7.0 LOCATION

The proposed project is located mainly on private 7(1)(a) lands in the Inuvik 1 and 2 blocks, and extends onto Crown lands in the Mackenzie River Delta region of the Northwest Territories. The program encompasses approximately 4200 km^2 of land, located primarily along the Middle and East Channels of the Mackenzie River (Figure 1). The seismic program is located between 68°30'-69°09'N and 133°42'-135°09'W. The project area is approximately 63 km south of Tuktoyaktuk and 25 km north of Inuvik at its closest point.

8.0 TRADITIONAL AND OTHER LAND USES

Land use in the region includes subsistence trapping, hunting and fishing, as well as tourism related recreation. Traditional land and continuing subsistence use by the Inuvialuit of the region is documented within Community Conservation Plans for each community in the Inuvialuit Settlement Region (ISR). The proposed project falls within the Tuktoyaktuk, Inuvik and Aklavik Conservation Planning Areas as defined by the respective Community Conservation Plans (TCCP, IICCP and AICCP 2000). The community conservation plans identify four management categories of lands (B through E). The project falls within categories B through D. The descriptions are as follows:

Category B: Lands and waters where there are cultural or renewable resources of some significance and sensitivity but where terms and conditions associated with permits and leases shall assure the conservation of these resources.

Category C: Lands and waters where cultural or renewable resources are of particular significance and sensitivity during specific times of the year. These areas shall be managed so as to guarantee the conservation of the resources.

Category D: Lands and waters where cultural or renewable resources are of particular significance and sensitivity throughout the year. As with Category C areas, these lands and waters shall be managed so as to guarantee the conservation of resources.

The proposed seismic program lies within areas defined as Special Management Areas, where the Inuvialuit outline recommended land use practices, and where timing of the program must be considered in relation to local harvesting of natural resources. Special Management Areas within or near the project area are listed in Table 5, illustrated in Figure 4 and described in relation to the proposed project.

TABLE 5

SPECIAL MANAGEMENT AREAS WITHIN OR NEAR THE PROJECT AREA*

Site Number And Protective Status Category	Name	Location Description	Location In Relation To Project
316C	Winter Fish Harvesting	Various sites within Tuktoyaktuk planning area including Liverpool Bay.	~210 km of line on southeast portion of program. Overlaps 6% of area.
322C	Grizzly Bear Denning Areas	Coastal areas including Richards Island and Tuktoyaktuk Peninsula.	~120 km of line north of Tunanuk. Overlaps 1.5% of denning area.
701B	Bluenose-west Winter Range	Starting at the southern ISR boundary, up to Tunanuk, northeast to include the western portion of the Tuktoyaktuk Peninsula, southeast to include the Anderson River, and south to the ISR boundary.	~368 km of line southeast of Swimming Point. Overlaps 3% of winter range.
702B	Caribou Hills	Upland area west of Parson's Lake and paralleling East Channel of Mackenzie River.	~306 km of line on southeast portion of program. Overlaps Caribou Hills.
704D	Fish Lakes and Rivers	Rivers & lakes along the shoreline to the west of Tuktoyaktuk, inland to their headwaters including Parsons and Yaya Lakes.	~0.75 km of line overlaps less than 1% of this Special Management Area on northwest portion of program.
715C	Key Migratory Bird Habitat	Includes Shallow Bay, Olivier and Ellice Islands, Perry Island and part of Richards Island.	~5 km of line running north/south, overlaps less than 1% just north of Reindeer Channel.
718D	Central Mackenzie Delta	Lands and waters defined by eastern edge of Mackenzie Bay, bordered to the south by Reindeer Channel, with the eastern border as Main Channel, with an extension along the East Channel.	~52 km of line overlaps 13% of area near East Channel and north of Reindeer Channel.
719C	Inner Mackenzie Delta	The boundary is marked by the western edge of the Mackenzie Delta, along Shallow Bay, with the northern border being Reindeer Channel, the eastern border being the East Channel, and the southern border being the ISR boundary line.	~240 km of line overlaps about 14% of this Special Management Area south of Tunanuk.

* AICCP, IICCP and TCCP, 2000

The habitats of many wildlife species harvested by the Inuvialuit are located within the general vicinity of the project, including site No. 316C – Winter Fish Harvesting, site No. 322C – Grizzly Bear Denning Areas, site No. 701B – Bluenose-west Caribou Winter Range, site No. 702B – Caribou Hills, site No. 704D – Fish Lakes and Rivers, site No. 715C – Key Migratory Bird Habitat, site No. 718D – Central Mackenzie Estuary, and site No. 719C – Inner Mackenzie Delta. A concern of communities utilizing the project area is that industrial development may have a negative impact on sensitive wildlife habitat that local users have traditionally utilized for subsistence harvesting (IICCP 2000). Wildlife/Environmental Monitors will be present during the entire seismic program and will alert ground crews to potential environmental conflicts

Site No. 316C – Winter Fish Harvesting is located on private 7(1)(a) and 7(1)(b) lands and Crown lands within the ISR. This area is important for subsistence harvesting in the summer, fall, and winter. The project area overlaps approximately 6% of this management area. No effects on fish habitat are predicted to result from this project due to the mitigative measures developed for aquatic resources (Section 5.2 of Table 10).

The northern portion of the proposed program occupies approximately 1.5% of site No. 322C – Grizzly Denning Habitat. This habitat is located on Crown lands within the ISR. Site No. 322C is an important denning area for grizzly bears from October to May. A wildlife/environmental monitor will be present during the entire seismic program and will alert ground crews to potential bear conflicts.

Site No. 701B – Bluenose-west/Cape Bathurst caribou winter range is located on private 7(1)(a) and 7(1)(b) lands and Crown lands within the ISR. This site is important as the herd is relied upon for harvesting by various Inuvialuit communities (within the winter caribou harvesting area (site No. 315C)) as well as aboriginal communities outside the ISR boundary. The proposed project overlaps approximately 3% of this management area. The community working group of Tuktoyaktuk is concerned that potential oil and gas activities within the ISR and neighbouring settlement areas may cause the herd to change its migration route due to a degradation of habitat (TCCP 2000). In order to mitigate any potential effects wildlife monitors will be employed to assess any potential wildlife conflicts.

Site 702B – Caribou Hills is located on private 7(1)(a) lands within the ISR. It is an important site due to the unusual transition zone between alluvial taiga and low tundra habitats, the unique successional characteristics of the plant life and the use of the area for subsistence harvesting and berry picking (IICCP 2000). The project area lies within 80% of the management area. The main concern of the community working group is that land use activities may have a negative impact on this sensitive site (IICCP 2000) however, the project will be completed during the dormant season for plants and impacts related to vegetation crushing will be restricted to aboveground woody material with the root systems remaining intact.

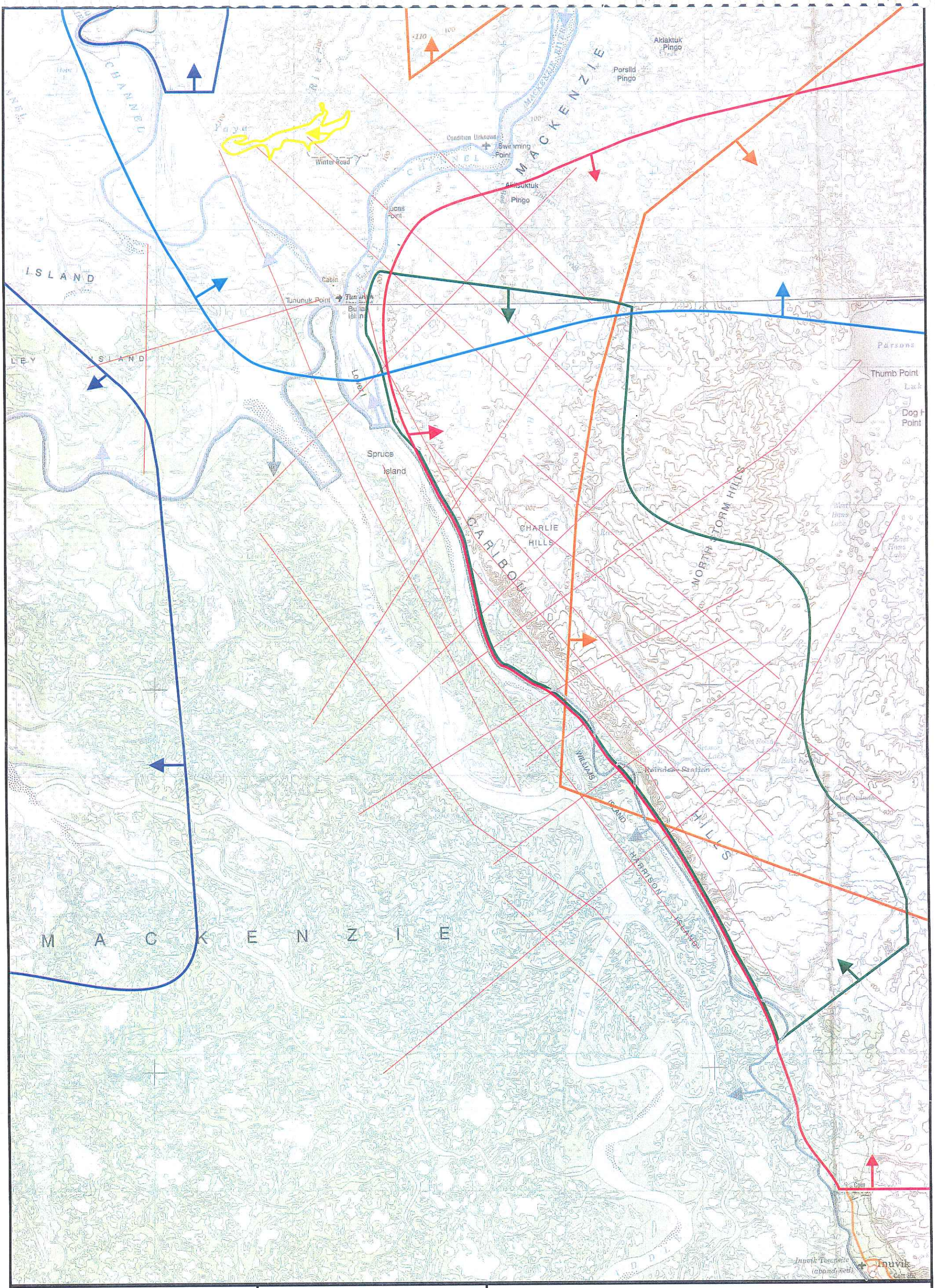
No. 704D – Fish Lakes and Rivers is located on private 7(1)(a) and 7(1)(b) lands and Crown lands and waters within the ISR. The area contains valuable fish habitat that is important to both communities of Tuktoyaktuk and Inuvik. Less than 1% of the project area falls within this management area and as previously mentioned, no effects on fish habitat are predicted to result from this project due to the mitigative measures developed (section 5.2 of Table 10).

Site No. 715C – Key Migratory Bird Habitat is located on private 7(1)(a) lands and Crown lands and waters within the ISR. The site is important nesting and breeding habitat for birds from May to September and subsistence harvesting of waterfowl occurs from June to September (IICCP 2000). Due to the timing of operations and minimal amount of overlap (less than 1%), migrating birds will not be affected by the proposed program.

Site No. 718D – Central Mackenzie Estuary is on both private 7(1)(a) lands and Crown lands within the ISR. This site is important for its concentration of beluga whales, use as an overwintering and nursery area for a variety of fish, extensive use by feeding anadromous coregonids (whitefish), and function as a transition area between Shallow and Kugmallit bays (IICCP 2000). The project area overlaps approximately 13% of the management area. Beluga whales will not be present in this area during the proposed program, and no effects on fish habitat are predicted to result from this project due to the mitigative measures developed (Section 5.2 of Table 10).

Site No. 719C – Inner Mackenzie Delta is located on private 7(1)(a) lands within the ISR. The site is important due to its habitat for fish, waterfowl, moose and furbearers. It is also used by the people of Aklavik for trapping and hunting muskrats during the spring and setting fish nets at all times of the year. Also found in the area are many historical, cultural and archaeological sites (IICCP 2000). The project area overlaps approximately 14% of this management area. In order to mitigate any potential effects, wildlife monitors will be employed to assess potential wildlife conflicts in the area of operations and known archaeological sites will be identified during survey control, and avoided through the use of a vehicle tracking alarm system. Setbacks will be employed during the course of the program to avoid disturbance to sensitive areas (Table 11, 8.2 and 5.2.5)

Chevron has undertaken consultation with local Hunters and Trappers Committees (HTC) to ensure that individuals are aware of ongoing exploration activities in the project area. Communication with HTC's will be ongoing during the course of the program.



Inuvialuit Environmental Inc.

Legend

- Seismic Lines
- 316C
- 322C
- 701B
- 702B
- 704D
- 715C
- 718D
- 719C

Special Management Areas Within or Near the Vicinity of the Project

Scale 1:250,000 (0 — 5km)	700-00	October 2000	Figure 4

9.0 DEVELOPMENT TIMETABLE

The winter 2000/2001 seismic program was initiated during August 2000 beginning with the project planning phase. Chevron and their seismic contractor are proposing to commence groundwork in January 2001. Table 6 provides the proposed schedule for the winter 2000/2001 seismic program.

TABLE 6

DEVELOPMENT SCHEDULE

Project Activity	Estimated Time Frame
Planning	August – December/2000
Pre-survey Scouting	September – December/2000
Mobilization Equipment	September – December/2000
Mobile Camp Set-up	December 2000
Survey Control	December 2000
Survey	January – February 2001
Drilling	January – March 2001
Recording	February – May 2001
Final Clean-up	March – August 2001

* Time lines given in the above table are approximate and subject to change depending upon variables such as weather or ice thickness on proposed routes of travel.

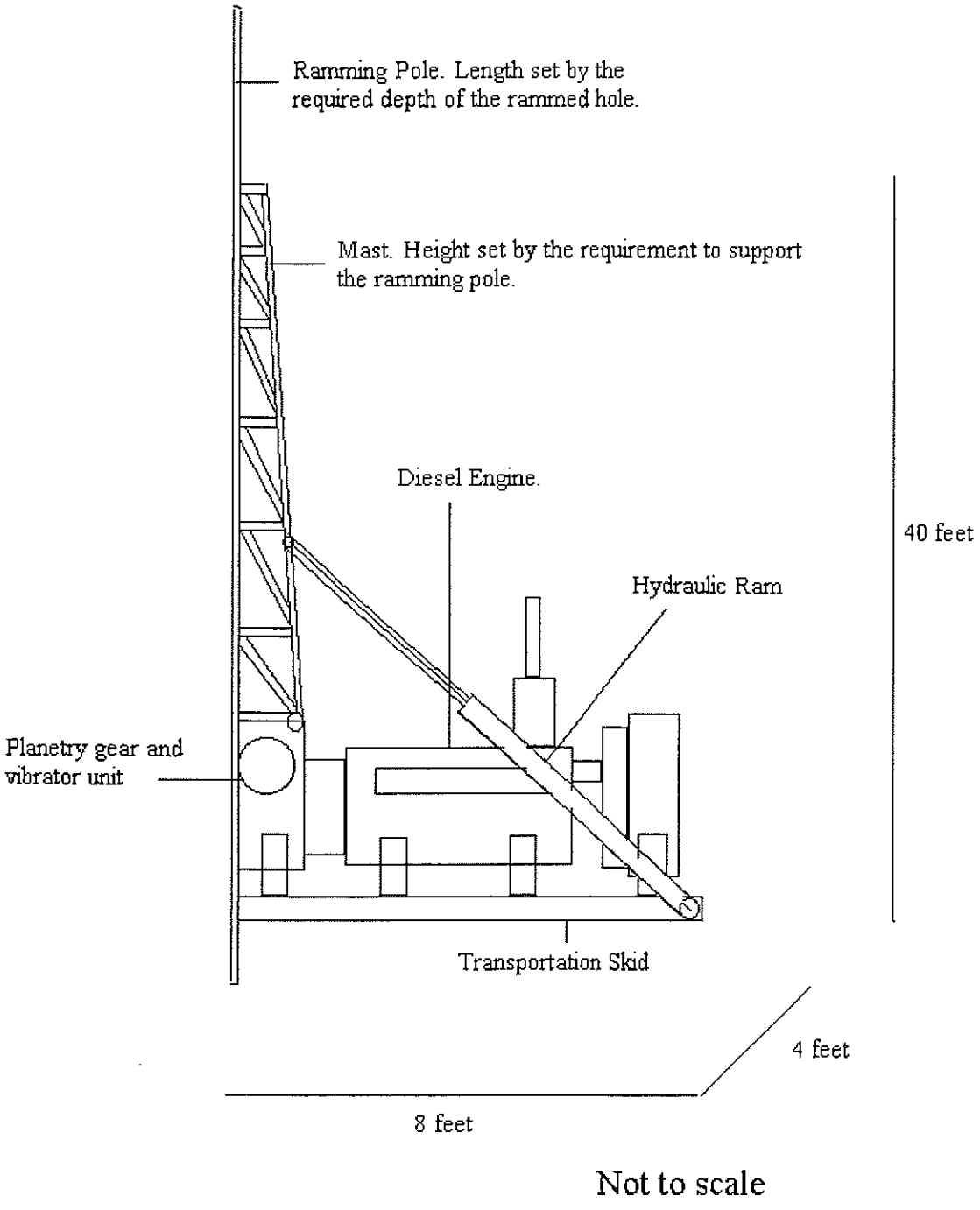
10.0 NEW TECHNOLOGY

10.1 Vibra-ram

Chevron and its seismic contractor Schlumberger, are proposing to utilize a drilling technology not previously used in the Mackenzie Delta region, as a secondary method to conventional drilling, on lakes that are not frozen to bottom. Vibra-ram is a drilling technology originally developed for use in environmentally sensitive wetland areas such as marshes, lakes and wetland areas.

The Vibra-ram consists of a mast approximately 14 m high that is used to support a 27 m hollow ram pole. The ram pole is a pipe of approximately 6.4 cm (2.5") diameter steel with a 3.8 cm (1.5") toothed rack attached to one side, and a rack-and-pinion mechanism used to push and retrieve the pole into and out of the ground. A vibrator unit attaches to the system below the mast. The vibrator unit is activated if the pole runs into a hard layer (i.e. permafrost) causing the pole to work with a hammer action until the hard layer is penetrated. The unit is hydraulically operated and powered by a diesel motor. All components are mounted on a single unit with skids that can then be mounted on a 110 Nodwell or equivalent (Drawing 1).

Drawing 1 Components of the Vibra-ram



10.1.1 Method of Explosive Emplacement

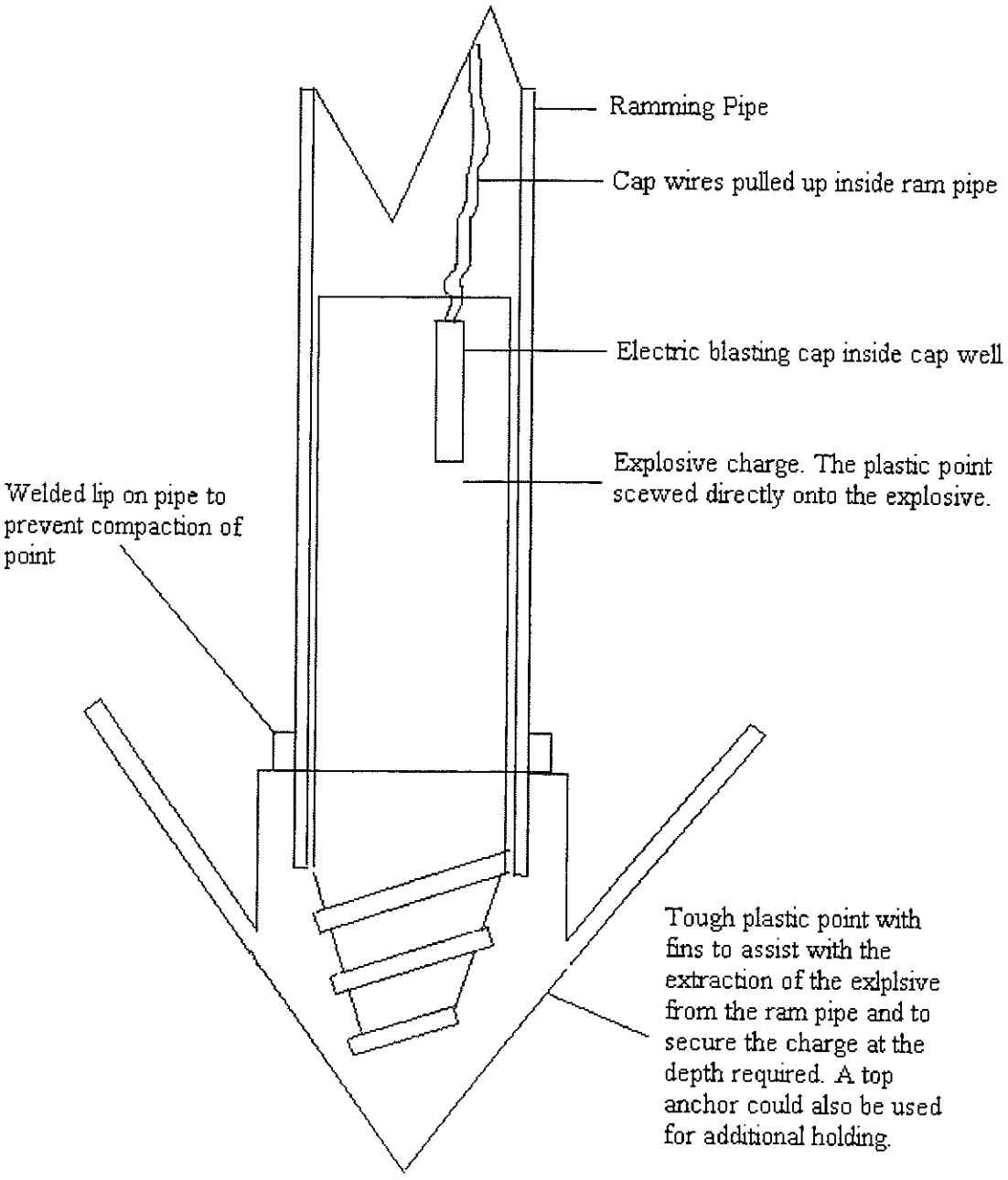
To submerge the charge to the setback depth required by Fisheries and Oceans Canada, the Vibra-ram operators must first run a rope down the inside of the ramming pole. The electric blasting cap is secured in a wooden block. The end of the cap wires are attached to a clip on the rope and pulled up inside the ramming pole, to protect them as the pole is forced into the ground. Once the majority of the wire is inside the pole, the cap is inserted into the charge and secured. A plastic point is screwed to the lower end of the charge (top anchors can also be used) and the charge is pulled into the pipe (Drawing 2). The plastic point is secured on the end of the pipe and the pipe is gradually inserted into the ground using a high frequency vibrating motion to the specific depth required. As the pipe is withdrawn from the hole, the charge is ejected out of the pipe and held in place by the fins on the point (Drawing 3).

The consistency of the lake bottom sediments should be such that redrawing the pipe creates a suction force. This suction will result in overlying sediments closing in on the shot hole creating a buffer to the explosive. Since the Vibra-ram technology does not employ a conventional augering technique, no cuttings are generated.

10.1.2 Environmental Benefits of Vibra-ram

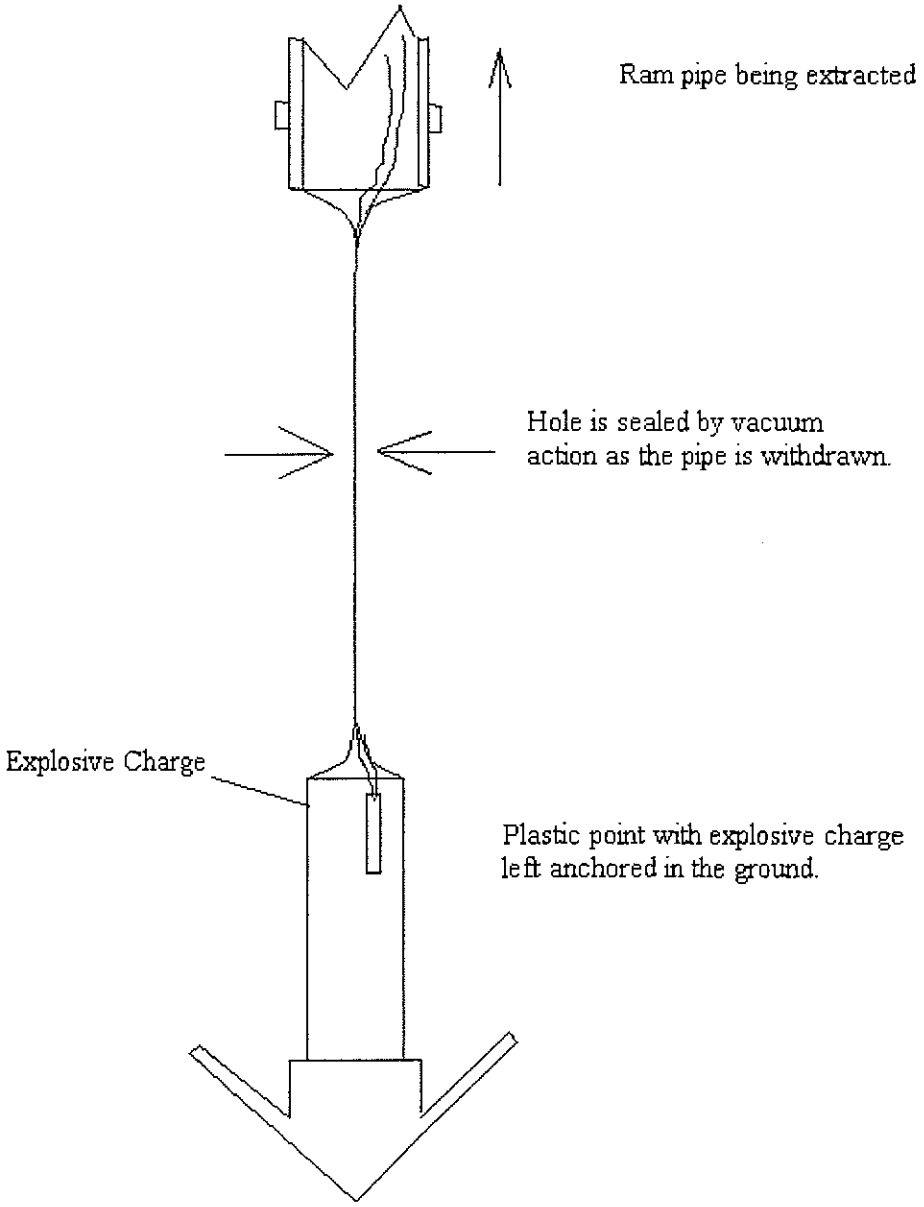
The Vibra-ram was designed to work in the sensitive wetland areas of the Mississippi River Delta in South Louisiana and operated there successfully for five years. The Vibra-ram technique should provide an environmentally sensitive alternative to conventional explosive emplacement, suitable for use within lakes not frozen to bottom in the Mackenzie River Delta. Minimal environmental impacts are predicted from the use of the Vibra-ram since no cuttings of any type are produced; the shot hole will seal due to the vacuum effect during recovery of the pipe; the ram creates very little disturbance at the location of the hole, thereby mitigating sediment suspension concerns and no circulation water is required.

Drawing 2 Explosive Deployment Stage 1



Not to Scale

Drawing 3 Explosive Deployment Stage 2



Not to scale

10.2 Sercel 408UL

A Sercel 408UL advanced seismic telemetry data acquisition system will be utilized on this project. The acquisition system consists of geophones, cabled to link the phones to the recording device inside a recording truck or "doghouse". Technical aspects of this new equipment includes Advanced Delta Sigma Technology (ADST) that allows 24 bit extended resolution recording with the highest instantaneous dynamic range and the lowest harmonic distortion of any land seismic system. The system also allows for superior spatial sampling capability, which will accommodate unlimited active channels (geophone groups) and unlimited line (entire lines with groups of geophones) with an additional roll-along capability of 8064 channels.

Significant advances in technology enables this unit to operate as a superior recording system having substantial impact on the quality of the data being recorded, while improving the environmental aspects of the project operation. Less travel is required along the seismic lines to service the equipment since power can be pushed down the line and the unit uses a simple battery management system.

Uncomplicated 4-wire cables, fewer components, a new telemetry scheme for superior cable break detection and rerouting of data, expedite and lessen the amount of trouble-shooting required, minimizing travel up and down a seismic line. The physical weight of the system on the ground is considerably lighter than other conventional systems, and therefore transport of equipment results in less ground impact along access routes or less air time when utilizing helicopters to deploy equipment.

10.3 Survey Control Network

The survey control points required for the 2000-2001 seismic program will be established using GPS survey methods. Surveyors will used tracked vehicles or snowmobiles for transportation while establishing survey control. Control points will be marked with a combination of wooden lath and steel rods with attached 2" aluminium caps.

Sites identified during survey control will be accurately plotted on maps and input to an Information Management System (IMS). The IMS includes a Vehicle Tracking System (VTS). The VTS tracks vehicle locations as they move along line sets. The system also has the ability to program exclusion zones including sensitive areas such as archaeological sites, identified during survey control. Therefore, the system can track the location of equipment used in the program and sound an alarm if a vehicle approaches an exclusion zone. This technology allows control of movement along lines, and restricts movement to identified access routes, thus reducing the potential for impacts to sensitive areas.

11.0 ENVIRONMENTAL OVERVIEW

11.1 Physiography and Bedrock Geology

The proposed seismic program lies both within the Tuktoyaktuk Coastal Plain Ecoregion of the Southern Arctic Ecozone and the Mackenzie Delta Ecoregion of the Taiga Plains Ecozone (ESWG 1995).

The Tuktoyaktuk Coastal Plain Ecoregion covers the outer Mackenzie River delta and the Tuktoyaktuk Peninsula bordering the Beaufort Sea (Plate 3). There are two main landscape types within the Tuktoyaktuk Coastal Plain ecoregion. One is composed of distinctive delta landforms at the mouth of the Mackenzie River. These include wetlands, active alluvial channels, and estuarine deposits. Characteristic wetlands, which cover 25–50% of the area, are lowland polygon fens, both the low- and high-centre varieties.

The second landscape type consists largely of broadly rolling uplands. Discontinuous morainal deposits mantle much of the area, except near the coast where fine-textured marine sediments cover the surface. Occurring less frequently are outwash aprons of crudely-sorted sand and gravel, and raised beach ridges along the shores of preglacial lakes. The resulting undulating terrain is studded with innumerable lakes and ponds (ESWG 1995).

The region is underlain by continuous permafrost with high ice content in the form of ice wedges and pingos. Sensitive terrain areas encountered within the project area include the eroded banks of the Mackenzie River and associated channels, as well as moderate to steep slopes adjacent to lakes (Plate 4). Permafrost slumping is often found adjacent to lakes.

The Taiga Plains feature typically subdued relief consisting of broad lowlands and plateaus incised by major rivers, the largest of which show elevation differences of several hundred metres (Plate 5).

Plate 3: Example of pingo and fen landscape found on the northern portion of Chevron's seismic program.

Plate 4: View of upland tundra east of the East Channel of the Mackenzie River where a portion of Chevron's proposed seismic program will be conducted.

Plate 5: Photo of upland tundra in the area of Chevron's proposed seismic program east of the East Channel of the Mackenzie River.

The nearly level to gently rolling plain is underlain by horizontal sedimentary rock, limestone, shale and sandstone and covered with organic deposits, or to a lesser degree, with undulating to hummocky morainal and lacustrine deposits (ESWG 1995). Alluvial deposits are common along the major river systems, including braided networks of abandoned channels.

The Mackenzie Delta Eoregion is composed of the southern two-thirds of the distinctive Mackenzie River Delta. The delta is a complex area of peat-covered deltas and fluvial marine deposits. The present delta is remarkable for its multitude of lakes and channels. Wetlands extend over 50% of this ecoregion, and are characteristically polygonal peat plateau bogs with ribbed fens (ESWG 1995).

11.2 Soils

The dominant soils of the Tuktoyaktuk Peninsula Ecoregion include Organic and Turbic Cryosols developed on level to rolling organic, morainal, alluvial, fluvioglacial, and marine deposits (ESWG 1995). These soils are underlain by a continuous layer of permafrost, unlike the soils of the Mackenzie Delta ecoregion, which are underlain by a discontinuous layer of permafrost. The dominant soils of the Mackenzie Delta ecoregion are Regosolic Static and

Gleysolic Static Cryosols with Organic Cryosols developed on level fluvioglacial, organic, and marine deposits (EWSG 1995). The organic soils found on the eskers of this ecozone are generally shallow, highly acidic, and nutrient-poor. The mineral soils are also poorly developed and often frozen (ESWG 1995).

11.3 Climate

Both ecoregions traversed by the proposed project experience very cold winters and cool summers. The mean annual temperature is approximately -9.5°C to 11.5°C in the Mackenzie Delta region with a mean summer temperature ranging from 4.5°C to 8.5°C and a mean winter temperature of -26.5°C (ESWG 1995). Winters in this area tend to be quite long as there is a period of approximately two months during which the sun does not rise above the horizon. In this dark period the ground radiates heat into space, the air grows colder and denser, and the atmospheric pressure begins to build. Very cold conditions prevail and may last for several weeks at a time. When temperatures reach such lows, the ability of the air to contain moisture is limited and very little precipitation falls. The mean annual precipitation ranges from 125–275 mm (ESWG 1995).

Snow and freshwater ice persist for six to eight months of the year. When the sun begins to rise above the horizon (January), the increased amounts of heat dissipate the high-pressure centre and storms prevail. By June most of the snow has melted, though lake ice may persist until July. During the seismic program, temperatures should average between -8°C and -36.4°C (RWED 1999).

11.4 Permafrost

Permafrost occurs throughout the project area. This layer often lies just a few centimetres below the surface and acts as a barrier that stops the downward flow of water. Consequently, even though there is little precipitation here, the soils are often waterlogged or frozen. Vegetation provides thermal protection against permafrost degradation. Vehicle and equipment traffic, and soil disturbance can degrade the permafrost (UMA 1999).

Repeated freezing and thawing of these soils creates features on the surface that include cell-like polygons, bulging hummocks, and bare mud boils where the soil is so active that no plants can take root. Intense frost heaving often splits apart the underlying bedrock and forces large angular "boulders" to the surface.

11.5 Vegetation

Permafrost detracts from soil productivity by chilling the soil and creating waterlogged conditions in the thawed active layer near the soil surface. Plant communities found in the vicinity of the project are relatively simple and are dominated by a few species that are well adapted to poor soil conditions and the harsh climate.

The predominant vegetation in the upland portion of the project consists of a ground cover of dwarf birch, willow, northern Labrador tea and tussocks of sedge (ESWG 1995). Poorly-drained sites usually support sedge and sphagnum moss, while tall dwarf birch, willow and alder up to 2.5 m in height may occur on warm sites (Gill 1971). Lowland delta vegetation consists primarily of black spruce, northern willow, horsetail and water sedge. Wetlands occur on 25–50% of the ecoregion and are lowland polygon fens, both the low- and high-centre varieties (ESWG 1995).

Eleven plant species of national significance are found in the delta (McJannet et al. 1995). However, due to the fact that the proposed project takes place in the winter these species will likely not be affected. Plants of national significance that may occur in the area are listed in Table 7.

TABLE 7

VEGETATIVE SPECIES OF SIGNIFICANCE FOUND IN THE VICINITY OF THE PROPOSED PROJECT

Common Name	Latin Name	Phytogeography	Habitat	NCR[1]
Pussytoes	*Antennaria friesiana*	Arctic-alpine	Alpine ridges and snowbeds.	N3T1
Mustard	*Braya pilosa*	Arctic	Sandy seashores.	NX
Fescue	*Festuca lenensis*	Arctic-alpine	Dry tundra.	N1
Junegrass	*Koeleria asiatica*	Arctic-alpine	Shale scree slopes and dry tundra.	N1
Pondweed	*Potamogeton subsibiricus*	Aquatic	Still waters.	N2
Goose grass	*Puccinellia poacea*	Arctic	Riverbanks, flood plains and tidal flats.	N1
Buttercup	*Ranunculus pallasii*	Arctic-alpine	Coasts and estuaries	N2
Buttercup	*Ranunculus turneri*	Arctic-alpine	Subalpine meadows.	N2
Willow	*Salix chamissonis*	Arctic-alpine	Tundra	N2
Willow	*Salix ovalifolia* var. *arctolitoralis*	Arctic	Sand beaches and terraces.	N2T2
Mustard	*Smelowski calycina* var. *media*	Arctic-alpine	Stony slopes and lakeshores.	N3T2

Notes:

1. The Nature Conservancy Ranks
   - Canada Rank (N): national status
   - Taxon Subrank (T): applied if a taxon is a subspecies or variety
   - The degree to which a species is imperiled is rated on a scale of 1 – 5 (from extremely rare to abundant), with X indicating the species is extirpated or extinct.

11.6 Wildlife

The habitats that include and surround the Mackenzie River Delta, support a wide variety of wildlife species including black and grizzly bear, polar bear, caribou, wolf, fox, snowshoe and arctic hare, beaver, muskrat, mink, ermine, arctic ground squirrel, beluga and seal. The proposed seismic exploration overlaps 1.5% of known grizzly bear denning area and approximately 3% of the winter range of the Cape Bathurst/Bluenose-west caribou herd. An Inuvialuit Environmental/Wildlife monitor will be present during the program to help manage potential wildlife conflicts as the project progresses.

Grizzly bears reside year round in the project area, although at low density. They have been designated the status of "Special Concern" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The major causes of decline of grizzly populations have been hunting and degradation of habitat (CWS 2000a). Between the years of 1973 to 1978 approximately four bears per 1000 km^2 were observed in the Richards Island region (WMAB 1998) and the current population is estimated at 4000-5000 in the Northwest Territories (CWS 2000a). Most local grizzly denning occurs on south and west facing lake/channel banks between sea level and 100 m above sea level within the bear's home range. Grizzlies will enter their dens beginning in October and will remain there until May (WMAB 1998). RWED will provide information on the potential locations of dens. Should a bear den be discovered, the regional wildlife biologist will be contacted and notified of the bear den location, and appropriate action as discussed between project personnel and the Wildlife Monitor will be taken to avoid disturbance to denning bears.

The project area overlaps 3% of the western edge of the Cape Bathurst/Bluenose-west caribou herd winter habitat. This caribou herd will move into the proposed seismic area in approximately September and breed in October. The herd then migrates north to the Brock, Hornaday and Horton River areas in April and May. The proposed seismic program will not begin until after the breeding period and caribou do not calve in the project area. Various Inuvialuit communities rely upon this herd for subsistence use and it is a common concern that oil and gas activities as well as an increase in tourism might have a negative impact on the herd. Currently the population of the Cape Bathurst/Bluenose-west herd is between 14,000 and 19,000 and can be found on the Tuktoyaktuk Peninsula and on northwestern Richards Island between September and April (TCCP 2000).

Beaver, mink and ermine are found in habitat associated with the streams and lakes found in upland tundra and adjacent delta. Foxes may also occur in the vicinity of the project. Ground squirrels inhabit dry upland ridges, while lemmings and voles occupy more heavily vegetated tundra and delta habitats. A wolf research program was undertaken by RWED in the western arctic from 1987-1993. These studies indicate that wolves may occur throughout the project area, most commonly in the Caribou Hills (Clarkson *et. al.* 1992).

The muskrat is a semi-aquatic rodent whose habitat includes the fresh water marshes, marshy areas of lakes, and slow-moving streams of the Mackenzie River Delta. They winter in lakes between one and two metres deep, ensuring that there is adequate supply of submerged aquatic plants available for forage (CWS 2000b). Muskrats extend their foraging distance under ice by creating push-ups, which are hollow mounds of vegetation that rise above the surface of the ice and are subsequently covered by snow. These are used as feeding stations and can be located up to 90 metres away from the muskrat's main burrow (CWS 2000b). The Inuvialuit Environmental Monitor will identify the muskrat push-ups found in the vicinity of the project activity. Muskrat harvesting occurs during the proposed timing of the seismic program.

A study of the impacts of seismic activity on muskrats in the Mackenzie River delta focused on both the direct effects (injuries and stress) and indirect effects (changes in population, reproduction, and activity) (Westworth 1977). The study used dynamite charges of 11.3 to 22.6 kg placed at the bottom of 18.2 m shot holes located 8 m from the lakeshore of two lakes. The findings indicated that muskrats within 15 m of shot holes may suffer from minimal haemorrhaging along suture lines of the middle ear, however it is believed that the degree of injury is sufficient only to cause transitory pain and discomfort but that it would not produce permanent injury and muskrats would recover quickly (Westworth 1977). Stress effects could not be determined, likely due to sampling techniques and there were no significant effects in reproduction. Although there was not a significant decrease in the number of pushups in the experimental versus control populations, the proportion of active pushups was larger at distances greater than 180 m from the seismic line and the number of visits to the burrow was temporarily reduced during seismic activity (Westworth 1977). Avoidance of pushups and setback distances described in Table 11 will be used to mitigate effects on muskrats.

Common bird species include the common redpoll, gray jay, common raven, red-throated loon, northern shrike, ptarmigan, and fox sparrow. Raptors include the bald eagle, gyrfalcon, peregrine falcon, and osprey. The Mackenzie Valley forms one of North America's most traveled migratory corridors for waterfowl (ducks, geese, and swans) breeding along the Arctic coast. The delta is important as a spring and fall staging area for migrating waterfowl. In spring, the largest concentrations occur along the Middle Channel during mid to late May (TCCP 2000). The Kendall Island Bird Sanctuary located approximately 13 km northwest of the project area at its nearest point, is an area of high use for breeding by geese and other waterfowl during the spring and summer. Migrating species are not likely to be found in the project area during the time proposed, as they move south for winter in early September and do not generally arrive in spring until mid May.

A number of species are found in the proposed project vicinity that are important to local subsistence harvesters as well as recreational users. Vertebrate species potentially found in the project area are listed in Table 8.

TABLE 8

VERTEBRATE SPECIES FOUND IN THE VICINITY OF THE PROPOSED PROJECT

Species [1]	Latin Name	Habitat	COSEWIC [2]
MAMMALS			
Caribou[3]	*Rangifer tarandus*	Hornaday, Brock and Horton Rivers area for calving, winter habitat northeast of Inuvik.	Not listed
Grizzly bear	*Ursus arctos*	Prefers open areas of alpine tundra, subalpine mountains or subarctic tundra. Richards Island, Kugaluk River, delta.	Special Concern
Polar bear	*Ursus maritimus*	Southern broken edge of the arctic ice pack. Less use of delta region during summer and fall.	Special Concern
Wolf	*Canis lupus arctos*	Treeline-tundra transition zone. Bluenose caribou wintering range. Caribou Hills.	Indeterminate
Wolverine	*Gulo gulo*	On tundra between treeline and arctic coasts. North Slope, Cache Creek, Sheep Creek, Big Fish River, Foothills west of Aklavik. Relatively few in delta.	Special Concern
BIRDS			
Yellow billed loon[3]	*Gavia adamsii*	Arctic tundra on large lakes or in backwater areas of flooded rivers. Winter in the Gulf of Alaska.	Not listed
Red-throated loon[3]	*Gavia stellata*	Coastal and tundra ponds during summer; large lakes, bays, estuaries, and ocean during migration and winter.	Not listed
Bald eagle[3]	*Haliaeetus leucocephalus*	Lakes, rivers, marches, seacoasts. Willow River, Fish Creek, First Creek, Mackenzie delta.	Not listed
Golden eagle[3]	*Aquila chrysaetos*	Mountain forests and open grasslands; can be found in any habitat during migration. Willow River, Fish Creek, First Creek, Mackenzie delta.	Not listed
Peregrine falcon	*Falco peregrinus tundrius*	Nests on cliffs or buildings, and hunts over open tundra habitats.	Special Concern
Gyrfalcon[3]	*Falco rusticolus*	Arctic tundra and rocky cliffs near water. Nests in cliffs and occasionally trees.	Not listed
Eskimo curlew[4]	*Numenuis borealis*	Formerly bred in the tundra and woodland transition zones of the Mackenzie District. Present day habitat is unknown.	Endangered
Short-eared owl	*Asio flammeus*	The owl prefers extensive stretches of relatively open habitat. It is primarily a bird of marshland and deep grass fields. It likes to hunt and roost in abandoned pastures, fields, hay meadows, grain stubble, airports, young conifer plantations and marshes in the winter. It frequents prairies, grassy plains or tundra in the summer.	Special Concern

Notes:

1. Bird species are included only if they are known to be confirmed, possible or probable breeders within a particular subregion that the proposed project impacts.

2. Committee on the Status of Endangered Wildlife in Canada 2000.

   Endangered = A species facing imminent extirpation or extinction.
   Special Concern= A vulnerable species because of characteristics that make it particularly sensitive to human activities or natural events.
   Indeterminate = A species for which there is insufficient scientific data to support status designation.

3. Species are included due to their listing in Community Conservation Plans as species of interest or declining in population.

4. Species not observed for approximately 100 years. Thought to be extinct.

11.7 Hydrology and Fish

The Mackenzie River delta is a dynamic complex of lakes, islands, braided channels and oxbows. The hydrological regime is the primary factor controlling vegetation and wildlife habitat in the area. It is an estuarine delta with poorly developed levees, formed largely from sediments transported by the Mackenzie River over the last 13,000 years. The southwest sector also receives sediment from the Peel and Rat rivers. The major channels appear largely unchanged in the last century. The present delta is flat and dotted with numerous lakes, ponds and river channels, but also contains land varying from stable forested areas to tidal flats (MRBC 1981).

Ice covers the waters of the delta for approximately eight months of the year and can be up to 2.5 m thick in the main stem of the Mackenzie River. Ice break-up usually begins in April, and ice movement occurs before peak spring water levels. Water levels fall during late summer and into fall. The basic hydrology of the delta is a complex interaction of aggrading and degrading forces, with spring break-up the major hydrological event each year (MRBC 1981).

A large number of fish species occur within the freshwater and marine environments of the project area. Fish species are listed in Table 9 along with their spawning habitats and spawning times.

Several studies have been conducted on fish and fish habitat in the Mackenzie River Delta. Research indicates that the delta provides overwintering habitat for a variety of fish species. In general, large, deep lakes with river channel connections are used more extensively for wintering than are small channels, which are in turn, more important for wintering fish than are large channels. Overwintering data is found primarily in research conducted by Mann (1975) during three winter surveys in October and November 1974 and April 1975 at locations between Moose Channel and Shallow Bay. Fisheries resource information from scientific reports and land use map data were compiled by Sekeraket al. (1992) in order to describe overwintering habitats and to note the occurrence of each of the major fish species in different habitat types of the near shore Beaufort Sea and Mackenzie River delta area. Site locations of winter catches reported in scientific reports up to and including 1992 are summarized and illustrated in Figure 5 for broad and lake whitefish, arctic and least cisco, inconnu, lake trout, burbot, pike, rainbow smelt and Pacific herring.

Habitat descriptions should be considered preliminary as limited amounts of physical, chemical and fish data are available for this area. The absence of a site marker on Figure 5 should not be interpreted as meaning that there is no overwintering potential for a particular waterbody. Fisheries and Oceans Canada has indicated that any waterbody with greater than 0.5 m of non-frozen water under ice may provide overwintering habitat for delta fish species (Wright Pers. Comm).

TABLE 9

FISH SPECIES FOUND IN THE VICINITY OF THE PROPOSED PROJECT

Species [1]	Latin Name	Habitat	Spawning Period	COSEWIC [2]
FRESHWATER				
Burbot	*Lota lota*	Mouths of creeks. Winter and spring may be abundant in fresh or brackish waters of Kugmallit Bay's coastal embayment.	January – March	Not listed
Arctic char	*Salvelinus alpinus*	Fish Hole, Rat River, Big Fish River, Fish Creek, Babbage River, Peel River, Shingle Point, occasionally travel the Mackenzie near Inuvik and Aklavik.	August, early September	Not listed
Flathead chub	*Platygobio gracilis*	Shallow sandy bars in smaller tributary streams, survives well in turbid water.	Summer	Not listed
Lake chub	*Couesius plumbeus*	Most of Canada west of Hudson Bay. Cool streams, lakes, ponds. Moves into deeper water during the summer.	Late March – early May	Not listed
Arctic cisco	*Coregonus autumnalis*	Mackenzie River and estuary, tributaries to the Mackenzie (spawning habitat - inland lakes).	Fall	Not listed
Least cisco	*Coregonus sardinella*	Mackenzie River and estuary, tributaries to the Mackenzie (spawning habitat), inland lakes. Inner Shallow Bay / Niakunak Bay and Kugmallit Bay are important overwintering and nursery areas.	Early October	Not listed
Finescale dace	*Chrosomus neogaeus*	Bog ponds, streams, and lakes. Mackenzie River drainage.	April to June	Not listed
Longnose dace	*Rhinichthys cataractae*	Prefers small streams, generally in riffles of gravel and boulders. Often found in turbulent waters. Also the wave lashed shores of very large lakes and often found in trout streams.	April and May	Not listed
Inconnu	*Stenodus leucichthys*	Mackenzie River and estuary (rearing habitat). Turbid lakes on Richard Island throughout summer, Mallik and Mason Bays.	Late September – early October	Not listed
Arctic grayling	*Thymallus arcticus*	Kugalak River, coastal rivers of North Slope. Occasionally Richards Island.	Spring	Not listed
Lake trout	*Salvelinus namaycush*	Outer delta lakes (including minor channels) with high oxygen levels, a good connection to adjacent water bodies, small to moderate volumes available and poor to moderate water quality.	Fall	Not listed
Northern pike	*Esox lucius*	Tributaries, creeks and shallow lakes in Mackenzie delta.	Early spring	Not listed
Deepwater sculpin	*Myoxocephalus thompsoni*	Habitat preferences are not known. Spawning areas are not known.	May and June	Threatened
Slimy sculpin	*Cottus cognatus*	Coldwater streams. Stream bottom.	Late April and May	Not listed
Spoonhead sculpin	*Cottus ricei*	Turbid rivers or deep areas of lakes.	Fall	Not listed
Pond smelt	*Hypomesus olidus*	Arctic and Pacific drainages from Rae River (Coronation Gulf) and Great Bear Lake in Northwest Territories, Canada to Copper River in Alaska Seines of Shallow Bay near mouth of west channel.	Late spring – early summer.	Not listed

TABLE 9 Cont'd

Species [1]	Latin Name	Habitat	Spawning Period	COSEWIC [2]
Rainbow smelt	*Osmerus mordax*	Found only along mainland coast from Bathurst Inlet westward.	Spring	Not listed
Ninespine stickleback	*Pungitius pungitius*	Shallow vegetated areas of lakes, ponds, and pools of sluggish streams. Sometimes in open water over sand. Seining locations Shallow Bay, Kendall Island, Swan Channel and East Channel.	Spring	Not listed
Longnose sucker	*Catostomus catostomus*	Arctic mainland in lakes and occasionally in the brackish water of estuaries.	Spring	Not listed
White sucker	*Catostomus commersoni*	Lakes, small rivers and streams.	Late April to June	Not listed
Trout-perch	*Percopsis omiscomaycus*	Stream habitats with high water quality, deep pools and bottoms consisting of sand and gravel. Lake populations avoid mud-filled bays.	May through August	Not listed
Walleye	*Stizostedion vitreum*	Intermediate to large cool lakes, rivers, and streams. Prefers large shallow lakes with high turbidity.	April to late June	Not listed
Broad whitefish	*Coregonus nasus*	Several overwintering areas in East Channel and Whitefish Bay. Tuktoyaktuk Harbour, Mason Bay, Mallik Bay, Shallow Bay, streams of Tuktoyaktuk Peninsula, spawning throughout the Mackenzie system.	October, November	Not listed
Round whitefish	*Prosopium cylindraceum*	Inhabits shallow areas of lakes and clear streams, rarely entering brackish water. Most often found in clear fast flowing water. Outer Mackenzie delta.		Not listed
SALTWATER				
Arctic char	*Salvelinus alpinus*	Fish Hole, Rat River, Big Fish River, Fish Creek, Babbage River, Peel River, Shingle Point, occasionally travel the Mackenzie near Inuvik and Aklavik.	Fall	Not listed
Arctic cod	*Boreogadus saida*	Within Mackenzie estuary.		Not listed
Blue herring	*Clupea spp.*	Mackenzie River and estuary, tributaries to the Mackenzie, inland lakes.	Late June	Not listed
Sand lance	*Amodytes sp.*	Shallow intertidal with sandy bottoms.	December - March	Not listed
Chum salmon	*Oncorhynchus keta*	Pacific and Arctic oceans, spawning in rivers from the Mackenzie westward.	Fall	Not listed
Pink salmon	*Oncorhynchus gorbusha*	Pacific and Arctic oceans, spawning in rivers from the Mackenzie westward.	Fall	Not listed
Fourhorn sculpin	*Myoxocephalus quadricornis*	Lakes and streams of the Arctic archipelago.	May and June	Special Concern

Notes:

1. Fish species are included only if they are known to be confirmed, possible or probable breeders within a particular subregion that the proposed project impacts.

2. Committee on the Status of Endangered Wildlife in Canada 2000.

   Threatened = A species likely to become endangered if limiting factors are not reversed.
   Special Concern = A vulnerable species because of characteristics that make it particularly sensitive to human activities or natural event