Grizzly Bear

Grizzly bears exist across coastal areas of the western Arctic in relatively low population densities. Nagy et al. (1983) recorded a density of 4 bears/1,000km2 in their study on Richards Island and the Tuktoyaktuk Peninsula. The apparent low density may have been the result of poor habitat quality combined with the level of past harvest (Nagy et al. 1983). It has been suggested by several authors that denning habitat may be a limiting factor across the western Arctic (Ruttan 1974, Pearson 1975, Harding 1976). Nagy (pers. comm., 2003) does not feel that this is the case around the Mackenzie Delta.

Grizzly bears den throughout the Mackenzie Delta where suitable denning habitat exists (Slaney 1975; Nagy et al. 1983). The majority of known grizzly bear dens in the delta occur on Richards Island (Nagy et al. 1983). Local residents attending community consultation meetings have also indicated the presence of denning grizzly bears on Richards Island. Grizzlies den in areas with topographic relief such as lake and channel banks, beach ridges, stabilized slumps, the Ya Ya esker-kame complex, the Trapp Hills, and on the mainland (e.g., Storm Hills and Parsons Lake area). Dens are typically on south to west aspects in sandy soils and where snow accumulates, occasionally in peat, and often associated with shrub cover (Nagy et al. 1983; Martell et al. 1984). Dens usually collapse due to the summer thawing of the sandy substrate in which they are constructed. Thus, predicting den locations at the pre-development stage consists of identifying suitable habitat and checking a site for bear denning activity in the fall prior to any development activities.

It has been noted that mortality, especially in the female cohort, is a primary factor limiting grizzly bear populations (Knight et al. 1988). In the western Arctic, grizzlies do not begin reproducing until about 6-9 years of age, and, they produce few young. Average litter size is less than two cubs, and juvenile mortality rates have been estimated at 25-75 percent for cubs of the year (Nagy et al. 1983; Yukon Renewable Resources 1997). As bears have one of the lowest reproductive rates of terrestrial mammals, grizzly bear researchers in other areas have noted that the loss of one or two adult female grizzly bears could have significant negative population consequences (Knight and Eberhardt 1985).

Thus, disturbance of bears in their dens is a major concern as it may have an adverse impact on grizzly bear populations (Nolan et al. 1973; Watson et al. 1973; Quimby 1974). If bears, especially females and cubs; are pushed from their dens they may not return, reducing their survival probability. Cub mortality is high without this added stress.

Low flying aircraft, especially helicopters, have been shown to create strong negative reactions (energy-costly flight responses) (Harding and Nagy 1980), and repeated overflights have pushed bears from their dens (Quimby 1974).

The grizzly bear is a quota species important for aboriginal guiding/outfitting opportunities. It is listed as Sensitive under the NWT Species 2000 classification (GNWT 2000) and of Special Concern by COSEWIC (2002).

Due to the relative sensitivity of the species and the critical aspect of denning habitat, the grizzly bear was selected as a final VC.

Polar Bear

The distribution of polar bears in the Southern Beaufort Sea (SBS) is regulated by the constantly changing sea ice, and by the distribution and abundance of seals (Messier et al. 1992, Amstrup 2000). The resultant need to frequently modify foraging strategies through relocation limits the ability to predict polar bear locations. Furthermore, polar bears tend to use only a portion of their large and loosely bounded home ranges in any one season or year, and demonstrate weak fidelity to activity areas in winter and early spring (Amstrup et al. 2000, Amstrup et al. 2001). Despite this, the movement of SBS polar bears is characterized by significant directional trends. Corresponding with ice formation and break-up, a net southward movement to nearshore foraging habitat occurs in October, while a net northward movement occurs from May to August (Amstrup et al. 2000). A trend of movement towards the east and west in winter may be attributed to foraging opportunities resulting from the development of persistent leads in the ice near the Mackenzie Delta, and in the Chukchi Sea to the west (Amstrup 2000).

Although polar bears in the SBS frequent nearshore habitats, radio telemetry indicates that they seldom venture onto land. However, the occurrence of bear visits to land is thought to be increasing (Amstrup 2000). Maternal denning constitutes a large proportion of bears demonstrating movement on or nearby land. Only pregnant females enter over-wintering dens, while the remainder of the population remains active throughout the year (Ramsay and Stirling 1990). The proposed program falls within an area of coastal denning habitat stretching from Kay Point in the Yukon to Kugmallit Bay (TCCP 2000). However, radio telemetry data indicate that the preferred region for maternal denning on land occurs to the west of the delta, along coastal areas of northeast Alaska and adjacent Yukon Territory (Amstrup 2000). Radio telemetry data collected from 1981 to 1999 revealed only two dens along the delta coastline (Amstrup 2000).

The polar bear population has increased over the last few decades and is suspected to be nearing carrying capacity, with an estimated 1,800 animals in the SBS population (Amstrup 2000). The polar bear is a quota species important for aboriginal guiding/outfitting opportunities. It is listed as Sensitive under the NWT Species 2000 classification (GNWT 2000) and of Special Concern by COSEWIC (2002). As noted in the various CCPS, there is interest in identifying and protecting important polar bear habitats from disruptive land uses (AICCP 2000, IICCP 2000, TCCP 2000). Local residents attending community consultation meetings noted that polar bears den on the north coast of Richards Island, and that the ice has been very close to the shore this past year. As a result of this close ice, local residents expect to see a lot of bears in the upcoming months. However, no issues of concern were raised with respect to the proposed program. Richards Island has been noted in CCPs as being important for polar bear denning.

Based on the above, the polar bear was selected as a final VC.

Arctic Fox

Arctic fox are top-level carnivores in marine and terrestrial ecosystems (Martell et al. 1984). They use coastal areas across the western Arctic and are linked to fluctuations in prey density (e.g., lemmings, ptarmigan) and the availability of suitable denning habitat (Martell et al. 1984; Burgess 2000).

During spring and summer arctic foxes occupy areas near terrestrial denning sites remaining there during the relatively snow-free period from May to August (Burgess 2000). Important denning sites occur along coastal areas of Richards Island and the northern Tuktoyaktuk Peninsula.

The arctic fox is listed as Secure in the NWT (Government of the Northwest Territories [GNWT] 2000) and is not listed by COSEWIC (2002). Research on arctic fox is minimal, but it is noted that dens must not be disturbed and important habitats must be protected from disruptive land uses (Community of Tuktoyaktuk et al. 2000).

Based on likelihood of encountering suitable denning habitat, the arctic fox was selected as a final VC.

Muskrat

In the ISR, muskrats occur in particular concentrations in the Mackenzie Delta and coastal Beaufort region (Dome et al. 1982, TCCP 2000). Although Richards Island contains less suitable muskrat habitat compared to the delta, an intermediate number of muskrat pushups on upland lakes of Richards Island and near the Parsons Lake area have been recorded (Slaney 1974). The exact number and distribution of muskrat pushups on and around the Burnt Lake project area on Richards Island are not known.

Muskrats burrow into the banks of lakes and streams in areas where aquatic plants are accessible for food and building materials (Dome et al. 1982, Jelinski 1989). Muskrats construct pushups, which are small mounds of vegetation built over holes in the ice that afford cover for feeding (Dome et al. 1982, Martell et al. 1984).

Muskrat numbers fluctuate widely in the Mackenzie Delta region, possibly exhibiting a cyclical pattern in response to factors such as food availability, suitability of denning sites, the freezing of shallow lakes, and predator abundance (Martell et al. 1984). Local residents have noted an apparent cycle with respect to the number of muskrats (IICCP 2000) and Erb et al. (2000) detected a four-year cycle of muskrat population highs and lows in subarctic-arctic ecozones. While muskrats in the ISR appear to be currently abundant, local residents have voiced concern that the health of the muskrat population was better when there was more trapping (IICCP 2000).

As such, the muskrat was selected as a final VC.

Waterfowl

Waterfowl are an important subsistence food resource for local communities during spring and fall hunts. Concern regarding potential effects on waterfowl relate to:

- brood-rearing and moulting by white-fronted and Canada geese
- moulting and staging of lesser scaup, greater scaup, white-winged scoter, surf scoter and long-tailed ducks
- nesting shorebirds
- brood rearing and moulting by tundra swans (of interest to the Canadian Wildlife Service)
- disturbance of colonial nesting gulls and terns

As this project is scheduled for completion by April 15, outside any timing windows related to the above waterfowl activities, waterfowl were not selected as a final VC.

11.6 Fisheries

The fisheries resources of the five lakes within the project area have not been assessed, but surveys of two similar lakes within the Burnt Creek watershed were conducted by DFO in 1980 (Lawrence et al. 1984). These lakes include Umiak Lake (472 ha; 4.5 m depth) and an unnamed lake (319 ha; 6.0 m depth). Fish populations in both lakes were similar and included broad whitefish, lake whitefish, least cisco, lake trout and burbot. Northern pike were captured in Umiak Lake but not in the unnamed lake. Lawrence et al, (1984) also recorded upstream and downstream migrations of anadromous broad whitefish in lower Burnt Creek, suggesting that lakes within the basin probably support both freshwater and anadromous populations of this species, dependant on degree of connectivity between specific lakes and Burnt Creek. Both lakes were reported as probable overwintering areas for all recorded species. Given the proximity and similarity between the lakes surveyed by DFO and the five lakes in the project area, it should be assumed that similar fish populations occur throughout.

The fish species discussed in the following sections are likely to be year-round residents in the project area lakes, and are of concern because of their potential importance to the local domestic fishery.

Broad Whitefish (Coregonus nasus)

Anadromous and non-migratory freshwater populations of broad whitefish are distributed throughout the Mackenzie River drainage and in the nearshore waters of the Mackenzie River estuary (TCCP 2000). Spawning adult fish probably overwinter in the Mackenzie River or Delta, while nonspawning adults overwinter in lakes of the outer Mackenzie Delta, including Richards Island (Lawrence et al. 1984; Sekerak 1992). During the summer, broad whitefish undergo feeding migrations along the coast of the Beaufort Sea. In the fall, adults undergo an upstream spawning migration, followed by spawning in mid-October to early November (Percy 1975; Lawrence et al. 1984) in rivers over gravel shoals (TCCP 2000). Post-spawning migrations occur gradually over the winter months (TCCP 2000).

Lake or Humpback Whitefish (Coregonus clupeoformis)

Lake whitefish are usually considered to be primarily a freshwater species, but both anadromous and non-migratory freshwater populations of lake whitefish are distributed throughout the Mackenzie Delta, nearshore areas of the Mackenzie estuary and the Tuktoyaktuk Coastal Plain. Overwintering occurs in the lakes and channels of the lower delta or in freshwater areas of the inner estuary and Tuktoyaktuk Coastal Plain (Sekerak et al. 1992; Lawrence et al. 1984). Lake whitefish spend the summer feeding along the coast and in lakes and streams of the outer delta. In the fall, adult whitefish migrate up the Mackenzie River to spawning locations. Spawning occurs in late September or early October over stone or hard silt substrates in the Mackenzie River or in lakes of the upper Mackenzie Delta (TCCP 2000; Percy 1975).

Least Cisco (Coregonus sardinella)

Non-migratory and anadromous populations of least cisco are present in a wide range of habitats in the southeastern Beaufort Sea and Mackenzie Delta regions. Lacustrine forms occur in upland and coastal lakes of the Mackenzie Delta and Tuktoyaktuk Coastal Plain, while anadromous forms migrate and feed along the coast in the summer from June to mid-September (Percy 1975) and undergo an upstream migration to spawning and overwintering areas beginning in August. Spawning occurs in late September or early October in shallow water over sand and gravel substrates. Overwintering occurs in nearshore areas and lakes of the inner and outer Mackenzie Delta (Sekerak et al. 1992). Least cisco constitute an important component of the Arctic food web, serving as a food source for many fish, mammals and birds (TCCP 2000).

Lake Trout (Salvelinus namaycush)

Although considered to be a deepwater species throughout much of its range, lake trout typically inhabit shallow tundra lakes within the Tuktoyaktuk Coastal Plain. These lakes are much less prone to flooding than lakes of the inner Mackenzie Delta and access to between lakes is variable. Lake trout are most often associated with this habitat in winter

(Sekerak et al. 1992). The general biology of lake trout in the region is not well understood.

Burbot or Loche (Lota lota)

Burbot are a primarily freshwater species (Lawrence et al. 1984) and are one of the few Canadian fish to spawn in mid-winter, from January to March (TCCP 2000). Burbot typically spawn in lakes. Burbot overwinter in lakes and estuarine coastal areas of the Beaufort Sea (Sekerak et al. 1992). They move into deeper water in the summer and to the mouths of creeks in the fall to feed (TCCP 2000; Percy 1975).

Northern Pike or Jackfish (Esox lucius)

Northern pike are primarily a freshwater species, able to tolerate only low levels of salinity (Percy 1975). Overwintering areas include deeper channels of the Mackenzie River drainage (Sekerak et al. 1992) and inland lakes throughout the region. In the early spring pike move into calm shallow lakes and smaller tributaries where they spawn on aquatic or flooded vegetation (TCCP 2000).

Species at Risk

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has been given legal responsibility under the Species at Risk Act (SARA) for assessing and identifying species at risk. At this time there are no COSEWIC listed (i.e., Endangered or Threatened) species that occur in the study area, although least cisco have been placed on Group 2 (Intermediate Priority) candidate list for review and assessment. The freshwater form of the fourhorn sculpin (Myoxocephalus quadricornis) has not been recorded in the project vicinity, but it is known to be widely distributed in the region Mackenzie Delta region and Tuktoyaktuk Coastal Plain. This species (freshwater form) was designated as a species of 'Special Concern' by COSEWIC in 1989 and is currently under review.

11.7 Heritage Resources

Heritage resources include all archaeological sites, historic sites, burial sites, artifacts and other objects of historical, cultural or religious significance. A review of current heritage site documentation and pertinent NTS maps, satellite images, air-photos and development plans was undertaken and integrated into a relational GIS for review and planning purposes. The review was followed by a detailed field assessment. The objective of the assessment was to examine the proposed well sites and access routes in relation to recorded and unrecorded heritage sites, and to provide construction alternatives to ensure avoidance of heritage resources. Bison Historical Services, in conjunction with IEG, conducted the assessment.

Proposed access routes and well sites were overflown in a helicopter at low elevation and slow speeds while the terrain was scanned for visible cultural materials or likely terrain. In cases where a possible site was identified from the air, the helicopter was landed and the area was examined and evaluated. In cases where terrain with potential for buried or difficult to identify sites was recognized, the helicopter was landed and an intensive ground reconnaissance accompanied by judgemental shovel testing was carried out.

Three new sites were identified. Newly identified sites are all prehistoric lithic scatters and/or campsites. Two previously identified sites were also examined in connection with the program.

Areas where potential sub-surface ground disturbances can reasonably be anticipated, were subjected to a higher level of sub-surface shovel testing than other locales. The majority of these tests were in proposed well site areas, where the greatest potential for sub-surface impacts exists, and at possible access points on the east shore of Richards Island. Access to the interior of Richards Island from the margin of Kittigazuit Bay is difficult, largely because of the height and steepness of the banks along shore. For practical reasons and to minimize impacts, a gentle upward slope is required. Such slopes are often encountered only at creek mouths. Not only are potential ground disturbances more likely in these settings, but a higher potential for heritage sites exists in such locations. Consequently, each of three access points was carefully examined and, if necessary, judgementally shovel tested. One of the proposed access routes could potentially have impacted sites in the area. The lead archaeologist, in conjunction with EnCana's construction supervisor, modified the proposed access to avoid all newly identified and previously known heritage sites. With this modification, all known sites will be avoided by the proposed Encana Burnt Lake well site and access route.

11.8 Site Reconnaissance

Additional field reconnaissance was conducted from June through August 2003. Water quality at nearby lakes was sampled and tested using standard analysis on lakes that may be used to supply the rig and camp. Vegetative cover at the potential drill locations consists of ground covers and low shrubs, including Labrador tea, lupin, willow, dwarf birch, crowberry, cranberry, blueberry, and grasses and sedges.

Kiggiak-EBA was contracted to assess and identify good potential sump locations in the vicinity of the well sites. At the proposed N16 location, the area is gently rolling (ridge <5% grade), with tussocks throughout and wet polygons in low-lying areas, south of the ridge. There is no standing water or apparent drainage courses on the ridge. Test pit logs at the proposed sump site show that soil is primarily silt (beginning at 0.1 m below grade) with traces of clay, and organics at the surface. Permafrost was encountered 0.2 m below the surface.

Plate 1 View northeast from proposed N16 well location.

The K16 location is also on rolling terrain, but with local side-slopes of up to 35%. Large tussocks have formed throughout with wet polygons in the low-lying areas. There is no standing water or apparent drainage courses. Soil is primarily silt (beginning at 0.03-0.12 m below grade), with traces of clay, medium and coarse-grained gravel and cobbles. Permafrost was encountered at 0.5 m below the surface, (9 August, 2003) with ice lenses up to 50 mm thick observed in the shallow testpits. Given the steep local side-slopes and presence gravel and cobbles, EnCana determined that this site was inappropriate for a sump.

The field reconnaissance at the proposed D16 location showed the topography surrounding the well site was not appropriate for the placement of a sump near the well site. A more appropriate location for a remote sump was identified approximately 200 m to the south. The proposed sump location is relatively flat with <2% gradient. Similar to N16, there are tussocks throughout and well-developed wet polygons in a low-lying area to the north. No standing water or apparent drainage courses were encountered in the vicinity of the proposed sump. Soil is primarily clayey-silt, with frozen soil at 0.35 m below grade, and peat to 0.1 m.

12 PROPOSED MITIGATION AND ANTICIPATED ENVIRONMENTAL IMPACTS

Without adequate mitigation, the potential exists for negative environmental impacts to occur during construction and drilling. Potential environmental impacts resulting from the construction of the well site, sump and access roads and the drilling program may include: damage to soils and permafrost, short-term disturbance to wildlife, degradation of aquatic environments and alteration of vegetation and wildlife habitat.

The following section identifies potential environmental impacts, and their significance, and recommends measures to avoid or mitigate those impacts. A key feature of environmental protection is planning to drill the well during the winter months and confine the physical footprint of the activities to the smallest possible area., thus minimizing the potential for damage.

With the implementation of this strategy and additional appropriate mitigation, it is anticipated that the program will not result in significant negative or residual impacts.

12.1 Mitigating Potential Environmental Impacts of Project Operations

12.1.1 Permafrost and Soils

The program could have negative impacts on permafrost and soils during access and lease construction, especially associated with sump construction, and during drilling.

Disturbance of the surface vegetation, soils and/or organic mat during construction and operations, could result in permafrost thaw and erosion. To minimize potential impacts to permafrost and soils the following mitigation measures will be implemented:

- The access will have a minimum of 15 cm snow and ice cover and be limited to approximately 20 m wide on overland portions;
- The lease will have a minimum 40 cm thick ice pad and dimensions of the lease will be limited to what is required to accommodate equipment and ensure safe working conditions;
- Activities will only take place when the surface is frozen and if any rutting occurs the activities will be suspended;
- Only tracked vehicles will be used until the access has been built up with a sufficient snow and ice cover;
- The lease and access will be clearly marked and signed, and no equipment (except snowmobiles) will be allowed to drive off of the designated lease or access;
- Sensitive environmental areas to be avoided will be identified with the assistance of the monitors and will be clearly flagged, marked and reported to all crew members;
- All pingos will be avoided, as per the conditions of the permit;
- Steep slopes will be avoided wherever feasible; and,
- If a steep bank (>1 m) cannot be avoided, a ramp will be constructed using only clean snow and ice.

Any inadvertent surface disturbance will be repaired immediately, with the coordinates of the location marked and reported by the Environmental Monitor.

The drilling process could create temperatures that cause the permafrost to thaw. A KCl drilling mud system and mud cooler will be used to prevent permafrost degradation during drilling. The annulus surrounding the conductor pipe will also be refrigerated to 20 m to minimize thermal disturbance and possible deterioration of the permafrost.

Surface vegetation and soils will be disturbed at the excavated sump site and could potentially cause erosion or permafrost thaw. During the planning phase, field assessments were conducted to examine the terrain, topography, surface drainage, soil and ground ice conditions and permafrost conditions in the vicinity of the proposed well sites. Based on the results of the assessment, and spatial requirements to construct the sump, two locations have been identified and surveyed as good potential sump sites.

Prior to excavation of the sump, core samples will be examined to confirm results of the field assessments. To mitigate impacts of equipment on the vegetation and soils, an ice pad (20 m width) will be built around the sump, prior to excavation. Equipment will only be allowed to operate on the ice pad and sump. Prior to blasting the sump, the topsoil and surface materials (approximately 30 cm) will be stripped and placed in a separate spoil pile on the ice pad. The remainder of the excavated material from the sump will also be placed in a spoil pile on the ice pad. Placing the spoil piles on the ice pad avoids inadvertent surface disturbance around the sump during the backfill operation.

Other mitigation measures to be implemented include:

- Drilling waste will be deposited in the sump throughout the operation in layers across the base of the sump to facilitate freezing and all materials will be tested to ensure they are completely frozen prior to backfilling;
- The backfill material will be replaced in layers with water (up to the level of the surrounding layer), track-packed and allowed to freeze before additional layers are replaced, which will minimize the settlement of the backfill material;
- There will be approximately 3.5 to 4 m of compacted backfill material placed between the drilling waste and the active layer;
- A 1.0 to1.5 m cap of compacted material will be placed on the top of the sump, with a minimum 2% grade and 2 m overlap on all sides;
- The topsoil will be replaced on the top of the sump to facilitate revegetation;
- The surface will be revegetated with a native or non-aggressive seed mix agreed to with the Inspector; and,
- The sub-surface temperature and salinity will be monitored at the sump and surrounding locations for three years to ensure the integrity of the sump has not been compromised.

With application of these mitigative measures, residual effects on soil, terrain and permafrost are not anticipated and thus the impacts concluded to be low in magnitude, local in extent, and short-term in duration. Effects at the sump site however, will be medium-term in duration.

12.1.2 Aquatic Resources

Potential impacts to drainages, waterbodies and fish populations may occur during construction or drilling operations and include the removal of aquatic habitat due to water drawdown in lakes, stream bank erosion, and the introduction of sediments and/or pollutants to waterbodies.

The following measures will be implemented to mitigate potential impacts of water withdrawal on aquatic resources:

- All water intake hoses will be fitted with screens, as per DFO guidance, to prevent impingement or entrainment of fish;
- Water will only be withdrawn from lakes, and at volumes, approved by DFO to ensure potential impacts on overwintering fish populations are negligible; and,
- Contour maps have been developed, and will be further refined with additional data in the winter, to ensure water is withdrawn from the

deepest part of lakes, wherever possible, to mitigate potential localized impacts.

Constructing and utilizing accesses across lakes may result in indirect impacts to waterbodies and streams if soil and permafrost are impacted, thereby causing erosion and sedimentation. Measures implemented to mitigate impacts to soil and permafrost, as detailed above, should also mitigate potential indirect impacts to waterbodies. In addition, the following measures will be implemented to mitigate impacts:

- Accesses will be constructed to intersect the bank at approximately 90°; and,
- No clearing of vegetation will be conducted, including clearing in riparian areas.

The potential well sites are located in an area with no identified permanent drainages, or ephemeral drainages, in order to minimize the potential for contaminants and/or spills from the lease pad to enter any waterbody. In addition, the proposed sump sites have also been located a minimum of 100 m from any permanent waterbody and in an area where no drainages or ephemeral drainages have been identified. To prevent pollutants from entering any waterbody during operations, the following measures will be implemented:

- No materials will be stored on the ice of any waterbody, unless approved by an Inspector;
- Ice profiling will be conducted throughout the program to minimize the risk associated with equipment falling through the ice;
- Fuel will be stored at least 100 m away from any waterbody and will have secondary containment, and/or be placed on an ice pad with a berm surrounding it;
- Drip pans will be used for all mobile equipment when being refueled, serviced or when stationary;
- Re-fuelling and maintenance of vehicles and equipment will be undertaken only at designated areas set back a minimum of 100 m from any waterbody
- Equipment will be maintained and checked regularly to identify leaks and potential leaks;
- Any waste oil from the drilling unit will be collected and stored at the drilling unit;
- Re-fuelling hoses will be equipped with spill proof mechanisms and only designated fuel managers will be authorized to conduct refuelling operations; and,
- Emergency re-fuelling and maintenance which may be required outside designated areas will observe all precautions including use of drip pans or other means to minimize the risk of fuels, oil or other fluids from leaking onto the ground.

All spills will be cleaned up immediately and reported appropriately as per the Oil and Chemical Spill Response Plan.

Potential impacts to aquatic resources related to water drawdown, erosion and sedimentation are considered low in magnitude, local in extent and short-medium term in duration, given the mitigation measures. Given mitigation, prevention and spill response plans in place, the risk of a waterbody being contaminated is low. Most spills, if they occur, are small, isolated events and are confined to the workspace with negligible impact.

12.1.3 Vegetation

Potential impacts to vegetation from construction and use of the access and lease include compression, compaction of the soil and root system and uprooting. Measures implemented to mitigate impacts to soil and permafrost will also minimize potential impacts to vegetation. The timing, location, and equipment used for this project will ensure that compression of vegetation, destruction of the peat layer, or exposure of the soil will be minimized. The project will be conducted in winter when the soil is completely frozen, thereby minimizing compaction of root systems. The snow and ice cover on the access and lease will also protect vegetation and no clearing of vegetation will be required. Monitoring will be undertaken throughout the project to ensure integrity of the snow and ice cover and that rutting into the vegetation and/or soil layer does not occur.

If it is inadvertent or deemed absolutely necessary (i.e., spills or other mitigation measures for accidents) the surface will be reinsulated with organic cut material to protect permafrost and promote natural revegetation. As agreed to with the Inspector, a native or non-aggressive seed mix may be applied to assist reclamation on all areas where surface organic mat was disturbed. Any disturbances will be stabilized.

Impacts to vegetation will be confined to the access and lease (Figure 6), and are expected to be low in magnitude, short-term and reversible.

12.1.4 Wildlife

Construction and ongoing operations may impact wildlife through temporary habitat removal or alteration or as a result of; direct human-wildlife interaction. Contact with humans and their activities may result inmortality due to collisions with vehicles or ingesting chemical or other harmful materials. Additionally,sensory disturbance may result in temporary loss of habitat and/or,disturbance of denning animals. Potential impacts related to key species are outlined below, with proposed mitigation measures. Wildlife and environmental monitors will be employed throughout the program and will assist in addressing any wildlife issues or concerns as they arise.

To limit the potential for, and impact of, direct human-wildlife interaction, the following measures will be employed:

- Speed limits will be established and enforced on all access routes to minimize the risk of wildlife mortality due to collisions;
- The sump area will be fenced to prevent access by wildlife;
- Chemicals, fuels and other potentially harmful materials will be stored in areas inaccessible to animals;
- Camp wastes will be incinerated daily and the camp area will be kept clean at all times to avoid attracting wildlife; and,
- Crew members will be informed that feeding or harassing any wildlife is strictly prohibited.

With mitigation measures implemented to minimize impacts to permafrost, soils, aquatic resources and vegetation, the potential impacts to wildlife habitat will be minimized. Project timing (winter) also avoids critical periods for wildlife, including breeding and migration.

Caribou

The construction and use of the access route may disturb caribou through direct human interaction or temporary habitat alteration causing them to avoid the area or potentially to use the access as a travel corridor. However, the program is located at the edge of the range of the Bathurst herd, the route will only be used by EnCana for a short time, and its effects will be localized, affecting at most only a small portion of the herd. The magnitude of the impact is expected to be low and be restricted to only a few individuals. No deliberate attempts will be made to force or control movement of the animals, if caribou are encountered.

Grizzly Bear

No human-bear interaction is anticipated during the operations phase of the drilling program, as no grizzly bears have been documented as occurring outside of their dens in winter over the last several years of activity in the Mackenzie Delta (Nagy 2002, pers. comm.).

However, given the suitable grizzly bear denning habitat in the vicinity of the proposed program, bears within their dens may be disturbed by program operations and activities associated with program access routes. If disturbed, a bear may incur energetic costs due to stress, or abandon its den and cubs (Jalkotzy et al. 1997).

Biologists from RWED will be conducting a survey in October to identify locations where radio-collared bears have denned. Biologists will also survey areas in the immediate vicinity of the proposed program to identify potential denning locations (Nagy, 2003 pers. comm.). After the survey, EnCana will discuss the sensitive locations with RWED and agree to appropriate avoidance measures. Linnel et al (2000) recommended a 1 km buffer around known denning sites. Given efforts to avoid potentially sensitive areas and the relatively low density of bears in the area (i.e. an average of 4 bears/1000 km2; Nagy et al. 1983), the potential effects are expected to be low to negligible.

In the unlikely event a bear is disturbed from its den, the Wildlife Monitor will be informed immediately and a 300-500 m pullback of construction activities will occur to allow the bear to return to its den. This exact distance of the pullback will be determined by the monitor according to the local terrain. RWED will be notified immediately if any bear is disturbed from the den.

Muskrat

Muskrat in the vicinity of the project may be subject to habitat loss or degradation directly by pushup destruction, and indirectly through the effects of water drawdown, erosion, and pollution to waterbodies.

Measures to mitigate impacts to aquatic resources are outlined above. Visible muskrat pushups will be avoided whenever possible to minimize disturbance. Potential impacts are expected to be localized and low in magnitude, being restricted to a few individuals.

Arctic Fox

Arctic fox may be denning in the vicinity of the proposed program. To minimize potential impacts, the wildlife monitor will alert crews to the presence of dens or arctic foxes in the vicinity of the program area, and ensure that measures to mitigate potential effects of direct human-wildlife interaction are implemented, including the avoidance of dens.

Polar Bear

The proposed program could potentially impact polar bears through direct human interaction, resulting in injury or harassment or through of bears that have already established dens. Newborn polar bears must remain in the den for over two months post partum, and are potentially vulnerable to disturbances near dens (Amstrup 1993). While it is suggested that polar bears are more sensitive to noise as the winter progresses due to decreasing fat reserves, preliminary observations of polar bear dens exposed to varying levels of human disturbance have indicated that the denned bears may not be exposed in ways that alter their productivity (Amstrup 1993). Furthermore, the low density of polar bear dens in the region make the occurrence of population level impacts from localized development unlikely (Amstrup 2000).

In the unlikely event a bear is disturbed from its den, the Wildlife Monitor will be informed immediately and a 300-500 m pullback of construction activities will occur to allow the bear to return to its den. This exact distance of the pullback will be determined by the monitor according to the local terrain. RWED will be notified immediately if any bear is disturbed from the den.