoping as well as through the development of the environmental document.

In 2002, the EPA conducted scoping for an EIS in response to the Applicant's proposed oil and gas development plans for the Point Thomson Unit and surrounding areas. As described in Chapter 1, preparation of the EIS was discontinued before its completion at the request of the Applicant. The scoping issues raised at that time were reviewed and applied to the currently proposed project, as appropriate.

6.2.1 Scoping Meetings

Five public scoping meetings and three agency scoping meetings were held in January 2010. The public meetings were held in the villages of Kaktovik, Nuiqsut, and Barrow because of their proximity to the proposed development area and potential for outreach to impacted parties. Anchorage and Fairbanks were included because of the statewide interest in developing the project and potential indirect effects on these communities, as well as to maximize efforts to engage the federal and state agencies in these communities. The agency meetings were conducted in Fairbanks, Anchorage, and Barrow.

The format for both the public and agency scoping meetings was an open-house informational opportunity with poster displays, followed by the Corps' presentation of the environmental review process and an audio-visual presentation of the proposed project by the Applicant. These meetings provided opportunity for the public and state and federal agency representatives to make comments and ask questions with responses from the Corps, the Applicant, and associated entities.

For the public scoping meetings an on-site court reporter transcribed the comments, questions, and responses and an Inupiaq language translator was provided in Nuiqsut and Barrow to facilitate questions and comments. The public was provided the opportunity to provide oral and written comments; however, the state and federal agencies were requested by the Corps to submit formal written comments. To be considered, the comments were required to be submitted to the Corps by February 25, 2010 by 5:00 pm.

Meeting materials associated with the scoping meetings and the resulting comments are all presented in the Point Thomson Project EIS Scoping Summary Report (April 2010) available in Appendix E.

In addition to the public scoping meetings, the public was encouraged to submit written comments regarding the project either electronically or by mail. These comments are also provided in Appendix E.

6.2.2 Newsletters

Three issues of a project newsletter were written to communicate project information prior to the distribution of the Draft EIS. The newsletters were developed to correspond with major project milestones. Each newsletter was distributed by mail to the mailing list and posted on the project Web site. Newsletters in both English and Inupiaq languages were made available on the project Web site.

The following provides a summary of the three newsletters and their information.

Table 6.2-1: Newsletter Summaries

January 2010 – Newsletter 1	April 2010 – Newsletter 2	November 2010 – Newsletter 3
• Description of the Applicant's proposed project • Applicant's purpose and need • Potential benefits and impacts • The NEPA process • The role of the Applicant, cooperating agencies, third-party EIS contractor, and the public • The review schedule • January public scoping meetings • Call for public involvement • Contact information	• Review of comments received during scoping period • Update on further studies needed o Impacts to subsistence and hunting o Data gaps identified for noise and visual impacts	• New Corps Project Manager • Summary of Reasonable Alternatives to be evaluated in Draft EIS • Map of proposed alternatives

6.2.3 Project Web Site

The project Web site (http://www.pointthompsonprojecteis.com/) for the proposed project is maintained by the Corps to provide information about the study and the proposed project for persons with Internet access.

The Web site includes the following pages and information:

- Home page, with welcome message and latest news
- Project overview page, with background, project description, location, and outreach activities
- Project schedule
- Public involvement page provides information on upcoming meetings for the public to participate
- Document page, with links to project and Draft EIS-related documents
- Links page provides links to the lead and cooperating agencies involved in the Draft EIS and links to other areas where the general public may want to find additional information about the project area
- Frequently Asked Questions and answers page
- Comments page, to accommodate online entries
- Contact information for the Corps' Project Manager, including phone, fax, mail, and e-mail address

The project Web site is updated on a regular basis. Comments and requests to be added to the project mailing list are also documented and responded to.

6.2.4 Project Mailing List

The Corps maintained an updated project mailing list with over 1,800 addresses to provide information to the stakeholders. This mailing list was used to send project materials in printed and electronic means. E-mail addresses were also collected to provide cost efficient transfer of project information and reminders to the stakeholders.

6.3 AGENCY COORDINATION

Following CEQ's NEPA guidelines, in 40 CFR 1501.7, the Corps solicited cooperation from state and federal agencies having jurisdiction by law or special expertise related to the environmental issues to be addressed in the Draft EIS. Coordination activities included participation in scoping meetings, small group meetings and briefings, agency review and input on study documents, and collaboration to develop the alternatives for analysis. Agency coordination was divided between the cooperating and commenting agencies.

Table 6.5-1 summarizes the Draft EIS development meetings. These meetings demonstrate the cooperation and consultation between the project partners.

In general, during scoping and the development of the proposed Purpose and Need, participation of the various partners was more inclusive and involved the Applicant. During the second phase, which included the development of Screening Criteria and the Reasonable Range of Alternatives, the participation was limited to the Corps and cooperating agencies.

Any information needed from the Applicant was documented in the form of an RFI from the Corps to the Applicant, and all the information provided was independently verified. Information requests related primarily to technical information needed in the development of the Draft EIS and engineering details of the Point Thomson Project. These requests are documented in a database available in Appendix E.

The following sections describe the agencies who were involved either as a cooperating or commenting agency.

6.3.1 Cooperating Agencies

Prior to publishing the NOI, the Corps invited agencies, local governments, and tribal governments to serve as cooperating agencies or commenting agencies. The EPA, USFWS, and ADNR Office of Project Management and Permitting responded, affirming their engagement as cooperating agencies for the Point Thomson Project EIS. Table 6.3-1 lists the agencies and their jurisdiction and expertise. By affirming their participation as cooperating agencies, these agencies committed personnel and resources to being active participants in developing the project study. Participation included attending scoping meetings, reviewing documents and project material, providing timely comments on products, and collaboration to develop the range of alternatives.

Table 6.3-1: Cooperating Agencies and Their Areas of Jurisdiction/Expertise

Cooperating Agency	Jurisdiction/Expertise
U.S. Environmental Protection Agency	Reviews and comments on the environmental impacts of major federal actions, including actions that are the subject of environmental impact statements under the CWA, RCRA, SDWA, and OPA. The EPA permits UIC wells.
U.S. Fish and Wildlife Service	Administers the Endangered Species Act, manages migratory bird populations, restores nationally significant fisheries, and conserves and restores wildlife habitat such as wetlands.
Alaska Department of Natural Resources, Office of Habitat Management and Permitting (OHMP)	OHMP is a division of the ADNR and is primarily responsible for the protection of Alaska's fish and wildlife resources and their habitats. The Division also coordinates with other agencies during plan reviews to provide expertise for protecting important fish and wildlife habitat throughout the state.

6.3.2 Commenting Agencies

Commenting agencies, for the purposes of the coordination process, are defined as agencies that "may have an interest in the project." Prior to the initiation of the project, the Corps, in collaboration with the cooperating agencies, invited state and federal agencies who may be interested in the project to participate. Following is a list of agencies which expressed interest in participating, provided comments during scoping, or participated in agency meetings.

Commenting agencies with regulatory jurisdiction over land, development, and/or permitting and that requested to be involved, included the following:

Table 6.3-2: Commenting Agencies and Their Areas of Jurisdiction/Expertise

Commenting Agency	Jurisdiction/Expertise
National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS)	NMFS is primarily responsive to the stewardship of living marine resource through science-based conservation and management.
Alaska Department of Environmental Conservation (ADEC)	ADEC is a department of the State of Alaska and is primarily responsible to conserve, improve, and protect its natural resources and environment and control water, land, and air pollution, to enhance the health, safety, and welfare of the people of the state and their overall economic and social well being.
Alaska Department of Natural Resources, Office of History and Archaeology (ADNR, OHA)	OHA is charged with the identification and protection of historic properties in the State of Alaska and is led by the State Historic Preservation Officer (SHPO). The National Historic Preservation Act Section 106 requires federal agencies to avoid or minimize impacts to properties on or eligible for the National Register of Historic Places and requires federal agencies to check for sites that may be eligible and determine eligibility. This consultation is done through the SHPO. For specific information on project specific Section 106 consultation, see Appendix P, NHPA Section 106 Documentation.
Alaska Department of Fish and Game (ADF&G)	ADF&G is a department of the State of Alaska and is primarily responsible for the protection, management, conservation, and restoration of Alaska's fish and game resources.
North Slope Borough (NSB)	NSB provides local government services for the communities inhabiting the North Slope region. NSB is primarily responsible for permitting and planning within Borough boundaries.
Alaska Department of Natural Resources, Joint Pipeline Office/State Pipeline Coordinator's Office (JPO/SPCO)	The State Pipeline Coordinator's Office (SPCO) was established within the Department of Natural Resources by Administrative Order in 1987. SPCO is the lead agency for the State in processing pipeline ROW leases under AS 38.35, the Right-of-Way Leasing Act. This responsibility includes coordination of the State's efforts related to the federal ROW process. The SPCO also coordinates the State's oversight of preconstruction, construction, operation and termination of jurisdictional pipelines,
Alaska Department of Natural Resources, Division of Oil and Gas	The Division of Oil and Gas develops and manages the state's oil and gas leasing programs. The division conducts competitive oil and gas lease sales and monitors collection of all funds resulting from its programs. It is also responsible for the development of the state's geothermal and coal bed methane resources.
Office of the Federal Coordinator (OFC)	The mission of the OFC is to advance the Nation's energy, environmental and economic security by expediting the delivery of clean natural gas from the North Slope of Alaska to North American markets.

6.3.3 Tribal Government

The Corps recognizes the sovereignty of tribal governments and works to coordinate communication and outreach efforts under Executive Order (EO) 13175 Consultation and Coordination with Indian Tribal Governments. In November 2009, the Corps initiated government-to-government consultation by letter to the Native Village of Barrow, Native Village of Nuiqsut, Kaktovik Village, and Iñupiat Community of the Arctic Slope (ICAS). The demographics for each community are described in detail in Section 3.13.

The tribal governments consulted are all federally recognized and listed by the Bureau of Indian Affairs. In general, tribal governments have taken on the responsibility of maintaining programs and activities related to, but not limited to social services, housing, environment, economic development, wildlife, and workforce development.

Table 6.3-3 summarizes the tribal government-to-government consultation. All correspondence and coordination efforts to engage the tribal governments identified was conducted by the Corps.

The Corps' goal for the tribal government consultation is to maintain a positive relationship throughout the project, and provide timely information and opportunities for the tribal governments to participate meaningfully in the project development. It is important to the Corps to fully understand the areas of concern and issues that evolve from the tribal governments.

Table 6.3-3: Tribal Government-to-government Consultation

	Participation								
Meeting Date	Corps	USFWS	EPA	ADNR	ICAS	Native Village of Kaktovik	Native Village of Nuiqsut	Native Village of Barrow	Purpose
November 2009	X	—	—	—	X	X	X	X	Consultation letter sent to tribal governments.
December 2009	X	X	X	X	X	—	X	X	Teleconference to introduce the project and discuss consultation protocols.
February 2010	X	—	—	—	—	—	—	X	Questionnaire received from Native Village of Barrow.
May 2010	X	—	—	—	X	X	X	X	Corps email to announce the availability of the Scoping Summary Report.
October 2010	X	—	—	—	—	—	X	—	Teleconference to introduce new Corps Project Manager, review schedule changes, discuss studies conducted, and development of the Range of Reasonable Alternatives.
March 2011	X	—	—	—	X	X	X	X	Corps project manager traveled to each community and met with the tribal governments to discuss the project and to begin discussions on the Section 106 process.
June 2011	X	—	—	—	X	X	X	X	Mailed newsletter #3 to the tribal governments and provided Inupiat version of newsletter on project web site.
September 2011	X	—	—	—	X	X	X	X	Corps mailed and emailed copies of the agency review copy of the Draft EIS to the tribal governments.
October 2011	X	—	—	—	X	X	X	X	Corps traveled to Barrow to provide preview and gather input on computer simulation modeling from tribal representatives.

6.4 APPLICANT OUTREACH

Prior to the Applicant's submittal to the Corps they engaged in coordination and communication with the project area communities. Separate from the project, but noteworthy, is the memorandum of understanding between the Applicant and governing organizations in the community of Kaktovik. These organizations (City of Kaktovik, Native Village of Kaktovik, and Kaktovik Inupiat Corporation) make up the "Kaktovik Working Group." The Applicant maintains separate communication and coordination with the group outside of the process to develop the EIS.

6.5 EIS DEVELOPMENT

During the formal scoping process, all stakeholders had the opportunity to be involved in the development of the Purpose and Need and to define the project study area. Once the purpose and need and project area were defined, the Corps and cooperating agencies began the process to develop screening criteria and the Reasonable Range of Alternatives. Chapter 2, Alternatives, documents the evaluation process and the evolution of the Reasonable Alternatives.

In the development of the Draft EIS there were 67 meetings between the Corps, cooperating agencies, commenting agencies, and the Applicant in various combinations of attendees. The following table provides the date and significant information related to the meeting.

Table 6.5-1: EIS Development Meetings

Meeting Date	Participation					Purpose
	Corps	USFWS	EPA	ADNR	Applicant	
November 3, 2009	X	X	X	X	X	Project Kickoff meeting.
November 18, 2009	X	—	—	—	X	Work Plan meeting.
November 24, 2009	X	X	X	X	X	Coordination meeting.
December 15, 2009	X	X	X	X	X	Coordination meeting.
January 5, 2010	X		X	—	—	Coordination meeting.
January 26, 2010	X		X	X	X	Health Study meeting (NOAA).
January 26, 2010	X	X	X	X	X	Noise and Visual Study meeting (NSB).
February 2, 2010	X	X	X	X	X	Coordination meeting.
February 18, 2010	X	X	X	—	X	Coordination meeting.
March 2, 2010	X	X	X	X	—	Coordination meeting.
March 9, 2010	X	X	X	X	—	Alternatives meeting.
March 16, 2010	X	X	X	X	—	Alternatives meeting.
March 23, 2010	X	X	X	X	—	Alternatives meeting.

Table 6.5-1: EIS Development Meetings						
	Participation					
Meeting Date	Corps	USFWS	EPA	ADNR	Applicant	Purpose
March 30, 2010	X	X	X	X	—	Alternatives meeting.
April 6, 2010	X	X	X	X	—	Alternatives meeting.
April 8, 2010	X	X	X	X	—	Alternatives meeting.
April 13, 2010	X	—	X	—	—	Alternatives meeting.
April 29, 2010	X	X	—	X	—	Alternatives meeting.
May 6, 2010	X	X	X	X	—	Alternatives meeting.
May 12, 2010	—	X	X	X	—	Alternatives meeting.
May 25, 2010	X	X	X	X	—	Alternatives meeting.
June 3, 2010	X	X	—	X	X	Alternatives meeting.
June 6, 2010	X	X	X	X	—	Alternatives meeting.
June 10, 2010	X	X	X	X	X	Coordination team alternatives meeting with the Applicant: Opportunity for Applicant to raise questions based on their review of the alternatives presented in the June 3 meeting.
June 16, 2010	X	X	X	X	X	New project manager from Corps introduced to the project team.
July 1, 2010	X	—	X	X	X	Alternatives refinement workshop: Discussed Applicant's understanding of and responses to the existing alternatives. Discussed additional information required to complete alternatives development and identify additional workshops to respond to agencies' information needs. Invited guest included PEAK Oilfield Services.
July 12, 2010	X	—	X	X	X	Discipline-specific alternatives workshop: Applicant presented briefs on the following topics: project sequencing, logistics, and modularization.
July 20, 2010	X	—	X	X	X	Discipline-specific alternatives workshop: Discussion of infield gravel roads and the East and West Pad design.
July 29, 2010	X	—	X	X	X	Discipline-specific alternatives workshop: Discussion of compressor processing options.
August 3, 2010	X	—	X	X	X	Coordination team meeting.
August 12, 2010	X	—	X	X	—	Agency screening workshop: Review full range of alternatives and discuss application of screening criteria.
August 17, 2010	X	X	X	X	X	Coordination team meeting.
September 9, 2010	X	—	X	—	X	Coordination team meeting.
September 21, 2010	X	X	X	X	X	Coordination team meeting.
September 24, 2010	X	X	—	—	X	Meeting to discuss noise analysis and work plan.
October 5, 2010	X	X	X	X	X	Coordination team meeting.

Table 6.5-1: EIS Development Meetings

Meeting Date	Participation					Purpose
	Corps	USFWS	EPA	ADNR	Applicant	
October 20, 2010	X	X	—	—	X	Noise analysis update meeting.
November 16, 2010	X	X	X	X	X	Coordination team meeting.
November 16, 2010	X	X	X	X	—	Noise analysis update to coordinating agencies.
December 2, 2010	X	X	X	X	X	Coordination team meeting focused on the Wetlands Functional Assessment methodology and its use for the analysis of impacts in the Draft EIS.
December 14, 2010	X	X	X	—	X	Coordination team meeting.
December 21, 2010	X	—	X	—	X	Coordination team meeting.
January 4, 2011	X	—	X	X	X	Coordination team meeting.
January 4, 2011	X	—	X	X	X	Preliminary Draft EIS rollout to the agencies and Applicant; all were provided with a scope and process to submit comments.
January 18, 2011	X	X	X	X	X	Coordination team meeting.
February 1, 2011	X	—	X	—	X	Coordination team meeting.
February 22, 2011	X	—	X	X	X	Meeting to discuss the Wetlands Functional Assessment and visual simulation scope
March 1, 2011	X	X	X	X	X	Coordination team meeting.
March 3, 2011	X	—	X	X	—	Meeting to discuss the use of significance in the Draft EIS, and the criteria used in the Draft EIS to determine the severity of impacts.
March 8, 2011	X	X	X	X	X	Discipline-specific workshop: Applicant shared the results of its hydrology studies and hydraulics analysis for its proposed alternative.
March 10, 2011	X	X	X	X	X	Alternatives and mitigation workshop.
March 15, 2011	X	X	X	X	X	Gravel mine workshop to discuss the Applicant's choice of gravel mine and the factors underlying mine site choice.
March 29, 2011	X	—	—	—	X	Meeting for Applicant to clarify project updates including service pier, emergency boat launch, gravel sources, export line VSM, utilities, and communication and flaring towers.
April 5, 2011	—	—	X	X	X	Coordination team meeting.
April 5, 2011	X	—	X	X	X	Meeting to discuss air quality impact analysis methodology, and ability of the EIS analysis efforts to compile the information required to submit permits and avoid rework.
April 19, 2011	—	—	X	X	X	Coordination team meeting.
April 21, 2011	—	—	X	X	X	Discipline-specific workshop to discuss ice road construction and water use permitting.
April 22, 2011	X	—	—	—	X	Meeting to discuss with Applicant project logistics and walk through the sequence of activities for the Applicant's Proposed Alternative following the February 2011 Project Update.
May 5, 2011	—	—	X	—	X	Coordination team meeting.

Table 6.5-1: EIS Development Meetings

Meeting Date	Participation: Corps	Participation: USFWS	Participation: EPA	Participation: ADNR	Participation: Applicant	Purpose
May 17, 2011	X	—	X	—	X	Coordination team meeting.
June 7, 2011	X	—	X	X	X	Coordination team meeting.
June 7, 2011	X	—	—	—	X	Discipline-specific workshop to discuss Applicant interpretation of CEQ guidance for analysis of a worst case scenario, and presentation of alternative subsistence impact criteria categories and definitions for Corps consideration.
June 21, 2011	X	—	X	X	X	Coordination team meeting.
July 5, 2011	X	—	—	—	X	Coordination team meeting.
August 2, 2011	X	—	X	X	X	Coordination team meeting.
August 16, 2011	X	X	X	—	X	Coordination team meeting.
September 8, 2011	X	—	X	X	X	Coordination team meeting.
October 11, 2011	X	—	X	X	X	Coordination team meeting.

Chapter 7. List of Preparers

Name	Project Role	Background	Years of Experience
Lead Federal Agency:	*United States Army Corps of Engineers*		
Hank Baij	Project Manager (June 1, 2010 – present)	B.S., Water Resources, University of Wisconsin, WI	24
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Serena Sweet	Deputy Project Manager (Dec. 2009 – May 2010)	B.A., Biological Sciences, University of Alaska, Anchorage, AK	6
Cooperating Agency:	*United States Environmental Protection Agency*		
Theodore L. Rockwell, Jr.	Project Manager	B.A., Environmental Conservation, Governor's State University, IL	30
Cooperating Agency:	*United States Fish and Wildlife Service*		
Louise Smith	Project Manager	M.S., Marine Biology, University of Alaska, Fairbanks, AK B.S., Wildlife Biology, Colorado State University, Fort Collins, CO	30
Cooperating Agency:	*Alaska Department of Natural Resources*		
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Third Party EIS Preparers:			
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Molly Koester Brown (HDR)	EIS Development Lead	B.S., Environmental Studies, The George Washington University, Washington, DC	19
Donna Robertson Aderhold, CWB (HDR)	Natural Environment Task Lead and Subject Matter Expert Lead	M.S., Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX B.S., Wildlife Sciences, North Carolina State University, Raleigh, NC	22
Connie Heitz (HDR)	Social Environment Task Lead	M.P.A., Environmental and Natural Resource Management, Indiana University, Bloomington, IN B.S., Public Affairs, Indiana University, Bloomington, IN	19
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Name	Project Role	Background	Years of Experience
Rosetta Alcantra (HDR)	Public Involvement Lead	B.A., Political Science, University of Alaska, Anchorage, AK	16
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Erin Begier (HDR)	Project Coordinator	B.S., Business Administration, University of Phoenix, CA	14
Stephen R. Braund (SRB&A)	Cultural Resources and Subsistence	M.A., Anthropology, University of Alaska, Fairbanks, AK B.A., Northern Studies/English, University of Alaska, Fairbanks, AK	32
Jeanette Brena, P.E. (Cardno ENTRIX)	Air Quality	M.S., Environmental Engineering, Washington State University, Pullman, WA B.S., Civil Engineering, University of Seattle, Seattle, WA	11
Lori Buffington (HDR)	Senior Technical Editor	College Classes in Business Administration	33
Gar Carothers (HDR)	Sr. Technical Adviser	B.S., Civil Engineering, University of Alaska, Anchorage, AK	22
Tim Casey (HDR)	Noise	B.S., Biology, St. Xavier College, Chicago, IL	21
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Name	Project Role	Background	Years of Experience
Sandra L. Cook (HDR)	Transportation	B.A., Landscape Architecture, University of Illinois, Champaign-Urbana, IL	16
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Adinda Demske (HDR)	Water Resources – Hydrology	B.S., Earth Science, Montana State University, Bozeman, MT	9
Jessica Eckerlin (HDR)	NEPA Writer	M.S., Water and Wetland Resources, SUNY-ESF, Syracuse NY M.P.A., Environmental Policy, Maxwell School, Syracuse, NY	7
Dagmar Fertl (HDR)	Marine Mammals	M.S. Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX	21
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Hannah Griego (HDR)	Socioeconomics, Environmental Justice, NEPA writer	M.S., Earth Systems, Stanford University, Stanford, CA B.S., Earth Systems, Stanford University, Stanford, CA	4
Zachary Halstead, PWS (HDR)	Wetlands and Vegetation	B.S., Biology, Creighton University, Omaha, NE	11
Erik Hilsinger (SRB&A)	Cultural Resources and Subsistence	M.A., Archaeology, University of Alaska, Fairbanks, AK B.A., Anthropology, Western Washington University, WA	11
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Glen Krogman (HDR)	Hydrology and Geomorphology	B.S., Civil Engineering, South Dakota School of Mines, SD	13
Paul Lawrence (SRB&A)	Cultural Resources and Subsistence	B.A., Anthropology, University of Alaska, Anchorage, AK	6

Name	Project Role	Background	Years of Experience
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Anne Leggett (HDR)	Wetland Functional Assessment	M.S., Plant Ecology, University of Washington, WA B.A., Environmental Studies/Economics, Middlebury College, VT	27
Keri Lestyk (HDR)	Marine Mammals	Ph.D. (in progress expected Dec 2011), Marine Biology, Universities of Alaska, Anchorage and Fairbanks, AK B.S, Marine Biology, Eckerd College, St. Petersburg, FL	12
Edward J Liebsch (HDR)	Air Quality	M.S., Meteorology, Pennsylvania State University, Pennsylvania, PA B.A., Earth Science/Chemistry, Saint Cloud State University, St. Cloud, MN	30
Tobin L. Lilly (HDR)	GIS Development	B.S., Computer Science; University of Illinois Champaign-Urbana, IL	7
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Cynthia Milligan (HDR)	Water Resources—Water Quality	M.S., Rangeland Ecology and Watershed Management/Water Resources, University of Wyoming, Laramie, WY B.A., Political Science, Michigan State University	6

Name	Project Role	Background	Years of Experience
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Michael D. Nagy (Cardno ENTRIX)	Agency Coordination	Graduate Studies in Natural Resources, Michigan State University, East Lansing, MI B.S., Natural Resources, Ball State University, Muncie, IN	33
Lynn Noel (Cardno ENTRIX)	Birds and Terrestrial Mammals	M.S., Natural Resources, Humboldt State University, Arcata, CA B.S., Biology, University of Illinois, Urbana-Champaign, IL	24
Aude Pacini (HDR)	Noise and Marine Mammals	Ph.D., Zoology, University of Hawaii at Manoa, Honolulu Hawaii	5
Mike Parsons, P.E. (HDR)	Noise Analysis	B.S., Civil Engineering, University of Wisconsin, Madison, WI	12
Kathryn Prater (HDR)	Technical Writer and Editor	M.F.A., Creative Writing, University of Notre Dame, Notre Dame, IN B.A., English and Spanish, University of Notre Dame, Notre Dame, IN	5
Amanda Prevel-Ramos (HDR)	Fish and Fish Habitat	B.S., Biological Sciences, California Polytechnic State University, San Luis Obispo, CA	8
Iris Prophet (SRB&A)	GIS Analyst	Certificate in GIS, Pennsylvania State University, Pennsylvania, PA B.S., Environmental Science, Alaska Pacific University, Anchorage, AK	6
Gina Ramirez (HDR)	Noise Analysis	B.A., Acoustics, Columbia College, Chicago, IL	2
Leslie Robbins (HDR)	NEPA Writer	Graduate studies in Environmental Law, Natural Resources Policy and Planning, University of Alaska/ Alaska Pacific University, Anchorage, AK B.A., Communication, Washington State University, Pullman, WA	8
Alyse Roberts (HDR)	NEPA Writer	B.A. Environment and Society, Certificate of Civic Engagement, University of Alaska, Anchorage, AK	1
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H. Maaike Schotborgh (HDR)	Health and Safety	M.S., in Conservation and Ecology – Lincoln University, New Zealand B.S., Nature Engineering and Landscape Management, Hogeschool Utrecht	9

Name	Project Role	Background	Years of Experience
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Liz Sears (SRB&A)	Subsistence	B.A., Anthropology, University of North Carolina at Chapel Hill, NC	5
Mari A. Smultea (HDR)	Marine Mammals	M.S., Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX B.A., Human Ecology, Connecticut College, New London, CT	25
Carol Snead (HDR)	Terrestrial Mammals	B.S., Geology, Boston College. Chestnut Hill, MA M.S. Geology, Rutgers University, New Brunswick, NJ	23
Kerri Snyder (HDR)	Cumulative Effects	M.S. Zoology, Duke University, Durham, North Carolina	11
Ronalee Spellecacy (HDR)	Land Use, Arctic Refuge	M.A., Political Science and Environmental Studies, Western Washington University, Bellingham, WA B.A., Anthropology, University of Alaska, Anchorage, AK B.A., Biological Sciences, University of Alaska, Anchorage, AK	7
Heidi Weigner (HDR)	Fish, Geology, Soils, Hydrology and Water Quality	B.S., Biology, University of Alaska, Anchorage, AK	9
Christine L. Whittaker, RLA (HDR)	Visual Resources	B.L.A., Landscape Architecture, University of Idaho, Moscow, ID	32
John Wolfe (HDR)	Purpose and Need, Recreation, Visual Assessment, Arctic Refuge, and Land Use	B.A., Writing and Northern Environmental Studies, Middlebury College, Middlebury, VT	19
Sharon Wright, AICP, LEED AP (HDR)	Transportation	B.S. Soil and Water Science, University of Florida, Gainesville, FL M.S. Urban and Regional Planning, Georgia Tech, Atlanta, GA	13
Scott Zilka (HDR)	Meteorology	B.S., Meteorology, St. Cloud State University, St. Cloud, MN	17

Contents

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Chapter 8. Distribution

8.1 Federal Agencies

U.S. Environmental Protection Agency (USEPA)

Jennifer J. Curtis, NEPA Reviewer
Christine Reichgott, ERASMU Manager (EPA Region 10)
Gayle Martin, Biologist
Office of Federal Activities (A-104)

U.S. Department of Interior, Fish & Wildlife Service (USFWS)

Louise Smith, Project Manager
Hollis Twitchell, Reviewer

U.S. Department of Interior, Bureau of Ocean Energy Management (BOEM)

Deborah Cranswick, Chief, Environmental Analysis Section 1, Alaska Region

U.S. National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA/NMFS)

James W. Balsiger, Ph.D., Administrator, Alaska Region
Brad Smith

8.2 Tribal Government

Iñupiat Community of the Arctic Slope

Doreen Lampe, President

Native Village of Barrow

Thomas Olemaun, President

Native Village of Kaktovik

Isaac Akootchook, President

Native Village of Nuiqsut

Bernice Kaigelak, President

8.3 State Government

Alaska Department of Natural Resources (ADNR)

Sara Longan, Large Project Manager
Judith Bittner, State Historic Preservation Officer
Mike Thompson, State Pipeline Coordinator

Alaska Department of Fish and Game (ADF&G)

Jack F. Winters

Department of Health and Social Services (DHSS)

Paul Anderson, HIA Program Manager

Department of Environmental Conservation (DEC)

Sean Palmer

8.4 Public Officials

Federal Congressional

Honorable Lisa Murkowski, Senator

Honorable Mark Begich, Senator

Honorable Don Young, Representative

State of Alaska

Honorable Sean Parnell, Governor

Honorable Donny Olson, Senator

Honorable Cathy Giessel, Senator

Honorable Charlie Huggins, Senator

Honorable Reggie Joule, Representative

Honorable Anna Fairclough, Representative

Honorable Mike Hawker, Representative

Honorable Charisse Millett, Representative

Local Government

North Slope Borough, Honorable Charlotte E. Brower, Mayor

City of Barrow, Honorable Dr. Robert Harcharek, Mayor

City of Kaktovik, Honorable Anne Tikiluk, Mayor

City of Nuiqsut, Honorable Thomas Napageak, Jr., Mayor

Municipality of Anchorage, Honorable Dan Sullivan, Mayor

Fairbanks North Star Borough, Honorable Luke Hopkins, Mayor

8.5 Alaska Native Claims Settlement Act (ANCSA) Corporations

Arctic Slope Regional Corporation (ASRC)

Ukpeagvik Inupiat Corporation

Kaktovik Inupiat Corporation

Kuukpik Corporation

8.6 Applicant

Exxon Mobil Corporation and PTE Pipeline LLC

8.7 Other Entities

Advisory Council on Historic Preservation

Alaska Eskimo Whaling Commission

Alaska Oil and Gas Association

Anchorage Chamber of Commerce

Arctic Slope Native Association

Alaska State Chamber of Commerce

Greater Fairbanks Chamber of Commerce

Northern Alaska Environmental Center

Resource Development Council for Alaska, Inc

Shell Exploration & Production

8.8 Libraries and Universities

Tuzzy Consortium Library

Harold Kaveolook School

Nuiqsut Trapper School

Fairbanks Noel Wien Library

Anchorage Z.J. Loussac Public Library

Alaska Resources Library and Information Services (ARLIS)

UAA Consortium Library

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9.2 FIGURE REFERENCES

9.2.1 Base Map References

Category	Author	Date	Description
Administrative Boundaries	Alaska Department of Fish and Game, Division of Wildlife Conservation	2009	ADF&G Game Management Units.
	Alaska Department of Natural Resources, Division of Oil and Gas	2008	Alaska oil and gas producing units
	Alaska Department of Natural Resources, Division of Oil and Gas	2009	National Petroleum Reserve Alaska
	Alaska Department of Natural Resources, Land Records Information Section	2007	Canada boundary
	Alaska Department of Natural Resources, Land Records Information Section	2007	State of Alaska boundary, including small islands
	Alaska Department of Natural Resources, Land Records Information Section	1996	Township boundaries
	Oasis Environmental, Inc.	2002	Coastline. For small scale (1 inch = 1 mile) mapping, uses data from US Fish and Wildlife Survey, BP Exploration, Alaska Department of Natural Resources, and the National Hydrography Dataset.
	US Fish and Wildlife Service	2009	Arctic National Wildlife Refuge
	US Fish and Wildlife Service	2009	Mollie Beattie Wilderness
Alternatives	United State Army Corp or Engineers, Alaska District	2011	Alternatives A-E
Cities, towns, villages	State of Alaska	2007	State of Alaska authoritative list of communities
Existing Oil/Gas Infrastructure	Alaska Department of Natural Resources, Land Records Information Section	2009	Existing Alaska pipelines
	Alaska Department of Natural Resources, Land Records Information Section	2009	Trans-Alaska Pipeline
	BP Cartography	2008	1:63360 BP pipelines
	Exxon Mobil Corporation	2008	Facilities
Hydrography	Alaska Department of Fish and Game	2011	Arctic anadromous streams
	BP Cartography	2008	Rivers
	BP Cartography	2002	Lakes
	ESRI	2002	US National Atlas Water Feature Lines
	Oasis Environmental, Inc.	2009	Potential water sources for construction and operation of Point Thomson project

Category	Author	Date	Description
Hydrography (Continued)	Oasis Environmental, Inc.	2002	Streams. For small scale (1 inch = 1 mile) mapping, uses data from US Fish and Wildlife Survey, BP Exploration, Alaska Department of Natural Resources, and the National Hydrography Dataset
	Oasis Environmental, Inc.	2002	Lakes. For small scale (1 inch = 1 mile) mapping, uses data from US Fish and Wildlife Survey, BP Exploration, Alaska Department of Natural Resources, and the National Hydrography Dataset.
	Oasis Environmental, Inc.	2002	Rivers. For small scale (1 inch = 1 mile) mapping, uses data from US Fish and Wildlife Survey, BP Exploration, Alaska Department of Natural Resources, and the National Hydrography Dataset.
Transportation	Alaska Department of Natural Resources, Land Records Information Section	2007	Major roads
	Alaska Department of Natural Resources, Land Records Information Section	2007	Secondary roads
	Alaska Department of Natural Resources, Land Records Information Section	2010	Bullen-Staines River Trail RS 2477
	BP Cartography	2008	Road centerlines
	JAGO Construction Management, LLC.	2010	Proposed 2010-2011 barge, tundra, sea ice, and helicopter travel routes from to Point Thomson from Deadhorse

9.2.2 Figures References

Figure #	Figure Name	Author	Date	Description
ES-1	Point Thomson Project Overview	Base Map References Only		
ES-3	Alternative B - Applicant's Proposed Action—Sheet 1 of 2	Base Map References Only		
ES-4	Alternative B - Applicant's Proposed Action—Sheet 2 of 2	Base Map References Only		
ES-6	Alternative C - Inland Pads with Gravel Access Road—Sheet 1 of 2	Base Map References Only		
ES-7	Alternative C - Inland Pads with Gravel Access Road—Sheet 2 of 2	Base Map References Only		
ES-10	Alternative D - Inland Pads with Seasonal Ice Access Road—Sheet 1 of 2	Base Map References Only		
ES-11	Alternative D - Inland Pads with Seasonal Ice Access Road—Sheet 2 of 2	Base Map References Only		
ES-13	Alternative E - Coastal Pads with Seasonal Ice Roads—Sheet 1 of 2	Base Map References Only		
ES-14	Alternative E - Coastal Pads with Seasonal Ice Roads—Sheet 2 of 2	Base Map References Only		
1.1-1	Project Location and Features	BP Cartography	2001	Thomson Sand Reservoir
2.4-5	Alternative B – Applicant's Proposed Action—Sheet 1 of 2	Base Map References Only		
2.4-6	Alternative B – Applicant's Proposed Action—Sheet 2 of 2	Base Map References Only		
2.4-14	Alternative C – Inland Pads with Gravel Access Road—Sheet 1 of 2	Base Map References Only		
2.4-15	Alternative C – Inland Pads with Gravel Access Road—Sheet 2 of 2	Base Map References Only		
2.4-21	Alternative D – Inland Pads with Seasonal Ice Access Road—Sheet 1 of 2	Base Map References Only		
2.4-22	Alternative D – Inland Pads with Seasonal Ice Access Road—Sheet 2 of 2	Base Map References Only		
2.4-26	Alternative E – Coastal Pads with Seasonal Ice Roads—Sheet 1 of 2	Base Map References Only		
2.4-27	Alternative E – Coastal Pads with Seasonal Ice Roads—Sheet 2 of 2	Base Map References Only		
3.4-1	Monitoring Site Locations for Regional Background Air Quality Concentrations	ENSR 2008, ExxonMobil 2009b		Air quality monitoring locations
3.6-1 -4	Surface Water Hydrology, Detail	PND	2009	Stream survey sites

Figure #	Figure Name	Author	Date	Description
	Sheets 1 - 4	MBJ	1998	Stream survey sites
3.9-1	Bird Habitats and Important Bird Areas	Audubon Alaska	2010	Important Bird Areas for the State of Alaska
3.9-3	Arctic Coastal Plain Steller's Eider Nesting Density	Waterfowl Branch, Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2009	Steller's eider breeding survey observations 1992-2009
		Waterfowl Branch, Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2003	Steller's eider nesting density based on 1992-2003 North Slope eider and Arctic Costal Plain breeding pair surveys 1992-2003
3.9-4	Arctic Coastal Plain Spectacled Eider Nesting Density with Post-Nesting Point Thomson Area Coastal Observations	Waterfowl Branch, Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2009	Spectacled eider breeding survey observations 1992-2009
		Waterfowl Branch, Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2006	Spectacled eider breeding survey observations from the North Slope eider aerial surveys 1992-2006
		Day et al. Troy Ecological Research Associates Ritchie et al. Schick et al. Frost et al. OASIS Environmental, Inc.	1995 2002 2003 2004 2007 2008	Spectacled eider nesting aerial surveys for the Point Thomson study area
		ABR Inc.	2007	Bullen Point ground survey 2006, 2007
		ABR Inc.	2002, 2006	Bullen Point aerial survey 1994, 2002, 2006
		ABR Inc.	1993	Kuvlum aerial survey
		Troy Ecological Research Associates	2001	Survey area for aerial-transect surveys for Spectacled eiders, 1998-2001 (12-17 June), on the outer portion of the Arctic Coastal Plain from the Badami oilfield west to the Staines River
		Waterfowl Branch, Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2003	Spectacled eider nesting density based on 1992-2003 North Slope eider and Arctic Costal Plain breeding pair surveys

Figure #	Figure Name	Author	Date	Description
3.9-5	Arctic Coastal Plain Yellow-billed Loon Nesting Density with Post-nesting Point Thomson Area Coastal Observations	Waterfowl Branch, Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2009	Yellow-billed loon breeding survey observations, 1992-2009
		ABR Inc.	2007	Yellow-billed loon nest locations, including data from Kendall et al. 2003, Kendall and Brackney 2004, Kendall and Villa 2006, and Kendall et al. 2007
		Waterfowl Branch, Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2008	Yellow-billed loon registry observations
		Waterfowl Branch, Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2005	Yellow-billed loon nesting density based on 1992-2005 North Slope eider and Arctic Costal Plain breeding pair surveys
3.10-1	ADF&G Game Management Unit Boundaries	Base Map References Only		
3.10-6	Arctic Alaska Caribou Herd Ranges, Calving Areas, and Seasonal Movements (WAH, TH, CAH, PH)	Alaska Department of Fish and Game, Division of Wildlife Conservation		Caribou seasonal movements
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2002	Caribou caving grounds
		OASIS Environmental, Inc.	2009	Caribou caving grounds based on data from Aero-Metric, Inc., U.S. Geological Survey, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, Alaska Department of Natural Resources (1955-2002).
		USGS Alaska Cooperative Fish and Wildlife Research Unit. D.B. Griffith.	2002	CAH range based on data collected by ADF&G and USFWS
		USGS Alaska Cooperative Fish and Wildlife Research Unit. D.B. Griffith.	2001	PH annual range
		Alaska Department of Fish and Game, Division of Wildlife Conservation		WAH and TH ranges

Figure #	Figure Name	Author	Date	Description
3.10-7	Average Caribou Density During Mid-June 1997 to 2003 and Central Arctic Herd Calving Locations 1990 to 2002	USGS Alaska Cooperative Fish and Wildlife Research Unit. D.B. Griffith.	2002	Locations of radio-collared CAH female caribou with calves east of the Sagavanirktok River during the calving season, 1990-2002
		Entrix Inc.	2003	Average caribou density from early June to Late July, 1997-2003
3.10-8	Average Caribou Density During Late June to Early August 1997 to 2003 and Photo Census Group Size and Location During July 1983 to 2008	Alaska Department of Fish and Game, Division of Wildlife Conservation	2003	Locations of CAH aggregations recorded during July photocensuses in 1983, 1992, 1995, 1997, 2000, and 2002
		Alaska Department of Fish and Game, Division of Wildlife Conservation.	2009	Locations of CAH aggregations recorded during photocensus in July 2008
		Entrix Inc.	2003	Average Caribou Density, early June to Late July. 1997-2003
3.10-9	Caribou Summer (June, July, August) Movement Density	Entrix Inc.	1990	Caribou summer (June, July, August) movement density between the Sagavanirktok and Canning river deltas based on radio telemetry for 34 caribou during 1983 and satellite telemetry for 15 CAH and 34 PH caribou during 1987 to 1990
3.10-11	Muskoxen Observations (1995 to 2003)	LGL Alaska Research Associates, Inc.	2002	Locations of muskoxen observed during aerial transect surveys for large mammals in June and July of 1993-1995 and 1997-2002 in the vicinity of the proposed Point Thomson project, Sagavanirktok River to Staines River.
		U.S Fish and Wildlife Service - Arctic National Wildlife Refuge	2002	Locations of muskoxen within 30 miles of Point Thomson from telemetry and incidental observations, 1982-2002
		Entrix Inc.	2003	Locations of muskoxen observed during aerial transect surveys for large mammals in the Badami study area in June and July 2003

Figure #	Figure Name	Author	Date	Description
		Entrix Inc.	2003	Locations of muskoxen observed during aerial transect surveys for large mammals in the Bullen Point study area in June and July 2003
3.10-12	Documented Fox Den Locations within the Study Area	LGL Alaska Research Associates, Inc.	2002	Locations of arctic fox dens recorded incidentally during aerial surveys for large mammals in the vicinity of the proposed Point Thomson project between the Sagavanirktok and Staines rivers, June and July 1993-1995 and 1997-2002
		LGL Alaska Research Associates, Inc.	2002	Locations and history of occupancy of arctic fox dens found by various researchers between the Sagavanirktok and Staines rivers during 1972-2002
		Entrix Inc.	2010	Boundary for Badami and Point Thomson fox den search
		LGL Alaska Research Associates, Inc. OASIS, Inc. HDR Alaska, Inc.	1994-2001 2009 2011	Suitable Burrow Habitat (Vc/Vd), Vegetation Mapping for Point Thomson project area.
3.10-14	Brown Bear Observations, Potentially Suitable Den Habitat, and Previously Used Den Locations	LGL Alaska Research Associates, Inc.	2010	Locations of grizzly bears recorded during aerial transect surveys for large mammals in the vicinity of the proposed Point Thomson project, June and July 1993-1995 and 1997-2002, Sagavanirktok River to Staines River
		Entrix Inc.	2003	Locations of grizzly bears recorded during aerial transect surveys for large mammals in the Bullen Point study area, June and July 2003
		Entrix Inc.	2003	Location of grizzly bears recorded during aerial transect surveys for large mammals in the Badami study area, July 2003

Figure #	Figure Name	Author	Date	Description
3.10-14 (Cont.)	Brown Bear Observations, Potentially Suitable Den Habitat, and Previously Used Den Locations (Continued)	Alaska Department of Fish and Game, Division of Wildlife Conservation	2009	Locations of grizzly bears recorded during radio-telemetry surveys in 1994-2006 in the vicinity of the proposed Point Thomson project
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2002	Locations of grizzly bears seen during VHF radio-telemetry surveys by ADFG in 1994 and 1996-2002 in the vicinity of the Point Thomson proposed project area
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2002	Locations of grizzly bear dens recorded from radio-telemetry in 1991-1997 and 1999-2001 in the vicinity of the Point Thomson proposed project area (mostly west of Badami)
		USGS Alaska Cooperative Fish and Wildlife Research Unit	2005	Extent of polar bear den modeling
		USGS Alaska Cooperative Fish and Wildlife Research Unit	2005	Modeled polar bear denning habitat
3.11-1	Designated Critical Habitat for the Polar Bear	U.S. Fish and Wildlife Service, Anchorage, Alaska, Fisheries and Ecological Services, Marine Mammals Management Office	2011	Areas of the barrier islands and mainland spits along the northern coast of Alaska that are designated as critical habitat for polar bears
		U.S. Fish and Wildlife Service, Anchorage, Alaska, Fisheries and Ecological Services, Marine Mammals Management Office	2011	One-mile wide no disturbance zone around the barrier islands and spits
		U.S. Fish and Wildlife Service, Anchorage, Alaska, Fisheries and Ecological Services, Marine Mammals Management Office	2011	Polar bear denning critical habitat
		U.S. Fish and Wildlife Service, Anchorage, Alaska, Fisheries and Ecological Services, Marine Mammals Management Office	2011	Areas of sea ice designated as feeding (sea ice) critical habitat for polar bears

Figure #	Figure Name	Author	Date	Description
3.11-2	Polar Bear Core Use Area, Denning Habitat, and Incidental Sightings	MMS	2007	Incidental observations of polar bears from MMS Bowhead Whale Aerial Survey Project (BWASP) data, 1987-2007
		USGS Alaska Cooperative Fish and Wildlife Research Unit	2005	Polar bear maternal den habitat on the coastal plain of northern Alaska between the Colville River and the Alaska/Canada border
3.12-1	Fish Sampling Locations in the Point Thomson Study Area	Cannon et al. Fechhelm. Fechhelm et al. Glass et al. Thorsteinson et al. Ward and Craig	1987 1996 2000 1990 1991 1974	Marine fish sampling sites
		Hemming Ward and Craig WCC and ABR Inc. Winters and Morris	1996 1974 1983 2004	Freshwater fish sampling sites
3.12-2	Anadromous Streams In and Near the Point Thomson Study Area	Alaska Department of Fish and Game	2011	Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes - Arctic Region
3.12-3	Overwintering Fish Habitat In and Near the Point Thomson Study Area	Craig and McCart	1974	Fish overwintering habitat
		Morris	2000	Fish overwintering sites
		Alaska Department of Fish and Game	2011	Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes - Arctic Region
3.13-1	Land Ownership and Management	BP Cartography	2008	Private Allotments and Federal Lands
		Alaska Department of Natural Resources, Land Records Information Section	2009	State lands selected by the North Slope Bureau, Native Corporation Land, State Land
		Alaska Department of Natural Resources, Land Records Information Section	2008	Point Thomson unit, in dispute
		North Slope Borough	2009	North Slope Borough Resource Development District
3.13-2	Leases and Development Bordering the Arctic Refuge	Alaska Department of Natural Resources, Division of Oil and Gas	2011	North Slope oil and gas leases
3.14-1	Arctic National Wildlife Refuge	Base Map References Only		

Figure #	Figure Name	Author	Date	Description
3.15-1	Point Thomson Project and Communities in the North Slope Borough	Base Map References Only		
3.17-4	Transportation Map	Base Map References Only		
3.18-1	Recreation	HDR Alaska Inc.	2011	Visual Assessment sample points
		HDR Alaska Inc.	2011	Destinations/camping and Hunting Sites for Local Users
		HDR Alaska Inc.	2011	Point Thomson Visibility Areas
		HDR Alaska Inc.	2011	Costal Corridor
3.19-1	Primary and Secondary Study Areas and Theoretical Maximum Visibility	HDR Alaska Inc.	2011	Visual Assessment primary study area boundary
		HDR Alaska Inc.	2011	Point Thomson Visibility Areas
3.19-2	Scenic Quality Inventory Mapping and Key Observation Points	HDR Alaska Inc.	2011	Visual Assessment sample points
		HDR Alaska Inc.	2011	Visual sensitivity level, (Appendix N)
		HDR Alaska Inc.	2011	Distance Zones from travel corridors
		HDR Alaska Inc.	2011	Visual Assessment primary study area boundary
3.20-1	Noise Assessment Monitoring Locations	PND	2010	Noise sample locations
3.20-11	Oil and Gas Units Along the North Slope Used for Baseline Data Comparison	Base Map References Only		
3.21-1	Documented Cultural Resources within the Point Thomson Cultural Resources Study Area	Stephen R. Braund and Associates		
3.22-1	Kaktovik Lifetime and 1996-2006 Use Areas, All Resources	Stephen R. Braund and Associates		
3.22-2	Kaktovik Partial 1996-2006 Subsistence Use Areas for Caribou, Point Thomson Vicinity	Stephen R. Braund and Associates		
3.22-3	Kaktovik Partial "Last 12 Month" Subsistence Use Areas for Caribou, Point Thomson Vicinity	Stephen R. Braund and Associates		
3.22-4	Percentage of Harvested Caribou by Harvest Place Name Location, Kaktovik	Stephen R. Braund and Associates		
3.22-9	Nuiqsut Lifetime and Post-1970s Use Areas, All Resources	Stephen R. Braund and Associates		

Figure #	Figure Name	Author	Date	Description
5.4-4 - 7	Contour Plots of Contaminant Concentrations From Air Quality Modeling Results	SLR	2011	
5.5-1	Historical and Worst Case Projected Shoreline Erosion	PND	2009a	Historic and projected shoreline erosion contours at the Central, East, and West pads
5.6-1 - 8	Alternative B - E —Streams and Water Bodies of Interest	Base Map References Only		
5.8-1 - 16	Vegetation Mapping—Alternatives B - E	LGL Alaska Research Associates OASIS, Inc. HDR Alaska, Inc.	1994-2001 2009 2011	Study area vegetation mapping
5.9-1	Occurrence of Birds and Existing Project Features in Point Thomson Bird Project Area	Entrix Inc.	2001	Bird ground nest locations
		Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2000	Bird observations from aerial survey for waterbirds in nearshore waters of the Beaufort Sea off the central Arctic Coastal Plain
		Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2006	Bird observations from the Arctic Coastal Plain aerial breeding waterbird surveys, 1992-2006
		Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2006	Bird observations from the North Slope eider aerial surveys, 1992-2006, on the northern half of the Arctic Coastal Plain
5.9-2	Alternative B— Summary of Bird Habitat Loss, Alteration, and Disturbance Areas and Occurrence of Conservation Birds of Concern	Entrix Inc.	2001	Ground nest locations
		Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2000	Bird observations from aerial survey for waterbirds in nearshore waters of the Beaufort Sea off the central Arctic Coastal Plain of Alaska
		Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2006	Bird observations from the Arctic Coastal Plain aerial breeding waterbird surveys, 1992-2006
		Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2006	Bird observations from the North Slope Eider aerial surveys, 1992-2006, on the northern half of the Arctic Coastal Plain

Figure #	Figure Name	Author	Date	Description
5.9-3	Alternatives B to E—Summary of Spectacled Eider Habitat Loss, Alteration, Disturbance Areas, and Occurrence of Spectacled Eiders	Waterfowl Branch, Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2009	Steller's eider breeding survey observations, 1992-2009.
		Waterfowl Branch, Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2006	Spectacled eider breeding survey observations from the North Slope eider aerial surveys, 1992-2006
		Day et al. Troy Ecological Research Associates Ritchie et al. Schick et al. Frost et al. OASIS Environmental, Inc.	1995 2002 2003 2004 2007 2008	Spectacled eider nesting aerial surveys in the Point Thomson study area
5.9-4	Alternatives B to E—Summary of Yellow-billed Loon Habitat Loss, Alteration, Disturbance Areas, and Occurrence of Yellow-billed Loons	Waterfowl Branch, Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2009	Yellow-billed loon breeding survey observations, 1992-2009
5.9-4	Alternatives B to E—Summary of Yellow-billed Loon Habitat Loss, Alteration, Disturbance Areas, and Occurrence of Yellow-billed Loons	ABR Inc.	2007	Yellow-billed loon nest locations, including data from Kendall et al. 2003, Kendall and Brackney 2004, Kendall and Villa 2006, and Kendall et al. 2007
		Waterfowl Branch, Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2008	Yellow-billed loon registry observations
		Waterfowl Branch, Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2005	Yellow-billed loon nesting density from North Slope eider and arctic Costal Plain breeding pair surveys, 1992-2005
5.9-5 -7	Alternative C -E — Summary of Bird Habitat Loss, Alteration, and Disturbance Areas and Occurrence of Conservation Birds of Concern	Entrix Inc.	2001	Bird ground nest locations
		Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2000	Bird observations from aerial surveys for waterbirds in nearshore waters of the Beaufort Sea off the central Arctic Coastal Plain
		Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska	2006	Bird observations from the Arctic Coastal Plain aerial breeding waterbird surveys, 1992-2006

Figure #	Figure Name	Author	Date	Description
5.9-5 -7 (Cont.)	Alternative C -E — Summary of Bird Habitat Loss, Alteration, and Disturbance Areas and Occurrence of Conservation Birds of Concern (Continued)	Migratory Bird Management, U.S. Fish and Wildlife Service, Region 7, Anchorage Alaska.	2006	Bird observations from North Slope Eider aerial surveys, 1992-2006, on the northern half of the Arctic Coastal Plain
5.10-1	Alternative B—Areas of Terrestrial Mammal Habitat Loss, Alteration, and Disturbance	LGL Alaska Research Associates OASIS, Inc. HDR Alaska, Inc.	1994-2001 2009 2011	Suitable burrow habitat (Vc/Vd) based on vegetation mapping for Point Thomson study area
		USGS Alaska Cooperative Fish and Wildlife Research Unit	2005	Polar bear maternal den habitat on the coastal plain of northern Alaska between the Colville River and the Alaska/Canada border
		LGL Alaska Research Associates, Inc.	2002	Locations of arctic fox dens recorded incidentally during aerial surveys for large mammals in the vicinity of the proposed Point Thomson project between the Sagavanirktok and Staines rivers, June and July 1993-1995 and 1997-2002
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2002	Locations of grizzly bear dens recorded from radio-telemetry in 1991-1997 and 1999-2001 in the vicinity of the Point Thomson proposed project area (mostly west of Badami)
5.10-2	Alternative B—Estimated Forage Production and Terrestrial Mammal Disturbance and Displacement from Gravel Infrastructure	USGS Alaska Cooperative Fish and Wildlife Research Unit	2002	Locations of radio-collared CAH female caribou with calves east of the Sagavanirktok River during the calving season, 1990-2002
		LGL Alaska Research Associates, Inc.	2010	Locations of grizzly bears recorded during aerial transect surveys for large mammals in the vicinity of the proposed Point Thomson project, June and July 1993-1995 and 1997-2002, Sagavanirktok River to Staines River

Figure #	Figure Name	Author	Date	Description
5.10-2 (Cont.)	Alternative B—Estimated Forage Production and Terrestrial Mammal Disturbance and Displacement from Gravel Infrastructure (Continued)	Entrix Inc.	2003	Locations of grizzly bears recorded during aerial transect surveys for large mammals in the Bullen Point study area, June and July 2003
		Entrix Inc.	2003	Location of grizzly bears recorded during aerial transect surveys for large mammals in the Badami study area, July 2003
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2009	Locations of grizzly bears recorded during radio-telemetry surveys in 1994-2006 in the vicinity of the proposed Point Thomson project
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2002	Locations of grizzly bears seen during VHF radio-telemetry surveys by ADFG in 1994 and 1996-2002 in the vicinity of the Point Thomson proposed project area
		LGL Alaska Research Associates, Inc.	2002	Locations of muskoxen observed during aerial transect surveys for large mammals in June and July of 1993-1995 and 1997-2002 in the vicinity of the proposed Point Thomson project, Sagavanirktok River to Staines River
		U.S Fish and Wildlife Service - Arctic National Wildlife Refuge	2002	Locations of muskoxen within 30 miles of Point Thomson from telemetry and incidental observations, 1982-2002
		Entrix Inc.	2003	Locations of muskoxen observed during aerial transect surveys for large mammals in the Badami study area in June and July 2003
		Entrix Inc.	2003	Locations of muskoxen observed during aerial transect surveys for large mammals in the Bullen Point study area in June and July 2003

Figure #	Figure Name	Author	Date	Description
5.10-2 (Cont.)	Alternative B—Estimated Forage Production and Terrestrial Mammal Disturbance and Displacement from Gravel Infrastructure (Continued)	Raynolds et al.	2010	Estimated phytobiomass on the Arctic Coastal Plain based on Normalized Vegetation Differential Index
5.10-3	Alternative B—Caribou Photocensus Groups, Movement Densities, and Potential Blockage Locations near Roads and Pipelines	Alaska Department of Fish and Game, Division of Wildlife Conservation	2003	Locations of CAH aggregations recorded during July photocensuses in 1983, 1992, 1995, 1997, 2000, and 2002
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2009	Locations of CAH aggregations recorded during photocensus in July 2008
		Entrix Inc.	1990	Caribou Summer (June, July, August) Movement Density Between the Sagavanirktok and Canning River Deltas Based on Radio Telemetry for 34 Caribou During 1983 and Satellite Telemetry for 15 CAH and 34 PH Caribou During 1987 to 1990
5.10-4	Alternative C—Areas of Terrestrial Mammal Habitat Loss, Alteration, and Disturbance	LGL Alaska Research Associates OASIS, Inc. HDR Alaska, Inc.	1994-2001 2009 2011	Suitable burrow habitat (Vc/Vd) based on vegetation mapping for Point Thomson study area
		USGS Alaska Cooperative Fish and Wildlife Research Unit	2005	Polar bear maternal den habitat on the coastal plain of northern Alaska between the Colville River and the Alaska/Canada border
		LGL Alaska Research Associates, Inc.	2002	Locations of arctic fox dens recorded incidentally during aerial surveys for large mammals in the vicinity of the proposed Point Thomson project between the Sagavanirktok and Staines rivers, June and July 1993-1995 and 1997-2002
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2002	Locations of grizzly bear dens recorded from radio-telemetry in 1991-1997 and 1999-2001 in the vicinity of the Point Thomson proposed project area (mostly west of Badami)

Figure #	Figure Name	Author	Date	Description
5.10-5	Alternative C – Estimated Forage Production and Terrestrial Mammal Disturbance and Displacement from Gravel Infrastructure	USGS Alaska Cooperative Fish and Wildlife Research Unit	2002	Locations of radio-collared CAH female caribou with calves east of the Sagavanirktok River during the calving season, 1990-2002
		LGL Alaska Research Associates, Inc.	2010	Locations of grizzly bears recorded during aerial transect surveys for large mammals in the vicinity of the proposed Point Thomson project, June and July 1993-1995 and 1997-2002, Sagavanirktok River to Staines River
		Entrix Inc.	2003	Locations of grizzly bears recorded during aerial transect surveys for large mammals in the Bullen Point study area, June and July 2003
		Entrix Inc.	2003	Location of grizzly bears recorded during aerial transect surveys for large mammals in the Badami study area, July 2003
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2009	Locations of grizzly bears recorded during radio-telemetry surveys in 1994-2006 in the vicinity of the proposed Point Thomson project
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2002	Locations of grizzly bears seen during VHF radio-telemetry surveys by ADFG in 1994 and 1996-2002 in the vicinity of the Point Thomson proposed project area
		LGL Alaska Research Associates, Inc.	2002	Locations of muskoxen observed during aerial transect surveys for large mammals in June and July of 1993-1995 and 1997-2002 in the vicinity of the proposed Point Thomson project, Sagavanirktok River to Staines River

Figure #	Figure Name	Author	Date	Description
5.10-5 (Cont.)	Alternative C – Estimated Forage Production and Terrestrial Mammal Disturbance and Displacement from Gravel Infrastructure (Continued)	U.S Fish and Wildlife Service - Arctic National Wildlife Refuge	2002	Locations of muskoxen within 30 miles of Point Thomson from telemetry and incidental observations, 1982-2002
		Entrix Inc.	2003	Locations of muskoxen observed during aerial transect surveys for large mammals in the Badami study area in June and July 2003
		Entrix Inc.	2003	Locations of muskoxen observed during aerial transect surveys for large mammals in the Bullen Point study area in June and July 2003
		Raynolds et al.	2010	Estimated phytobiomass on the Arctic Coastal Plain based on Normalized Vegetation Differential Index
5.10-6	Alternative C—Caribou Photocensus Groups, Movement Densities, and Potential Blockage Locations Near Roads and Pipelines	Alaska Department of Fish and Game, Division of Wildlife Conservation	2003	Locations of CAH aggregations recorded during July photocensuses in 1983, 1992, 1995, 1997, 2000, and 2002
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2009	Locations of CAH aggregations recorded during photocensus in July 2008
		Entrix Inc.	1990	Caribou Summer (June, July, August) Movement Density Between the Sagavanirktok and Canning River Deltas Based on Radio Telemetry for 34 Caribou During 1983 and Satellite Telemetry for 15 CAH and 34 PH Caribou During 1987 to 1990
5.10-7	Alternative D—Areas of Terrestrial Mammal Habitat Loss, Alteration, and Disturbance	LGL Alaska Research Associates OASIS, Inc. HDR Alaska, Inc.	1994-2001 2009 2011	Suitable burrow habitat (Vc/Vd) based on vegetation mapping for Point Thomson study area
		USGS Alaska Cooperative Fish and Wildlife Research Unit	2005	Polar bear maternal den habitat on the coastal plain of northern Alaska between the Colville River and the Alaska/Canada border

Figure #	Figure Name	Author	Date	Description
5.10-7 (Cont.)	Alternative D—Areas of Terrestrial Mammal Habitat Loss, Alteration, and Disturbance (Continued)	LGL Alaska Research Associates, Inc.	2002	Locations of arctic fox dens recorded incidentally during aerial surveys for large mammals in the vicinity of the proposed Point Thomson project between the Sagavanirktok and Staines rivers, June and July 1993-1995 and 1997-2002
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2002	Locations of grizzly bear dens recorded from radio-telemetry in 1991-1997 and 1999-2001 in the vicinity of the Point Thomson proposed project area (mostly west of Badami)
5.10-8	Alternative D – Estimated Forage Production and Terrestrial Mammal Disturbance and Displacement from Gravel Infrastructure	USGS Alaska Cooperative Fish and Wildlife Research Unit	2002	Locations of radio-collared CAH female caribou with calves east of the Sagavanirktok River during the calving season, 1990-2002
		LGL Alaska Research Associates, Inc.	2010	Locations of grizzly bears recorded during aerial transect surveys for large mammals in the vicinity of the proposed Point Thomson project, June and July 1993-1995 and 1997-2002, Sagavanirktok River to Staines River
		Entrix Inc.	2003	Locations of grizzly bears recorded during aerial transect surveys for large mammals in the Bullen Point study area, June and July 2003
		Entrix Inc.	2003	Location of grizzly bears recorded during aerial transect surveys for large mammals in the Badami study area, July 2003
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2009	Locations of grizzly bears recorded during radio-telemetry surveys in 1994-2006 in the vicinity of the proposed Point Thomson project

Figure #	Figure Name	Author	Date	Description
5.10-8 (Cont.)	Alternative D – Estimated Forage Production and Terrestrial Mammal Disturbance and Displacement from Gravel Infrastructure (Continued)	Alaska Department of Fish and Game, Division of Wildlife Conservation	2002	Locations of grizzly bears seen during VHF radio-telemetry surveys by ADFG in 1994 and 1996-2002 in the vicinity of the Point Thomson proposed project area
		LGL Alaska Research Associates, Inc.	2002	Locations of muskoxen observed during aerial transect surveys for large mammals in June and July of 1993-1995 and 1997-2002 in the vicinity of the proposed Point Thomson project, Sagavanirktok River to Staines River
		U.S Fish and Wildlife Service - Arctic National Wildlife Refuge	2002	Locations of muskoxen within 30 miles of Point Thomson from telemetry and incidental observations, 1982-2002
		Entrix Inc.	2003	Locations of muskoxen observed during aerial transect surveys for large mammals in the Badami study area in June and July 2003
		Entrix Inc.	2003	Locations of muskoxen observed during aerial transect surveys for large mammals in the Bullen Point study area in June and July 2003
		Raynolds et al.	2010	Estimated phytobiomass on the Arctic Coastal Plain based on Normalized Vegetation Differential Index
5.10-9	Alternative D—Caribou Photocensus Groups, Movement Densities, and Potential blockage Locations near Roads and Pipelines	LGL Alaska Research Associates OASIS, Inc. HDR Alaska, Inc.	1994-2001 2009 2011	Suitable burrow habitat (Vc/Vd) based on vegetation mapping for Point Thomson study area
		USGS Alaska Cooperative Fish and Wildlife Research Unit	2005	Polar bear maternal den habitat on the coastal plain of northern Alaska between the Colville River and the Alaska/Canada border

Figure #	Figure Name	Author	Date	Description
5.10-9 (Cont.)	Alternative D—Caribou Photocensus Groups, Movement Densities, and Potential blockage Locations near Roads and Pipelines (Continued)	LGL Alaska Research Associates, Inc.	2002	Locations of arctic fox dens recorded incidentally during aerial surveys for large mammals in the vicinity of the proposed Point Thomson project between the Sagavanirktok and Staines rivers, June and July 1993-1995 and 1997-2002
5.10-10	Alternative E—Areas of Terrestrial Mammal Habitat Loss, Alteration, and Disturbance	LGL Alaska Research Associates OASIS, Inc. HDR Alaska, Inc.	1994-2001 2009 2011	Suitable burrow habitat (Vc/Vd) based on vegetation mapping for Point Thomson study area
		USGS Alaska Cooperative Fish and Wildlife Research Unit	2005	Polar bear maternal den habitat on the coastal plain of northern Alaska between the Colville River and the Alaska/Canada border
		LGL Alaska Research Associates, Inc.	2002	Locations of arctic fox dens recorded incidentally during aerial surveys for large mammals in the vicinity of the proposed Point Thomson project between the Sagavanirktok and Staines rivers, June and July 1993-1995 and 1997-2002
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2002	Locations of grizzly bear dens recorded from radio-telemetry in 1991-1997 and 1999-2001 in the vicinity of the Point Thomson proposed project area (mostly west of Badami)
5.10-11	Alternative E – Estimated Forage Production and Terrestrial Mammal Disturbance and Displacement from Gravel Infrastructure	USGS Alaska Cooperative Fish and Wildlife Research Unit	2002	Locations of radio-collared CAH female caribou with calves east of the Sagavanirktok River during the calving season, 1990-2002
		LGL Alaska Research Associates, Inc.	2010	Locations of grizzly bears recorded during aerial transect surveys for large mammals in the vicinity of the proposed Point Thomson project, June and July 1993-1995 and 1997-2002, Sagavanirktok River to Staines River

Figure #	Figure Name	Author	Date	Description
5.10-11 (Cont.)	Alternative E – Estimated Forage Production and Terrestrial Mammal Disturbance and Displacement from Gravel Infrastructure (Continued)	Entrix Inc.	2003	Locations of grizzly bears recorded during aerial transect surveys for large mammals in the Bullen Point study area, June and July 2003
		Entrix Inc.	2003	Location of grizzly bears recorded during aerial transect surveys for large mammals in the Badami study area, July 2003
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2009	Locations of grizzly bears recorded during radio-telemetry surveys in 1994-2006 in the vicinity of the proposed Point Thomson project
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2002	Locations of grizzly bears seen during VHF radio-telemetry surveys by ADFG in 1994 and 1996-2002 in the vicinity of the Point Thomson proposed project area
		LGL Alaska Research Associates, Inc.	2002	Locations of muskoxen observed during aerial transect surveys for large mammals in June and July of 1993-1995 and 1997-2002 in the vicinity of the proposed Point Thomson project, Sagavanirktok River to Staines River
		U.S Fish and Wildlife Service - Arctic National Wildlife Refuge	2002	Locations of muskoxen within 30 miles of Point Thomson from telemetry and incidental observations, 1982-2002
		Entrix Inc.	2003	Locations of muskoxen observed during aerial transect surveys for large mammals in the Badami study area in June and July 2003
		Entrix Inc.	2003	Locations of muskoxen observed during aerial transect surveys for large mammals in the Bullen Point study area in June and July 2003

Figure #	Figure Name	Author	Date	Description
5.10-11 (Cont.)	Alternative E – Estimated Forage Production and Terrestrial Mammal Disturbance and Displacement from Gravel Infrastructure (Continued)	Raynolds et al.	2010	Estimated phytobiomass on the Arctic Coastal Plain based on Normalized Vegetation Differential Index
5.10-12	Alternative E—Caribou Photocensus Groups, Movement Densities, and Potential Blockage Locations near Roads and Pipelines	Alaska Department of Fish and Game, Division of Wildlife Conservation	2003	Locations of CAH aggregations recorded during July photocensuses in 1983, 1992, 1995, 1997, 2000, and 2002
		Alaska Department of Fish and Game, Division of Wildlife Conservation	2009	Locations of CAH aggregations recorded during photocensus in July 2008
		Entrix Inc.	1990	Caribou Summer (June, July, August) Movement Density Between the Sagavanirktok and Canning River Deltas Based on Radio Telemetry for 34 Caribou During 1983 and Satellite Telemetry for 15 CAH and 34 PH Caribou During 1987 to 1990
5.19-1	Shoreline Key Observation Point—View Within 0.2 Mile	HDR Boise, Inc.	2011	Photosimulation
5.19-2	Inland Key Observation Point—View Within 0.8	HDR Boise, Inc.	2011	Photosimulation
5.19-3	Mary Sachs Island Key Observation Point—View from about 1.8 miles	HDR Boise, Inc.	2011	Photosimulation
5.19-4	Brownlow Spit Key Observation Point—Daylight —Views of East Pad (5 miles) and Central Pad (8.2 Miles)	HDR Boise, Inc.	2011	Photosimulation
5.19-5	Brownlow Spit Key Observation Point—Winter, Dark—Views of East Pad (5 miles) and Central Pad (8.3 Miles)	HDR Boise, Inc.	2011	Photosimulation
5.19-6	Aerial Key Observation Point—View From 500 Ft Elevation	HDR Boise, Inc.	2011	Photosimulation
5.19-7	Inland View—Pipeline—View From 225 Feet	HDR Boise, Inc.	2011	Photosimulation
5.20-1 - 4	Alternative B - E Construction Winter Noise Contours	PND Engineering	2010	Noise sample locations
		United State Army Corp or Engineers, Alaska District.	2011	Noise contours Alt B - E

Figure #	Figure Name	Author	Date	Description
5.20-11	Arctic Refuge Modeled Noise Receptors	HDR Alaska, Inc.		Noise monitoring locations, surface water features, and upland coastal plain points
5.22-1	Point Thomson Subsistence Project Area Vicinity	Stephen R. Braund and Associates	2011	Point Thomson project area vicinity for subsistence, by alternative
5.22-2	Alternative Footprints with Kaktovik Subsistence Use Areas, All Resources	Stephen R. Braund and Associates	2010	1996-2006 Kaktovik use areas overlapped with project alternative footprints
		Pedersen	1979	Lifetime Kaktovik use areas overlapped with project alternative footprints
5.22-3	Alternative Footprints with Nuiqsut Subsistence Use Areas, All Resources	Stephen R. Braund and Associates	2010	1996-2006 Nuiqsut use areas overlapped with project alternative footprints
		Pedersen	1986	1973-1985 Nuiqsut use areas overlapped with project alternative footprints
		Pedersen	1979	Lifetime Nuiqsut use areas overlapped with project alternative footprints

Chapter 10. Index

Index has been updated for the Final EIS.

B

C

E

G

H

M

N

O

P

U

V

W

Y

Z

Chapter 11. Glossary

Ablation	The process by which the surface of the ice sheet melts or sublimes, depending upon temperature and other conditions, at the upper surface and generally freezes at the lower surface; in terms of an oil spill, it is the process by which oil migrates from the underside of ice at the time of a spill toward the surface of the ice by spring
Accretion	The process where coastal sediments return to the visible portion of the beach following storm erosion resulting in a gradual accumulation of sediments
Active layer	Near-surface soils subject to seasonal thaw
Adsorption	The adhesion of atoms, ions, biomolecules or molecules of gas, liquid, or dissolved solids to a surface
Advecting	The horizontal movement of a mass of fluid (as air or an ocean current)
Aggradation	An increase in land elevation due to the deposition of sediment
Albedo	A measure of how the surface reflects incoming radiation
Aliphatic	Pertaining to any organic compound having an open-chain structure
Alkalinity	The quantitative capacity of water to neutralize an acid
Altricial	A species that is born blind, naked, and helpless and requires shelter and parental care
Amphipods	Any of a large order of small crustaceans with a laterally compressed body
Anthropogenic	Relating to or resulting from the influence of human beings on nature
Anthropogenic	Of, relating to, or resulting from the influence of human beings on nature.
Apron	The part of the aerodrome set aside for loading, unloading, or maintaining aircraft.
Aufeis	A sheet-like mass of layered ice that forms from successive flows of ground water during freezing temperatures.
Bathymetry	The measurement of water depth at various places in a body of water; the information derived from such measurements
Beach seining	A technique used to capture fish in which one end of a net is held in place on the shore and the other end moves in an arch around the first net, until a loop is completed and fish are trapped in the net
Beaded channel/stream	Deep thaw ponds connected by narrow, deep channels; contains deep pools and submerged and aquatic vegetation
Benthic	Relating to, or occurring at the bottom of a body of water; in the depths of the ocean
Cap and trade system	An environmental policy tool in which the government limits, or caps, the overall amount of emissions per source, which can then be used, banked, or sold/traded to other sources.
CAT-trains	Trailers pulled by tractors across frozen ground
Christmas tree	An assembly of valves, spools, pressure gauges and chokes fitted to the wellhead of a completed well to control production
Circumneutral	Term applied to water with a pH of 5.5 (acidic) to 7.4 (alkaline)
Class I disposal well	A Class I disposal (or injection) well is a well permitted by the EPA for disposal of hazardous or nonhazardous wastes into isolated rock formations thousands of feet below the lowermost underground sources of drinking water.
Class I injection well	Injects wastes, both hazardous and non-hazardous, into isolated rock formation, which are thousands of feet below the lowermost underground sources of drinking water (USDW). Class I disposal wells on the North Slope are non-hazardous industrial waste disposal wells.
Clockwise gyre	A large system of ocean currents rotating in a clockwise direction

CO_2 equivalents	The EPA gives the same weight, in terms of emissions impacts, to carbon dioxide and the other 5 regulated GHGs, and refers to them collectively as CO_2 equivalents unless referring to a specific gas.
Coeval	Of or belonging to the same age or generation
Commissioning	The series of inspections and tests that verify an installed building is ready for safe occupation and use.
Copepods	Small crustaceans found in the sea and nearly every freshwater habitat
Coregonid	A member of the fish family Coregonidae
Cryoturbation	The mixing of materials from various horizons of the soil right down to the bedrock due to freezing and thawing
Delineate	To depict in words or gestures; describe
Demersal	Describes fish and animals that live near water bottoms
Diachronous	Sedimentary rock formation in which apparently similar material varies in age from place to place
Diadromous	Migrate between freshwater and marine environments
Distributary	A branch of a river that does not return to the main stream after leaving it (as in a delta).
Ecoregion	Geographic areas of relative homogeneity in ecological systems or in relationships between organisms and their environment
Eolian	Deposited by the wind
Epibenthic mysids	A group of small, shrimp-like crustaceans, living on the surface of the sea bottom
Epibenthic organisms	Plants and animals living on top of the sea floor or lake bed that are either freely moving or permanently attached to the substrate
Epifaunal	Living on top of the sediment
Epontic algae	Algae that grows in a low-light environment below sea ice.
Euphausiid	Small invertebrates found in all oceans of the world (common name is krill)
extraLimital	A species that does not normally occur in an area, but for which there are one or more records that are considered beyond the normal range of the species
Fetch	Length of water surface over which the wind is blowing
Fish assemblages	Mixed species groups of fish using the same habitat
Flexifloat®	A combination of portable, interlocking modular barges and auxiliary attachments, which are used in inland marine, heavy-construction applications
Floe edge	In springtime, where the frozen ocean meets the open ocean
Fluvial	Of or relating to or happening in a river
Foraminifera	A type of protozoa, mostly marine, with a shell of lime, silica or agglutinated sand grains
Formation water	Water that occurs naturally within the pores of rock. Water from fluids introduced to a formation through drilling or other interference, such as mud and seawater, does not constitute formation water.
Full field development	A reasonably foreseeable future action (or actions) that would allow for the complete development of hydrocarbon resources in the Thomson Sand Reservoir; it would include the additional equipment, manpower and infrastructure that would be needed beyond what is proposed in this EIS in order to recover and produce additional hydrocarbon resources from the reservoir
Fyke nets	Large hoop nets that act as funnels to trap swimming fish.
g	A common value of acceleration equal to 9.8 m/sec/sec (the acceleration due to gravity at the surface of the earth)

Habitat patch	An area of contiguous habitat type used in habitat fragmentation analyses
Halophytic	Salt tolerant; applied to vegetation and animals
Hibernacula	Shelters occupied during the winter by dormant animals
Hummocks	Rounded knolls or hillocks
Infaunal	Benthic invertebrates that live within sediments
Infield gathering pipelines	Pipelines that transfer hydrocarbons from production wells to the central processing facility
Isobath	An imaginary line on the earth's surface or a line on a map connecting all points which are the same vertical distance above the upper or lower surface of a water-bearing formation
Krill	Krill are an important trophic connection that feed on phytoplankton and zooplankton, converting these into a form suitable for many larger animals for whom krill makes up the largest part of their diet.
Land-fast ice	Sea ice that is either frozen to land or to the benthos (bottom of the sea) and is relatively immobile throughout the winter
Lead	Linear openings or cracks in the sea ice caused by the actions of winds, currents, and temperature
Letter of Authorization	A letter granted to an organization by the National Marine Fisheries Service to incidentally harass a small number of marine mammals during project activities provided there will be no more than a negligible impact on species that are not listed as depleted under the MMPA.
Liquefaction	Conversion of soil into a fluidlike mass during an earthquake or other seismic event
Long-reach directional drilling	The process of drilling a curved well, in order to reach a target that is an extended distance laterally from the drill site
Maintenance pigging	Sending a pig to clear debris from the pipeline.
Mean annual air temperatures	The air temperatures of a location averaged over the course of a year
Mean sea level	The average height of the surface of the sea for all stages of the tide; used as a reference for elevations. Also called MSL.
Micropascals	The unit of pressure commonly used in acoustics; one micropascal is approximately 10^{-11} times the normal atmospheric pressure.
Microtine	A general name for a rodent of the subfamily Microtinae (family Muridae) of rodents, which includes voles, lemmings, muskrats, and mole-voles
Mooring dolphins	Man-made marine structures that extend above the water level and is not connected to shore; usually installed to provide a fixed structure when it would be impractical to extend the shore to provide a dry access facility
Nonattainment	A region's inability to meet National Ambient Air Quality Standards and to maintain them over time
Oligotrophic	An organism that can live in an environment low in nutrients
Orographic	Associated with or induced by the presence of mountains
Otolith	A small particle, comprised mainly of calcium carbonate, found in the inner ear of vertebrates, being part of the balance sense
Oversummer	To be stored for the duration of the summer.
Oxbow lake	A crescent-shaped lake created when a river channel is separated from the river itself by erosion and deposition
Pack ice	Annual and heavier multiyear ice that is in constant motion due to winds and currents
Palynology	A branch of science dealing with pollen and spores
Pelagic	Relating to, or living, or occurring in the open sea

Periglacial	Of or pertaining to the area around the edge of a glacier
Permafrost	A permanently frozen layer at variable depth below the surface in frigid regions of a planet (as earth)
Photodegradation	Degradation by photon absorption
Physiographic	Pertaining to the origin and evolution of landforms
Phytobiomass	Amount of living plant material
Pig	A device pumped through the normal flow of a pipeline to clean the walls of the pipe or monitor pipe conditions
Pig launching facility	A structure adjacent to a pipeline for inserting a pig into a pipeline
Pingo	A low hill or mound forced up by hydrostatic pressure in an area underlain by permafrost
Piscivore	Feeding on fish
Polynya	Areas of open sea surrounded by sea ice
Portland cement	Also known as Ordinary Portland Cement (OPC); the most common form of cement, comprised of concrete, mortar, stucco, and nonspecialty grout.
Precocial	Mature and mobile at birth or hatching
Pressure ridges	Ice formation typically found on sea ice during the winter; a long crack in the ice that occurs because of repeated heating and cooling.
Produced fluid	Liquid extracted from the production wells; expected to be predominantly gas condensate but may include crude oil, produced water (which is usually saline to some extent), and entrained sand
Prograde	A direction of rotation that is counterclockwise as viewed from the north pole of the sky or the planet
Reservoir connectivity	Some hydrocarbon reservoirs are a single large chamber, while others are multichambered structures that may not be connected to each other. Testing reservoir connectivity at Point Thomson for this project requires production facilities because the produced fluids would be gathered at the Central Processing Facility, the condensate would be removed, and the dry gas would be pressurized and injected into the reservoir. Monitors at each well would gather data about the pressure at that well; if the pressure at each well remains constant during production and reinjection, that constant pressure would indicate connections between the areas being drilled. If pressure at a well declines despite reinjection, the decline indicates a lack of connectivity between the production and injection wells.
Rut	An annually recurrent state of sexual excitement in the male animal.
Scour pits	See strudel scour
Secondary treatment	Level of wastewater treatment – secondary vs. tertiary. Same level as some municipal wastewater, but not as high as others.
Seining	Method of harvesting fish by hauling a seine net (also called a drag net) across a water body
Senesce	To grow older, reach maturity
Sequestered	The capture of carbon dioxide, such as within trees during photosynthesis.
Shore-fast ice	Ice that grows seaward from a coast and remains stationary throughout the winter and that is typically stabilized by grounded pressure ridges at its outer edge
Special aquatic sites	Sanctuaries and refuges, wetlands, mud flats, vegetated shallows, coral reefs, and riffle pool complexes, as identified in 40 CFR 230 Subpart E; they are geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values; these areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region

Strangmoor	A type of bog with a landscape consisting of alternating low bog ridges and wet sedgy hollows. The ridges and hollows ore oriented across the major slope of the peatland at right angles to water movement.
Strudel scour	Localized, seasonal phenomenon that occurs in the spring when melting fresh water in rivers and streams flows into the Beaufort Sea and out over the surface of frozen shore-fast ice.
Subnivean	Below the snow layer
Substrate	A surface on which an organism grows or is attached
Surficial soils	Soils that are at or near the surface
Talik	Thaw basin
Thaw lakes	Water that melts and collects on the surface, above a layer of unbroken permafrost
Thermokarst	A land surface that forms as ice-rich permafrost thaws; it occurs extensively in arctic areas
Tradition	The handing down of information, beliefs, and customs by word of mouth or by example from one generation to another without written instruction
Transshipped	To transfer for further transportation from one ship or conveyance to another
Trophic	Relating to nutrients/nutrition
Troughs	A linear structural depression that extends laterally over a distance, while being less steep than a trench
Tundra-safe, low-ground-pressure vehicles	Vehicles with large, soft tires that can travel across tundra with minimal damage to the vegetation in the area.
Turbidity	A condition in water caused by the presence of suspended material resulting in scattering and absorption of light rays
Tussock	An area of raised solid ground in a marsh or bog that is bound together by roots of low vegetation
Upwelling	The process of upward movement to the ocean surface of deeper cold usually nutrient-rich waters especially along some shores due to the offshore movement of surface waters
Waters of the U.S.	1. All waters that are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters subject to the ebb and flow of the tide; 2. All interstate waters, including interstate wetlands; 3. All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce, including any such waters: i. That are or could be used by interstate or foreign travelers for recreational or other purposes; or ii. From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or iii. That are used or could be used for industrial purpose by industries in interstate commerce; 4. All impoundments of waters otherwise defined as waters of the United States under the definition; 5. Tributaries of waters identified in paragraphs (a)(1)-(4) of this section; 6. The territorial seas; 7. Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (a)(1)-(6) of this section. Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of CWA (other than cooling ponds as defined in 40 CFR 123.11(m), which also meet the criteria of this definition) are not waters of the United States.

Young-of-the-year	Age-0 fish, or those animals born within the past year, from transformation to juvenile until January 1 in the northern hemisphere or July 1 in the southern hemisphere, which have not yet reached one year of age; abbreviated as YOY
Zooplankton	The passively floating or weakly swimming usually minute animal life of a body of water