INTRODUCTION

This section supports an application for the development of the Norman Wells infrastructure site near Norman Wells. It contains:

- an overview map with the site location (Figure 4-1)
- an estimate of the personnel requirements
- a summary of the operations
- a description of potential environmental and resource effects
- construction equipment estimates

The location of the Norman Wells infrastructure site is shown in the photographs and site-specific map provided in Figure 4-2, Figure 4-3 and Figure 4-4.

PERSONNEL (PART 3)

The construction of the Norman Wells infrastructure site will require clearing, grading, camp construction and mechanical crews. These crews, of up to 60 people, will be established specifically for infrastructure development. Initially, these crews will reside at a mobile pioneer camp installed in Norman Wells.

The Norman Wells camp pad will be completed at the Norman Wells infrastructure site during the winter of 2006-2007 and a 350-person camp will be commissioned in the summer of 2007.

Initial crews will move from the mobile pioneer camp to the 350-person camp at the Norman Wells infrastructure site as soon as it is commissioned. This camp will require a support staff of about 35 people. These people are included in the 350-person total.

In the summer of 2007, the 350-person construction camp will be expanded to a capacity of about 1,350 personnel. This camp will require a camp support staff of about 120 people. These people are included in the 1,350-person total.

Figure 4.1 has been moved to reduce file size. To view it, click on the link to the figure in the web page List of Figures for this document.

Construction personnel will occupy the camp over two winter construction seasons (2007-2008 and 2008-2009 for pipeline construction) and for a further winter season in 2009-2010 for commissioning and reclamation. Personnel will begin arriving in November of each year. Numbers will peak in mid-winter and taper off toward spring. A limited camp support staff will remain on the site between construction seasons.

SUMMARY OF OPERATION (PART 5)

The land use activities and operations associated with the Norman Wells infrastructure site include:

- developing and operating:
  - an administration office
  - a fuel storage site to support construction activities
  - a stockpile site for the storage of material, equipment, modules and pipe, and for construction equipment maintenance
  - sequentially, a 350-person camp expanding to a 1,350-person camp for worker accommodation during construction activities
- use of the existing Canadian Coast Guard Barge Landing (CCG Barge Landing), about 2.5 km west of the Norman Wells infrastructure site along the east bank of the Mackenzie River.

Preconstruction Activities

Before site development begins:

- a preconstruction survey will be conducted to finalize the location and site-specific layout
- geotechnical evaluations will be conducted, as required, to support engineering of the infrastructure site components

Development Activities

Initial development activities will commence in 2006 and will include clearing and construction of the pad that will support the Norman Wells infrastructure site. The pad material might be obtained from nearby borrow sites on municipal, private and Crown land. The borrow sites on private and Crown land will be included in the land use permit applications for private and Crown lands within the SSA. Detailed discussion of development of borrow sites on land within the Norman Wells municipal boundary is included in Section 5. The Norman Wells

airport. By placing all the related facilities together, operational efficiencies are realized and the overall footprint of construction activities is reduced. These facilities include:

- an administration office
- a module, pipe, material and equipment stockpile
- a fuel storage depot
- a camp

A conceptual 1,350-person camp layout is provided in Section 3.

Infrastructure Site Access

Access to the Norman Wells infrastructure site will be along Quarry Road (TD-B1-A-7.057P), which is an existing, all-weather municipal road (see Figure 4-2).

Fuel Storage Depot

The fuel storage depot will require the installation of pads of a sufficient depth to permit truck movement around the site and to safely support refuelling activities. The pads will be sufficient to stabilize the traffic areas of the site, to provide a suitable driving surface and to support the fuel tanks. The fuel depot will be located within the overall infrastructure site footprint. Additional information on typical fuel storage depots is provided in Section 3.

Storage tanks will be used to supply the site requirements for electric power generation and pipeline construction equipment. Tank storage for about 150,000 L will be required at the Norman Wells infrastructure site. These tanks are planned to contain diesel fuel and will be re-supplied from the existing bulk storage facility in Norman Wells.

The fuel storage depot at the Norman Wells infrastructure site will be monitored by computerized systems and site security patrol. It will be equipped with management control systems for access, and authorization controls for fuel handling. An emergency shutdown system will also be provided.

Stockpile Site

The stockpile at the Norman Wells infrastructure site will require the installation of pads to permit truck movement around the site and to safely support unloading and storing large loads of equipment, various modules and materials. The pad will be of sufficient depth to stabilize the storage areas of the stockpile site and provide a suitable driving surface for heavy truck traffic. Pad material requirements, the stockpile layout, and size will be finalized after the preconstruction survey. Typical stockpile sites are discussed in Section 3.

Camp Site

Development of the temporary camp site will require the installation of pads of sufficient depth to permit the transport and erection of about 300 modular camp structures. Pad material requirements, camp site layout and size will be finalized after the preconstruction survey. Typical camp layout and services are described in Section 3.

Start-up of camp activities will involve the mobilization of supplies and materials.

Water for the camp might be obtained from the Town of Norman Wells, subject to negotiations with the town. The water will be transported by truck from the source to the camp site for use as camp and fire suppression water.

Barge Landing Site

The existing CCG Barge Landing is situated about 2.5 km west of the Norman Wells infrastructure site along the east bank of the Mackenzie River (see Figure 4-3). The existing developed area will be used for unloading material and equipment from the barges onto trucks for subsequent transport to the stockpile site.

The multi-year use of the barge landing site might require maintenance activities each season. This might require maintaining a small stockpile (about 1,000 m^3) of till and granular resources. The need for and size of this stockpile will be determined at the site after the quality of the excavated material and local river edge material has been assessed.

Operations Activities

The Norman Wells infrastructure site will act as a staging area for various pipeline segments and facilities in the vicinity.

Fuel Depot Operations

Fuel will be delivered by truck to the fuel depot from the existing bulk storage facility in Norman Wells. This will reduce the size of the depot facilities at the Norman Wells infrastructure site. Fuel storage tanks will be filled using fuel trucks shuttling between the existing bulk storage and the fuel storage tanks. Required fuel will be delivered from the depot to the construction sites. This will require daily truck traffic through the fuel depot during construction operations.

Stockpile Operations

The stockpile will be used to store the material required for construction of the pipeline. Material and equipment will be barged from Hay River to Norman Wells along the Mackenzie River.

During the barge-unloading period (about seven weeks each year), trucks will operate continuously until all the required material has been stockpiled. A preliminary estimate of materials to be stockpiled at the Norman Wells infrastructure site includes about 43,600 tonnes of pipe and 7,200 tonnes of camp modules and supplies. A list of equipment that might be stored at the site is included in Section 6.

During construction, the material required for constructing the pipeline will be hauled from the stockpile site to locations along the pipeline right-of-way. When construction is underway, truck activity will occur along the proposed access roads from the stockpile site to the pipeline right-of way.

Camp Site Operations

The camp will be used to feed and house construction personnel. The largest element of the operations will be catering and housekeeping for the camp residents. Other activities will include the maintenance operations of the camp and restocking of fuel and supplies by truck.

Food and other supplies will be trucked in periodically from Norman Wells. Daily water truck cycles will bring the necessary volume of water (about 227 L per person daily or 300 m^3 daily at full occupancy) to the camp.

The camp will have attendants and facilities to handle medical problems as they arise. All project camps will have a zero tolerance policy for alcohol and illegal drugs.

Barge Site Operations

The existing CCG Barge Landing will be used for unloading cargo barges of pipeline materials, pipeline construction equipment and construction consumables for construction activities.

About six 1500 Series cargo barges could be moored simultaneously near the barge landing site while waiting to be unloaded. They will be moored where they will not interfere with other river traffic or result in potential safety concerns. The immediate shore area will not need to be disturbed for mooring. The mooring distance from the shore will depend on the water depth and the draft of the barges. Tie lines to temporary mooring points on shore, such as mooring screw anchors or anchor blocks, will be required to secure the barges to the shore while they wait to be unloaded. The temporary mooring points will be re-established at the

beginning of each operation season, if they are destroyed or removed by ice activity.

SUMMARY OF POTENTIAL ENVIRONMENTAL AND RESOURCE EFFECTS (PART 6)

ENVIRONMENT

The following topics provide specific biophysical and human environment setting, effects and mitigation information for the Norman Wells infrastructure site. This information includes data collected during the 2004 field programs.

Biophysical Environment

Air Quality Setting

Since Norman Wells is an air quality monitoring site, the air quality setting for this site will be similar to the regional air quality setting for the SSA described in Section 8.

Air Quality Potential Effects and Mitigation

Potential effects on air quality associated with the development of the Norman Wells infrastructure site, such as dust, vehicle and equipment emissions, are expected to be limited and localized. Site-specific effects and mitigation are expected to be similar to regional effects and mitigation for the SSA described in Section 8.

Noise and Light Setting

The noise setting for this site is expected to be similar to the regional noise setting for the SSA described in Section 8.

At the present time, there are no man-made sources of light at the site.

Noise and Light Potential Effects and Mitigation

The potential effects and mitigation pertaining to noise and lighting are discussed next. These items are combined because both affect sensory perception.

Potential effects on noise levels associated with the development of the Norman Wells infrastructure site are expected to be limited and localized. Site-specific effects and mitigation are expected to be similar to regional effects and mitigation for the SSA described in Section 8.

Industrial lighting can cause increases in ambient light. Sources of light include vehicles, flares and lighting around the site.

Lighting will be used during non-daylight hours. During the winter months, this might mean periods where lighting is required on a 24 hour basis. Conversely, during the late spring and through the summer months, lighting will likely not be required because of the extended daylight hours.

The potential visual effect of lighting can be partially reduced by proper placement and use of lighting only in areas where it is required.

Soils, Landforms and Permafrost Setting

The Norman Wells infrastructure site is located on a gently sloping moraine plain within the zone of intermediate discontinuous permafrost. Moraine deposits might be underlain by permafrost (50 to 80% of area) with an ice content where permafrost is present that might range from 80 to 100% by weight. To the south, the moraine plain is locally overlain by glaciofluvial deposits that form small upland areas. These deposits are expected to be free of permafrost. The moraine is moderately well to imperfectly drained and has likely developed soils of the Cryosolic Order. The site will be accessed by an existing all-weather road.

The CCG Barge Landing has been constructed on recent fluvial deposits of the Mackenzie River. The landing site lies at the base of a fluvial terrace with steep slopes. Permafrost might underlie these fluvial deposits (40 to 60% of area) and ice contents might range from 30 to 70%, by weight. The CCG Barge Landing is accessible by an all-weather road.

Soils, Landforms and Permafrost Potential Effects and Mitigation

Landform-related environmental effects are not predicted for the Norman Wells infrastructure site. The construction of granular pads at the site will result in a small amount of soil loss because of burial.

General mitigation strategies to offset potential effects are outlined in Section 8.

Vegetation Setting

The portion of the Norman Wells infrastructure site that will contain a 1,350-person construction camp is within a previously disturbed area southeast of Norman Wells. The disturbed area is 95% bare ground and 5% weedy species and seedlings of native trees and shrubs. The CCG Barge Landing is an existing gravelled and bare ground site with native seedlings and occasional weedy species. Vegetation and rare plant surveys have been completed in both areas.

Access between the Norman Wells infrastructure site and the CCG Barge Landing will use an existing all-weather municipal road (TD-B1-A-7.057P and TD-BL-A-482.7).

Vegetation Potential Effects and Mitigation

Development of the undisturbed portions of the Norman Wells infrastructure site and its associated access road will affect vegetation through clearing and mechanical damage to trees, shrubs, forbs and non-vascular species, the permanent loss of vegetation and underlying substrates through infrastructure site expansion and potential changes in site drainage and drainage along the access road.

The majority of effects on vegetation will occur because of project activities arising from site preparation of the undisturbed areas. These effects might include the potential influence of dust deposition on the health and growth of nearby vegetation, as well as the potential accidental introduction of non-native plant species to the Norman Wells infrastructure site and along the access road. Effects on vegetation resulting from the development of the Norman Wells infrastructure site and access road will persist into the far future (effect extends beyond 30 years past decommissioning and abandonment) given the slow rate of vegetation growth in the North.

Implementation of primary mitigation measures, as described in Section 8, will help reduce the magnitude of effects on vegetation at this site and its access road.

Wildlife Setting

Wildlife habitat located in and around the Norman Wells infrastructure site is composed of a closed black spruce forest. Dominant tree and shrub are black spruce and Labrador tea, respectively. These types of habitat are common in the region. An abundance of lichen for woodland caribou, and berries, grass and forbs for grizzly bears occur on the site. In addition to its proximate location to the Town of Norman Wells, the site is also located between a quarry and a commercial development, and thus experiences human disturbance.

Key wildlife species recorded at the Norman Wells infrastructure site include moose and caribou. Key species are species selected because of their importance in the subsistence economy or because they are listed as species of conservation concern or as species of particular ecological relevance. Other species detected included grizzly bear, wolf, snowshoe hare, northern flicker, chipping sparrow, common raven, and white-crowned sparrow.

An assessment of key habitat features, such as percent cover of forage species, indicated that the Norman Wells infrastructure site is considered to provide high quality foraging habitat for woodland caribou, and moderate quality foraging for grizzly, marten, and beaver (Table 4-1). The infrastructure site does not provide suitable denning habitat for grizzly bears. Habitat quality is considered to be low for all key bird species.

Table 4-1: Habitat Quality for Key Wildlife Species at the Norman Wells Infrastructure Site

Group	Species	Habitat Use	Habitat Quality[a]
Mammals	Woodland caribou	Winter foraging	High
	Moose	Winter foraging	Low
	Grizzly bear	Fall foraging	Moderate
		Spring foraging	Moderate
		Denning	Low
	Marten	Winter foraging	Moderate
	Lynx	Winter foraging	Low
	Beaver	Cover	Low
		Foraging	Moderate
Birds	Scaup	Nesting	Low
	Peregrine falcon	Nesting	Low
	Lesser yellowlegs	Nesting	Low
	Boreal chickadee	Nesting	Low

NOTE:
[a]Habitat quality was determined by comparing the vegetation and terrain characteristics at the site to each species' habitat requirements, such as shrub availability for moose.

Based on habitat availability, a variety of species might inhabit the infrastructure site. These include several species that have special status designation at the national and territorial levels, as determined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Department of Resources, Wildlife and Economic Development (RWED, now ENR), respectively. These species are summarized in Table 4-2.

Table 4-2: Special Status Species That Were Observed or That Might Occur at the Norman Wells Infrastructure Site

Species	Status[a]			
	RWED[b]	COSEWIC[c]	SARA[d]	IUCN[e]
Woodland caribou	Sensitive	Threatened	Schedule 1 – threatened	Lower risk – least concern
Rock ptarmigan	Sensitive	-	-	-
Northern flicker	Sensitive	-	-	-
Olive-sided flycatcher	Sensitive	-	-	-
Blackpoll warbler	Sensitive	-	-	-

Table 4-2: Special Status Species That Were Observed or That Might Occur at the Norman Wells Infrastructure Site (cont'd)

Species	Status[a]			
	RWED[b]	COSEWIC[c]	SARA[d]	IUCN[e]
American tree sparrow	Sensitive	-	-	-
Harris' sparrow	Sensitive	-	-	-
White-throated sparrow	Sensitive	-	-	-

NOTES:
[a]A hyphen indicates no status has been assigned for that species.
[b]RWED – Resources, Wildlife and Economic Development (known as ENR since April 1, 2005)
[c]COSEWIC – Committee on the Status of Endangered Wildlife in Canada
[d]SARA – *Species at Risk Act*
[e]IUCN – The World Conservation Union

Wildlife Potential Effects and Mitigation

The Norman Wells infrastructure site is composed of moderate overall quality habitat for mammals and low overall quality habitat for birds. Habitat types at the Norman Wells infrastructure site are also common in the region, indicating they are not a limiting resource for wildlife.

General potential effects resulting from development and maintenance of the Norman Wells infrastructure site on wildlife include direct and indirect habitat loss, disruption of wildlife movements and wildlife mortality. The timing of project activities, as well as the small footprint of disturbances relative to regional habitat availability, suggests that the magnitude of project effects on birds and most mammals, including those with special status designation, will be low. However, specific issues of concern at the Norman Wells infrastructure site and along the access road include:

- attraction of grizzly bears to the Norman Wells infrastructure site during spring, summer and fall (if site is active at these times) and potential mortality of problem grizzly bears

- potential displacement of woodland caribou from high quality foraging habitat during winter

Some displacement of woodland caribou from high quality winter foraging habitat might have already occurred, based on the proximity to Norman Wells, the quarry, and the commercial development area. In addition, development of the site is unlikely to alter access and thus, increased hunting and trapping of key wildlife species in the area is also unlikely.

Implementation of general mitigation measures, as outlined in Section 8, will reduce effects on wildlife during infrastructure site and access road development

and operations. Specifically, the following mitigation measures are considered important for this site:

- limit disturbance to riparian vegetation communities
- follow the waste management plan to reduce attraction of grizzly bears to work sites
- reduce project activities during the nesting period
- prohibit the recreational use of project roads and rights-of-way by project staff while on the job site
- establish and enforce regulations to prevent wildlife harassment

Hydrology Setting

The Norman Wells infrastructure site is located on the southwest side of Kee Escarpment and about 1.5 km upslope of an unnamed watercourse flowing from Seepage Lake to Sherwood Lake. The watercourse drains into the Mackenzie River. The area encompassing the site that contributes runoff at the mouth of the watercourse into the Mackenzie River is about 28 km^2.

Hydrology Potential Effects and Mitigation

The slope of the ground from the Norman Wells infrastructure site towards the unnamed watercourse is steep. It is expected that site drainage to control runoff and sediment control measures would be necessary to reduce effects on the downstream waterbodies during high runoff events. An increase in mean annual runoff flow due to the higher runoff coefficient of the disturbed area and in mean sediment concentration on the downslope watercourse is expected to be limited with use of appropriate mitigation measures.

Groundwater Setting

The 2004 field investigation identified till containing large boulders at this site. The area is mapped as thin drift covering limestone bedrock. A spring was reported upslope at a distance of about 1 km and there is potential for perennial springs in the area. The permafrost and groundwater table conditions have not be established at this site.

At site, where continuous permafrost exists, groundwater flow is expected to be limited, seasonal and restricted to the active layer.

Groundwater Potential Effects and Mitigation

The development of the infrastructure site has the potential to reduce or remove an area of groundwater storage and recharge. This could result in alterations to groundwater flow patterns, increases in surface water runoff and changes to springs, seeps or groundwater-fed wetlands associated with this area of groundwater recharge. The removal of surface vegetation also has potential to result in siltation of shallow aquifers, where present, because of increased sediment load in surface waters. These effects will be effectively managed by the implementation of the following mitigation measures:

- maintain sufficient permeable surface area to permit groundwater recharge in these areas, as necessary

- implement drainage, erosion and sediment controls, as appropriate, to limit the mobilization of fine sediment particles

Water Quality Setting

Water quality data for the Mackenzie River at Norman Wells is summarized in Section 8.

Water Quality Potential Effects and Mitigation

The Norman Wells infrastructure site might affect water quality through the release of treated domestic wastewater from the camp, leaks and spills, sediment releases from disturbed land and activities associated with the barge landing sites, and changes in surface water flow and level resulting from water withdrawals.

Effects of small-scale leaks will be reduced through management practices, contingency plans, mitigation and emergency response plans. Therefore, effects are not expected from leaks.

The effect on mean annual flows and total suspended solids (TSS) concentrations in the Mackenzie River due to activities associated with the barge landing sites are expected to be limited. Therefore, limited effects are expected on water quality parameters associated with sediment inputs, e.g., nutrients and metals.

Fish and Fish Habitat Setting

The Mackenzie River, at this location, has many permanent islands, exposed sand and silt bars, and side channels. The watercourse at the CCG Barge Landing is characterized as a deep run with some shallow flats along both shore margins. Mean wetted channel width was 1,375 m with mean water depths along three transect ranging from 4.2 to 4.4 m. The maximum depth recorded was 12.2 m. Channel bed material is dominated by sand, with some gravel and cobble. In-

stream cover is primarily provided by water depth and turbidity. Some additional cover is provided by woody debris.

Sixteen species of fish (10 large-bodied, major species and six small-bodied, minnow species) have been captured or reported in the Mackenzie River in and around Norman Wells. Longnose sucker dominated the major species, which also included Arctic grayling, northern pike, walleye, goldeye, burbot, inconnu, mountain whitefish, broad whitefish and Arctic lamprey. Migratory, diadromous species, such as chum salmon and Arctic cisco, have also been found in this area.

The cover provided by depth, and seasonally by high turbidity, makes the run habitats in the near-shore east downstream bank of the Mackenzie River suitable for rearing, and adult feeding and holding, by species such as northern pike, longnose sucker, whitefish species and burbot. The potential use of habitat at the Canadian Coast Guard Barge Landing is outlined in Table 4-3. Spawning is unlikely, although gravel and higher velocity waters, along the toe of the Canadian Coast Guard Barge Landing structure, might provide small potential spawning areas for species such as longnose sucker and whitefish species.

Table 4-3: Potential Use of Habitat at the CCG Barge Landing

Species	Overwintering	Spawning and Incubating	Rearing	Adult Feeding and Holding
Arctic grayling	Yes	No	Yes	No
Northern pike	Yes	Yes	Yes	Yes
Longnose sucker[a]	Yes	Yes	Yes	Yes
Whitefish species	Yes	Yes	Yes	Yes
Burbot	Yes	Yes	Yes	Yes

NOTE:
[a]Of the species and species groups listed, only longnose sucker and lake chub minnows have been confirmed near the barge landing site during the present study.

Protected depositional areas, backwaters, and near-shore shallow flat habitats might be used in the open-water season for rearing by longnose sucker, northern pike, inconnu, Arctic grayling, walleye and small-bodied fish species. Based on a watercourse depth maximum greater than 12 m, and bathymetric profiles that indicate several 3.0 m deep bed depressions along the right downstream channel near the Canadian Coast Guard Barge Landing, it is likely that parts of the channel near the barge site are suitable for overwintering by several species. The Mackenzie River in this area also provides a corridor for movement of diadromous fish species between the Beaufort Sea and upstream areas of the Mackenzie River.

Fish and Fish Habitat Potential Effects and Mitigation

The Norman Wells infrastructure site is located sufficiently far away from local waterbodies so that direct effects on fish habitat or effects related to runoff and sediment yield are not expected.

The CCG Barge Landing is an existing operational site. Any effects on shoreline and nearshore habitats associated with this site occurred when it was initially developed and additional effects are not anticipated. Effects of surface runoff from the Norman Wells infrastructure site will be mitigated through development and implementation of erosion and sediment control plans.

Human Environment

This topic contains a description of the protected areas and heritage resource setting and effects and mitigation for the Norman Wells infrastructure site. Other human environment information is described in Section 8.

Protected Areas Setting

The Norman Wells infrastructure site is located within the proposed Mackenzie River Special Management Area. This area was identified in the Sahtu Preliminary Draft Land Use Plan as a very important regional and territorial travel and transportation corridor, heritage place and traditional use location.

Protected Areas Potential Effects and Mitigation

The development will result in a decrease in the land base available for other land uses within this area. The presence of development within this area will be a permanent change to the landscape.

Heritage Resources Setting

This site was inspected during the 2003 and 2004 field programs. The location was considered to have low potential for the discovery of heritage resources. No new heritage sites were recorded as a result of the reconnaissance.

The nature of the heritage resource potential and results of preliminary investigations at this location were provided to the Prince of Wales Northern Heritage Centre in a report under permit 2003-933. Results of an aerial reconnaissance conducted in the 2004 field program will be submitted to the Prince of Wales Northern Heritage Centre under permit 2004-956.

Heritage Resources Potential Effects and Mitigation

Before the development of this site, a Heritage Resource Impact Assessment will be conducted and provided to the Prince of Wales Northern Heritage Centre. If it

is determined that the development will affect any heritage resources, mitigation plans will be prepared.

PUBLIC INVOLVEMENT

The Ernie McDonald Land Corporation (EMLC) requested that the Norman Wells construction camp be located on Tulita District private lands (inside MACA boundaries). Imperial evaluated this possibility and found that the areas were either too small or required substantial cut and fill or both. It was determined that they would not be suitable for a main construction camp but could potentially be used for pioneer camps.

A number of pipeline construction camp locations within the MACA boundaries were presented to the community as possible alternatives. The town of Norman Wells and EMLC suggested a preferred camp location, which was located to the southwest of one of the proposed camp locations. They indicated that their preferred campsite location could be used as an industrial site after the project is completed. Imperial agreed to assess the preferred alternative. The public involvement activities are documented in Section 10 of this application.

EQUIPMENT (PART 10)

The following tables show an estimate of the equipment that might be required at the Norman Wells infrastructure site. An exact list and numbers will not be known until immediately before construction. Table 4-4 lists the site construction equipment. Table 4-5 lists site operations equipment.

Table 4-4: Estimate of Site Construction Equipment

Type and Approximate Number per Site	Size, Model or Equivalent	Proposed Use
Crew cabs and pick-ups – 2	4x4	Transporting crews
Bulldozers with GP buckets, U blades and brush rakes – 2	Large sized bulldozer (405 HP)	Site grading, pad and access road development, spreading granular material, snow removal.
Dump trucks (double axle) – 2	Truck with trailer (12 m^3)	Hauling granular material
Front end loader with GP bucket – 1	Large sized loader (5.5 m^3 bucket loader)	Site preparation work
Road grader – 1	Large sized grader (4.9 m blade)	Site preparation work, grading ramps and access roads
Tracked mechanical ditcher – 1	Medium sized excavator (1.45 m^3 bucket)	Excavating and removing organic material
Tree feller-buncher and skidder -1	Tracked 35,490 kg feller-buncher with a high speed saw head	Site clearing and timber handling

Table 4-4: Estimate of Site Construction Equipment (cont'd)

Type and Approximate Number per Site	Size, Model or Equivalent	Proposed Use
Compactor – 1	Medium sized compactor (20,879 kg sheepsfoot packer)	Compaction of camp site pad fill materials and access road construction
Crane (tracked) – 1	Medium sized crane (100 t)	Unloading and placement of camp modules
Mechanic's truck with welder – 1	4x4	Equipment repair
Water truck – 1	Tandem axle (16-24 m^3)	Site and road work
Sea containers – 2	6 m	Storage
Mobile camp – 1	35 person	Site development
Fuel trucks – 1	3785 L	Fuel for equipment
Skid steer loaders – 2	Large sized skid steer (80 HP)	Site work

Table 4-5: Estimate of Site Operations Equipment

Type and Approximate Number per Site	Size, Model or Equivalent	Proposed Use
Sea containers – 4	6 m	Storage
Tractor trailers – 4	Dry van 14.6 m or 16.2 m	Parts and supplies
Road graders – 2	Large sized grader (4.9 m blade)	Earthwork, road maintenance and snow removal
Front end loader with GP bucket – 1	Large sized loader (5.5 m^3 bucket loader)	Movement of camp supplies and snow removal
Snow machines – 6	Small sized snow machine (400 cc)	Personnel transport
4x4 crew cab pick-up – 4	4x4	Transporting crews
Crane (tracked) – 1	Medium sized crane (100 t)	Loading and unloading pipe, equipment and materials
Flatbed trucks with pickers – 2	10 ton truck	Transporting materials and maintenance
Truck and water tank trailers – 5	Tandem axle (16-24 m^3)	Bringing water to the camp for domestic use and fire protection
Skid steer loaders – 2	Large sized skid steer (80 HP)	Site work

FUELS (PART 11)

Table 4-6 itemizes fuel storage. This represents an estimate of fuel requirements.

Table 4-6: Estimate of Fuel Storage

Fuels	Number of Containers	Capacity of Containers	Location
Diesel	3	50,000 L	Fuel Depot
Other	As required	As required	Fuel Depot

PERIOD OF OPERATIONS (PART 14)

Site operations will be continuous from 2006-2010 (see Section 3 for a schedule of development activities in the SSA).

LOCATION OF ACTIVITIES BY MAP COORDINATES (PART 16)

Map coordinates of the site centroids are shown in Table 4-7. A map showing the location of the site is provided in Figure 4-2.

A photograph of the Norman Wells infrastructure site appears in Figure 4-3.

Table 4-7: Map Coordinates for Site Centroids

Activity	Latitude (DD)	Longitude (DD)	UTM Easting (m)	UTM Northing (m)	UTM Zone
CCG Barge Landing	65.2709	-126.7795	603634	7240469	9
Norman Wells infrastructure site	65.2874	-126.7390	605458	7242378	9

FEES (PART 18)

The total land area required for activities contained in this subject is 24.9 ha. The land requirements are shown in Appendix A.

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Figure 4.3 has been moved to reduce file size. To view it, click on the link to the figure in the web page List of Figures for this document.

INTRODUCTION

This section supports an application for the development of a camp within the Norman Wells compressor station footprint. It contains:

- an overview map with the site location (Figure 4-5)
- an estimate of the personnel requirements
- a summary of the operations
- a description of potential environmental and resource effects
- construction equipment estimates

The camp site will be situated completely within the footprint of the Norman Wells compressor station site and is shown in Figure 4-7.

PERSONNEL (PART 3)

The construction of the infrastructure site for the Norman Wells gas compression facility will require clearing, grading, camp construction and mechanical crews. These crews, of up to 35 people, will be obtained from the main pipeline clearing and grading crews or will be established specifically for infrastructure development. Initially, they will reside at a pioneer camp installed in Norman Wells.

The Norman Wells camp pad will be completed during the winter of 2006-2007. The 120-person construction camp will be completed in the summer of 2007. Personnel constructing the Norman Wells compressor station will reside at the camp as soon as it is commissioned. The camp will be occupied until the summer of 2010.

At full occupancy, this camp will require a camp support staff of about 10 people. These people are included in the 120-person total.

SUMMARY OF OPERATION (PART 5)

The land use activities and operations associated with the Norman Wells compressor station include:

- developing and operating:
    - an administration office

- a fuel storage site to support construction activities
- a stockpile site for storage of material, equipment, modules and pipe, and for construction equipment maintenance
- a 120-person camp for worker accommodation during construction activities

- use of the existing Imperial Oil Resources Northwest Territories Ltd. (IORNWTL) Barge Landing, locally referred to as the Esso Dock Barge Landing, about 500 m west of the Norman Wells compressor station site along the east bank of the Mackenzie River

Preconstruction Activities

Before site development begins:

- a preconstruction survey will be conducted to finalize the location and site-specific layout
- geotechnical evaluations will be conducted, as required, to support engineering of the infrastructure site components

Development Activities

Initial development activities will commence in 2006 and will include clearing and construction of the pad that will support the proposed camp site. The pad material might be obtained from nearby borrow sites on municipal, private and Crown land. The borrow sites on private and Crown land will be included in the land use permit applications for private and Crown lands within the SSA. Detailed discussion of development of borrow sites on land within the Norman Wells municipal boundary is included in Section 5.

The camp layout, within the Norman Wells compressor station footprint, is shown in the artist's impression in Section 7. This figure demonstrates how the camp might be integrated into the facility site.

Infrastructure Site Access

Access to the infrastructure site will be the same as for the Norman Wells compressor station (see Section 7).

The infrastructure site for the Norman Wells compressor station will be used as the staging area for the construction of the facility. The permanent access to this facility will be built on land within Norman Wells municipal boundary.

Figure 4.4 has been moved to reduce file size. To view it, click on the link to the figure in the web page List of Figures for this document.

Fuel Storage Depot

The fuel storage depot will require the installation of pads of a sufficient depth to permit truck movement around the site and to safely support refuelling activities. The pads will be sufficient to stabilize the traffic areas of the site, to provide a suitable driving surface and to support the fuel tanks. The fuel depot will be located within the overall infrastructure site footprint. Additional information on typical fuel storage depots is provided in Section 3.

Storage tanks will be used to supply the site requirements for electric power generation and facility construction equipment. Tank storage for about 100,000 L will be required at the Norman Wells compressor station site. These tanks are planned to contain diesel fuel.

The fuel storage depot at the Norman Wells compressor station site will be monitored by computerized systems and site security patrol. It will be equipped with management control systems for access and authorization controls for fuel handling. An emergency shutdown system will also be provided.

Stockpile Site

The stockpile at the Norman Wells compressor station site will require the installation of pads to permit truck movement around the site and to safely support unloading and storing large loads of pipe, equipment, various modules and materials. The pad will be of sufficient depth to stabilize the storage areas of the stockpile site and provide a suitable driving surface for heavy truck traffic. Pad material requirements, the stockpile layout, and size will be finalized after the preconstruction survey. Typical stockpile sites are discussed in Section 3.

Camp Site

Development of the temporary camp site will require the installation of pads of sufficient depth to permit the transport and erection of about 60 modular camp structures. Pad material requirements, campsite layout and size will be finalized after the preconstruction survey. Typical camp layout and services are described in Section 5.

Start-up of camp activities will involve the mobilization of supplies and materials.

Water for the camp will likely be obtained from the Town of Norman Wells, subject to negotiations with the town. The water will be transported by truck from the source to the camp site for use as camp and fire suppression water.

Operations Activities

The Norman Wells infrastructure site will act as a staging area for the construction activities for the Norman Wells compressor station.

Fuel Depot Operations

Fuel will be delivered by truck to the fuel depot from the existing bulk storage facility in Norman Wells. This will reduce the size of the depot facilities at the Norman Wells compressor station site. Fuel storage tanks will be filled using fuel trucks shuttling between the existing bulk storage and the fuel storage tanks. Required fuel will be delivered from the depot to the construction sites. This will require daily truck traffic through the fuel depot during construction operations.

Stockpile Operations

The stockpile will be used to store the material required for construction of the Norman Wells compressor station site. An existing all-weather access road (TD-BL-A-476.3) and the proposed all-weather access road (TD-F-A-476.3) will be used for transporting equipment and material from the existing Esso Dock Barge Landing to the Norman Wells compressor station stockpile site. This activity will primarily take place in the summer during the open-water barging season.

A preliminary estimate of materials to be stockpiled at the infrastructure site for the Norman Wells compressor station includes about 740 tonnes of camp modules and supplies for the Norman Wells compressor station camp. A list of equipment that might be stored at the site is included in Section 7.

During construction, the material required for constructing the facilities for the project will be hauled from the stockpile site and set in place at the Norman Wells compressor station site.

Camp Site Operations

The camp will be used to feed and house construction personnel. The largest element of the operations will be catering and housekeeping for the camp residents. Other activities will include the maintenance operations of the camp and restocking of fuel and supplies by truck.

Food and other supplies will be trucked in periodically from Norman Wells. Daily water truck cycles will bring the necessary volume of water (about 227 L per person daily or about 27 m^3 daily at full occupancy) to the camp.

The camp will have attendants and facilities to handle medical problems as they arise. All project camps will have a zero tolerance policy for alcohol and illegal drugs.

SUMMARY OF POTENTIAL ENVIRONMENTAL AND RESOURCE EFFECTS (PART 6)

A description of the potential environmental and resource effects and primary mitigation strategies for this site can be found in Section 7.

PUBLIC INVOLVEMENT

The EMLC requested that the Norman Wells compressor station be located on Tulita private lands. This site was evaluated and it was determined not feasible without shifting the location of other compression facilities upstream or downstream of the Norman Wells compressor station site.

EQUIPMENT (PART 10)

The following tables show an estimate of the equipment that might be required at the Norman Wells compressor station site. An exact list and numbers will not be known until immediately before construction. Table 4-8 lists the site construction equipment. Table 4-9 lists site operations equipment.

Table 4-8: Estimate of Site Construction Equipment

Type and Approximate Number per Site	Size, Model or Equivalent	Proposed Use
Crew cabs and pick-ups – 2	4x4	Transporting crews
Bulldozers with GP buckets, U blades and brush rakes – 2	Large sized bulldozer (405 HP)	Site grading, pad and access road development, spreading granular material, snow removal
Dump trucks (double axle) – 2	Truck with trailer (12 m^3)	Hauling granular material
Front end loader with GP bucket – 1	Large sized loader (5.5 m^3 bucket loader)	Site preparation work
Road grader – 1	Large sized grader (4.9 m blade)	Site preparation work, grading ramps and access roads
Tracked mechanical ditcher – 1	Medium sized excavator (1.45 m^3 bucket)	Excavating and removing organic material
Tree feller-buncher and skidder – 1	Tracked 35,490 kg feller-buncher with a high speed saw head	Site clearing and timber handling
Compactor – 1	Medium sized compactor (20,879 kg sheepsfoot packer)	Compaction of camp site pad fill materials and access road construction
Crane (tracked) – 1	Medium sized crane (100 t)	Unloading and placement of camp modules
Mechanic's truck with welder – 1	4x4	Equipment repair
Water truck – 1	Tandem axle, 16-24 m^3	Site and road work
Sea containers – 2	6 m	Storage
Mobile camp – 1	35 person	Site development

Table 4-8: Estimate of Site Construction Equipment (cont'd)

Type and Approximate Number per Site	Size, Model or Equivalent	Proposed Use
Fuel trucks – 1	3785 L	Fuel for equipment
Skid steer loaders – 2	Large sized skid steer (80 HP)	Site work
Sea containers – 4	6 m	Storage
Tractor trailers – 4	Dry van 14.6 m or 16.2 m	Parts and supplies
Road graders – 2	Large sized grader (4.9 m blade)	Earthwork, road maintenance and snow removal
Front end loader with GP bucket – 1	Large sized loader (5.5 m^3 bucket loader)	Movement of camp supplies and snow removal
Snow machines– 6	Small sized snow machine (400 cc)	Personnel transport
4x4 crew cab pick up – 4	4x4	Transporting crews
Crane (tracked) – 1	Medium sized crane (100 t)	Loading and unloading pipe, equipment and materials
Flatbed trucks with pickers – 2	10 ton truck	Transporting materials and maintenance
Truck and water tank trailers – 5	Tandem axle, 16-24 m^3	Bringing water to the camp for domestic use and fire protection
Skid steer loaders – 2	Large sized skid steer (80 HP)	Site work

FUELS (PART 11)

Table 4-10 itemizes fuel storage. This represents an estimate of fuel requirements.

Table 4-9: Estimate of Fuel Storage

Fuels	Number of Containers	Capacity of Containers	Location
Diesel	2	50,000 L	Fuel Depot
Other	As required	As required	Fuel Depot

PERIOD OF OPERATIONS (PART 14)

Site operations will be continuous from 2006 through the summer of 2010. See Section 3 for a schedule of development activities in the SSA and Norman Wells.

LOCATION OF ACTIVITIES BY MAP COORDINATES (PART 16)

Map coordinates of the site centroids are shown in Table 4-11. A map showing the location of the site is provided in Figure 4-6.

Photographs of the Norman Wells compressor station site and Esso Dock Barge Landing appear in Figure 4-7 and Figure 4-8.

Table 4-10: Map Coordinates

Activity	Latitude (DD)	Longitude (DD)	UTM Easting (m)	UTM Northing (m)	UTM Zone
Esso Dock Barge Landing	65.2796	-126.8758	599107	7241291	9
Norman Wells facility site	65.2928	-126.9014	597863	7242718	9

FEES (PART 18)

The area required for fuel storage, stockpile and camp is included within the footprint of the Norman Wells compressor station. See Section 7, Facility Sites, for land area required.

The land requirements are also shown in Appendix A.

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Figure 4.6 has been moved to reduce file size. To view it, click on the link to the figure in the web page List of Figures for this document.

Figure 4.7 has been moved to reduce file size. To view it, click on the link to the figure in the web page List of Figures for this document.

INTRODUCTION

This section supports an application for the development of a fuel storage and a stockpile site, a barge landing and related access roads near Fort Good Hope. It contains:

- an overview map with the site location (Figure 4-8)
- an estimate of the personnel requirements
- a summary of the operations
- a description of potential environmental and resource effects
- construction equipment estimates

The location of these sites within the municipal boundary of Fort Good Hope is shown in the site-specific map and photograph provided in Figure 4-9 and Figure 4-10.

PERSONNEL (PART 3)

The construction of the Fort Good Hope fuel storage and stockpile site, barge landing site and related access roads will require clearing, grading, construction and mechanical crews. These crews, of up to 60 people, will be specifically for infrastructure development. Initially, these crews will reside at a barge-based pioneer camp until the Fort Good Hope camp on Crown land is commissioned in the summer of 2007.

SUMMARY OF OPERATION (PART 5)

The land use activities and operations associated with these sites include:

- developing and operating:
    - a fuel storage and stockpile site for storage of equipment, materials and line pipe, and for construction equipment maintenance
    - a barge landing
    - a day trailer with living accommodation to support construction activities
    - a new 0.6 km all-weather road from the Fort Good Hope barge landing to the existing airport road

- a 2.3 km all-weather road from the existing airport road to the fuel storage and stockpile site

Preconstruction Activities

Before site development begins:

- a preconstruction survey will be conducted to finalize the location and site-specific layout
- geotechnical evaluations will be conducted, as required, to support engineering of the infrastructure site components

Development Activities

Initial development activities will commence in 2006 and will include clearing and construction of the pads that will support the fuel storage and stockpile site and the barge landing site. The pad material might be obtained from nearby borrow sites on municipal, private and Crown land. The borrow sites on private land will be included in the land use permit application for private land within the SSA. The borrow sites on Crown land will be included in the land use permit application for Crown land within the SSA. Detailed discussion of development of borrow sites on land within the Fort Good Hope municipal boundary is included in Section 5.

The fuel storage and stockpile site, barge landing and related access roads will be developed on the east side of the Mackenzie River. By placing all the related facilities as close together as possible, operational efficiencies are realized and the overall footprint of construction activities is reduced.

The fuel storage and stockpile site includes:

- a module, pipe, material and equipment stockpile
- a fuel storage depot
- a day trailer

A conceptual stockpile site layout is provided in Section 3.

The barge landing is situated on the east shore of the Mackenzie River about 3.0 km south of Fort Good Hope. The existing site will be enhanced to support the construction of the project.

Figure 4.8 has been moved to reduce file size. To view it, click on the link to the figure in the web page List of Figures for this document.

Infrastructure Site Access

Access to the stockpile site will be from the barge landing along access road KG-BL-A-341.9, which is a proposed all-weather road, and along the existing municipal road.

Access from the fuel storage and stockpile site to the Fort Good Hope infrastructure site on Crown land will be along access road KG-PS-A-341.9 (see Figure 4-9 and Table 4-12).

Table 4-11: Fort Good Hope Access

Access Road Name	Kilometre Post (KP)	Land Use			Estimated Length (km)
		Municipal Length (km)	Private Length (km)	Crown Length (km)	
KG-BL-A-341.9	341.9	0.6	-	-	0.6
KG-PS-A-341.9	341.9	2.3	-	1.6	3.9
Total length of access on lands within the Fort Good Hope municipal boundary:		2.9			

Stockpile Site and Fuel Storage Depot

This site is only expected to be required for one summer season.

The stockpile site will require the installation of pads to permit truck movement around the site and to safely support unloading and storing large loads of pipe, equipment, modules and materials. The pads will be of sufficient depth to stabilize the storage areas of the stockpile site and provide a suitable driving surface for heavy truck traffic. Pad material requirements, the site layout, and size will be finalized after the preconstruction survey. Typical stockpile sites are discussed in Section 3.

The fuel storage depot at the stockpile site will require the installation of pads of a sufficient depth to permit truck movement around the site and to safely support refuelling activities. The pads will be sufficient to stabilize the traffic areas of the site, to provide a suitable driving surface and to support the temporary fuel tanks. This fuel depot will be located within the stockpile site footprint. Additional information on typical fuel storage depots is provided in Section 3.

Temporary fuel storage tanks will be used to supply the Fort Good Hope infrastructure site on Crown land requirements for electric power generation and facility construction equipment. Tank storage for about 1.2 million L will be required at the fuel storage and stockpile site. These tanks are planned to contain diesel fuel.

Barge Landing

The barge landing is situated on the east shore of the Mackenzie River about 3.0 km south of Fort Good Hope. The barge landing will be developed primarily on the beach area of the Mackenzie River (see Figure 4-9). The developed area will be used for unloading material and equipment from the barges onto trucks for transport to the stockpile site.

The selected location of the barge landing:

- reduces the impact on commercial river traffic
- is close to existing infrastructure to reduce physical impacts

In-stream activities will be restricted to the excavating required to prepare a smooth flat base for beaching a 600 Series spud barge. Work on the river bank will involve installing temporary mooring points, consisting of anchor blocks or screw-in anchors, and constructing the barge access ramp adjacent to the spud barge for transferring material and equipment to trucks. No pier piles are required at this site. The material excavated from the river edge will either be used as fill, if suitable, to create the barge access ramp, or to level and fill low-lying areas at the barge landing site. The barge access ramps will be constructed by building up granular materials to the level of the spud barge's deck. Fill material will be obtained from local granular sites and granular resource suppliers. The need for rig mats or geotextiles to stabilize the fill material and improve the weight-bearing capacity of the ramps will be determined in the field during construction.

The multi-year use of the barge landing might require the barge ramp to be replaced each season because of the wash-out effects caused by the spring ice flows on the Mackenzie River. This might require maintaining a small stockpile (about 1,000 m^3) of till and granular resources for annually reconstructing the barge landing site. The need for and size of this stockpile will be determined at the site after the quality of the excavated material and local river edge material has been assessed.

Operations Activities

The fuel storage and stockpile site will act as a staging area for the construction activities for the Fort Good Hope infrastructure site on Crown land.

Fuel Storage and Stockpile Operations

The fuel storage and stockpile site will be used to store the material required for construction of the Fort Good Hope infrastructure site on Crown land. Material and equipment will be barged from Hay River to Fort Good Hope along the Mackenzie River.

During the barge-unloading period (about seven weeks each year), trucks will operate continuously until all the required material has been stockpiled. A

preliminary estimate of materials to be stockpiled at the stockpile site includes camp modules and supplies for the 120-person camp. A list of equipment that might be stored at the site is included in Section 6.

During construction, the material required for constructing the Fort Good Hope infrastructure site will be hauled from the stockpile site to the infrastructure site on Crown land. When construction is underway, truck activity will occur along the proposed access roads from the fuel storage and stockpile site to the Fort Good Hope infrastructure site on Crown land.

Fuel Depot Operations

Fuel will be delivered by truck from the Fort Good Hope barge landing to the fuel storage depot located at the stockpile site. Required fuel will be delivered from the temporary fuel depot to the construction site fuel depot. This will require daily truck traffic through the temporary fuel depot during construction of the Fort Good Hope infrastructure site.

Barge Landing Operations

The 600 Series spud barge will be used for unloading cargo barges of pipeline materials, pipeline construction equipment and construction consumables for construction activities. The spud barge will be berthed at the barge landing for about three weeks each season.

About six 1500 Series cargo barges could be moored simultaneously near the barge landing site while waiting to be unloaded. They will be moored where they will not interfere with other river traffic or result in potential safety concerns. The immediate shore area will not need to be disturbed for mooring. The mooring distance from the shore will depend on the water depth and the draft of the barges. Tie lines to temporary mooring points on shore, such as mooring screw anchors or anchor blocks, will be required to secure the barges to the shore while they wait to be unloaded. The temporary mooring points will be re-established each operation season, if they are destroyed or removed by ice activity.

SUMMARY OF POTENTIAL ENVIRONMENTAL AND RESOURCE EFFECTS (PART 6)

ENVIRONMENT

The following topics provide specific biophysical and human environment setting, effects and mitigation information for the Fort Good Hope fuel storage and stockpile site, barge landing and related access roads. This information includes data collected during the 2004 field programs.

Biophysical Environment

Air Quality Setting

The air quality setting for this site is expected to be similar to the regional air quality setting for the SSA described in Section 8.

Air Quality Potential Effects and Mitigation

Potential effects on air quality associated with the development of these sites, such as dust, vehicle and equipment emissions, are expected to be limited and localized. Site-specific effects and mitigation are expected to be similar to regional effects and mitigation for the SSA described in Section 8.

Noise and Light Setting

The noise setting for this site is expected to be similar to the regional noise setting for the SSA described in Section 8.

At the present time, there are no man-made sources of light at the site.

Noise and Light Potential Effects and Mitigation

The potential effects and mitigation pertaining to noise and lighting are discussed next. These items are combined because both affect sensory perception.

Potential effects on noise levels associated with the development of these sites are expected to be limited and localized. Site-specific effects and mitigation are expected to be similar to regional effects and mitigation for the SSA described in Section 8.

Industrial lighting can cause increases in ambient light. Sources of light include vehicles and lighting around the site.

Lighting will be used during non-daylight hours, which, during the winter months, might mean periods where lighting is required on a 24 hour basis. Conversely, during the late spring and through the summer months, lighting will likely not be required because of the extended daylight hours.

The potential visual effect of lighting can be partially reduced by proper placement and use of lighting only in areas where it is required.

Soils, Landforms and Permafrost Setting

The barge landing site is situated on the east shore of the Mackenzie River about 3.0 km south of Fort Good Hope and is located at the base of a colluvial slope. The barge landing at this site will be developed on alluvial deposits of the Mackenzie River. The proposed access road that connects the barge landing site

to the airstrip will climb the colluvial slope of the Mackenzie River to reach a glaciofluvial plain above it. Alluvial floodplains adjacent to the watercourse typically lack permafrost. Colluvial slopes adjacent to the watercourse might contain areas of permafrost, although the amount of permafrost might be lower than average, as the parent materials are likely coarse grained and well drained.

The stockpile site will be constructed to the east of the Fort Good Hope airstrip on a glaciofluvial plain. Glaciofluvial plains of the region are well to moderately well drained and typically have developed soils of the Brunisolic Order. The site lies within the zone of extensive discontinuous permafrost, although glaciofluvial deposits in this region generally lack permafrost.

Soils, Landforms and Permafrost Potential Effects and Mitigation

Colluvial slope deposits along the banks of the Mackenzie River are subject to erosion following disturbance of the surface layer. The use of fine-grained materials to construct barge pads might increase the sediment load of the Mackenzie River during high water events. Construction of barge landing site will result in soil loss, although soil development on alluvial deposits of the Mackenzie River is likely minimal.

Landform-related environmental sensitivities are not predicted for the fuel storage and stockpile site. However, construction of granular pads at the site could result in a small amount of soil loss because of burial.

General mitigation strategies to offset potential effects are outlined in Section 8.

Vegetation Setting

The barge landing site and stockpile site are composed of upland white spruce – Alaska birch and black spruce – Labrador tea/mountain cranberry forest. Vegetation surveys have been completed in the area of the fuel storage and stockpile site. No rare plants were recorded at the site.

The barge landing and fuel storage and stockpile site are dominated by upland white spruce – Alaska birch forest, which is characterized by an open to closed tree canopy of black spruce, white spruce and Alaska birch. Shrub cover is composed largely of green alder, willows and short black spruce and Alaska birch, with a moderate cover of moss and lichens. The black spruce dominated forest is characterized by an open tree canopy of black spruce and abundant cover of low and dwarf shrubs. Lichens, in particular reindeer lichens, are a dominant component of the ground cover.

Access from the fuel storage and stockpile site to the Fort Good Hope infrastructure site will use an existing cutline for most of the route. This line appears to have been recently cut or is frequently used. In either case, trees and shrubs are absent except for occasional and very short individuals. The portion of

the route from the barge landing to the Fort Good Hope airstrip is undisturbed and will cross a black spruce – Labrador tea forest and a small area of upland white spruce – Alaska birch forest along a north west facing slope. Vegetation along this portion will be cleared. Trees on the slope are potentially mature and tall, and a community of concern.

Vegetation Potential Effects and Mitigation

Development of fuel storage and stockpile site, barge landing site and related access roads will affect vegetation through clearing and mechanical damage to trees, shrubs, forbs and non-vascular species, the permanent loss of vegetation and underlying substrates through site expansion and potential changes in site drainage and along the access road.

The majority of effects on vegetation will occur because of project activities arising from site construction and operations. These effects might include the potential influence of dust deposition on the health and growth of nearby vegetation, as well as the potential accidental introduction of non-native plant species to the stockpile site and along the access road. Effects on vegetation because of the fuel storage and stockpile site, barge landing and related access roads may persist into the far future (effect extends beyond 30 years past decommissioning and abandonment) given the slow rate of vegetation growth in the North. At decommissioning, introduction of non-native reclamation species might also occur. Vegetation on the sites and along the access road might develop into a different vegetation community than what was there before development.

Implementation of primary mitigation measures, as described in Section 8, will help reduce the magnitude of effects on vegetation at this site and its access road.

Wildlife Setting

Wildlife habitat at the Fort Good Hope barge landing and fuel storage and stockpile site is composed of closed mature black spruce–tamarack forest. Alder, willow, and lichen dominates the open shrub layer. These important features at the site provide foraging habitat for moose (winter) and woodland caribou (winter).

Although detailed wildlife field surveys were not conducted, habitat quality is predicted to be moderate to high. Based on habitat availability, a variety of species might inhabit the sites. These include several species that have special status designation at the international, national and territorial levels, as determined by the World Conservation Union (IUCN), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Department of Resources, Wildlife and Economic Development (RWED, now ENR), respectively. These species are summarized in Table 4-13.

Table 4-12: Special Status Species That Were Observed or That Might Occur at the Fort Good Hope Fuel Storage and Stockpile Site and Barge Landing Site

Species	Status[a]			
	RWED[b]	COSEWIC[c]	SARA[d]	IUCN[e]
Grizzly bear (northwestern population)	Sensitive	Special concern	Schedule 3 – special concern[f]	-
Northern flying squirrel	Sensitive	-	-	Lower risk – least concern
Wolverine	Secure	Special concern	Schedule 3 – special concern[f]	Vulnerable
Woodland caribou (boreal population)	Sensitive	Threatened	Schedule 1 – threatened	Lower risk – least concern
Golden eagle	Sensitive	Not at risk	-	-
Peregrine falcon (anatum)	At risk	Threatened	Schedule 1 – threatened	-
Peregrine falcon (tundra)	May be at risk	Special concern	Schedule 3 – special concern	-
Olive-sided flycatcher	Sensitive	-	-	-
Boreal chickadee	Sensitive	-	-	-
Blackpoll warbler	Sensitive	-	-	-
Gray-headed chickadee	May be at risk	-	-	-
Harris' sparrow	Sensitive	-	-	-
American tree sparrow	Sensitive	-	-	-
Northern flicker	Sensitive	-	-	-
Rusty blackbird	Sensitive	-	-	-
White-throated sparrow	Sensitive	-	-	-
Northern pintail	Sensitive	-	-	-
Common snipe	Sensitive	-	-	-
White-winged scoter	Sensitive	-	-	-
Lesser yellowlegs	Sensitive	-	-	-
Red-necked phalarope	Sensitive	-	-	-
Short-eared owl	Sensitive	Special concern	Schedule 3 – special concern	-
Short-eared owl	Sensitive	Special concern	Schedule 3 – special concern	-

Table 4-12: Special Status Species That Were Observed or That Might Occur at the Fort Good Hope Fuel Storage and Stockpile Site and Barge Landing Site (cont'd)

Species	Status[a]			
	RWED[b]	COSEWIC[c]	SARA[d]	IUCN[e]
Boreal chorus frog	Sensitive	-	-	-

NOTES:
[a]A hyphen indicates no status has been assigned for that species.
[b]RWED – Resources, Wildlife and Economic Development (known as ENR since April 1, 2005)
[c]COSEWIC – Committee on the Status of Endangered Wildlife in Canada
[d]SARA – *Species at Risk Act*
[e]IUCN – The World Conservation Union
[f]SARA status is to be reassigned (i.e., potentially added to Schedule 1) pending results of public consultation, stakeholder consultation and final Ministerial approval.

Wildlife Potential Effects and Mitigation

The fuel storage and stockpile site is composed of moderate to high quality habitat for wildlife. The barge landing site provides high quality winter foraging habitat for moose and woodland caribou, while the fuel storage and stockpile site provides high quality foraging for woodland caribou (winter), moose (winter), and grizzly bear (spring).

General potential effects resulting from development and operation of the fuel storage and stockpile site include direct and indirect habitat loss, disruption of wildlife movements and wildlife mortality. The small footprint of disturbance relative to regional habitat availability suggests that the magnitude of project effects on birds and most mammals, including those with special status designation, will be low. However, specific issues of concern at the fuel storage and stockpile site include:

- disturbance of browsing moose during winter
- disturbance of foraging woodland caribou during winter
- disturbance of foraging grizzly bears during spring

Implementation of general mitigation measures, as outlined in Section 8, will reduce effects on wildlife during infrastructure site development and operations. Specifically, the following mitigation measures are considered important for this project site:

- limit project activities in key caribou winter range between October and January to limit interaction with caribou

- limit disturbance to riparian vegetation communities

- limit disturbance to drainages by designing appropriate drainage control measures
- maintain buffer zones between access roads, other infrastructure sites and riparian zones associated with watercourses, lakes or wetlands, except where waterbodies need to be crossed by a road
- construct fencing in situations where wildlife needs to be kept out of particular areas for safety and conservation reasons
- follow the waste management plan to reduce attraction of grizzly bears to work sites
- develop protocols for managing potential grizzly bear–human interaction, including measures to deter grizzly bears from camps and other facilities that are consistent with *Safety in Grizzly Bear Country: A Reference Manual* (RWED, now ENR)

Hydrology Setting

The fuel storage and stockpile site is located about 3.0 km south of Fort Good Hope and most of the runoff would potentially flow into the Mackenzie River. The area encompassing the fuel storage and stockpile site that contributes runoff to the Mackenzie River is about 1 km^2. The barge landing site is located on the Mackenzie River, downslope of the fuel storage and stockpile site.

Hydrology Potential Effects and Mitigation

An increase in mean annual runoff flow due to the higher runoff coefficient of the disturbed area and of any increase in mean sediment concentration from the sites is expected to be limited with the use of appropriate mitigation measures. Effects on the Mackenzie River due to the barge landing site and runoff from the fuel storage and stockpile site are expected to range from limited to some localized effects because of the relatively large flows in the watercourse and the high dilution capacity.

Groundwater Setting

No groundwater features, such as springs, seeps, or extensive icings have been noted in association with these sites. There was a reported spring at the base of an esker ridge about 2.3 km northeast of Fort Good Hope. This feature was investigated in 2002. While no spring was observed on the ground, the gravel exposed in a road cut across the esker exhibited considerable calcite ($CaCO_3$) coating, which indicates that groundwater discharge or seepage has occurred in the past, or might be occurring intermittently.

At site locations where continuous permafrost exists, groundwater flow is expected to be limited, seasonal and restricted to the active layer.

Groundwater Potential Effects and Mitigation

There do not appear to be any groundwater related issues associated with the barge landing or fuel storage and stockpile site at Fort Good Hope. Other than the generally accepted need to prevent groundwater contamination as a result of the designated land use, no mitigation measures are proposed at present.

Water Quality Setting

Water quality data for this site is expected to be similar to regional water quality data described in Section 8.

Water Quality Potential Effects and Mitigation

Site-specific water quality effects and mitigation are expected to be similar to the regional biophysical effects and mitigation described in Section 8.

Fish and Fish Habitat Setting

The Fort Good Hope barge landing is located on the east shore of the Mackenzie River, about 3.0 km south of Fort Good Hope.

Fish captured or reported to have been captured from the Mackenzie River included at least 16 species: 10 large-bodied, major species and six small-bodied, minnow species. Longnose sucker was the dominant species, with other major species including Arctic grayling, northern pike, walleye, goldeye, burbot, inconnu, mountain whitefish, broad whitefish and Arctic lamprey.

The Mackenzie River in this area provides a corridor for movement of diadromous fish species between the Beaufort Sea and upstream areas of the Mackenzie River. Species that have been found include chum salmon, Arctic cisco and least cisco.

The Mackenzie River at the barge landing site is comprised entirely of deep run (R1) habitat.

Channel bed material was primarily sand and gravel, with some cobble, boulders and woody debris. Water depth and turbulence, with occasional boulders, provide most of the instream cover near the barge landing site.

Cover provided by depth, and seasonally by turbidity, makes the run habitats of near-shore right downstream bank potentially suitable for rearing, and adult feeding and holding by species such as northern pike, longnose sucker, whitefish species and burbot. Shallow shore margin flats, during summer, will provide

rearing habitat for species such as inconnu, longnose sucker, other whitefish species, and small forage and minnow species. Mainstem spawning potential at the barge landing site is limited, but some woody debris might be used in side channels by northern pike. Spring spawning species likely move up the Hare Indian (Rabbitskin) River and smaller tributaries to spawn. Spawning by inconnu and other whitefish species might occur in fall, farther upstream at The Ramparts. With shallow shore margin habitats in the area, and downstream, might be used for transitory rearing by fry of these species. Based on a watercourse depth maximum deeper than 16 m and bathymetric profiles, it is likely that some parts of the mainstem channel and the Hare Indian (Rabbitskin) River confluence, near the barge landing site, are suitable for overwintering.

Fish and Fish Habitat Potential Effects and Mitigation

Development of the fuel storage and stockpile site, the barge landing and related access roads might affect fish and fish habitat directly through activities associated with construction of the barge landing site and indirectly through introduction of sediment carried by surface run from the fuel storage and stockpile site.

Maintaining a vegetated buffer zone between the site and local waterbodies, if required, and implementation of site-specific erosion and sediment control plans will prevent sediment from reaching surface waters.

Human Environment

This topic contains a description of the protected areas and heritage resource setting and potential effects and mitigation for these sites. Other human environment information is described in Section 8.

Protected Areas Setting

The Fort Good Hope infrastructure site is located within the proposed Mackenzie River Special Management Area. This area was identified by the Sahtu Preliminary Draft land use plan as a very important regional and territorial travel and transportation corridor, heritage place and traditional use location.

Protected Areas Potential Effects and Mitigation

The development of this site in the proposed Mackenzie River Special Management Area will result in a decrease in the land base available for other land uses within this area. The presence of development within this area will be a permanent change to the landscape.

Heritage Resources Setting

This site was investigated during the 2004 field programs. The barge landing site was considered to have moderate potential for the discovery of heritage resources. A heritage resource site has been previously recorded within a 2 km range of the development area. Cultural features including a number of saw and axe cut stumps were recorded in the area at this time.

The fuel storage and stockpile site was considered to have low potential for the discovery of heritage resources. A heritage resource site has been previously recorded within a 2 km range of the development area. No heritage sites were recorded as a result of the surface reconnaissance.

The nature of the heritage resource potential and results of preliminary investigations at these locations will be provided to the Prince of Wales Northern Heritage Centre in a report under permit 2004-956.

Heritage Resources Potential Effects and Mitigation

Before the development of these sites, a Heritage Resource Impact Assessment will be conducted and provided to the Prince of Wales Northern Heritage Centre. If it is determined that the development will affect any heritage resources, mitigation plans will be prepared.

PUBLIC INVOLVEMENT

The Fort Good Hope barge landing site originally proposed by Imperial was near the Hare Indian (Rabbitskin) River area. During public meetings, workshops and one-on-one consultations in Fort Good Hope, residents voiced concerns about the proximity of the proposed barge landing to the local recreational area. The community recommended that the barge landing be located further south of Fort Good Hope. Alternative locations were considered and a new barge landing near the Fort Good Hope airport was selected.

Initially several construction camp sites were proposed within the municipality of Fort Good Hope. Community feedback received during public meetings, workshops and during fieldworker one-on-one consultations indicated that many residents preferred the camp to be further away from the community in order to reduce potential impacts. Alternative locations were considered and a new camp location south of the Fort Good Hope airport and outside the municipal boundaries was selected.

The public involvement activities are documented in Section 10 of this application.

EQUIPMENT (PART 10)

The following tables show an estimate of the equipment that might be required for the development of these sites. An exact list and numbers will not be known until immediately before construction. Table 4-14 lists the site construction equipment. Table 4-15 lists site operations equipment.

Table 4-13: Estimate of Site Construction Equipment

Type and Approximate Number per Site	Size, Model or Equivalent	Proposed Use
Crew cabs and pick-ups – 2	4x4	Transporting crews
Bulldozers with GP buckets, U blades and brush rakes – 2	Large sized bulldozer (405 HP)	Site grading, pad and access road development, spreading granular material, snow removal
Dump trucks (double axle) – 2	Truck with trailer (12 m^3)	Hauling granular material
Front end loader with GP bucket – 1	Large sized loader (5.5 m^3 bucket loader)	Site preparation work
Road grader – 1	Large sized grader (4.9 m blade)	Site preparation work, grading ramps and access roads
Tracked mechanical ditcher – 1	Medium sized excavator (1.45 m^3 bucket)	Excavating and removing organic material
Tree feller-buncher and skidder – 1	Tracked 35,490 kg feller-buncher with a high speed saw head	Site clearing and timber handling
Compactor – 1	Medium sized compactor (20,879 kg sheepsfoot packer)	Compaction of camp site pad fill materials and access road construction
Crane (tracked) – 1	Medium sized crane (100 t)	Unloading and placement of camp modules
Mechanic's truck with welder – 1	4x4	Equipment repair
Water truck – 1	Tandem axle (16 – 24 m^3)	Site and road work
Sea containers – 2	6 m	Storage
Mobile camp – 1	35 person	Site development
Fuel trucks – 1	3785 L	Fuel for equipment
Skid steer loaders – 2	Large sized skid steer (80 HP)	Site work
Sea containers – 4	6 m	Storage

Table 4-14: Estimate of Site Operations Equipment

Type and Approximate Number per Site	Size, Model or Equivalent	Proposed Use
Sea containers – 4	6 m	Storage
Tractor trailers – 4	Dry van 14.6 m or 16.2 m	Parts and supplies
Road graders – 2	Large sized grader (4.9 m blade)	Earthwork, road maintenance and snow removal
Front end loader with GP bucket – 1	Large sized loader (5.5 m^3 bucket loader)	Movement of camp supplies and snow removal
Snow machines – 6	Small sized snow machine (400 cc)	Personnel transport
4 x 4 crew cab pick-up – 4	4x4	Transporting crews
Crane (tracked) – 1	Medium sized crane (100 t)	Loading and unloading pipe, equipment and materials
Flatbed trucks with pickers – 2	10 ton truck	Transporting materials and maintenance
Truck and water tank trailers – 5	Tandem axle (16 – 24 m^3)	Bringing water to the camp for domestic use and fire protection
Skid steer loaders – 2	Large sized skid steer (80 HP)	Site work

FUELS (PART 11)

Table 4-16 itemizes fuel storage. This represents an estimate of fuel requirements.

Table 4-15: Estimate of Fuel Storage

Fuels	Number of Containers	Capacity of Containers	Location
Diesel	6	200,000 L each	Fuel Depot
Other	As required	As required	Fuel Depot

PERIOD OF OPERATIONS (PART 14)

Site operations for the barge landing will be continuous during the primary pipeline construction period from 2006 through the summer of 2010 and may be required during the operations phase.

Site operations for the fuel storage and stockpile site will be continuous during the summer of 2006 and are anticipated to end during the 2006-2007 construction season.

LOCATION OF ACTIVITIES BY MAP COORDINATES (PART 16)

Map coordinates of the site centroids are shown in Table 4-17. A map showing the location of the sites is provided in Figure 4-9.

A photograph of these sites appears in Figure 4-10.

Table 4-16: Map Coordinates for Site Centroids

Site	Latitude (DD)	Longitude (DD)	UTM Easting (m)	UTM Northing (m)	UTM Zone
Fort Good Hope barge landing site	66.2454	-128.6617	515205	7347306	9
Fort Good Hope fuel storage and stockpile site	66.2408	-128.6280	516724	7346804	9

FEES (PART 18)

The total land area required for activities contained in this section is 8.7 ha, comprised of 2.3 ha for the fuel storage and stockpile site, 4.6 ha for access to the fuel storage and stockpile site, 0.6 ha for the barge landing site and 1.2 ha for access to the barge landing site.

A full breakdown of land requirements is shown in Appendix A.

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Figure 4.10 has been moved to reduce file size. To view it, click on the link to the figure in the web page List of Figures for this document.