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Report

Indian and Northern Affairs Canada

North Arm of Great Slave Lake proposed Area of Interest Phase 1 Ecological Assessment

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North Arm of Great Slave Lake proposed Area of Interest Phase 1 Ecological Assessment

Prepared by:

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Project Number:

111111

Date:

March 31, 2009

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March 30, 2009 Project Number: 111111

Gina Ridgely
Protected Areas Strategy Advisor
Environment and Conservation
Indian and Northern Affairs Canada
P.O. Box 1500
Yellowknife, NT X1A 2R3

Dear Ms. Ridgely:

Re: North Arm of Great Slave Lake proposed Area of Interest
Phase 1 Ecological Assessment – Final Report

AECOM is pleased to provide you with the Final version of the North Arm Phase 1 Ecological Assessment. While finding and processing the information took longer than anticipated, we think that the added wait was time well spent for all involved.

Compiling existing data proved a challenging task, as most published information sources were neither current nor readily accessible. The result was a more exhaustive search of data and frequent discussions with regional experts. During this process, the Project Team was able to track down unpublished and newly acquired information sources that enhance the state of knowledge for key ecological components. Our research efforts further revealed a comprehensive list of data gaps that future studies will benefit from.

The research findings have been summarized and presented in a manner that highlights the study area's main ecological components, and assesses the region's overall merit for conservation status. We trust that the report will lead to a productive and well-informed decision on whether or not to continue to a Phase 2 Ecological Assessment.

Sincerely,
AECOM Canada Ltd.

Bob Wooley
bob.wooley@aecom.com

BS:cs
Encl.
cc: File

Distribution List

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Signature Page

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1. Introduction

Tłı̨chǫ elders have identified the area surrounding the North Arm of Great Slave Lake as an important area for birds and other wildlife (INAC 2009). The site has also been recognized by the Canadian Wildlife Service for containing a Key Migratory Bird Terrestrial Habitat Site, NT Site-20 (Latour *et al.* 2008). This area lies within Tłı̨chǫ and Akaitcho claim areas. Given these identified values, the area was selected as a Protected Areas Strategy *Area of Interest*, and a Phase 1 Ecological Assessment (this report) conducted as part of the process for determination as a protected area.

1.1 The Protected Areas Strategy Process

The Protected Areas Strategy (PAS) is a process for making decisions to protect lands using the best available knowledge. The Protected Areas Strategy provides an effective community-based tool for advancing culturally and ecologically significant areas toward long-term protection status. The PAS process consists of eight steps for protected area planning and establishment (GNWT 1999). Step 2 includes an initial Phase 1 assessment of the region's economic, cultural and ecological values, collecting and reviewing existing data, assessing and evaluating the data, and compiling the data into a report. This report comprises the Phase 1 Ecological Assessment (EA) of the Step 2 PAS process. The EA involves a detailed inventory of key ecological components in the area, as well as an evaluation of the contribution of the area to the conservation of those components. The EA is intended to:

- evaluate species diversity and habitat potential
- improve the state of knowledge of ecological processes
- provide a coordinated and consistent process for planning and implementation of candidate protected areas
- provide information for the assessment of social and economic implications of the ecological values

Phase 1 of the EA is intended to:

1. define an initial study area that considers the physiographic, e.g., ecoregion, or phytogeographic character of the candidate protected area
2. compile and evaluate available existing ecological data, including preliminary habitat delineation, and ecoregion/landscape unit representation analysis
3. identify occurrence of focal vertebrate species significant to ecosystem and/or cultural integrity
4. determine deficiencies in existing ecological information for conservation designation of the candidate protected area, and requirements for additional data from field studies (GNWT 1999)

Finally, the report's findings are meant to contribute towards a Terms of Reference for a possible PAS Phase 2 Ecological Assessment. A plain language summary of the report is available to communities.

2. Methodology

For the preparation of the North Arm Area of Interest (NAAI) Phase 1 EA, AECOM completed six linked tasks.

Task 1. Definition of Initial Study Area: Task 1 consisted of a team discussion to list the search parameters and potential data sources for the study, and to discuss the study area boundary.

Task 2 Compilation of Existing Data: Task 2 consisted of the acquisition and review of existing regional and local data on the NAAI's ecological components. Sources reviewed included territorial and federal government documents, scientific journals, non-government organizations, and personal interviews with regional experts.

Task 3 Evaluation of Existing Ecological Data: Upon acquisition of existing regional and local ecological data and maps, a detailed assessment and evaluation was completed. Qualitative and quantitative data was reviewed to estimate the abundance, vitality, and range of ecological components in the region. From this assessment focal species and interests were identified. Initial focal species and interests were selected based on the identification of Tłı̨chǫ elders for their high cultural significance and from the area's designation as a Key Migratory Bird Terrestrial Habitat site by the Canadian Wildlife Service (CWS) (Latour *et al.* 2008 and Alexander *et al.* 1991). Focal species and interests were also selected according to their degree of ecological importance. To provide a better gauge for the study area's conservation value, focal interests were also identified for abiotic ecosystem components.

A review of species listed as at-risk was undertaken and those species determined to have the potential to be within the study area were added as focal species. Some species of importance were excluded from the analysis in order to focus on the species of interest to the North Arm. To the extent possible, the focal species selected represent the family of species within the broader region.

Where sufficient data existed, GIS mapping was used to identify and demonstrate spatial patterns of the ecological components.

Task 4. Determination of Deficiencies in Existing Data and Recommendations: Task 4 consisted of determination of data required for a confident ecological assessment, and the identification of data gaps. This task was accomplished through the use of professional judgment and a predefined set of criteria that defined the requirements necessary to maintain ecological integrity. Data gaps were summarized, and recommendations made for future ecological studies and data collection.

Task 5. Data Reporting and Revisions: Completed material was compiled and prepared into a draft report for the Protected Areas Strategy Working Group. The draft report contained the completed findings and evaluations of the Project Team, and was consistent with the Final Report's framework. The

draft report was discussed with the Working Group in order to ensure their expectations were addressed, and comments were incorporated into the final report.

Task 6. Final Reporting and Summary Documentation: A final report was prepared based on the recommendations from the draft report. Supporting documentation includes map products and a Plain Language summary.

3. Study Area

3.1 Study Area Description

The NAAI is bisected by a physiographic boundary that is characterized by the Interior Plains to the west and the Precambrian Shield to the east. The west side of the North Arm is characterized by sculpted landscape smoothed by glaciers, while the east side of the North Arm is characterized by hundreds of small lakes and erosion resistant strata of the Precambrian Shield (Mackenzie River Basin – State of the Aquatic Ecosystem Report 2003). Surficially, much of the area is till veneers less than 2 m deep that have been modified by meltwater and glaciolacustrine processes (Kerr and Wilson, 2000). Permafrost is widespread in those parts dominated by silts and clays, occurring less frequently in sands and gravels and is absent where bedrock is exposed (Aspler, 1978).

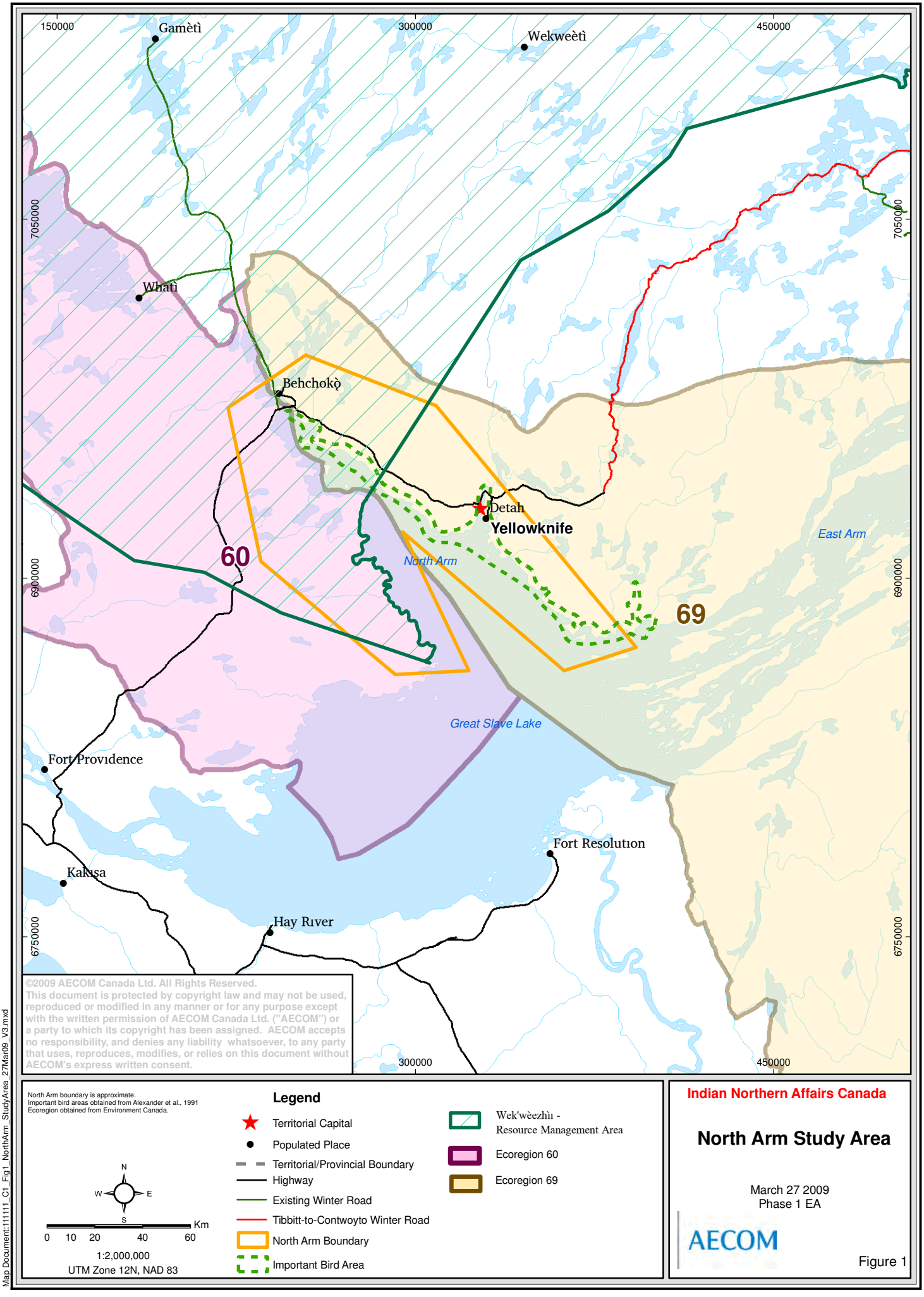
The NAAI contains two ecoregions. The ecoregion in the northeast portion and north of Great Slave Lake is the Great Slave Lake Plain (Ecoregion 60) and is in the Taiga Plains Ecozone, while the ecoregion to the southwest is the Tazin Lake Upland (Ecoregion 69) and is part of the Taiga Shield Ecozone (Northwest Territories Protected Areas Strategy Science Team 2009) (see Figure 1).

The human environment within the NAAI is made up of four communities: Behchokǫ̀ in the North, and Yellowknife, N'Dilo and Dettah in the south-east. The combined human population for the study area is approximately 21,041 (Yellowknife 18,700; N'Dilo 200; Dettah 247; Behchokǫ̀ 1,894) (Statistics Canada 2006). The north and western region of the NAAI lies within the Tłı̨chǫ lands. This area falls under the jurisdiction of the Wek'èezhíi Co-Management Boards (WLWB 2009). The south-west corner of the study area falls within the Dehcho lands. The east side of the NAAI lies on Akaitcho lands.

The current and proposed protected areas within and adjacent to Ecoregions 60 and 69 are also outlined in Figure 1 and indicate that a small portion of Ecoregion 60 is currently within the Mackenzie Bison Sanctuary and the proposed Edéhzhíe Protected Area, while the proposed East Arm Park will provide protection for a portion of Ecoregion 69.

3.2 Candidate Study Area Boundary

The NAAI outlined in Figure 1 is preliminary, and was provided to the Study Team as the basis for their evaluation of the available values and information for the area. It was generalized and expanded from an area identified as a Key Migratory Bird Habitat by the Canadian Wildlife Service (CWS) (Latour *et al.* 2008 and Alexander *et al.* 1991). The same area is also designated as an Important Bird Area (IBA) under the IBA Program coordinated by BirdLife International (IBA Canada 2004). The North Arm area was identified by CWS because it provides key spring migratory habitat to Tundra Swans and Cackling Canada Geese, as well as nesting habitat for Caspian Terns (Latour *et al.* 2008 and Alexander *et al.* 1991). Input by Tłı̨chǫ Elders in a recent mapping workshop was also important in determining the NAAI (INAC 2009).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Kakisa
Hay River
Fort Resolution
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North Arm boundary is approximate.
Important bird areas obtained from Alexander et al., 1991
Ecoregion obtained from Environment Canada.
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Territorial/Provincial Boundary
Highway
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Tibbitt-to-Contwoyto Winter Road
North Arm Boundary
Important Bird Area
Wek'wèezhìı - Resource Management Area
Ecoregion 60
Ecoregion 69
Indian Northern Affairs Canada
North Arm Study Area
March 27 2009
Phase 1 EA
AECOM
Figure 1
Map Document:111111_C1_Fig1_NorthArm_StudyArea_27Mar09_V3.mxd

3.3 Traditional Knowledge for the Area of Interest

Traditional Ecological Knowledge (TEK) for the North Arm Area of Interest was incorporated into the research findings based on its availability in the literature reviewed and from the interviewed experts. It was agreed at the start-up meeting between the PAS North Arm Working Group and AECOM, January 26th, 2009 to limit TEK inclusion at this time. It was understood that the lack of TEK in the draft Phase 1 Ecological Assessment report would be seen as a weakness.

4. Ecological Assessment

4.1 Hydrology

The physiographic differences found in Ecoregions 60 and 69 in the NAAI result in a marked difference in the hydrology and runoff of the area which sees a much more stable flow regime on the northeast side of the North Arm due to attenuation provided by the many surface lakes. Runoff is also higher on the northeast side, as the vegetation provides initial abstraction and evapo-transpiration, which results in less surface runoff from rainfall events.

The identification of a focal interest from a hydrological perspective is difficult. For the NAAI, lakes in the northeast portion of the NAAI (Ecoregion 69) were selected as they attenuate flow and provide more consistent flow patterns into the North Arm, while wetlands in the southwest portion of the NAAI (Ecoregion 60) were selected because they remove sediments and increase productivity (see Table 1).

Table 1. List of Hydrology Components in the North Arm Area of Interest and Valuation of Ecological Significance

Ecological Component	Ecological Significance
Lakes in Ecoregion 69	Attenuate flow, reduce erosion and sediment loading, provide more consistent flow patterns to the North Arm.
Wetlands in Ecoregion 60	Support water quality enhancement for the removal of nutrients and sediments

4.1.1 State of Knowledge

The majority (77%) of the flow into Great Slave Lake is provided by the Slave River which enters the lake in the Southeast near Fort Resolution directly opposite the North Arm. The other major tributary is the Hay River which enters the lake in the Southwest. Flow from the lake is via the Mackenzie River which discharges on the west side and flows to the Arctic Ocean.

The North Arm of the Lake is generally characterized by shallow water with most regions being well under 70 m depth. In contrast the eastern portions of Great Slave Lake provide much deeper areas with the maximum recorded value of 614m (Mackenzie River Basin Study Report, 1981). Research indicates that the water level in the lake does not fluctuate to any great amount with an annual average fluctuation of approximately 0.52m (Mackenzie River Basin Study Report, 1981).

Flow into the North Arm is generally via the Emile River and the Snare River which both enter the North Arm at the northern tip. Both of these rivers have their catchments areas dominated by the Precambrian shield physiographic characteristics found in Ecoregion 69, which helps provide a more stable flow regime into the North Arm.

4.1.2 Hydrology Data Assessment and Evaluation

The Emile River enters the North Arm at the northern most tip and has had recorded flow data via the Water Survey of Canada hydrometric gauging station 07TB001 (see Figure 2 North Arm Hydrometric Stations) for the years 1979 through 1997. For this period, the lowest and highest recorded flows were 8.05 m^3/s and 56.3 m^3/s occurring on July 26, 1995 and August 12, 1984 respectively (WSC, HYDAT 2005).

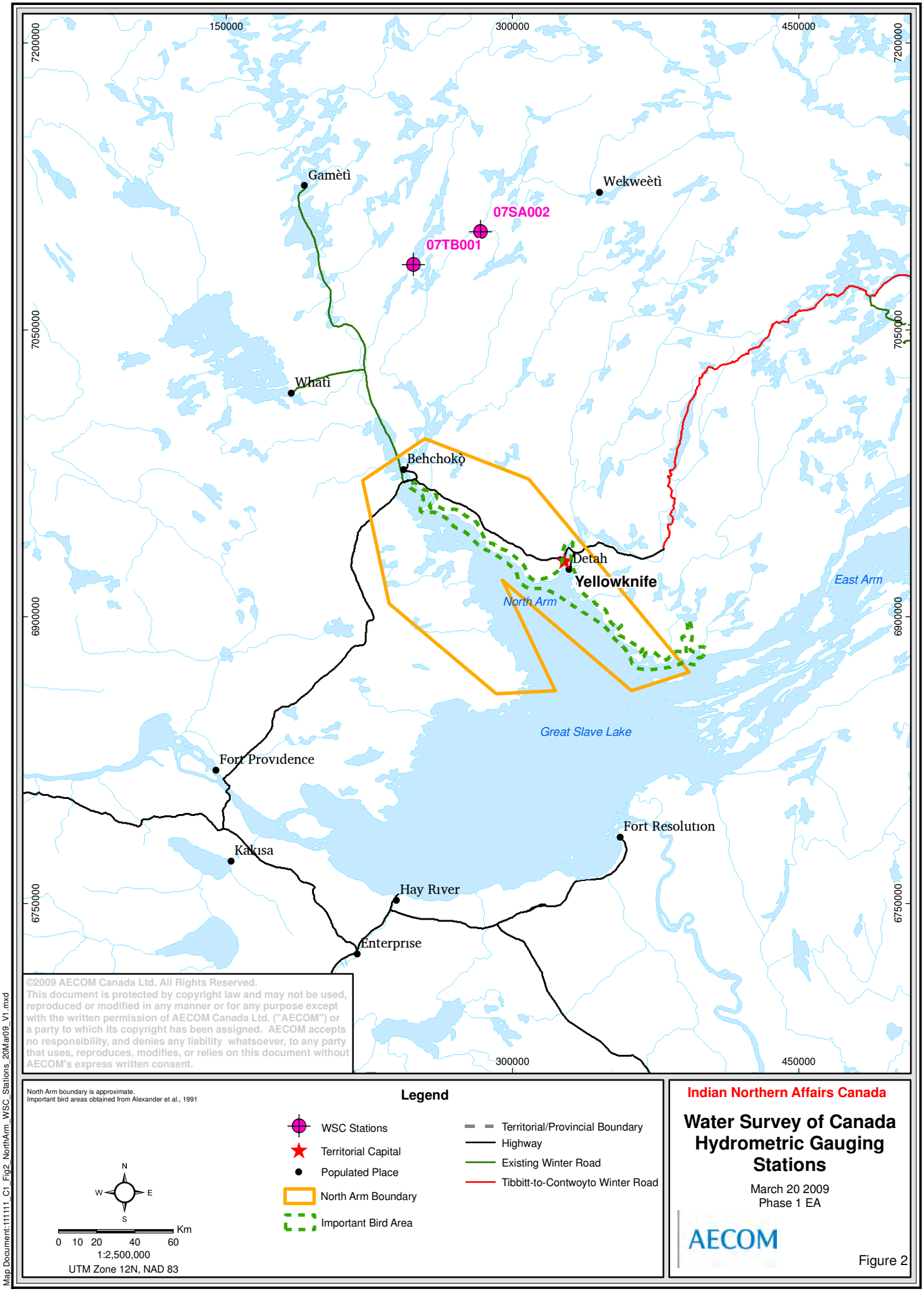
The Snare River enters the North Arm just east of the confluence of the Emile River and Great Slave Lake and has flows that are affected by a hydroelectric project (Snare River Minimum Flow Assessment Report 2000). Hydrometric gauging of the flows in the Snare River at gauge 07SA002 (see Figure 2 North Arm Hydrometric Stations) indicate that for the period between 1985 and 2005 the river experienced low and high flows of 57.6 m^3/s and 335 m^3/s occurring on August 1, 2003 and June 27, 1999 respectively (WSC, HYDAT 2005).

Climate in the NAAI ranges greatly through-out the year from a historical average low temperature in January of -32.2° C to a high in July of 20.8° C. In general, ice conditions can be found on most water bodies between November and late April to early May of each year (Environment Canada 2009a).

Precipitation measured at Yellowknife provides a good indication of precipitation across the NAAI and indicates that annual rainfall averages 280.7 mm based on meteorological data from the period 1971-2000. On a yearly basis, an average of 119 days of the year have precipitation, with the highest contribution of monthly precipitation occurring in August (Environment Canada 2009a).

A study undertaken in 2005 by Gibson *et al,* researched the impacts of climate and flow regulation to water levels in Great Slave Lake. Their findings indicate that climate change is having a statistically significant effect on the water level in the lake. Results indicate that climate change has increased the amplitude of the level fluctuations and is leading to an overall rise in the water level by approximately 0.1m. Another impact of climate change appears to be the early return of spring freshet to the aquatic system. Overall, the freshet seems to be occurring 2 days earlier per decade for the period of analysis between 1964 and 2000 and the peak flow on the Slave River is occurring 6 days earlier per decade (Mackenzie River Basin Board 2004).

Flow regulation of the rivers and streams entering the lake has also had impacts. Construction and operation of the Bennett Dam on the Peace River had temporal effects while filling Williston Reservoir and continues to impact the seasonal average flows between May and October showing a reduction of nearly 20% (Mackenzie River Basin Board 2004). The report further indicates that the effect of the dam has been to increase the over-winter base flows, while greatly attenuating the summer freshet flows by nearly 2000 m^3/s. On the other hand, indications of sediment loading entering the Lake via the Slave River has shown a marked decrease since the dam was constructed.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Yellowknife
North Arm
East Arm
Great Slave Lake
Fort Providence
Kakisa
Hay River
Enterprise
Fort Resolution
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North Arm boundary is approximate.
Important bird areas obtained from Alexander et al., 1991
Legend
WSC Stations
Territorial Capital
Populated Place
North Arm Boundary
Important Bird Area
Territorial/Provincial Boundary
Highway
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UTM Zone 12N, NAD 83
Indian Northern Affairs Canada
Water Survey of Canada Hydrometric Gauging Stations
March 20 2009
Phase 1 EA
AECOM
Figure 2
Map Document:111111_C1_Fig2_NorthArm_WSC_Stations_20Mar09_V1.mxd

Spence and Saso (2005) undertook a study on the prediction of stream flow within the Mackenzie Valley using a regional approach. Their findings indicate the necessity of having good data sources that are dense enough to provide significance in hydrological studies. The hydrometric network of river gauging stations operated by the Water Survey of Canada across the country is an invaluable resource. Budget constraints in the 1990's resulted in over 38% of the stations that serve the Mackenzie River Basin being decommissioned.

Of the 34 stations that were once operating, only 21 remain, which may make future hydrological analysis more difficult and less exact as reference sources of data are reduced.

4.1.3 Hydrology Data Gaps

Hydrological information for the NAAI is available for two stations (Snare River and Emile River), and does provide good time-series information that can be used to model the hydrological regime in those systems. Additional stations may be required to accurately model smaller systems in the NAAI.

4.2 Plants and Vegetation Communities

4.2.1 Plants

The lack of detailed comprehensive vegetation surveys in the area limits the ability to determine the number of plant species in the NAAI. The Ecosystem Classification Group (2007 and 2008), provide plant species lists for the ecoregions that comprise the NAAI (see Appendix A).

Due to the large number of potential species of plants within the NAAI, selection of focal species for plants was limited to plants that were considered species at risk because they have conservation needs due to their rarity or sensitivity to disturbance. Other plant species that were selected as focal species were those that were considered non-native or alien and may have the potential to cause damage to wildlife or native plant communities and may be introduced from the highway corridor and communities located within or adjacent to the NAAI.

4.2.2 Vegetation Communities

Within the NAAI, the Great Slave Plain ecoregion (Ecoregion 60) is characterized by extensive Jack pine (*Pinus banksiana*) forests with sparse bearberry (*Arctostaphylus spp*)-lichen understories that have a frequent fire-return history. White spruce (*Picea glauca*) stands are interspersed throughout the area, especially adjacent to small streams and wetlands. Trembling aspen (*Populus tremuloides*) are more frequent near Great Slave Lake. There are often long, low ridges of till deposits that run north-south through the centre of the ecoregion that are too dry to support tree growth, and thus sparse communities of bearberry and shrubby cinquefoil (*Potentilla fruticosa*) reside instead. A large portion of the ecoregion is covered with small sedge-dominated fens occurring alongside calcareous ponds (Ecosystem Classification Group 2007).

The portion of Ecoregion 69 (Tazin Lake Upland) within the NAAI that is adjacent to Great Slave Lake is noted for its ponds, lakes, shallow bays and marshes that provide an extensive assortment of aquatic and shoreline vegetation. It also consists of discontinuous forests of Jack pine, aspen, white spruce and birch (*Betula spp*) throughout or on top of rock outcrops that surround the locally shrubby and sedge fens in the wet depressions (Ecosystem Classification Group 2008).

A comprehensive ecological classification of vegetation communities to an ecosystem level has not been completed at this time in the NWT, which limits the ability to select specific vegetation communities as potential focal interests. Although the mapping is limited, wetlands as a group were chosen as a focal interest due to their importance as wildlife habitat and their role in nutrient cycling and hydrology.

4.2.3 State of Knowledge

The state of knowledge for rare and invasive plants is limited, with the extent of information available for areas within the NAAI limited to areas near the existing road system and close proximity to Yellowknife. Wetlands are extensive within the NAAI, but classification of vegetation communities has not been completed in sufficient detail to allow delineation of wetland types or identification of potential rare communites.

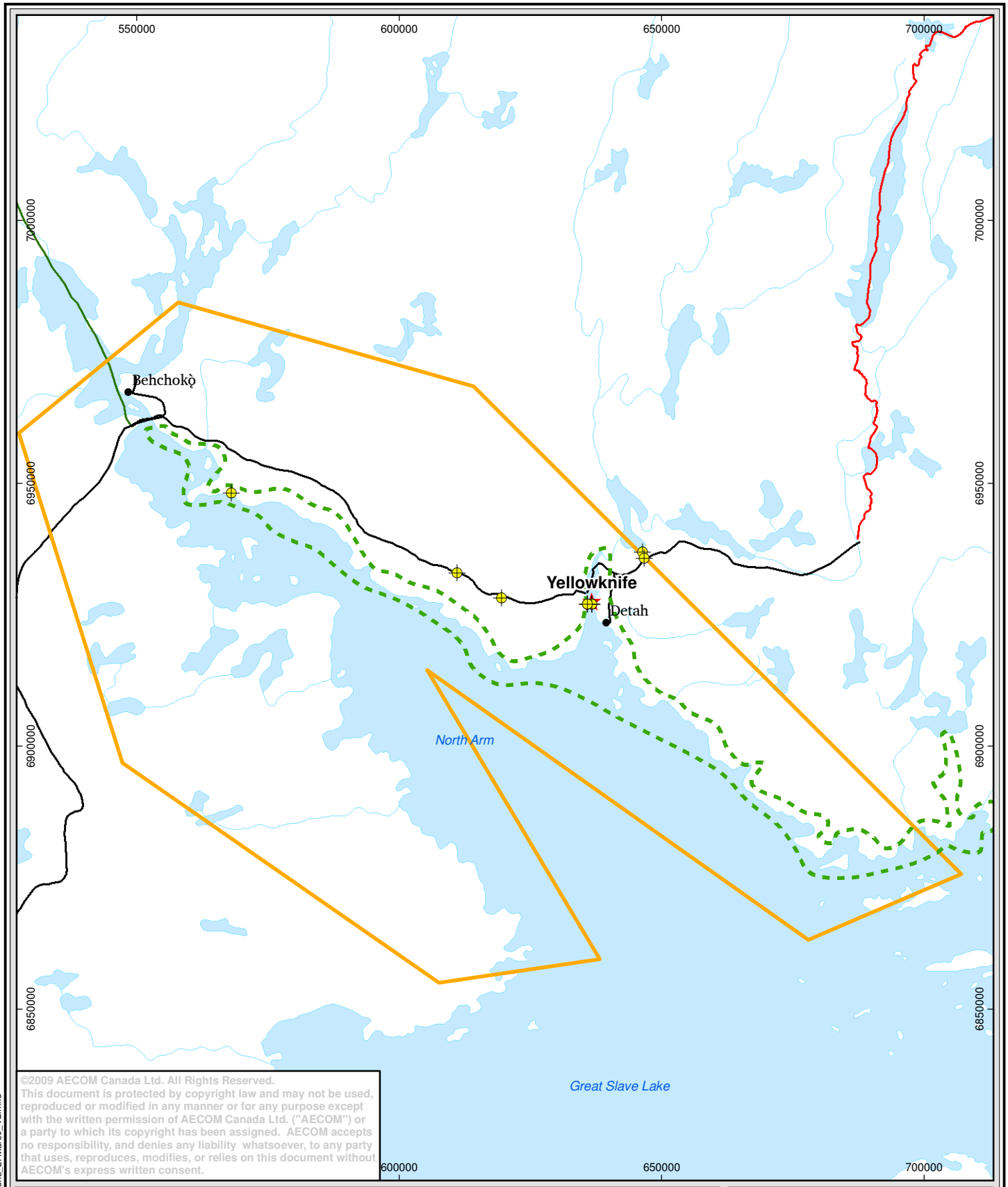
4.2.3.1 Rare Plants

Seven plant species have been found within the NAAI to be ranked by the 2010 General Status Ranking Program as *May be at Risk.* The available information on these species is outlined in Table 2 and their locations are outlined in Figure 3. *May be at Risk* is the highest rank that can be given to a species using the General Status Ranking system independent of a more detailed assessment (ENR 2009a).

Table 2. Plant Species Designated as *May be at Risk* Located in the NAAI

NWT Status Rank	Scientific Name	Common Name	Typical Habitat	# Occurrences in NAAI
May Be At Risk	*Cardamine parviflora*	Small-flowered bittercress	sandy, open places or rocky ledges	1
May Be At Risk	*Crassula aquatica*	Water pigmy-weed	Shallow ponds	3
May Be At Risk	*Acorus americanus*	Several vein sweetflag (Rat Root)	wetlands	1
May Be At Risk	*Malaxis monophylla var brachypoda*	White adder's mouth	damp calcareous fens	1
May Be At Risk	*Lobelia dortmanna*	Water lobelia	shallow, sandy shores of lakes and ponds	1
May Be At Risk	*Epilobium leptophyllum*	Linear-leaved willowherb	Uplands lake	1
May Be At Risk	*Chenopodium rubrum*	Red pigweed (Coast-blite goosefoot)	Gravel pit	1

(from ENR 2009a)



North Arm boundary is approximate.
Important Bird Areas obtained from Alexander et al., 1991.

Legend

Plant Locations
Rank
- May be at risk
- Important Bird Areas
- North Arm Boundary
- Territorial Capital
- Populated Place
- Territorial/Provincial Boundary
- Highway
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Watercourse
- Waterbody

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Indian Northern Affairs Canada

North Arm Plant Locations

27 March 2009
Phase 1 EA

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Figure 3

Map Document: 111111_C1_Fig3_NorthArmPlantLocations_27Mar09_V2.mxd

4.2.3.2 Non-Native/Alien Plants

Non-native or alien species have been identified within portions of the NAAI. This information has been collected over the years and stored in a database to identify vegetation species that are non-native and potentially invasive to the area. In 2006, Michael Oldham conducted a survey of exotic plants along Northwest Territories highways, which contributed to the master database that the Department of Environment and Natural Resources has been building. Table 3 outlines the number of occurrences of non-native plant species identified within the NAAI and potential risk to existing plant communities.

Table 3. Non-native Vegetation Species Located in the NAAI

Scientific Name	Common Name	Habitat Occurance	Historical Distribution	Predicted Invasiveness	# of Occurrences in the NAAI
Sagina procumbens	Procumbent pearlwort	Garden in front of Northern Frontier Visitor Centre	Native to Canada but introduced to NWT	None	1
Stellaria media	Common starwort	A weed in garden -shallow peat over sand; scattered. Prostrate on moist peat of garden	Introduced from Eurasia	None	2
Melilotus alba var typica	White sweet clover	In sandy gravel	Introduced from Eurasia	Moderate/low	1
Melilotus officinalis var typica ?	Yellow sweet clover	Sandy gravel along roadside	Introduced from Eurasia	Moderate/low	1
Plantago major	Nipple-seed plantain	Disturbed ground around buildings.	Possibly introduced	None	1
Polygonum achoreum	Striated knotweed	in sandy gravel, rare	Introduced from elsewhere in North America	None	1
Chenopodium album	Lamb's quarters	Moist peat in garden	Introduced from Europe	None	1
Galeopsis tetrahit	Brittle-stem hemp nettle	A small colony in shallow peat over sand	Introduced from Europe	None	1
Achillea ptarmica	Pearl yarrow	Open bulldozed trail beside Niven Lake, N side of Yellowknife	Introduced from elsewhere in North America	None	1
Matricaria discoidea	Pineapple weed	Common in moist fill along bay, scattered in sandy gravel	Generally introduced	None	2
Senecio vulgaris	Common ragwort	A weed in market garden; scattered	Introduced from Europe	None	2
Descurainia sophia	Herb Sophia	Fairly common around buildings.	Introduced from Europe	None	2
Capsella bursa-pastoris	Shepherd's purse	Scattered in sandy gravel, airstrip	Introduced from Eurasia	None	1
Thlaspi arvense	Field penny cress	Shallow layer of humus over sand or sandy gravel; rare	Introduced from Eurasia	None	2

(ENR 2009a)

4.2.3.3 Wetlands

No comprehensive or extensive wetland mapping has been undertaken within the NAAI, although the work by the Ecosystem Classification Group (2007 and 2008) to describe the ecoregions that the NAAI is located within does provide some general information on the dominant wetland types found in the ecoregions. National Topographic System (NTS) (Government of Canada 2001) are available at a 1:50,000 scale, but do not provide sufficient detail on wetland types to be effective in classification (see Figure 4).

Another source of mapping that delineates general wetland types (treed, shrub, herb) is based on a largely unsupervised[1] classification of Landsat satellite imagery for the NWT (ESOD, 2006) (see Figure 5). This data is limited for wetland classification in its current form due to the resolution (25 m) and the lack of ground-based or aerial photo verification to help in the classification (Evelyn Gah, pers comm.).

4.2.4 Plant and Vegetation Community Data Assessment and Evaluation

Few well-documented vegetation studies have taken place within the NAAI for rare plants, invasive plants or vegetation communities. The overall knowledge of plants and vegetation communities for the NAAI is therefore of relatively broad scale and limited detail. Additional information may be available for rare and invasive plants in personal collections that have not been documented, but they were not discovered during the data gathering exercise.

Overall, given the distribution of the rare and invasive plant information along the highway system and in close proximity to Yellowknife, it is likely that additional rare and invasive plants would be found in similar conditions within the NAAI.

[1] Supervised classification requires the operator to determine distinct land cover types and then the computer computes the spectral signatures. Unsupervised classification has the computer creates the spectral signatures using mathematical data clustering in the multidimensional feature space and then the image is interpreted and ground verified (http://www.emporia.edu/earthsci/student/banman5/perry3.html).

North Arm boundary is approximate.
Wetlands obtained from NTDB 1:250,000 data.
Important Bird Areas obtained from Alexander et al., 1991.

Legend

- Important Bird Areas
- North Arm Boundary
- Wetlands
- Territorial Capital
- Populated Place
- Territorial/Provincial Boundary
- Highway
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Watercourse
- Waterbody

N
W E
S

0 5 10 20 Km

1:1,000,000

UTM Zone 12N, NAD 83

Indian Northern Affairs Canada

North Arm Wetland Locations

27 March 2009
Phase 1 EA

AECOM

Figure 4

Map Document: 111111_C1_Fig4_NorthArmWetlands_27Mar09_V2.mxd

Figure 5. North Arm Land Classification

(courtesy NWT PAS 2009)

4.2.5 Plant and Vegetation Community Data Gaps

Based on the results of the plant and vegetation community component of this evaluation, a number of data gaps have been identified:

- Comprehensive, systematic rare plant surveys should be undertaken to determine the extent and distribution of rare plants within the NAAI.
- A systematic survey of invasive plant species should be completed in areas away from the NWT highways within the NAAI to determine if invasive plants have distributed outside of the previously surveyed area.
- More detailed vegetation community classification would help determine the distribution and amounts of wetlands and other vegetation communities within the NAAI and provide important information to help in potential wildlife and waterfowl habitat use studies.

4.3 Wildlife

For the purpose of this ecological assessment, focal wildlife species were identified based on federal and NWT status rankings of species as well as those wildlife species identified as being throughout the region with the NAAI in their range. A list of wildlife species following these criteria is listed in Table 4. Input from biologists with the Canadian Wildlife Service (CWS), and the Government of Northwest Territories (GNWT) helped identify species of importance in the region and to resident communities. Hence focal wildlife species for this report include:

- Moose: source of subsistence foods;
- Woodland caribou (boreal ecotype); primary food source;
- Barren-ground caribou (Bathurst and Bluenose East); food source;
- Wood Bison: importance for predator–prey dynamics, listed species;
- Waterfowl and Waterbirds: key migratory bird terrestrial habitat site;
- Furbearers: species trapped by resident communities. These include fisher, marten, beaver, lynx, weasel species, mink, muskrat, red fox, wolf, wolverine, and red squirrel.
- Other bird species of interest: birds of prey, listed species;
- Amphibians and Reptiles: general occurrences and listed species;
- Rare/accidental occurrences.

Table 4. List of Wildlife Species in the North Arm area of Interest and Valuation of Ecological Significance

Species	NWT status	COSEWIC status	Range Overlaps with the NAAI	Known Occurrences in the NAAI
Amphibians				
Western Toad	May be at Risk	Special Concern	N	
Northern Leopard Frog	Sensitive	Special Concern	?	
Birds – Waterfowl and Waterbirds				
Black Tern	Sensitive	Not at Risk	Y	Y[a,b,c]
Caspian Tern	Sensitive	Not at Risk	Y	Y[a,b]
Harlequin Duck	May be at Risk	--	Y	
Lesser Scaup	Sensitive	--	Y	Y[b,d]
White Pelican	May be at Risk	Not at Risk	Y	Y[j]
Birds – Other				
Boreal Chickadee	Sensitive		Y	Y[d]
Common Nighthawk	Secure	Threatened	Y	Y[e]
Olive-sided Flycatcher	Sensitive	Threatened	Y	Y[e]
Short-eared Owl	Sensitive	Special Concern	Y	
Peregrine Falcon	Sensitive	Special Concern	Y	
Rusty Blackbird	May be at Risk	Special Concern	Y	Y[e]
Yellow Rail	May be at Risk	Special Concern	Y	
Mammals				
Barren-ground Caribou – Bathurst herd	--	--	Y	Y[f]
Barren-ground Caribou – Bluenose East herd	--	--	Y	
Moose	Secure	--	Y	Y[g]
Wolverine	Sensitive	Special Concern	Y	Y[h]
Wood Bison	At Risk	Threatened	Y	Y[g]
Woodland Caribou – Boreal Population	Sensitive	Threatened	Y	Y[i]

a McCormick and Sirois 1988, Sirois and Seddon 1990, Sirois et al. 1989 ;
b Latour et al. 2006;
c Sirois and Fournier 1993;
d USGS 2009 -Christmas Bird Count for Yellowknife;
e Audubon 2002;
f GNWT. 2009c;
g Cluff 2005;
h GNWT 2005, 2007;
i Hillis and Cluff 2005;
j Sirois et al. 1995.

4.3.1 State of Knowledge

Information for focal species was gathered from reports, surveys and information obtained from federal and regional biologists with knowledge of the area. Two lists were generated based on available information on wildlife in the general area: 1) potential wildlife species in the NAAI (Appendix B); 2) Potential rare/accidental wildlife occurrences in the NAAI (Appendix C).State of knowledge varied amongst the focal species identified. Information within the area of interest was minimal for some species, so information within the territory was also reviewed to get an understanding of the potential importance of the area for certain species.

4.3.1.1 Woodland Boreal Caribou

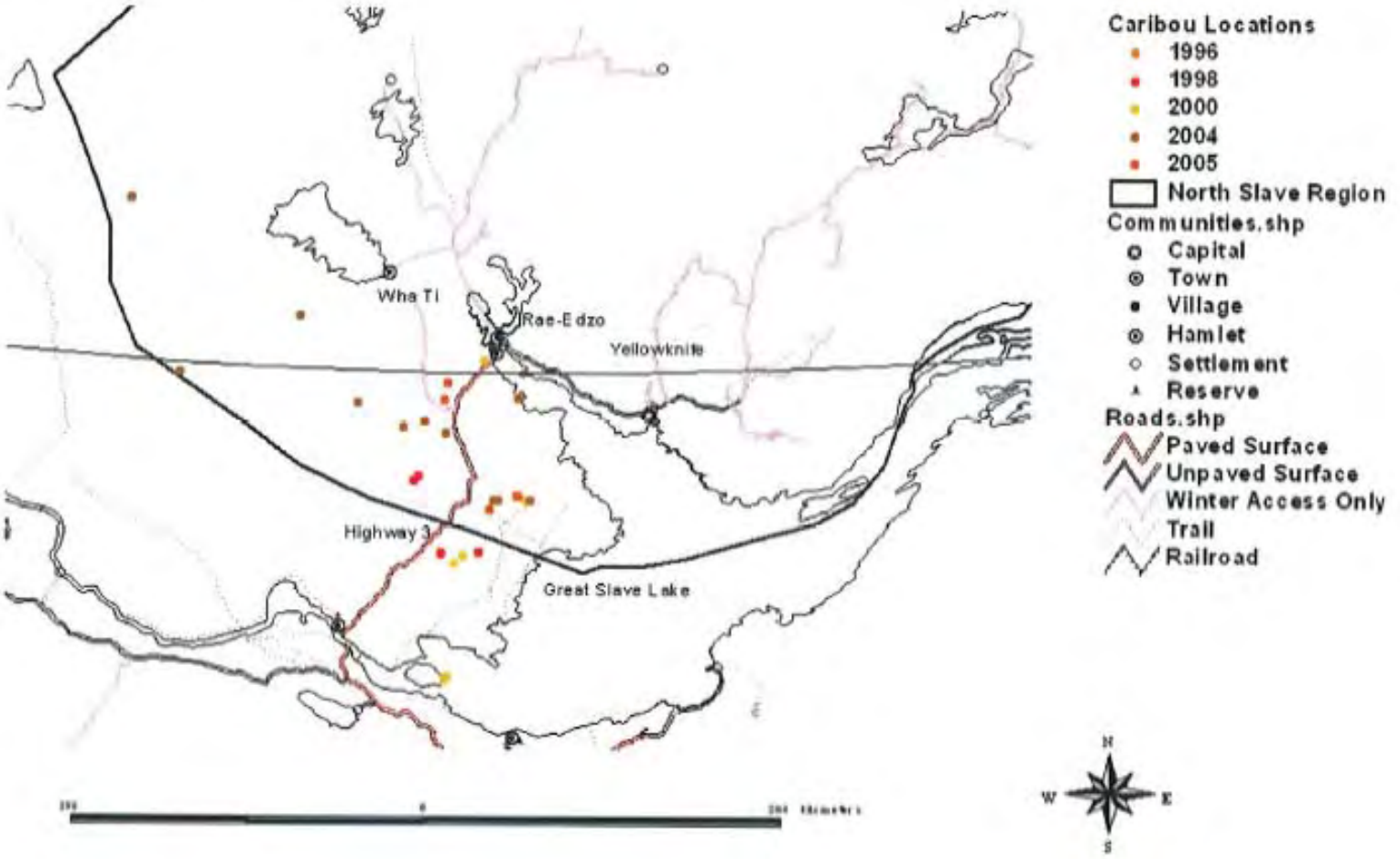
Boreal caribou are listed as *Threatened* by COSEWIC and *Sensitive* in the Northwest Territories (COSEWIC 2009, Working Group on General Status of NWT Species 2006). Boreal caribou are a valuable economic and cultural resource to residents of the NWT (Cluff 2006). The most recent population estimate of boreal caribou in NWT was between 4,000 and 6,400 individuals in 2001 (GNWT 2009c).

The range of the boreal caribou covers the south-western portion of the NAAI (Figure 6) (Hillis and Cluff 2005 and Cluff 2006). Collared individuals in the North Slave Region have been found in and near the NAAI in 2000 and 2004 (Hillis and Cluff 2005). in low densities ranging from 0.17 to 3.44 animals / 100 km^2 (Hills and Cluff 2005) cross the Mackenzie River Valley, although this is not unusual for this species and is likely a predator-avoidance strategy (Jan Adamczewski, pers. comm.).

Spruce-lichen forests appear to be the dominant habitat used by boreal caribou in the North Slave Region, where caribou can be are found 32.3% of the time. Caribou are found less frequently in jack pine stands (18% occurrence) and shoreline habitat (15% occurrence) (Hillis and Cluff 2005). Fire regenerated habitat are also used by this species, with caribou found in regenerated low shrub and deciduous habitat 6% of the time (Hillis and Cluff 2005). McLoughlin *et al.* (2005) found that large peatland areas may represent 'Critical Habitat' for avoiding predators.

Most of the populations of boreal caribou have decreased over their range in Canada (Thomas and Gray 2002). Some potential and current threats to boreal caribou in other areas of Canada include increased predation and harvesting because of increased access from roads, pipeline right of ways and seismic line developments (GNWT 2009c). Activities such as timber harvesting, oil and gas and other resource development are expected to increase in the NWT and boreal caribou numbers could also decrease. In the NWT, caribou harvests are limited to one woodland caribou per year for resident hunters and non-resident hunters are only allowed to hunt in the Mackenzie Mountains (GNWT 2009c). Aboriginal hunters have no restrictions as to the number of caribou or timing of harvest. Actual harvest of woodland caribou in the NWT is thought be low, however, not all harvest information is collected (GNWT 2009c).

Figure 6. Boreal Caribou Locations in the North Slave Region



(courtesy of Cluff 2006)

(111111_final rpt_north arm ea _31mar09_r2.doc)
- 20 -

An *Action Plan* is now being developed for boreal caribou conservation in the NWT (GNWT 2009c). Caribou are important for the survival of northern people playing a pivotal role in the lives of Aboriginal people and other residents of the north. Caribou within the region play a key role in food chain dynamics, particularly as a prey source for carnivorous animals. Large carnivores, including grizzly bears and wolves, rely on caribou, as do medium sized carnivores that scavenge on caribou remains, including wolverines and black bears.

4.3.1.2 Barren-ground Caribou

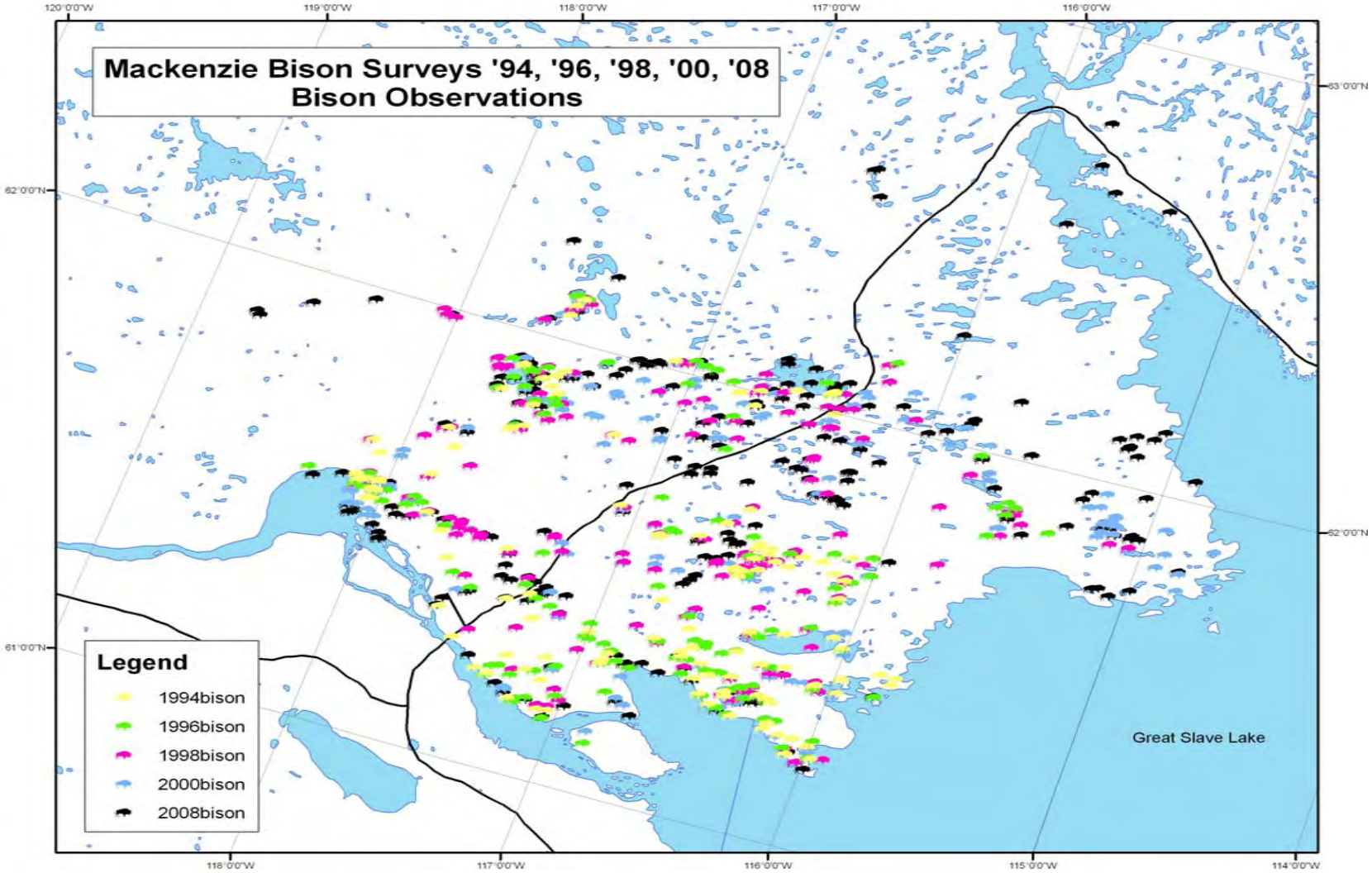
The eastern portion of the North Arm is part of both the Bathurst and Blue-nose East herd ranges (GNWT 2009a). Radio-collared individuals from the Bathurst herd have been located in the northeast portion of the North Arm in winter (GNWT 2009a). Although the western portion of the North Arm is within both the Bathurst and Bluenose East herd ranges, caribou appear to switch use of winter range regions from year to year (Tara Barrier, pers. comm.). The 2006 population estimate found that the Bathurst and Bluenose East herds were 128, 000 ± 27,300 and 65,200 ± 3500, respectively (GNWT 2009c). These latest population estimates indicate that both herds are declining when compared to estimates in 2000 (GNWT 2009c). Although barren-ground caribou are not a frequent occurrence in the North Arm area, it was noted that they were an important resource for game hunters in the area (Jan Adamczewski, pers. comm.). Presence of barren-ground caribou in the NAAI appears to be more of an occasional occurrence and from radio collared individuals the Bathurst herd appears to occur in the area more than the Bluenose East herd (GNWT 2009c).

As with boreal caribou, barren-ground caribou are subject to hunting pressures from both resident, non-resident and aboriginal hunters and are an important prey species for many carnivores. Resident hunters are restricted to two caribou a year, and they must be male caribou only. Non-resident hunters require a licensed outfitter and are allowed to harvest a maximum of two caribou per year. Development pressures that increase hunter access could affect caribou populations if not properly regulated.

4.3.1.3 Wood Bison

Wood Bison are listed federally as *Threatened* (COSEWIC 2009) and *At Risk* in NWT (Working Group on General Status of NWT Species 2006). In August 1963, captive bred Wood Bison, originating from Wood Buffalo National Park, were released 25 km North of Fort Providence and became the founders of the Mackenzie herd (GNWT 2008). The Mackenzie herd of Wood Bison occur west of Great Slave Lake up to the North Arm portion (GNWT 2008). The area occupied by this population has increased since 1963, with an exponential rate of 0.288 ± 0.017 km^2/year from 1968 to 1987 (Gates and Larter 1990). Meadow habitats are a key factor in range expansion of Wood Bison, where they occupy sedge-dominated wet meadows almost exclusively in winter (Gates and Larter 1990). Since 1994, the Mackenzie Bison herd has been expanding its range into the NAAI (see Figure 7) (ENR 2009b). The first known year where bison had been documented in the northern portion of the NAAI and along the eastern side of the NAAI was in 2008 (ENR 2009b).

Figure 7. Mackenzie Valley Bison Surveys, ’94, ’96; 98, ’00, ’08: Bison Observations



(Courtesy of ENR 2009b)

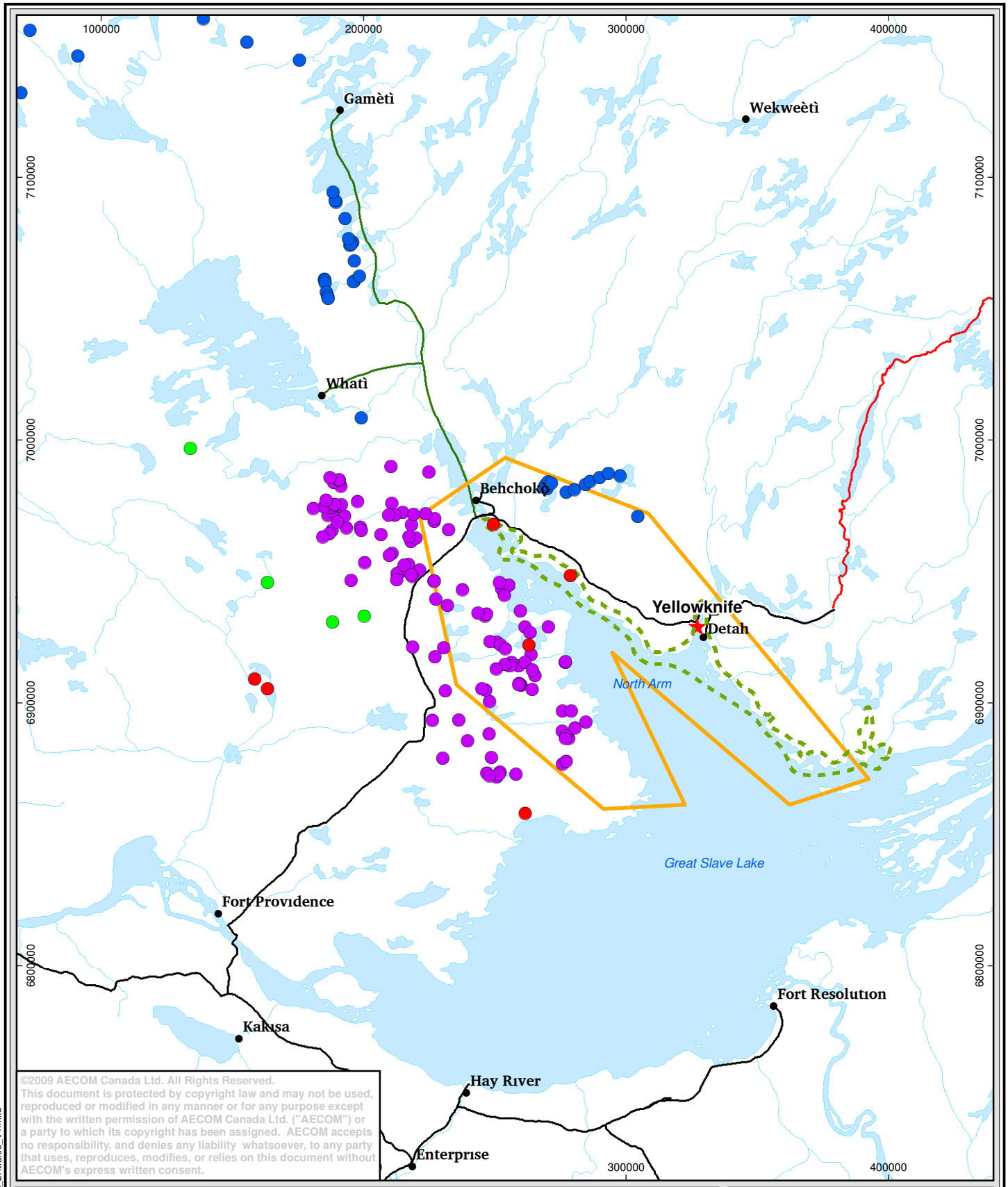
The Mackenzie population was estimated at 1,600 bison in March 2008, which was 20% lower than estimates obtained in 1998 and 2000 (GNWT 2008). Hunting of the wood bison is allowed under the national recovery strategy and is regulated by a quota system (GNWT 2008). Harvest permits of the Mackenzie population were first issued in 1987-88 (GNWT 2009c). Current tag allocations consist of 3 for Rae-Edzo, 20 for Fort Providence, 9 for non-resident trophy hunts and 15 for resident limited entry draw (GNWT 2009c).

4.3.1.4 Moose

Moose provide an important food resource to Aboriginal and resident hunters in the NWT. The population estimate of moose in NWT is approximately 20, 000 (GNWT 2009c). Increased hunting access and loss of adequate winter cover for moose is a management concern in the NWT. Estimated total harvest of moose in the NWT is 1,000 to 2,000 /year (GNWT 2009c), but the amount of moose harvest in the NAAI is poorly documented (Cluff 2005).

Two surveys conducted in 1962 (Kuyt 1962) and 1989 (Case and Graf 1992), found that moose densities in the Yellowknife area were low. The most recent survey of moose in the North Arm area was conducted in March 2004 over 7,669 km^2 in the Taiga Plain ecozone near Behchokǫ̀ (formerly Rae-Edzo) (see Figure 8). The survey found similar results as the two historical surveys (Cluff 2005). During this survey 30 moose (11 bulls, 14 cows, 3 unclassified and 2 calves) were observed within the sampling unit and 19 moose (7 bulls, 10 cows, and2 calves) were observed incidentally outside of the sampling unit. Density was estimated to be 3.99 moose/100 km^2 at a total of 305 moose for the survey area using Geospatial point estimate methodology (Cluff 2005). During November 2004, a survey of boreal caribou with incidental sightings of moose yielded similar results with 60 moose sightings and a total of 99 individual moose observed (36 bulls, 47 cows and 16 calves) (Cluff 2005). Including incidental sightings, the March 2004 survey yielded a ratio of calves to cow moose of 0.159 (S.E. = 0.56) which suggests poor calf survival. However, the bull: cow ratio was high for late winter at 0.801(S.E. = 0.263).

Areas of good moose habitat can often be characterized as those areas with semi-open forest cover close to riparian areas where an abundance of willow and aspen stands and aquatic vegetation can be found. Forests regenerating from fire disturbance are also important to moose they provide all of the habitat types they require by this species (GNWT 2009c).



North Arm boundary is approximate.
Wetlands obtained from NTDB 1:250,000 data.
Important Bird Areas obtained from Alexander et al., 1991.
Ungulate information provided by D.Cluff.

N
W E
S

0 10 20 40 Km
1:2,000,000
UTM Zone 12N, NAD 83

Legend

- Boreal Caribou
- Barren-Ground Caribou
- Bison
- Moose
- Important Bird Areas
- North Arm Boundary
- Territorial Capital
- Populated Place
- Territorial/Provincial Boundary
- Highway
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Watercourse
- Waterbody

Indian Northern Affairs Canada

North Arm Ungulate Sightings

27 March 2009
Phase 1 EA

AECOM

Figure 8

Map Document: 111111_C1_Fig8_NorthArm_Ungulates_27Mar09_V1.mxd

4.3.1.5 Furbearers

A number of furbearer species are known to occur or are likely to be found within the NAAI (Table 5). Fur harvest monitoring uses a co-management approach and is ongoing in the NWT. Government personnel are assisted by trappers, community members and elders that know the area and its furbearer resources. Information usually comes in the form of harvest data, tissue samples, carcasses and knowledge of species within trapping areas. Furbearers are an important commodity to trappers in the North Slave Region. Information of trapping and hunting areas in the 1970's shows 5 trap locations in the NAAI (GNWT 1978). From harvest information and pelt sales in the North Slave Region in 2004/2005 and 2006/2007, marten, mink, muskrat and beaver appear to be the most common species harvested (GNWT 2005, GNWT 2007). This information includes harvest data and income generated from pelt sales for the following communities: Behchokǫ̀, Gameti, Wekweti, Whati and Yellowknife (GNWT 2005, GNWT 2007). Prey species for commonly harvested furbearers, such as mice, voles and snowshoe hare are also useful information supplied to the GNWT (GNWT 2009c). Marten are the most common furbearer harvested and generates the most income for furbearer harvests in these communities.

Table 5. Furbearer Species of Interest in the NAAI

Common Name	Scientific Name
Beaver	*Castor canadiensis*
Fisher	*Martes pennanti*
Least weasel	*Mustela rixosa*
Lynx	*Lynx canadensis*
Marten	*Martes americana*
Mink	*Neovison vison*
Muskrat	*Ondatra zibethicus*
Red Fox	*Vulpes vulpes*
Red Squirrel	*Sciurus vulgaris*
Short-tailed weasel	*Mustela erminea*
Wolf	*Canis lupus*
Wolverine	*Gulo gulo*

The Wolverine and the Fisher are both listed *Sensitive* in the NWT (Working Group on General Status of NWT Species 2006), although the Western Population of the Wolverine is the only one federally listed as *Special Concern* by COSEWIC (COSEWIC 2003). All other furbearers present in the NAAI are considered either secure or were not assessed.

4.3.1.6 Waterfowl and Waterbirds

The North Arm of Great Slave Lake has been designated as a key migratory bird terrestrial habitat site (Latour *et al.* 2008). This site includes numerous islands, shallow bays and wetlands along the northeastern portion of the North Arm, which provide important habitat to waterfowl and waterbirds. Stop-over habitat at this site is provided during spring and fall migration for Tundra Swans, Canada Goose and Cackling Geese, as well as a variety of other waterbirds and waterfowl (Table 6) (Latour *et al.* 2008). During the autumn

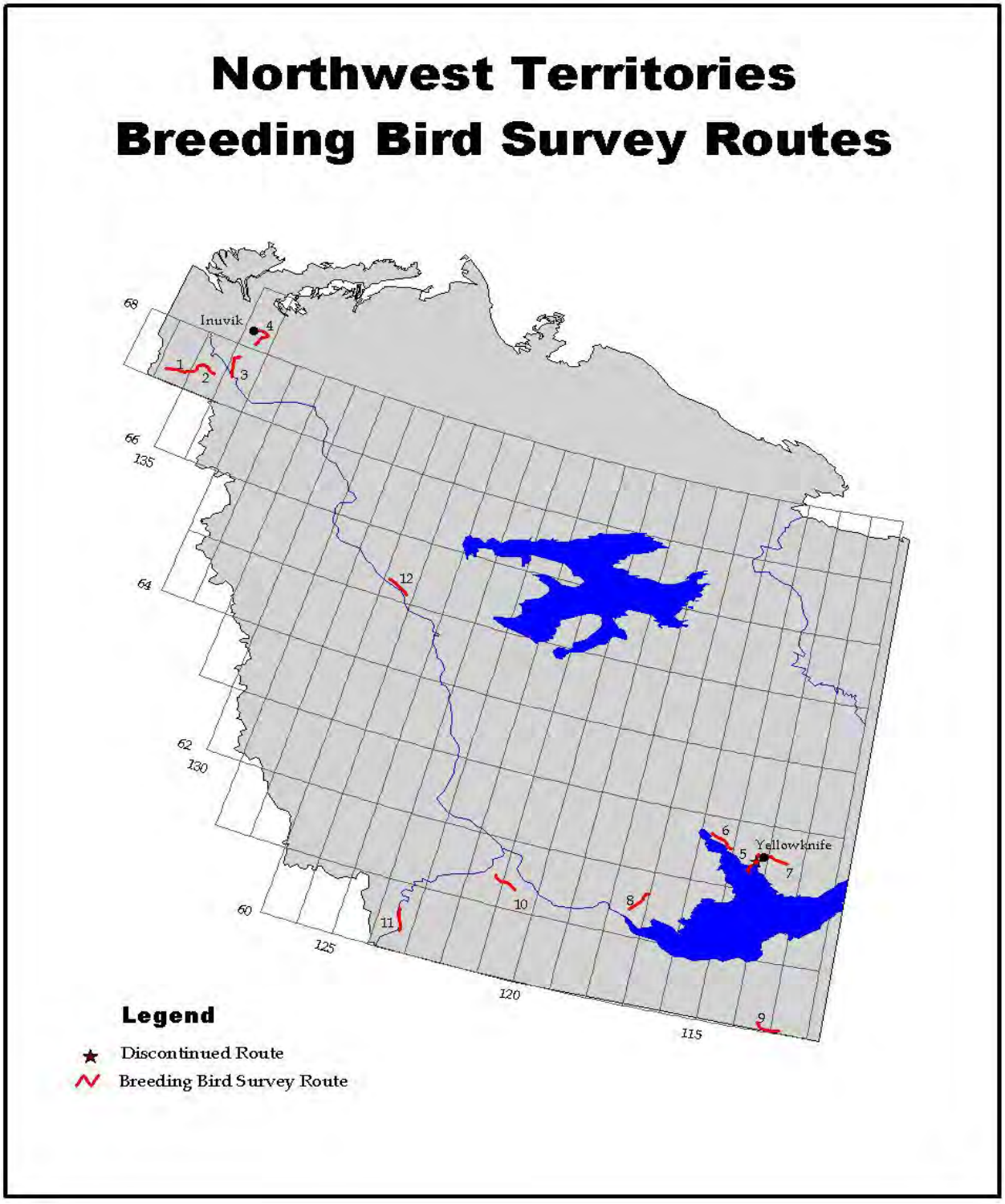
months this site becomes an important fall staging area with numbers ranging from 1,000 to 35,000 for some species (Latour *et al.* 2008).

Table 6. Waterfowl and Waterbird Species of Interest in the NAAI

Common Name	Scientific Name
American Wigeon	*Anas americana*
Arctic Tern	*Sterna paradisaea*
Black Tern	*Chlidonias niger*
Bonaparte's Gull	*Larus philadelphia*
Cackling Goose	*Branta hutchinsii*
California Gull	*Larus californicus*
Canada Goose	*Branta canadensis*
Caspian Tern	*Sterna caspia*
Common Tern	*Sterna hirundo*
Greater Scaup	*Aythya marila*
Green-Wing Teal	*Anas crecca*
Herring Gull	*Larus argentatus*
Lesser Scaup	*Aythya affinis*
Mallard duck	*Anas platyrhynchos*
Mew Gull	*Larus canus*
Northern Pintail duck	*Anas acuta*
Northern Shoveller	*Anas clypeata*
Parasitic Jaegar	*Stercorarius parasiticus*
Red-breasted Merganser	*Mergus serrator*
Ring-billed Gull	*Larus delawarensis*
Tundra Swan	*Cygnus columbianus*

Numerous waterfowl nests have also been observed from Frank Channel to Yellowknife Bay during surveys for breeding gulls, terns, and skimmers (see Figure 9) (Sirois and Seddon 1990). Breeding waterfowl observed in these areas include Canada Goose, American Widgeon, Mallard, Northern Pintail, Red-breasted Merganser, Northern Shovelers, Green-wing Teal and Great and Lesser Scaup (McCormick and Sirois 1988, Sirois and Seddon 1990, Fast *et al.* 2004). Among these waterfowl the Northern Pintail and the Lesser Scaup are listed as *Sensitive* species in the NWT (GNWT 2009b).

Figure 9. Northwest Territories Breeding Bird Survey Routes



(Breeding Birds Survey Map) (courtesy of CWS 2009)

(Note: routes 5 and 6 around the North Arm are now inactive)

During summer this key migratory bird site is heavily used by breeding gulls and terns (McCormick and Sirois 1986, Sirois *et al.* 1989, Sirois and Seddon 1990, Sirois and Fournier 1993). A total of 67 nests of Caspian Terns were found along the east portion along the North Arm from 1986 to 1988 (McCormick and Sirois 1988, Sirois *et al.* 1989, Sirois and Seddon 1990). Although federally listed as *Not at Risk*, Caspian Terns are listed as *Sensitive* in the NWT (GNWT 2009b). The islands of the North Arm provides habitat for 27% and 1% of the breeding populations of Caspian Terns in the NWT and Canada, respectively (Figure 10) (Latour *et al.* 2006). Islands between Frank Channel and Trout Rock appear to be heavily used for breeding populations of Caspian Terns as well as Common Tern, Arctic Tern, Herring Gull, Ring-billed Gull, Mew Gull, Bonaparte's Gull, California Gull and Parasitic Jaegar (McCormick and Sirois 1988, Sirois and Seddon 1990, Sirois *et al.* 1995). Similar larid species have also been found breeding on islands between Yellowknife Bay and Gros Cap (Sirois *et al.* 1989), although this area appeared to be not be as heavily used as the area between Frank Channel and Trout Rock.

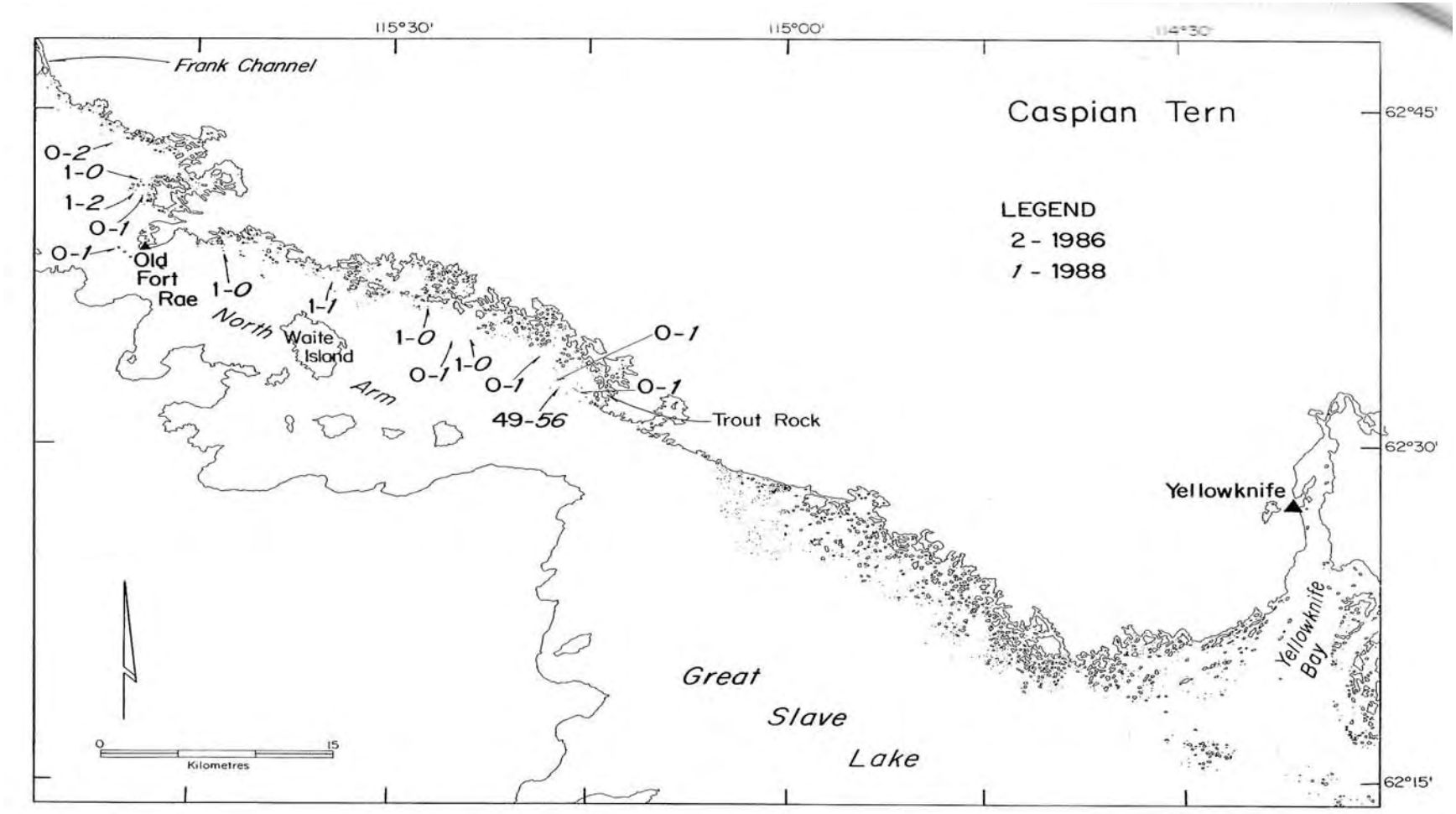
The first breeding record of the Black Tern north of Great Slave Lake was found in 1986 with the nest location found by a small oxbow pond in the Slave Lake Delta (Sirois and Fournier 1993). The Black Tern is listed as *Sensitive* in the NWT (GNWT 2009b) and federally listed by COSEWIC as *Not at Risk*. In 1989, the first breeding record of the Black Tern was confirmed when a fledgling was observed in a marsh near Trout Rock (Sirois and Fournier 1993). Since then several other probable breeding locations have been observed (Sirois *et al.* 1995).

4.3.1.7 Other Bird Species of Interest

The North Arm of Great Slave Lake also provides habitat for breeding migratory songbirds and shore birds. Based on surveys by CWS, the United States Geological Survey and the National Audubon Society conducted between 1988 and 2008, 117 species were documented (Audubon 2009, USGS 2009). This information was used to generate a list of potential bird species in the North Arm area, based on previous occurrences and range maps (Appendix B). Two species of interest were observed during the BBS: the Olive-sided Flycatcher and the Common Nighthawk. The Olive-sided Flycatcher and the Common Nighthawk are considered *Sensitive* and *Secure* in the NWT, respectively (GWNT 2009b), and are both listed federally as *Threatened* (COSEWIC 2009). A few species of note from the generate potentail list (Appendix B), include the Harlequin Duck, Rusty Blackbird and Yellow Rail, all of which are listed as *May be at Risk* in NWT and *Special Concern* federally (COSEWIC 2009). Since 1985, a Christmas Bird Count has been conducted every year out of Yellowknife. From these surveys only three species listed as *Sensitive* in the NWT were observed: the Lesser Scaup, the Boreal Chickadee and the Harris's Sparrow (Audubon 2002). None of the species observed during these surveys are federally listed.

Raptors are also a group of interest as they play an important role as predators in the food chain. From BBS and Christmas Bird Counts (CBC) several birds of prey have been observed in and adjacent to the NAAI including (Appendix B). Of these species the Short-eared Owl and the Peregrine Falcon are the only species considered *Sensitive* (GWNT 2009b); both species are federally listed as *Special Concern* (COSEWIC 2009).

Figure 10. Caspian Tern Nest Locations between Frank Channel and Trout Rock, June 1986 and 1988



(courtesy of Sirois and Seddon 1990)

(Caspian Tern map)

4.3.1.8 Amphibians and Reptiles

Potential common amphibians in the the NAAI include Wood Frog (*Pseudacris maculata*) and Boreal Chorus Frog (*Rana sylvatica*) both of which are considered *Secure* in NWT and are not listed federally. Of the four NWT status ranked amphibian or reptile species occurring in the Northwest Territory, only the Western Toad (*Bufo boreas*) and the Northern Leopard Frog (*Rana pipiens*) are likely to be found in the study area. The Western Toad can be found in the Dehcho region around Fort Liard and are found mostly in the extreme south-western corner of the territory (GNWT 2006); and the Common Red-sided Garter Snake and Canadian Toad are known to occur only in the Fort Smith region.

The Northern Leopard Frog is listed federally as *Special Concern* (COSEWIC 2009) and *Sensitive* in the NWT. Although this species has not been documented in the North Arm region of Great Slave Lake; the species may occur more widely distributed than originally thought (Environment Canada 2008). It requires a mosaic of breeding, non-breeding and overwintering habitat types to meet the requirements of its life history stages. Northern Leopard Frogs breed in lakes, ponds, marshes and flooded areas of steams and rivers (GNWT 2006). They require open or semi-open areas with short vegetation along the margins of water bodies for summer feeding habitat, and well-oxygenated water bodies that do not freeze to the bottom during winter for overwintering (GNWT 2006).

4.3.2 Wildlife Data Assessment and Evaluation

The purpose of this evaluation was to identify the extent and utility of the current data and knowledge available to support the ecological assessment of the North Arm as a special natural and cultural area. The information gathered in this report can give an impression of the overall ecological value of the habitat within the area of interest and identify critical habitat areas in the North Arm.

4.3.2.1 Woodland Boreal Caribou

The existing information on boreal caribou use in the NAAI is limited and interpretation of habitat use is primarily based on studies outside of the area of interest. The available information indicates that boreal caribou use the NAAI, although the extent and intensity of use is unknown, but potentially limited due to the low densities of animals overall in the NWT. Lack of collared animals in the NAAI may not be due to lack of use of the area, but the failure to collar the sub-set of the population that does use the NAAI extensively. Based on the available information, and what is understood about the preferred habitats of the boreal caribou, it is likely that boreal caribou do frequent the area.

4.3.2.2 Barren-ground Caribou

Presence of barren-ground caribou in the North Arm area appears to be more of an occasional occurrence and based on data from radio collared individuals, the Bathurst herd appears to occur in the area more than the Bluenose East herd. The NAAI does not appear to be an extensive area of use by barren ground caribou or provide extensive critical habitat, although that is based on limited information.

4.3.2.3 Wood Bison

Information on Wood Bison in the NAAI is minimal. Use of the NAAI by Wood Bison appears to be a recent range expansion of bison from the Mackenzie herd. The northeast portion of the NAAI may not provide high value habitats compared to other areas of their range where large meadow complexes are more available. Interpretation of Wood Bison use and ecosystem dynamics in the North Arm is primarily based on studies conducted on the Mackenzie herd as a whole and not specific to the NAAI.

4.3.2.4 Moose

Of the four ungulate species described in this EA, moose appear to be the most studied ungulate in the NAAI. The available information on moose density is useful and based on the surveys conducted, moose densities are low in the NAAI. and do not appear to be changing. Survey information for moose provide important recruitment information, but there is no comprehensive harvest information to help manage the populations in the area effectively. Moose densities and use areas appear to be higher in the southwest portion of the NAAI (Ecoregion 60) than in the northeast portion (Ecoregion 69).

Although moose are found at low densities in the NAAI, this is not uncommon for most areas in the NWT as it is at the northern range for this species. Development of a habitat suitability model may be possible using the available land cover mapping which would allow analysis of quantity and quality of habitat for moose in the NAAI and determine portions of the NAAI that are most suitable for moose.

4.3.2.5 Furbearers

Information on furbearers in the area of interest is extremely limited. Furbearer information was limited to harvest and pelt cost data. It is evident that furbearers are an important commodity to trappers in the North Slave Region from historical and recent harvest data. Marten, mink, muskrat and beaver appear to be the most common species harvested in the area, however, abundance, population demographics and dispersal of these species is largely unknown in the area of interest. More information is needed to give a quality assessment of the importance of a PAS to furbearers in this area.

4.3.2.6 Waterfowl and Waterbirds

Information available on waterfowl and waterbirds in the North Arm area is adequate to asses the importance of a PAS to these species. The east portion of North Arm of Great Slave Lake has been designated as a key migratory bird terrestrial habitat site – NT Site 20 (Latour *et al.* 2008). This site is an important bird area in Canada and provides habitat to waterfowl and waterbird species for staging, nesting, and brood-rearing. Increased access to this area could cause increased disturbance and predation which may affect populations of species using this area within NWT and Canada. The numerous waterfowl and waterbird species that use this site make this area of interest an important component to waterfowl and waterbird conservation in the NWT and Canada. Based on the available information, a PAS that included the island habitats from Frank Channel to François Bay would benefit waterfowl and waterbirds in the North Arm area. These habitats along with wetlands and small ponds surrounding the North Arm would also be expected to be included in any potential PAS. This inclusion of wetlands and small ponds would benefit waterfowl, such as the Lesser Scaup (Fast *et al.* 2004), waterbirds, as well as include species such as the Black Tern whose breeding sites have been found in marsh areas north of Trout Rock.

The area outlined in Latour *et al.* (2008) is based on information obtained from the mid 1980's to the late 1990's. Based on available information, recent surveys have not been conducted in the area to monitor trends in use by waterfowl. More information on the use of surrounding wetlands and small ponds should also be completed to further justify the importance of the inclusion of these areas in a PAS.

4.3.2.7 Other Bird Species of Interest

The existing information on other migratory birds in the NAAI is very limited and interpretation of use is primarily based on a few breeding bird surveys in limited areas of the NAAI. Breeding Bird and Christmas Bird Count Surveys have been conducted in the east side of the North Arm since 1985. These surveys are a great resource for presence/absence and species trends over several years. However, since they are one day surveys over the same routes year after year, they do not give a good understanding of seasonal patterns, distribution and population estimates.

No known surveys have been conducted in the southern portion of the North Arm. This area is within the Great Slave Plains High Boreal ecoregion in the Taiga Plains ecozone. Habitat in this regions is diverse, with coniferous forests of jack pine and white spruce, deciduous forests of trembling aspen and as well as mix-wood forests. Several small lakes and ponds occur south of the North Arm including Bras d'Or Lake and Chedabucto Lake. The area along the southern portion of the North Arm has the potential to offer a diversity of habitat to migratory birds.

The available information indicates that the North Arm area has the potential to provide diverse habitats for other migratory birds and raptors. The extent and intensity of migratory and resident bird species use in the North Arm area is unknown and limited to information available for a specific site and time period. Through the breeding bird surveys we know that the areas along North Arm does provide habitat to listed species such as the Olive-sided Flycatcher, Harlequin Duck, Rusty Black Bird, Yellow Rail, Common Nighthawk and Short-eared Owl however, the extent of use and quality and quantity of habitat available for these species in the area is unknown. More information is needed to clarify PAS boundaries that would benefit such species.

4.3.2.8 Amphibians and Reptiles

Information on amphibians and reptiles is lacking. No species at risk have been documented in the NAAI, but this may be due to the NAAI being at the northern limit of some species' range.. The lack of available information on amphibians and reptiles limits the ability to evaluate the potential of the NAAI to provide habitat for those species.

4.3.3 Wildlife Data Gaps

Identification of data gaps was determined upon assessment and evaluation of existing regional and local ecological data. A data gap exists where available regional and local ecological data was insufficient to assess the viability or habitat use of a species in the NAAI boundaries this was identified as a data gap. Further information on these data gaps will aid in the overall understanding of the ecological importance of the NAAI:

- Additional information on the extent of boreal caribou use of the NAAI should be obtained. The small number of collar locations in the vicinity of the NAAI may not reflect actual use of the area.
- Moose harvest levels and habitat use patters within the NAAI would provide important information on the delineation of the NAAI boundary to ensure that high value habitats are protected and the population is maintained. Information from surveys completed in early March 2004 and in November/December of 2007 needs to . Efforts should be added to the evaluation when it is made available.
- More information on furbearer populations and distributions is needed. Currently, information is only available on furbearers that are extensively harvested.
- Breeding bird surveys should be undertaken within the NAAI to identify the species using the area and identify high value habitats and population levels. Breeding bird surveys may also determine if there are any species at risk in the NAAI that would require protection.
- It may be helpful to conduct amphibian surveys within the NAAI to determine if which amphibians use the area and if there are any species at risk in the NAAI that would require protection.

4.4 Fish and Fish Habitat

4.4.1 Fish

There have been 27 species of fish documented in Great Slave Lake and most species have been confirmed within the NAAI (Table 7). One species, the Blackfin Cisco (*Coregonus nigripinnis*) (COSEWIC *Data Deficient)* has been suspected in Great Slave Lake (Rawson 1951); however, data on this species is deficient in Canada (COSEWIC 2007). Many rivers and lakes within the NAAI have also been known to support fish (INAC 1975a & b). Less information appears to be readily available from river and lake systems within the NAAI than the portion within Great Slave Lake. Fish abundance in the North Arm appears to be the greatest at Yellowknife Bay (Rawson 1951).

Commercial, domestic, and sports fishing are quite common activities within the identified NAAI both in Great Slave Lake and within rivers and lakes (INAC 1975a, b & c). Within the NAAI, a large portion of Yellowknife Bay and a large area southwest of Behchokò are closed to commercial fishing to reserve stocks for domestic fishing (Mackenzie River Basin Board 2004, Keleher and Haight 1964) (Figure 11). Fish obtained during the domestic fishery are used mainly for human and dog consumption (INAC 1975a & b, Keleher and Haight 1964).

Due to the large number of species in the NAAI, a list of 10 species which were confirmed or likely found within the NAAI were identified as focal species. The focal species were based on cultural importance (Keleher and Haight 1964), economic importance, species sensitivity, and listed status according to COSEWIC and the Government of the Northwest Territories (GNWT). The following fish species have been identified as focal species:

- Shortjaw Cisco (*Coregonus zenithicus*) - COSEWIC *Threatened*
- Arctic Grayling (*Thymallus arcticus*) - NWT Status – *Sensitive*
- Deepwater sculpin (*Myoxocephalus thompsoni*) - NWT Status – *Sensitive*
- Blackfin Cisco (*Coregonus nigripinnis*)

- Brook Stickleback (*Culaea inconstans*)
- Inconnu (*Stenodus leucichthys*) - NWT Status – *Sensitive and May Be At Risk*
- Walleye (*Stizostedion vitreum vitreum*) - NWT Status – *Sensitive*
- Lake Whitefish (*Coregonus clupeaformis*)
- Lake Trout (*Salvelinus namaycush*)
- Northern Pike (*Esox lucius*)

Table 7. List of Fish Species Found in Great Slave Lake, Confirmed or Unconfirmed Occurrence in the NAAI and the Valuation of Ecological Significance

Species	Occurrence in NAAI	Focal Species Y/N	Rationale	Reference
Short Jaw Cisco (*Coregonus zenithicus*)	Unconfirmed but most likely in NAAI	Y	COSEWIC *Threatened*	Todd 2003, Rawson 1951
Arctic Grayling (*Thymallus arcticus*)	Confirmed	Y	GNWT Status - *Sensitive*	Rawson 1951 GNWT 2009b.
Deepwater Sculpin (*Myoxocephalus thompsoni*)	Confirmed	Y	GNWT Status - *Sensitive*	COSEWIC 2006 Rawson 1951 GNWT 2009b.
Blackfin Cisco (*Coregonus nigripinnis*)	Unconfirmed in NAAI and in Great Slave Lake.	Y	COSEWIC *Data Deficient;* However, Rawson (1951) indicated that the specimens found in 1944 "resembled" *Coregonus nigripinnis*.	Rawson 1951 COSEWIC 2007
Brook Stickleback (*Culaea inconstans*)	Not likely in NAAI	Y	GNWT Status – *Sensitive*, Brook stickleback are not likely in the NAAI.	Richardson *et al*. 2001 Rescan Environmental Services Ltd. 2000
Inconnu (*Stenodus leucichthys*)	Confirmed	Y	GNWT Status – *May be at Risk* and *Sensitive* Identified as a fish important in commercial and domestic fisheries	Rawson 1951 GNWT 2009b.
Walleye (*Stizostedion vitreum vitreum*)	Confirmed	Y	GNWT Status – Sensitive, Identified as a Commercially Important Fish	Rawson 1951 GNWT 2009b.
Lake Whitefish (*Coregonus clupeaformis*)	Confirmed	Y	Identified as a culturally important fish. Identified as a fish important in commercial and domestic fisheries	Rawson 1951
Lake Trout (*Salvelinus namaycush*)	Confirmed	Y	Identified as a fish important in commercial and domestic fisheries	Rawson 1951

Species	Occurrence in NAAI	Focal Species Y/N	Rationale	Reference
Northern Pike (*Esox lucius*)	Confirmed	Y	Identified as a Commercially Important Fish	Rawson 1951
Burbut (*Lota lota*)	Confirmed	N	N/A	Rawson 1951
Long Nose Sucker (*Catostomus catostomus*)	Confirmed	N	N/A	Rawson 1951
White Sucker (*Catostomus commersoni*)	Confirmed	N	N/A	Rawson 1951
Lake Herring or Cisco (*Coregonus artedi)*	Confirmed	N	N/A	Rawson 1951
Round Whitefish (*Prosopium cylindraceum*)	Confirmed	N	N/A	Rawson 1951
Slimy Sculpin (*Cottus cognatus*)	Confirmed	N	N/A	Rawson 1951
Lake Chub (*Couesius plumbeus*)	Confirmed	N	N/A	Rawson 1951
Spottail Shinner (*Notropius hudsonius*)	Confirmed	N	N/A	Rawson 1951
Trout-perch (*Percopsis omiscomaycus*)	Confirmed	N	N/A	Rawson 1951
Ninespine Stickleback (*Pungitius pungitius*)	Confirmed	N	N/A	Rawson 1951
Spoonhead Sculpin (*Cottus ricei*)	Confirmed	N	N/A	Rawson 1951
Chum Salmon (*Oncorhynchus keta*)	Unconfirmed	N	N/A	Keleher 1972
Yellow Perch (*Perca flavescens*)	Unconfirmed	N	N/A	Keleher 1972
Fourhorn Sculpin (*Myoxocephalus quadricornis*)	Unconfirmed	N	N/A	Keleher 1972
Arctic Lamprey (*Lampetra camtschatica*)	Unconfirmed	N	N/A	Rawson 1951
Flat head Chub (*Hybopsis gracilis*)	Unconfirmed	N	N/A	Rawson 1951
Goldeye (*Hiodon alosoides*)	Unconfirmed	N	N/A	Rawson 1951
Emerald Shiner (*Notropis atherinoides*)	Unconfirmed	N	N/A	Rawson 1951

Legend

- Populated Place
- Important Fish Habitat Area
- North Arm Boundary
- Important Bird Areas
- Tibbitt-to-Contwoyto Winter Road
- Highway
- Existing Winter Road
- Watercourse
- WaterBodies

Notes:
Basemapping from NTDB 1:250,000 scale.
North Arm Boundary is approximate.
Important bird areas obtained from Alexander et al., 1991.

N
W E
S

Km
0 5 10 20 30 40

1:850,000
UTM Zone 12N, NAD 83

Indian Northern Affairs Canada

Important Fish Habitat Areas

27 March 2009
Phase 1 EA

AECOM

Figure 11

File: 111111_C1_Fig11_ImportantFishHabitatAreas_27Mar09_V2.mxd

4.4.2 Fish Habitat

The northeast shore of the NAAI is within the Precambrian Shield and the margins are steep and irregular (Fuller 1955). Rivers flowing into the lake in this section are known to be cold and clear (Fuller 1955). Rapids and waterfowls are frequent in these river systems (INAC 1975a, Fuller 1955). Turbidity is high in the western section of the Great Slave Lake due to the Slave River (INAC 1975a). The west area of the NAAI is situated in the Great Slave Plain. This area is known as having poor drainage. In the area; marshes and bogs are common, lakes are intermittent and shallow, and the margins are irregular (INAC 1975b & c). Water depth is shallow near the tip of the north arm and deep near Yellowknife Bay (Rawson 1951). Recorded depths in the North Arm range from 2 m to 70 m (Rawson 1951).

Specific details on fish habitat known for the focal species within the NAAI are presented in Section 4.5.2.

4.4.3 State of Knowledge

The state of knowledge of the identified focal fish species in the NAAI is quite variable. More information is available on the main commercial, domestic, and sport fish (i.e., Lake Whitefish, Lake Trout, Inconnu, Walleye, Northern pike). Less information appears to exit on the other species (i.e., Short Jaw Cisco, Deepwater Sculpin, Blackfin Cisco, Brook Sticklback and Arctic Grayling).

4.4.3.1 Short Jaw Cisco (Coregonus zenithicus)

Short Jaw Cisco are listed as a *Threatened* species in Canada according to COSEWIC (Todd 2003).

Rawson (1951) reported that Cisco were highly abundant and widely distributed throughout Great Slave Lake and in the NAAI. Up to three species of Ciscocisco may have been found in the study conducted by Rawson (1951): *Coregonus artedi* (confirmed), *Coregonus nigripinnis* (unconfirmed) and one unidentified species of Cisco. This finding suggests that the second or third unconfirmed species may have possibly been the Short Jaw Cisco. Fishermen interviews in 1973 indicated that ciscoes (species not identified) were quite abundant in the North Arm at Wool Bay (Bond 1974) (Figure 12). Short Jaw Cisco populations are currently reported as declining in Great Slave Lake (Todd 2003).

The spawning grounds of the Short Jaw Cisco are unknown in Great Slave Lake (Murray and Reist 2003). Short Jaw Cisco's are usually found in waters greater that 40 m (Murray and Reist 2003). In general, a lack of knowledge exists regarding the habitat requirements and the general biology of the Short Jaw Cisco (Richardson *et al*. 2001). Limited accurate information is available on this species in Great Slave Lake and no confirmed information could be found for the NAAI.

4.4.3.2 Arctic Grayling (Thymallus arcticus)

Arctic Grayling are listed as a *Sensitive* species (GNWT 2009b). Grayling are also a targeted sport fish in Great Slave Lake.

Arctic Grayling have been identified at Gros Cap Outpost Island within the rocky shores in the North Arm (Rawson 1951) (Figure 12). Grayling have also been collected below Snare Falls on the Snare River located in the far northwest corner above Great Slave Lake (Rescan Environmental Services Ltd. 2000) (Figure 12).

Arctic Grayling have been known to migrate and spawn in Mosquito Creek and the Beaulieu River which are within the NAAI (INAC 1975a & b) (Figure 12). Potential grayling spawning habitat also exists between Snare Falls and Snare Cascades on the Snare River (Rescan Environmental Services Ltd. 2000). No information could be found on the overwintering of arctic grayling within the NAAI.

One study conducted by (Rescan Environmental Services Ltd. 2000) assessed the affects of removing the minimum flow requirements of Snare Falls and Snare Forks hydroelectric dams on Arctic Grayling. They concluded that changes in flow should not have a noticeable impact on grayling spawning success.

4.4.3.3 Deepwater Sculpin (Myoxocephalus thompsoni)

Deepwater Sculpin are listed as a *Sensitive* species (GNWT 2009b).

The Deepwater Sculpin appears to be an important part of the diet of trout caught at Gros Cap, which is located within the NAAI (Rawson 1951) (Figure 12). Deepwater Sculpin have been found in water depths ranging from 5 m to 461 m (Rawson 1951). No information could be found on the spawning or overwintering of Deepwater Sculpin within the NAAI.

4.4.3.4 Blackfin Cisco (Coregonus nigripinnis)

Blackfin Cisco are listed as *Data Deficient* in Canada (COSEWIC 2007).

According to the reviewed literature, the presence of the Blackfin Cisco in Great Slave Lake is not confirmed (Rawson 1951). Rawson (1951) found that ciscoes were widely distributed and abundant throughout Great Slave Lake and captured specimens were sent to J.R. Dymond from the Royal Ontario Museum in Toronto for species identification. Dymond indicated “that there were at least three species, one of which was definitely *Leucicthys artedi* (now *Coregonus artedi*), a second resembled in some respects *L. nigripinnis* (now *Coregonus nigripinnis*) and a third, the ;largest could not be named at this time”. However, according to COSEWIC (2007), the reported distribution of the Blackfin Cisco does not extend into the Northwest Territories.

No information could be found on the spawning or overwintering of Blackfin Cisco within the NAAI.

4.4.3.5 Brook Stickleback (Culaea inconstans)

Brook Stickleback are listed as *Sensitive* (GNWT 2009b).

Reviewed literature has not confirmed the presence of the Brook Stickleback in the NAAI. According to the reviewed literature in Richardson *et al.* (2001), Brook Stickleback are present in Great Slave Lake near Hay River and the MacKenzie River. Some literature does not include the Brook Stickleback on the list of species found or known to be found in Great Slave Lake (Keleher 1972, Rawson 1951). According to the reviewed literature in Rescan Environmental Services Ltd. (2000), Brook Stickleback were not listed as a known fish species between Snare Falls and Slemon Rapids (close to the NAAI). Rescan Environmental Services Ltd. 2000 also did not observe any Brook Stickleback in their study.

Brook Stickleback are known to be a highly tolerant fish which can adapt to a variety of environmental conditions (Joynt and Sullivan 2003). Brook Stickleback spawn in aquatic vegetation (Joynt and Sullivan 2003). The western section of the NAAI is known to contain marshes and shallow lakes (INAC 1975b & c), which may provide spawning habitat for Brook Stickleback if they are present. No information could be found on the spawning or overwintering of Brook Stickleback within the NAAI.

4.4.3.6 Inconnu (Stenodus leucichthys)

The Inconnu are listed as *Sensitive* and a species that *May be at Risk* (GNWT 2009b). The Inconnu is also an important fish for the domestic and commercial fisheries. According to Read and Taptuna (1997), the Inconnu are the third major commercial fish in Great Slave Lake. The main use of the Inconnu in the domestic fishery is for dog feed (Fuller 1955)

Inconnu have been confirmed in the NAAI; however, the abundance of this fish is the NAAI appears to be low (Bond 1974, Fuller 1955, Rawson 1951). Inconnu populations in Great Slave Lake appear to be stable (Mackenzie River Basin Board 2004).

According to domestic fishery records, Inconnu likely overwinter in the NAAI (Keleher and Haight 1964). The main spawning runs of the Inconnu are not in the NAAI (Fuller 1955). No information could be found on spawning locations or runs within the NAAI.

4.4.3.7 Walleye (Stizostedion vitreum vitreum)

Walleye are listed as a sensitive species (GNWT 2009b). Walleye are also an important species for commercial fishing and make up a small percentage of the commercial fishery catch (Keleher 1972).

Mackenzie River Basin Board (2004) indicated that information on populations of Walleye in Great Slave Lake is insufficient. Some information exists on potential Walleye distribution the NAAI. For example, walleye appear to be abundant in the near Behchokò (Rawson 1951) (Figure 12). In addition, no Walleye were recorded in a commercial fishery near Wool Bay (Bond 1974) (Figure 12). Further, Walleye have been located in the Yellowknife River and at Gros Cap Island (Rawson 1951) (Figure 12).

Walleye have been known to spawn and migrate in multiple locations within or near the NAAI. The areas which support Walleye spawning and migration include: the Beaulieu River system, (INAC 1975a), Mosquito

Creek, and the Horn River (INAC 1975b) (Figure 12). Walleye have also been known to spawn in multiple rivers in the far northwest corner of the North Arm (INAC 1975b) (Figure 12). The Horn River is also suspected as a rearing area for Walleye (INAC 1975b).

4.4.3.8 Lake Whitefish (Coregonus clupeaformis)

Lake Whitefish were chosen as a FOCAL SPECIES in the NAAI due to their importance in the commercial, domestic and sport fisheries. According to Read and Taptuna (1997), Lake Whitefish are the most important major commercial fish in Great Slave Lake. Lake Whitefish are identified as important part of the diet for local individuals (Keleher and Haight 1964). The following areas have been reserved for Lake Whitefish domestic and sport fishing (INAC 1975b) (Figure 12):

- The North Arm of Great Slave Lake
- Marian Lake
- James Lake

Lake Whitefish are abundant in Great Slave Lake including the NAAI (Rawson 1951). For example, Lake Whitefish were quite abundant during a commercial fishery in Wool Bay (Bond 1974) (Figure 12). The population of this species seems stable in the western basin of Great Slave Lake (Mackenzie River Basin Board 2004). Mobility of Lake Whitefish in the NAAI was greater than other areas of the lake (Keleher 1963).

Lake Whitefish have been known to spawn within the NAAI along the eastern shore (INAC 1975a). Lake Whitefish have been known to migrate from Mills Lake and spawn in the Horn River (INAC 1975b) (Figure 12). Mosquito Creek also supports migration for Lake Whitefish (INAC 1975b) (**Error! Reference source not found.**). In addition, Lake Whitefish have been known to migrate between the North Arm of Great Slave Lake and Marian Lake after spring break up (INAC 1975b) (Figure 12). According to domestic fishery records, whitefish likely overwinter in the NAAI (Keleher and Haight 1964).

4.4.3.9 Lake Trout (Salvelinus namaycush)

Lake Trout were chosen as a focal species in the NAAI due to their importance in the commercial, domestic, and sport fisheries. According to Read and Taptuna (1997), Lake Trout are the second major commercial fish in Great Slave Lake

The following areas have been reserved for Lake Whitefish domestic and sport fishing (INAC 1975b) (Figure 12):

- The North Arm of Great Slave Lake
- Marian Lake
- James Lake

Populations of Lake Trout in the western basin of Great Slave Lake have declined (Mackenzie River Basin Board 2004). Lake Trout in the NAAI appear to be quite mobile (Keleher 1963).

Lake Trout have been known to spawn within the NAAI along the eastern shore (INAC 1975a). Lake Trout may overwinter in the NAAI (Keleher and Haight 1964).

4.4.3.10 Northern Pike (Esox lucius)

Northern Pike were chosen as a focal species in the NAAI due to their importance in the commercial fishery. According to Read and Taptuna (1997), Northern Pike are a major commercial fish in Great Slave Lake.

Northern Pike populations appear to be stable in Great Slave Lake; however, the source of this information may be inadequate (Mackenzie River Basin Board 2004). Rawson (1951) indicated that one of the highest concentrations of Northern Pike was at Yellowknife Bay (Figure 12). Northern Pike have also been caught in Wool Bay (Bond 1974) (Figure 12).

Northern Pike have been known to spawn in Mosquito Creek (INAC 1975b) (Figure 12). Mosquito Creek also supports pike migration. The Horn River is a suspected rearing area for Northern Pike (INAC 1975b) (Figure 12). According to domestic fishery records, Northern Pike likely overwinter in the NAAI (Keleher and Haight 1964).

4.4.4 Fisheries Data Assessment and Evaluation

The data acquired and presented for the focal fish species in the NAAI would be considered poor to moderate and most of the data is quite dated.

More data is likely available for main commercial, domestic, and sport fish since numerous commercial, domestic and sports fishing appear to occur within the NAAI (INAC 1975a,b & c). However, due to budget and time constraints further data could not be acquired.

Sufficient data does not appear to be available on the biology or distribution of the Short Jaw Cisco in Great Slave Lake Most studies on the Short Jaw Cisco have been completed within the Great Lakes in Ontario (Todd 2003).

Data on the Deepwater Sculpin in GLS appears to be limited to a study completed by Rawson (1951). Most studies on the Deepwater Sculpin have been completed within the Great Lakes in Ontario (COSEWIC 2006). A few articles which were not obtained for this report due to time and budget constraints may have additional information (e.g., T. Sheldon, unpubl. Data *In* COSEWIC 2006, Parker, B.J. 1988, McAllister 1961).

Confirmed presence or absence of Blackfin Cisco in Great Slave Lake has not been determined. This species is listed as *Data Deficient* across Canada (COSEWIC 2007). According to the reviewed literature, only one document mentioned an unconfirmed occurrence of Blackfin Cisco in the Great Slave Lake (Rawson 1951).

Literature was not found confirming the presence or absence of Brook Stickleback in the NAAI. More data may be available on this species in the NAAI; however, due to budget and time constraints further data could not be acquired.

Information on the Arctic Grayling in the NAAI appears to be limited to several studies (Rescan Environmental Services Ltd. 2000, INAC 1975a & b, Rawson 1951). One study completed on Arctic Grayling in Great Slave Lake only focused on areas outside of the NAAI (Bishop 1967). More data is likely available on this species in the NAAI since grayling are a targeted sport fish in Great Slave Lake; however, due to budget and time constraints further data could not be acquired.

4.4.5 Fisheries Data Gaps

According to the results of the fisheries component of this study the following data gaps have been identified:

- Information on historic and current domestic, commercial, and sports fisheries within the NAAI is limited.
- Current abundance and distribution data to determine the stability of walleye (GNWT Status *Sensitive*), Arctic Grayling, (GNWT Status *Sensitive*) and Northern Pike populations in the NAAI is required.
- Further information is required on the distribution of the Short Jaw Cisco (COSEWIC *Threatened)* and the Deepwater Sculpin (GNWT Status *Sensitive*) within Great Slave Lake and the NAAI. Potential distribution of these species within the NAAI should be determined.
- More information is required to confirm the presence or absence of the Blackfin Cisco (COSEWIC *Data Deficient)* in Great Slave Lake. Further knowledge is required on the habitat requirements of this species. Field sampling studies may need to be conducted in Great Slave Lake and within the NAAI in order to determine the presence or absence of this species.
- More information is required to confirm the presence or absence of the Brook Stickleback (GNWT Status Sensitive) in the NAAI. If historic literature does not exist to confirm the presence or absence of this species in the NAAI, then field sampling studies may need to be conducted within the NAAI.
- More information is required on the extent of the spawning, overwintering, and rearing habitats of all the focal species within the NAAI in order to determine if the proposed boundaries are sufficient to protect fish species which are listed as sensitive, threatened, or potentially at risk (i.e., Short Jaw Cisco, Deepwater Sculpin, Blackfin Cisco, Brook Stickleback, Arctic Grayling, Inconnu, and Walleye).
- Information on the instream flow needs of major or important overwriting, spawning, and migration areas and routes of identified focal species needs to be obtained.

5. Significance of Ecological Values

The available information obtained during this evaluation indicates that a number of ecological values that are significant exist within the NAAI and should be provided some form of protection. The geological and hydrological features found in the NAAI appear to be representative of the ecoregions in which they are found and other than the City of Yellowknife do not have any significant development pressures that have the potential to compromise their values. Climate change is causing higher water levels in Great Slave Lake and has the potential to affect the hydrological regime by causing earlier freshets. For vegetation communities, the NWT PAS Science Team analysis found that the NAAI contained many of the landscape units, physiographic units and land cover classes within the ecoregions 60 and 69 (Northwest Territories Protected Areas Strategy Science Team, 2009). A small number of rare plant species records determined during this evaluation to be within the NAAI. The lack of comprehensive rare plant surveys and the fact that the records were nearly all obtained close to the highway corridor, suggest that a high probability exists that additional rare plants would be found within the NAAI and that creation of a protected area would protect these values.

Wildlife values, especially for waterfowl, are significant within the NAAI. The northern shoreline and inland wetlands provide significant nesting and spring migration areas for a number of waterfowl species, including Tundra Swan, Cackling Canada Geese, Caspian Terns and Black Terns (Latour *et al.* 2008). Woodland and barren-ground caribou, moose and bison are also found within the NAAI along with furbearers and carnivores such as wolf and bears. Although it does not appear that the NAAI contains significant amounts of critical habitats for these species, wintering, rutting and calving habitats likely exist within the NAAI and a protected area would benefit these species.

There are many fisheries values within the NAAI, although the identification of high value habitats is limited due to a lack of comprehensive and detailed studies. A number of fisheries species at risk are assumed to be found within the NAAI, due to their presence in Great Slave Lake, but limited information is available on their exact distribution and critical habitats such as spawning, overwintering or rearing areas.

5.1 Protected Area Designation Options

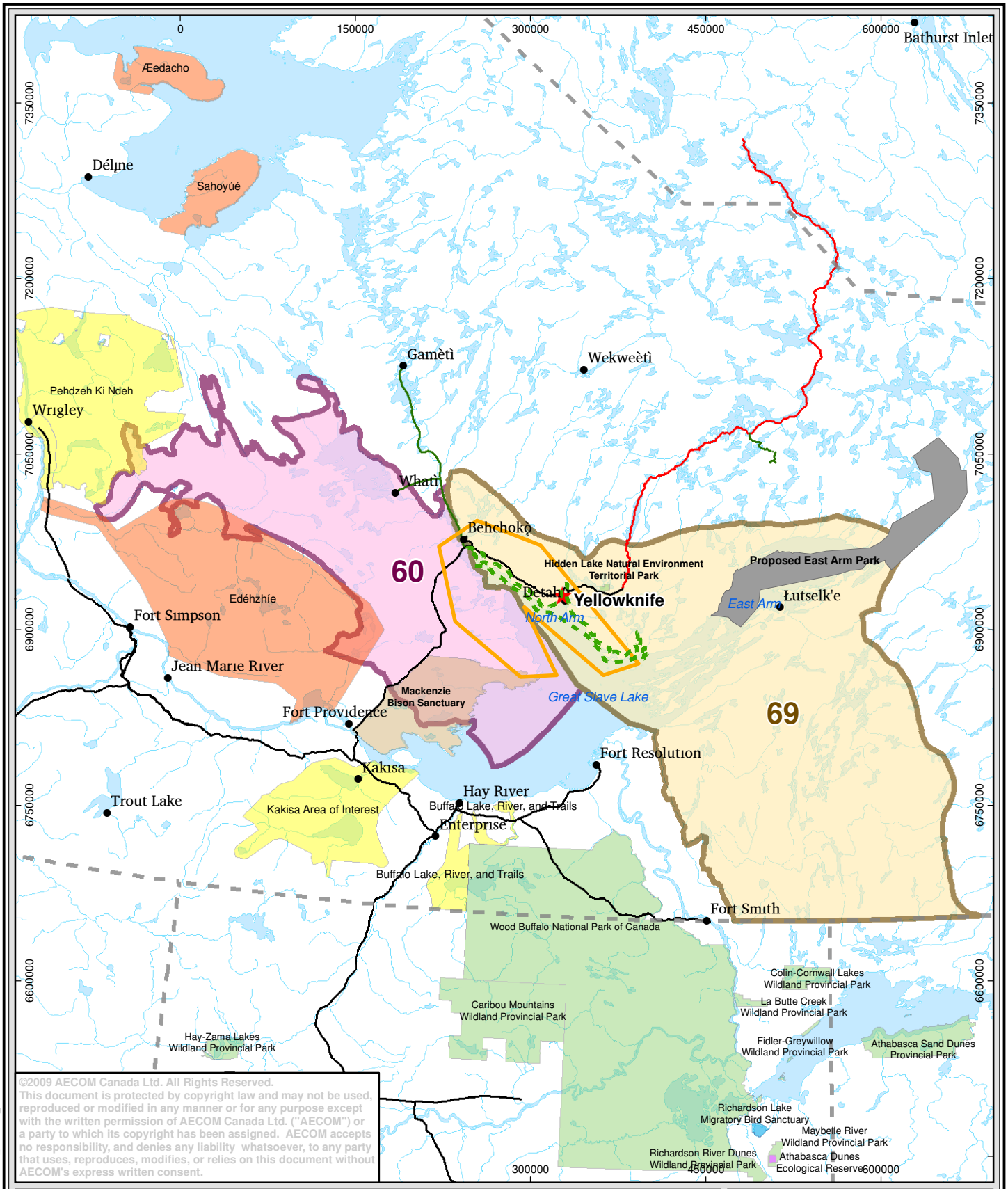
Several existing and proposed protected areas are located within the general area of the NAAI (see Figure 12) and provide a context for any future development of protected areas. The NWT PAS provides three designations for conservation available: National Wildlife Areas (NWA) (administered by CWS), National Park (administered by Parks Canada) and Wilderness Conservation Area (WCA) (administered by GNWT Industry, Tourism and Investment). Table 8 below summarizes the conservation goals and activities that may occur under the three designations.

Table 8. Conservation Goals and Activities for Selected Protected Area Designations

Designation	Conservation Goal	Activities
National Wildlife Area	Protection of wildlife habitat for research, conservation and interpretation. Primarily for migratory birds and species at risk.	Activities must not harm the species or habitats that the NWA is established for.
National Park	Protection of representative natural areas of Canadian significance.	Conservation and recreation activities allowed, industrial activities generally not allowed.
Wilderness Conservation Area	Protection of core representative areas that contribute to regional biodiversity (e.g., landforms, watersheds, wildlife habitats).	Generally activities must not damage core representative area and industrial activity prohibited to the extent available to the GNWT

Of the three potential designations, a designation under a National Park would likely be the most difficult to achieve. Parks Canada has identified 39 terrestrial Natural Regions and has a goal of establishing National Parks within each region. The NAAI is within a Natural Region wherein the East Arm of Great Slave Lake is currently being considered as a potential National Park, so an additional National Park would be unlikely to be considered at this time.

The high migratory bird values found in the NAAI, would meet the criteria for establishing a NWA, as well as for a WCA. Both designations provide for protection of wildlife values, allow recreational, scientific and conservation uses and provide for limited commercial and other activities that don't affect wildlife values. Public consultation and review would be required for designation under both of these options and that process may provide direction on the most appropriate conservation designation.



North Arm boundary is approximate.
Important bird areas obtained from Alexander et al., 1991
Ecoregion obtained from Environment Canada.
NWT PAS Area of Interest- A special area or site of natural or cultural value with formal support of communities and/or regional organizations (Step 1 or 2).
The boundary is preliminary. Existing legislation applies and there are no newrestrictions.

N W E S

0 20 40 80 120 Km

1:4,500,000

UTM Zone 12N, NAD 83

Legend

- Territorial Capital
- Populated Place
- Territorial/Provincial Boundary
- Highway
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- North Arm Boundary
- Important Bird Area
- Ecoregion 60
- Ecoregion 69
- NWT PAS Candidate Protected Areas with Interim Protection
- NWT PAS Areas of Interest
- East Arm Park
- Bird Sanctuary
- Bison Sanctuary
- Ecological Reserve
- Park

Indian Northern Affairs Canada

North Arm Study Area Ecoregions, Parks and Protected Areas Strategy

March 27 2009
Phase 1 EA

AECOM

Figure 12

Map Document:111111_C1_Fig12_NorthArm_Ecoregions Parks_27Mar09_V3.mxd

6. Draft Terms of Reference for a Phase II Ecological Assessment

6.1 Ecological Knowledge Gaps and Recommendations

Based on the available information and the ecological assessment, a number of ecological knowledge gaps were identified that may require additional information before any determination can be conducted on the designation of the NAAI as a protected area. A summary of the knowledge gaps and recommendations on possible methods to obtain the required information are provided in Table 9.

6.2 Priority Information Needs/Research Tasks

Although a large number of information gaps and research needs were identified during the Phase 1 Ecological Assessment, three knowledge gaps have been identified as being a high priority requiring attention for the NAAI:

1. Due to budget constraints, a joint decision was made between INAC and AECOM to reduce the scope of the Phase 1 Ecological Assessment related to Traditional Knowledge of the NAAI. This review of available TEK for the NAAI, is therefore still required as a component of the Phase 1 ecological assessment and should be completed as soon as possible. Based on available information, it is understood that the Tłı̨chǫ and Dene Nation have completed TEK studies which could be requested to be reviewed, but it is unknown how detailed or extensive the information is related to the NAAI.
2. One of the reasons the NAAI was selected as a potential PAS was the importance of the area as migratory and nesting habitat for waterfowl, including Tundra Swans, Canada Goose, Cackling Geese, Black Terns and Caspian Terns. Surveys should be completed during the spring and summer to determine current waterfowl use of the area for migration and nesting and assess if the use of the area has increased, decreased, or is the same as previously observed. The assessment of trends would have to take into account any available information on population trends of the species of interest.
3. Completion of detailed vegetation communities mapping and a rare and introduced plant survey is considered a priority for the NAAI. Vegetation community mapping will provide the basis for identification of potential rare plant communities that may require protection as well as identification of potential high value wildlife habitats through habitat suitability mapping. Completion of vegetation surveys for rare and introduced plant species within the NAAI, will allow for the identification of priority conservation areas for rare plant species, while determining the extent and types of introduced plant species will allow for decisions on management on potential invasive species.

Table 9. Knowledge Gaps Identified in the North Arm Area of Interest and Recommendations to Improve the State of Knowledge.

Knowledge Gaps	Recommendations for Improvement
Traditional Knowledge	
Traditional knowledge of specific locations, detailed species information and traditional usage of plants were not obtained or unavailable for the Phase 1 assessment.	A comprehensive Traditional Ecological Knowledge (TEK) assessment is required to obtain and describe the traditional knowledge available for the NAAI on plants, wildlife and fisheries values.
Detailed information on traditional use of wildlife use or traditional knowledge of wildlife and high value wildlife habitats was not obtained or unavailable for the Phase 1 assessment.	
Detailed information on traditional use of fish or knowledge of high value fish habitats was not obtained or unavailable for the Phase 1 assessment.	
Hydrology	
Decommissioning of hydrometric stations within the Mackenzie Basin limits the ability to accurately predict flows and climate change effects in systems without stations.	If detailed hydrological studies are conducted in the NAAI, installation of local hydrometric and climate stations will be required to ensure adequate confidence in data analysis and modeling.
Plants and Vegetation Communities	
Data on rare plant species within the NAAI is limited to areas close to roads and Yellowknife.	A comprehensive, systematic rare plant survey should be undertaken to determine the extent and distribution of rare plants within the NAAI and the vegetation communities they are found in.
Specific locations of the non-native species present in the NAAI are not known.	A systematic survey of invasive plant species should be completed in areas away from the roads within the NAAI to determine if invasive plants have distributed outside of the previously surveyed area. Where occurrences are found, recommendations on mitigation measures should be completed.
The 1:50,000 scale digital map of wetland areas supplied by the GNWT appears to be missing data for the north eastern portion of the North Arm.	A more thorough review of available digital data sources should be undertaken to determine if a complete wetland coverage is available.
Detailed mapping of vegetation communities and field verification is lacking.	More detailed vegetation community mapping should be undertaken, and should include a terrain and soils component to allow for more detailed interpretation of wildlife habitat use as well as determination of potential rare vegetation communities.
Wildlife and Wildlife Habitat	
Information on boreal caribou use of NAAI is minimal. Habitat associations and critical habitat attributes are lacking.	More detailed habitat use and population inventory of boreal caribou within the NAAI could be initiated through a GPS and/or radio collaring program. Available or new vegetation community mapping should be used to create habitat suitability mapping for boreal caribou and determine the availability of high value habitats in the NAAI.
Information on use of the NAAI by Wood Bison is minimal. The limited information is unpublished and was unavailable for detailed review.	Recent studies conducted on population estimates for the Mackenzie bison herd will soon be completed and available in report form. These reports should be obtained and evaluated to determine how the NAAI is being used by bison. Available or new vegetation community mapping should be used to create habitat suitability mapping for bison and determine the availability of high value habitats in the NAAI.
Moose harvest levels and habitat use patterns in the NAAI are unavailable, and recent population inventory information is unpublished.	Recent studies on moose in the NAAI will be published shortly and should be reviewed to assess moose use of the NAAI. Available or new vegetation community mapping should be used to create habitat suitability mapping for moose and determine the availability of high value habitats in the NAAI.
More information on furbearer populations and distributions in the NAAI is required, especially for wolverine and fisher.	Additional research on furbearer, especially wolverine and fisher harvest levels, habitat use and populations is required and could be obtained through review of Hudson Bay Company fur return records, a more thorough review of GNWT files and a Traditional Knowledge study.

Knowledge Gaps	Recommendations for Improvement
Information on waterfowl and waterbird use of the NAAI offshore islands is almost 20 years old and there is limited information on habitat use of mainland wetlands and ponds.	Waterfowl and waterbird surveys should be conducted to help determine trends and if the NAAI is still an important area for waterfowl. Additional surveys to determine extent and importance of mainland wetlands could also help in assessment of NAAI as PAS.
Breeding forest bird and raptor information is limited and out of date.	Breeding bird surveys using point counts and raptor nest surveys using call-playback (e.g., owls and some hawks) and aerial surveys (e.g., bald eagles and osprey) should be conducted to determine species using the area and if there are any species at risk using the NAAI.
Information on amphibians and reptiles within the NAAI is lacking.	Presence/absence surveys should be done for amphibians and reptiles to determine the species using the area and if any species at risk using the NAAI.
Fish and Fish Habitat	
Information on domestic, commercial and sports fisheries within the NAAI is lacking.	Detailed fisheries use surveys should be conducted for the NAAI.
Information on the distribution of Short Jaw Cisco, Deepwater Sculpin, Blackfin Cisco and Brook Stickleback is lacking in the NAAI.	Conduct more detailed fisheries studies to determine and/or confirm the distribution of these species in the NAAI.
Information on the population levels and trends for walleye, Arctic Grayling and Northern Pike is not current.	Population inventories should be conducted in the NAAI for these species to determine their current status and if the populations are stable, increasing or declining.
Limited information available on spawning, rearing and overwintering habitats for fish in the NAAI is available.	Detailed habitat studies should be completed to determine the extent of spawning, overwintering, and rearing habitats of fish species within the NAAI.

6.3 Draft Schedule and Budget for Priority Tasks

Table 10 outlines a draft schedule and estimated budget to complete the priority tasks of a Phase 2 Ecological Assessment for the NAAI.

Table 10. Schedule and Budget for Priority Tasks to be Completed During Phase 2 Ecological Assessment

Task	Study Methods	Timing	Estimated Person Days*	Estimated Budget
Assessment of TEK information	Information gathering and assessment	Spring 2009	~ 15	~ $15,000`
Waterfowl surveys of NAAI	Spring aerial surveys to count waterfowl using NAAI	Spring 2009 or 2010	~ 10	~ $25,000
	Ground nest searches of known Black and Caspian Tern nesting sites	Summer 2009 or 2010	~ 10	~ $15,000
Vegetation community mapping and plant surveys	Vegetation community mapping	Spring/Summer 2009 & 2010	~ 100	~ $140,000
	Plant surveys**	Summer 2009	~ 30	~ $40,000

** includes time for report preparation;*

*** completed concurrently with vegetation mapping (costs increase if completed separately)*

7. References

Adamczewki, Jan. (Pers. Comm.).
Wildlife Biologist, Ungulates. Environment & Natural Resources, Government of Northwest Territories. January, 2009.

Altman, B. and R. Sallabanks. 2000.
Olive-sided Flycatcher (*Contopus cooperi*i), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/ species/502doi:10.2173/ bna.502

Aspler, L.B. 1978.
Surficial geology, permafrost and related engineering problems, Yellowknife area, part of 85J/8;EGS 1978-08, NWT Geology Division, Indian and Northern Affairs Canada, Yellowknife, text and one map, 16 p., scale 1:6000

Austin, J. E., C. M. Custer and A. D. Afton. 1998.
Lesser Scaup (*Aythya affinis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online:

Avery, M. L. 1995.
Rusty Blackbird (*Euphagus carolinus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/200doi:10.2173/bna.200

Barrier, Tara (Pers. Comm.).
M.Sc. Candidate. Thesis topic: Winter range ecology and distribution of the Bathurst herd in NWT. Natural Resources and Environmental Studies Program, University of Northern British Columbia, Prince George, February 2009.

Bishop, F.G. 1967.
The biology of the Arctic grayling, *Thymallus arcticus* (Pallas), in Great Slave Lake. M.Sc. Thesis. University of Alberta, Edmonton, Alberta. 166p

Bond, W.A. 1974.
Data on ciscoes, burbot and longnose suckers from Great Slave Lake, Northwest Territories, 1973. Department of the Environment Fisheries and Marine Service Data Report Series No.: CEN/D-74-3. Fishery Management Division, Resource Management Branch, Winnipeg.

Bookhout, T. A. 1995.
Yellow Rail (*Coturnicops noveboracensis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/139doi:10.2173/bna.139

Brook, R. W., and R. G. Clark. 2005.
Breeding season survival of female Lesser Scaup in the northern boreal forest. *Arctic* 58:16–20.

Canadian Council on Ecological Areas (CCEA). 2009.
Terrestrial Ecozones of Canada. Website: http://www.ccea.org/ecozones/ accessed January 2009.

Canadian Wildlife Service (CWS). 2009.
Map of Northwest Territories Breeding Bird Survey Routes. Website: http://www.cws-scf.ec.gc.ca/nwrc-cnrf/default.asp?lang=en&n=CCA32432 accessed February 2009.

Carriere, S. and J. Lange. 2002.
General Status Ranks of Wild Species in the Northwest Territories. Department of Environment and Natural Resources, Wildlife and Economic Development. Manuscript Report 143. 61 pp.

Case, R., and R. Graf. 1982.
A moose survey stratified by using Landsat TM data, north of Great Slave Lake, NWT, November 1989. Government of the Northwest Territories, Department of Renewable Resources, Manuscript Report No. 59.

Cluff, H.D. 2005.
Survey of moose abundance in the boreal forest around Rae-Edzo, Northwest Territories. Final Report to the Northwest Territories Cumulative Impact Monitoring Project, Yellowknife, NT Canada.

Cluff, H.D. 2006.
Boreal woodland caribou workshops in North Slave Communities Project Repot, March 31, 2006. Environment and Natural Resources Government of the Northwest Territories. Yellowknife, NWT.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2003.
COSEWIC assessment and update status report on the wolverine Gulo gulo in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 41 pages.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2006.
COSEWIC assessment and update status report on the deepwater sculpin *Myoxocephalus thompsonii* (Western and Great Lakes-Western St. Lawrence populations) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 39 pp.
(www.sararegistry.gc.ca/status/status_e.cfm).

Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2007.
COSEWIC assessment and update status report on the blackfin cisco *Coregonus nigripinnis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa vi + 23pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2009.
website http://www.cosewic.gc.ca/eng/sct5/index_e.cfm accessed February 2009.

Deh Cho Atlas. 2003.
Version 2b. Deh Cho Land Use Planning Committee.

Department of Indian Affairs and Northern Development (DIAND). 2005.
A Preliminary State of Knowledge of Valued Components for the NWT Cumulative Impact Monitoring Program (NWT CIMP) and Audit. February 1, 2002; updated February 2005.

Dunn, E. H. and D. J. Agro. 1995.
Black Tern (*Chlidonias niger*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/147doi:10.2173/bna.147

Dyer, S. J., J. P. O'Neill, S. M. Wasel, and S. Boutin. 2001.
Avoidance of industrial development by woodland caribou. Journal of Wildlife Management 65:531-542.

Earth Observation for Sustainable Development of Forests (EOSD). 2006.
Website: http://cfs.nrcan.gc.ca/subsite/eosd, accessed February 2009.

Ecosystem Classification Group. 2007.
Ecological Regions of the Northwest Territories – Taiga Plains. Department of Environment and Natural Resources, Government of Northwest Territories, Yellowknife, NT, Canada. viii + 209 pp. + folded insert poster map.

Ecosystem Classification Group. 2008.
Ecological Regions of the Northwest Territories – Taiga Shield. Department of Environment and Natural Resources, Government of Northwest Territories, Yellowknife, NT, Canada. viii + 146 pp. + insert map.

Environment and Natural Resources (ENR). 2005.
Spatial Data Warehouse Geospatial Portal. GNWT. Online: http://maps.gnwtgeomatics.nt.ca/portal/index.jsp Accessed February 2009.

Environment and Natural Resources (ENR). 2009a.
NWT Virtual Herbarium: DAO information only. GNWT, Yellowknife, NT.

Environment and Natural Resources (ENR). 2009b.
Mackenzie Valley Bison Surveys, '94, '96; 98, '00, '08: Bison Observations. Unpublished material. GNWT, Yellowknife, NT.

Environment and Natural Resources (ENR) 2009c.
NWT Small Mammal and Hare Surveys in the Northwest Territories - Yellowknife Site. GNWT, ENR, Wildlife Division, Yellowknife, NT. Website: www.nwtwildlife.com, accessed: February 2009).

Environment Canada. 2008.
Species at Risk in the Northwest Territories: a guide to NWT species legally listed under the federal *Species at Risk Act* and those under consideration for listing. Canadian Wildlife Service, Yellowknife, NT.

Environment Canada. 2009a.
National Climate Data and Information Archive. Website: http://www.climate.weatheroffice.ec.gc.ca/climate_normals/results_e.html?StnID=1706&autofwd=1 accessed March 2009.

Fast, P.L.F., Clark, R.G., Brook, R.W. and J.E. Hines. 2004.
Patterns of wetland use by brood-rearing Lesser Scaup in northern boreal forest of Canada. Waterbirds 27(2): 177-182.

Fisher, J.T., Roy, L.D. and M. Hiltz. 2008.
Barren-ground caribou management in the Northwest Territories: An independent peer review. Alberta Research Council, Sustainable Ecosystems Unit, Ecological Conservation Management Program, Vegreville, Alberta.

Fuller, W.A. 1955.
The inconnu (*Stenodus leucichthys mackenziei*) in Great Slave Lake and adjoining waters. J. Fish. Res. Board Can. 12: 768-780.

Gah, Evelyn (Pers. Comm.).
GIS Analyst, Protected Areas Strategy Department of Environment and Natural Resources, Government of the NWT. February, 2009.

Gates, C.C. and N.C. Larter. 1990.
Growth and dispersal of an erupting large herbivore population in northern Canada: The Mackenzie wood bison *(Bison bison athabascae*). Arctic 43(3): 231-238.

Government of Canada. 2001.
Natural Resource Canada, Centre for Topographic Information.

Government of the Northwest Territories (GNWT). 1978.
Preliminary description of hunting and trapping in Invuik and Fort Smith Regions, NWT, 1977/1978. Environment and Natural Resources, Yellowknife, NT.

Government of the Northwest Territories (GNWT). 1999.
NWT Protected Areas Strategy: A Balanced Approach to Establishing Protected Areas in the Northwest Territories. The NWT Protected Areas Strategy Advisory Committee, Department of Resources, Wildlife and Economic Development.

Government of the Northwest Territories (GNWT). 2002.
Protected areas strategy: Ecological Assessment Guidelines. October 2002. 7 pp.

Government of the Northwest Territories (GNWT). 2005.
Harvest summary data for the North Slave Region 2004/2005. Environment and Natural Resources, Yellowknife, NT

Government of the Northwest Territories (GNWT). 2006.
Amphibians and Reptiles of the Northwest Territories pamphlet and 2006 pamphlet update. Environment Canada, Indian and Northern Affairs Canada, Ducks Unlimited, and Environment and Natural Resources, Yellowknife, NT.

Government of the Northwest Territories (GNWT). 2007.
Harvest summary data for the North Slave Region 2006/2007. Environment and Natural Resources, Yellowknife, NT

Government of the Northwest Territories (GNWT). 2008.
Draft - Wood Bison Management Strategy for the Northwest Territories. NWT Species at Risk, Environment and Natural Resources.

Government of the Northwest Territories (GNWT). 2009a.
Environment and Natural Division, http://www.nwtwildlife.com/NWTwildlife/caribou/satcollars.htm accessed January 2009.

Government of the Northwest Territories (GNWT). 2009b.
NWT Species Monitoring Infobase. Website:
http://www.nwtwildlife.com/enr_infobase/asp/search.asp last accessed February, 2009.

Government of the Northwest Territories (GNWT). 2009c.
NWT Species Accounts. Website: http://www.nwtwildlife.com/NWTwildlife/ last accessed February, 2009.

Gunn, A., J. Antoine, J. Boulanger, J. Bartlett, B. Croft and A. D'Hont. 2004.
Boreal caribou habitat and land use planning in the Deh Cho Region, Northwest Territories. Manuscript Report No. 153. Department of Resources, Wildlife, and Economic Development, Government of the Northwest Territories, Yellowknife, NT.

Hill, T. and D. Cluff. 2005.
Status of Boreal Caribou, *Rangifer tarandus caribou*, in the North Slave Region, Northwest Territories, Canada. Department of Environment and Natural Resources. Government of the Northwest Territories, Yellowknife, NT.

Indian and Northern Affairs (INAC). 1975a.
Hearne Lake: District of Mackenzie, Northwest Territories: 85I. Northern Land Use Information Series (NLUIS): mapping project of Lands Directorate, Environmental Management Service. Indian and Northern Affairs Canada, Department of Environment.

Indian and Northern Affairs (INAC). 1975b.
Rae: District of Mackenzie, Northwest Territories: 85K. Northern Land Use Information Series (NLUIS): mapping project of Lands Directorate, Environmental Management Service. Indian and Northern Affairs Canada, Department of Environment.

Indian and Northern Affairs Canada (INAC). 1975c.
Sulphur Bay: District of Mackenzie, Northwest Territories: 85G. Northern Land Use Information Series (NLUIS): mapping project of Lands Directorate, Environmental Management Service. Indian and Northern Affairs Canada, Department of Environment.

Indian and Northern Affairs Canada (INAC). 2009.
Supply Arrangement Request for Quote (RFQ) - Phase 1 Ecological Assessment: North Arm of Grate Slave Lake Area of Interest.

James, A. R. C. and A. K. Stuart-Smith. 2000.
Distribution of caribou and wolves in relation to linear corridors. Journal of Wildlife Management 64:154-159.

Keleher, J.J. 1963.
The movements of tagged Great Slave Lake fish. J. Fish. Res. Board Can. 20: 319-326

Keleher, J.J. 1972.
Great Slave Lake: effect of exploitation on salmonid community.J. Fish. Res. Board Can. 29: 741-753

Keleher, J.J. and C.G. Haight. 1964.
Survey of Great Slave Lake domestic fishery in 1959 and 1962. I. 1962 Census and fish supply in North Arm manuscript reports of the Great Slave Lake investigations No. 41. Fisheries and Oceans Canada, Winnipeg, MB.

Kerr, D.E. 1990.
Surficial geology of the Yellowkife River basin, parts of NTS85I. J.O.P and 86A; EGS 1990-03. NWT Geology Division, Indian and Northern Affairs Canada, Yellowknife, scale 1:250 000.

Kerr, D.E. and P. Wilson. 2000.
Preliminary surficial geology studies and mineral exploration considerations in the Yellowknife area, Northwest Territories: in Current Research. Geological Survey of Canada.

Kuyt, E, 1962.
Aerial survey of moose in the area east of Yellowknife, NWT, 1962. Unpublished Canadian Wildlife Service report 62-27, Edmonton, Alberta.

Latour, P.B., J. Leger, J.E. Hines, M.L. Mallory, D.L. Mulders, H.G. Gilchrist, P.A. Smith and D.L. Dickson. 2008.
Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut. Occasional Paper 114. Canadian Wildlife Service, Environment Canada, Ottawa.

Mackenzie River Basin Board. (2004).
Mackenzie River Basin: State of the aquatic ecosystem report, 2003. Fort Smith, N.T.: Mackenzie River Basin Board.

Marles, R, .C. Clavelle, L. Monteleone, N. Tays, and D. Burns. 2000.
Aboriginal Plant Use in Canada's Northwest Boreal Forest. Natural Resources Canada and Canadian Forest Services, UBC Press, Vancouver, BC.

McAllister, D.E. 1961.
The origin and status of the deepwater sculpin, *Myoxocephalus thompsonii*, a Nearctic glacial relict. National Museum of Canada Bulletin 172:44-65.

McCormick, K.J. and J. Sirois. 1988.
Larid breeding sites on the North Arm of Great Slave Lake, Northwest Territories: 1986. Canadian Wildlife Service Technical Report Series No. 30, Yellowknife.

McLoughlin, P. D. M., J. S. Dunford, and S. Boutin. 2005.
Relating predation mortality to broad-scale habitat selection. Journal of Animal Ecology. 2005. 74:701–707.

Mulders, R. 2000.
Wolverine Ecology, Distribution, and Productivity in the Slave Geological Province. Final Report to the West Kitikmeot/Slave Study Society. Department of Resources, Wildlife and Economic Development, Yellowknife, NT.

Murray, L., and J. D. Reist. 2003.
Status report on the shortjaw cisco (*Coregonus zenithicus*) in central and western Canada. Can. MS Rep. Fish. Aquat. Sci. 2638: vii + 56 p.

National Audubon Society (Audubon) 2002.
The Christmas Bird Count Historical Results [Online]. Available http://www.audubon.org/bird/cbc accessed February 2009.

National Audubon Society (Audubon) 2009.
Christmas Bird Count database. Website: http://www.audubon.org/bird/cbc/hr/index.html accessed February 2009.

Northwest Territories Cumulative Impact Monitoring Program (NWT CIMP). 2007.
A Preliminary State of Knowledge of Valued Components for the NWT Cumulative Impact Monitoring Program (NWT CIMP) and Audit - Final Draft. NWT CIMP and Audit Working Group.

Northwest Territories Protected Areas Strategy (NWT PAS). 2009.
Ecological Representation of the North Arm Study Area. Prepared by the NWT PAS Science Team, February 2009.

Oldham, M. J. 2007.
2006 Survey of Exotic Plants Along Northwest Territories Highways.

Parker, B.J. 1988.
Status of the deepwater sculpin, *Myoxocephalus thompsoni*, in Canada. Canadian Field-Naturalist 102(1):126-131.

Rawson, D.S. 1951.
Studies of the fish of Great Slave Lake. J. Fish. Res. Board Can. 8: 207-240.

Read, C.J. and W.E.F. Taptuna. 1997.
Data from the commercial fishery for lake whitefish, *Coregonus clupeaformis* (Mitchill), on Great Slave Lake, Northwest Territories, 1993/94 to 1995/96. Can. Data Rep. Fish. Aquat. Sci. 1019: v + 32p.

Rescan Environmental Services Ltd. 2000.
Snare river minimum flow assessment report. Prepared for; Northwest Territories Power Corporation, Yellowknife, Northwest Territories, 72 pp.

Richardson, E.S., Reist, J.D. and C.K. Minns. 2001.
Life history characteristics of freshwater fishes occurring in the Northwest Territories and Nunavut, with major Emphasis on Lake Habitat Requirements. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2569, 158 p.

Sheldon, T. unpubl. Data. *In* COSEWIC 2006.
COSEWIC assessment and update status report on the deepwater sculpin *Myoxocephalus thompsonii* (Western and Great Lakes-Western St. Lawrence populations) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 39 pp.
(www.sararegistry.gc.ca/status/status_e.cfm).

Sirois, J. and M.A. Fournier. 1993.
Clarification of the Status of the Black Tern (*Chlidonias niger*) in the Northwest Territories, Canada. Colonial Waterbirds 16(2): 208-212.

Sirois, J., and L. Seddon. 1990.
Status of Larid breeding sites between Frank Channel and Yellowknife Bay, and other observations of Larids in the North Arm of Great Slave Lake: 1988. Canadian Wildlife Service Technical Report Series No. 90. Western and Northern Region.

Sirois, J., Cameron, G.G., and K.J. McCormick. 1989.
Laird breeding sites between Yellowknife and Gros Cap, North Arm of Great Slave Lake, Northwest Territories, 1987. Canadian Wildlife Service Technical Report Series No. 69. Western and Northern Region.

Sirois, J., Fournier, M.A., and M.F. Kay. 1995.
The colonial waterbirds of Great Slave Lake, Northwest Territories: an annotated atlas. Canadian Wildlife Service Occasional Paper No. 89, Yellowknife. 59 pp.

Smith, Lisa (Pers Comm)
Inventory and Analysis Forester Forest Resources, Forest Management Division Department of Environment and Natural Resources Government of the NWT. February, 2009.

Soil Classification Working Group. 1998.
The Canadian system of soil classification. 3rd ed. Agriculture and Agri-Food Canada Publication 1646. NRC Research Press, Ottawa. 187pp

Statistics Canada. 2006.
2006 Census: 2006 Community Profiles. Online at: http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-591/index.cfm?Lang=E Accessed February 2009.

Sugden, D.E., and John, B.S. 1976.
Glaciers and Landscape, a Geomorphological Approach. Edward Arnold, London. 376 p.

System of Agents for Forest Observation Research with Automation Hierarchies (SAFORAH). 2009.
Website: http://www.saforah.org/ accessed February 2009.

Thomas, D.C., and D.R. Gray. 2002.
Update COSEWIC status report on the woodland caribou *Rangifer tarandus caribou* in Canada, *in* COSEWIC assessment and update status report on the Woodland Caribou *Rangifer tarandus caribou* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-98 pp.

Todd, T.N. 2003.
Update COSEWIC status report on the shortjaw cisco *Coregonus zenithicus* in Canada in COSEWIC assessment and update status report on the shortjaw cisco *Coregonus zenithicus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa 1-19 pp.

USGS Patuxent Wildlife Research Center. 2009.
North American Breeding Bird Survey Internet data set, 17 February 2009 (http://www.pwrc.usgs.gov/bbs/retrieval/).

Wayland, M., Hobson, K.A., and J. Sirois. 2000.
Environmental Contaminants in Colonial Waterbirds from Slave Lake, NWT: Spatial, temporal and food-chain considerations. Arctic 53(3): 221-233.

Wek'èezhíi Land and Water Board (WLWB). 2009.
Homepage: Background. Online at: http://www.wlwb.ca/background.html Accessed February, 2009.

Working Group on General Status of NWT Species. 2006.
NWT Species 2006-2010 - General Status Ranks of Wild Species in the Northwest Territories, Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT. III pp.

Appendix A

List of Plant Species within the Taiga Plain and Taiga Shield Ecozones

Appendix 2. Plant Species List

For the reader's convenience, the following plant species list is sorted by both scientific and common name. Vascular plant scientific and common names follow *NWT Species 2006-2010* (Working Group on General Status of NWT Species (2006)); scientific names are based on the Flora of North America[10]. Non-vascular plant names follow those given in *Alberta Plants and Fungi – Master Species List and Species Group Checklists* (Alberta Environmental Protection 1993).

Some unusual plants of the Taiga Plains Ecoregion are shown below.

The northern groundcone, *Boschniakia rossica*, has no chlorophyll and is a parasite of alders and willows. It is uncommon in the southern Taiga Plains, but frequently occurs under white spruce-alder-willow stands on the Mackenzie Delta. This specimen is about 10 cm tall.*Photo: R. Decker*

Insectivorous plants are found on wetlands throughout the Taiga Plains. The English sundew (*Drosera anglica*) catches insects on modified leaves with glue-tipped hairs (inset) that fold over and trap the victim; the leaf surface secretes digestive enzymes. Individual plants are only a few centimeters across. *Photo: D. Downing*

The northern pitcher plant, *Sarracenia purpurea*, is another insectivorous plant of wetlands. It has thick, leathery leaves (at the base of the flower stalk) that form a container holding water and digestive enzymes. Insects crawl onto the leaves searching for nectar, but cannot escape because of downward-facing hairs on the inner leaf surface (inset) and eventually drown in the pool of water below. The flowering stalks are about 30 cm high; the leaves are about 10cm long. *Photo: D. Downing*

Red glasswort (*Salicornia rubra*) is an uncommon plant with a fleshy stem and rudimentary leaves (inset) that grows on saline meadows of the Slave Lowland MB Ecoregion in the southeast Taiga Plains and occasionally on saline soils elsewhere. Individual plants are less than 10 cm tall and have a spreading growth form. *Photo: R. Decker*

[10] http://hua.huh.harvard.edu/FNA/. Information on vascular plant nomenclature sources provided by Suzanne Carrière, Government of the Northwest Territories, February 2007.

Alaska paper birch	**Betula neoalaskana** Michx**.**
Alnus viridis (Chaix.) DC.	green alder
alpine bilberry, bilberry	**Vaccinium uliginosum** L.
Aralia nudicaulis L.	wild sarsaparilla
Arctostaphylos rubra (Rehd. & Wils.) Fern)	red bearberry
Arctostaphylos uva-ursi (L.) Spreng.	common bearberry
awned sedge	**Carex atherodes** Spreng.
balsam poplar	**Populus balsamifera** L.
Betula glandulosa Michx.	dwarf birch, ground birch
Betula neoalaskana Michx.	Alaska paper birch
Betula papyrifera Marsh.	paper birch, white birch
black crowberry	**Empetrum nigrum** L. ssp. **hermaphroditum** (Lge.) Böcher.
black spruce	**Picea mariana** (Mill.) BSP.
Boschniakia rossica (Cham. & Schlecht.) Fedsch.	northern groundcone
bunchberry, dwarf dogwood	**Cornus canadensis** L.
Calamagrostis canadensis (Michx.) Beauv.	reed bent-grass, bluejoint
Carex atherodes Spreng.	awned sedge
Carex spp.	sedges
Cassiope tetragona (L.) D. Don	arctic white heather, mountain-heather
Chamaedaphne calyculata (L.) Moench	leatherleaf
Chamerion angustifolium (L.) Holub	fireweed
Cladina mitis (Sandst.) Hale & W. Culb.	reindeer lichen
Cladonia spp., **Cladina** spp**.**	lichens, reindeer lichens
cloudberry, baked-apple	**Rubus chamaemorus** L.
common bearberry	**Arctostaphylos uva-ursi** (L.) Spreng.
common Labrador tea	**Ledum groenlandicum** Oeder
common wild rose, woods rose	**Rosa woodsii** Lindl.
Cornus canadensis L.	bunchberry, dwarf dogwood
Cornus sericea L.	red osier dogwood
cotton-grass	**Eriophorum** spp.
Drepanocladus spp.	One of several mosses comprising wet moss peat
Drosera anglica Huds.	English sundew
Dryas integrifolia M.Vahl.	mountain avens (entire-leaved mountain avens)
dwarf birch, ground birch	**Betula glandulosa** Michx.
dwarf red raspberry, dewberry	**Rubus pubescens** Raf.
Empetrum nigrum L. ssp. **hermaphroditum** (Lge.) Böcher	black crowberry
Equisetum pratense Ehrh.	meadow horsetail
Equisetum spp.	horsetails
Eriophorum spp.	cotton-grass
fireweed	**Chamerion angustifolium** (L.) Holub.
fox-tail barley	**Hordeum jubatum** L**.**
green alder	**Alnus viridis** (Chaix.) DC.
Hordeum jubatum L.	fox-tail barley
horsetails	**Equisetum** spp.
jack pine	**Pinus banksiana** Lamb.
junipers	**Juniperus** spp.
larch (tamarack)	**Larix laricina** (Du Roi) Koch
Larix laricina (Du Roi) Koch	larch (tamarack)
leatherleaf	**Chamaedaphne calyculata** (L.) Moench
Ledum groenlandicum Oeder	common Labrador tea
Ledum palustre subsp. **decumbens** (Aiton) Hultén	northern Labrador tea, narrow-leaved Labrador tea
lichens, reindeer lichens	**Cladonia** spp., **Cladina** spp**.**
lodgepole pine	**Pinus contorta** Loud. var. **latifolia** Engelm.
lodgepole x jack pine	**Pinus contorta** x **banksiana**
low-bush cranberry, squashberry	**Viburnum edule** (Michx.) Raf.

meadow horsetail	**Equisetum pratense** Ehrh.
mountain avens (entire-leaved mountain avens)	**Dryas integrifolia** M.Vahl.
mountain cranberry, rock cranberry, bog cranberry	**Vaccinium vitis-idaea** L.
mountain-heather, arctic white heather	**Cassiope tetragona** (L.) D. Don
northern groundcone	**Boschniakia rossica** (Cham. & Schlecht.) Feddsch.
northern Labrador tea, narrow-leaved Labrador tea	**Ledum palustre** subsp. **decumbens** (Aiton) Hultén
paper birch, white birch	**Betula papyrifera** Marsh
peat mosses	**Sphagnum** spp, **Drepanocladus** spp, .
Picea glauca (Moench) Voss	white spruce
Picea mariana (Mill.) BSP.	black spruce
Pinus banksiana Lamb.	jack pine
Pinus contorta Loud. var. **latifolia** Engelm.	lodgepole pine
Pinus contorta x **banksiana**	lodgepole x jack pine
northern pitcher plant	**Sarracenia purpurea** L.
Plantago eriopoda Torr.	saline plantain
Populus balsamifera L.	balsam poplar
Populus tremuloides Michx.	trembling aspen
Dasiphora fruticosa (L.) Rydberg	shrubby cinquefoil
prickly rose	**Rosa acicularis** Lindl.
reed bent-grass, bluejoint	**Calamagrostis canadensis** (Michx.) Beauv.
red bearberry	**Arctostaphylos rubra** (Rehd. & Wils.) Fern)
red glasswort	**Salicornia rubra** A. Nels.
red osier dogwood	**Cornus sericea** L.
reindeer lichen	**Cladina mitis** (Sandst.) Hale & W. Culb.
Rosa acicularis Lindl.	prickly rose
Rosa spp.	wild and prickly rose
Rosa woodsii Lindl.	common wild rose, woods rose
Rubus chamaemorus L.	cloudberry, baked-apple
Rubus pubescens Raf.	dewberry, dwarf red raspberry
Salicornia rubra A. Nels.	red glasswort
saline plantain	**Plantago eriopoda** Torr.
Salix spp.	willows
Sarracenia purpurea L.	northern pitcher plant
sedges	**Carex** spp.
Shepherdia canadensis (L.) Nutt.	Canada buffaloberry, soapberry
shrubby cinquefoil	**Dasiphora fruticosa** (L.) Rydberg.
snowberry	**Symphoricarpos albus** (L.) Blake
soapberry, Canada buffaloberry	**Shepherdia canadensis** (L.) Nutt.
Sphagnum spp.	peat mosses
English sundew	**Drosera anglica** Huds.
Symphoricarpos albus (L.) Blake	snowberry
trembling aspen	**Populus tremuloides** Michx.
Vaccinium uliginosum L.	alpine bilberry, bilberry
Vaccinium vitis-idaea L.	rock cranberry, bog cranberry, mountain cranberry
Viburnum edule (Michx.) Raf.	squashberry, low-bush cranberry
white birch, paper birch	**Betula papyrifera** Marsh
white spruce	**Picea glauca** (Moench) Voss
wild and prickly rose	**Rosa** spp.
wild sarsaparilla	**Aralia nudicaulis** L.
willows	**Salix** spp.

Appendix 1. Plant Species List

For the reader's convenience, the following plant species list is sorted by both scientific and common name. Vascular plant scientific and common names follow *NWT Species 2006-2010* (Working Group on General Status of NWT Species (2006). Scientific names are based on the Flora of North America[36]. Non-vascular plant names follow those given in *Alberta Plants and Fungi – Master Species List and Species Group Checklists* (Alberta Environmental Protection 1993).

Alnus viridis (Chaix.) DC.	green alder
alpine bilberry, bilberry	**Vaccinium uliginosum** L.
Aralia nudicaulis L.	wild sarsaparilla
Arctostaphylos rubra (Rehd. & Wils.) Fern)	red bearberry
Arctostaphylos uva-ursi (L.) Spreng.	common bearberry
balsam poplar	**Populus balsamifera** L.
Betula glandulosa Michx.	dwarf birch, ground birch
Betula occidentalis. Hook.	Water birch
Betula papyrifera Marsh.	paper birch, white birch
black crowberry	**Empetrum nigrum** L. ssp. **hermaphroditum** (Lge.) Böcher.
black spruce	**Picea mariana** (Mill.) BSP.
bunchberry, dwarf dogwood	**Cornus canadensis** L.
Calamagrostis canadensis (Michx.) Beauv.	reed bent-grass, bluejoint
Carex atherodes Spreng.	awned sedge
Carex spp.	sedges
Cassiope tetragona (L.) D. Don	mountain-heather, Arctic white heather
Chamaedaphne calyculata (L.) Moench	leatherleaf
Chamerion angustifolium (L.) Holub	fireweed
Cladina mitis (Sandst.) Hale & W. Culb.	reindeer lichen
Cladonia spp., **Cladina** spp**.**	lichens, reindeer lichens
cloudberry, baked-apple	**Rubus chamaemorus** L.
common bearberry	**Arctostaphylos uva-ursi** (L.) Spreng.
common Labrador tea	**Ledum groenlandicum** Oeder
common wild rose, woods rose	**Rosa woodsii** Lindl.
Cornus canadensis L.	bunchberry, dwarf dogwood
Cornus sericea L.	red osier dogwood
cotton-grass	**Eriophorum** spp.
Drepanocladus spp.	One of several mosses comprising wet moss peat
Drosera anglica Huds.	English sundew
Dryas integrifolia M.Vahl.	mountain avens (entire-leaved mountain avens)
dwarf birch, ground birch	**Betula glandulosa** Michx.
dwarf red raspberry, dewberry	**Rubus pubescens** Raf.
Empetrum nigrum L. ssp. **hermaphroditum** (Lge.) Böcher	black crowberry
Equisetum pratense Ehrh.	meadow horsetail
Equisetum spp.	horsetails
Eriophorum spp.	cotton-grass
fireweed	**Chamerion angustifolium** (L.) Holub.
fox-tail barley	**Hordeum jubatum** L**.**
Galium boreale L.	northern bedstraw
green alder	**Alnus viridis** (Chaix.) DC.
Hordeum jubatum L.	fox-tail barley
horsetails	**Equisetum** spp.
jack pine	**Pinus banksiana** Lamb.
junipers	**Juniperus** spp.
larch (tamarack)	**Larix laricina** (Du Roi) Koch
Larix laricina (Du Roi) Koch	larch (tamarack)
leatherleaf	**Chamaedaphne calyculata** (L.) Moench

[36] http://hua.huh.harvard.edu/FNA/. Information on vascular plant nomenclature sources provided by Suzanne Carrière, Government of the Northwest Territories, February 2007.

Ledum groenlandicum Oeder	common Labrador tea
Ledum palustre subsp. **decumbens** (Aiton) Hultén	northern Labrador tea, narrow-leaved Labrador tea
Linnaea borealis L.	twinflower
lichens, reindeer lichens	**Cladonia** spp., **Cladina** spp.
low-bush cranberry, squashberry	**Viburnum edule** (Michx.) Raf.
meadow horsetail	**Equisetum pratense** Ehrh.
mountain avens (entire-leaved mountain avens)	**Dryas integrifolia** M.Vahl.
mountain cranberry, rock cranberry, bog cranberry	**Vaccinium vitis-idaea** L.
mountain-heather, Arctic white heather	**Cassiope tetragona** (L.) D. Don
northern bedstraw	**Galium boreale** L.
northern Labrador tea, narrow-leaved Labrador tea	**Ledum palustre** subsp. **decumbens** (Aiton) Hultén
Nuphar variegata Durand	variegated pond lily
paper birch, white birch	**Betula papyrifera** Marsh
peat mosses	**Sphagnum** spp, **Drepanocladus** spp,.
Picea glauca (Moench) Voss	white spruce
Picea mariana (Mill.) BSP.	black spruce
Pinus banksiana Lamb.	jack pine
northern pitcher plant	**Sarracenia purpurea** L.
Plantago eriopoda Torr.	saline plantain
Populus balsamifera L.	balsam poplar
Populus tremuloides Michx.	trembling aspen
Dasiphora fruticosa (L.) Rydberg	shrubby cinquefoil
prickly rose	**Rosa acicularis** Lindl.
reed bent-grass, bluejoint	**Calamagrostis canadensis** (Michx.) Beauv.
red bearberry	**Arctostaphylos rubra** (Rehd. & Wils.) Fern)
red glasswort	**Salicornia rubra** A. Nels.
red osier dogwood	**Cornus sericea** L.
reindeer lichen	**Cladina mitis** (Sandst.) Hale & W. Culb.
Rosa acicularis Lindl.	prickly rose
Rosa spp.	wild and prickly rose
Rosa woodsii Lindl.	common wild rose, woods rose
Rubus chamaemorus L.	cloudberry, baked-apple
Rubus pubescens Raf.	dewberry, dwarf red raspberry
Salicornia rubra A. Nels.	red glasswort
saline plantain	**Plantago eriopoda** Torr.
Salix spp.	willows
Sarracenia purpurea L.	northern pitcher plant
sedges	**Carex** spp.
Shepherdia canadensis (L.) Nutt.	Canada buffaloberry, soapberry
shrubby cinquefoil	**Dasiphora fruticosa** (L.) Rydberg.
snowberry	**Symphoricarpos albus** (L.) Blake
soapberry, Canada buffaloberry	**Shepherdia canadensis** (L.) Nutt.
Sphagnum spp.	peat mosses
English sundew	**Drosera anglica** Huds.
Symphoricarpos albus (L.) Blake	snowberry
trembling aspen	**Populus tremuloides** Michx.
twinflower	**Linnaea borealis** L.
Vaccinium uliginosum L.	alpine bilberry, bilberry
Vaccinium vitis-idaea L.	rock cranberry, bog cranberry, mountain cranberry
variegated pond lily	**Nuphar variegata** Durand
Viburnum edule (Michx.) Raf.	squashberry, low-bush cranberry
water birch	**Betula occidentalis** Hook.
white birch, paper birch	**Betula papyrifera** Marsh
white spruce	**Picea glauca** (Moench) Voss
wild and prickly rose	**Rosa** spp.
wild sarsaparilla	**Aralia nudicaulis** L.
willows	**Salix** spp.

Appendix B

Potential Wildlife Species in the North Arm Area of Interest

Appendix B

Potential Wildlife Species in the North Arm Area of Interest[a]

Common Name	Scientifc Name	NWT General Status
Terrestrial Mammals		
Arctic Shrew	*Sorex arcticus*	Secure
Barren Ground Caribou (Bathurst and Blue-nose East)	*Rangifer tarandus groenlandicus*	Secure
Barrenground Shrew	*Sorex ugyunak*	Undetermined
Beaver	*Castor canadensis*	Secure
Black Bear	*Ursus americanus*	Secure
Deer Mouse	*Peromyscus maniculatus*	Secure
Dusky Shrew	*Sorex monticolus*	Secure
Eastern Heather Vole	*Phenacomys ungava (P. intermedius)*	Secure
Ermine (Stoat)	*Mustela erminea*	Secure
Gray Wolf	*Canis lupus*	Secure
Grizzly Bear	*Ursus arctos*	Sensitive
Least Chipmunk	*Neotamias minimus*	Secure
Least Weasel	*Mustela nivalis*	Secure
Lynx	*Lynx canadensis*	Secure
Marten	*Martes americana*	Secure
Masked Shrew	*Sorex cinereus*	Secure
Meadow Jumping Mouse	*Zapus hudsonius*	Undetermined
Meadow Vole	*Microtus pennsylvanicus*	Secure
Mink	*Mustela vison*	Secure
Moose	*Alces alces*	Secure
Muskrat	*Ondatra zibethicus*	Secure
North American Porcupine	*Erethizon dorsatum*	Secure
Northern Bog Lemming	*Synaptomys borealis*	Secure
Northern Flying Squirrel	*Glaucomys sabrinus*	Secure
Northern Red-backed Vole	*Clethrionomys rutilus*	Secure
Northern River Otter	*Lontra canadensis (Lutra canadensis)*	Secure
Pigmy Shrew	*Sorex hoyi*	Secure
Red Fox	*Vulpes vulpes*	Secure

Common Name	Scientifc Name	NWT General Status
Red Squirrel	*Tamiasciurus hudsonicus*	Secure
Snowshoe Hare	*Lepus americanus*	Secure
Taiga Vole (Chestnut-cheeked vole)	*Microtus xanthognathus*	Secure
Wolverine	*Gulo gulo*	Sensitive
Wood Bison	*Bos bison athabascae*	At Risk
Woodland Caribou (Boreal)	*Rangifer tarandus caribou*	Sensitive
Amphibians		
Boreal Chorus Frog	*Pseudacris aculate (Pseudacris triseriata)*	Secure
Canadian Toad	*Bufo hemiophrys*	May Be At Risk
Northern Leopard Frog	*Rana pipiens*	Sensitive
Wood Frog	*Rana sylvatica*	Secure
Amphibians		
Reptiles		
Common Red-sided Gartner Snake	*Thamnophis sirtalis*	May Be At Risk
Terrestrial Gartner Snake	*Thamnophis elegans*	Presence Expected
Birds		
Alder Flycatcher	*Empidonax alnorum*	Secure
American Bittern	*Botaurus lentiginosus*	Sensitive
American Coot	*Fulica americana*	Secure
American Crow	*Corvus brachyrhynchos*	Secure
American Kestrel	*Falco sparverius*	Secure
American Robin	*Turdus migratorius*	Secure
American Tree Sparrow	*Spizella arborea*	Sensitive
American White Pelican	*Pelecanus erythrorhynchos*	May Be At Risk
American Wigeon	*Anas americana*	Secure
Arctic Tern	*Sterna paradisaea*	Secure
Bald Eagle	*Haliaeetus leucocephalus*	Secure
Barn Swallow	*Hirundo rustica*	Sensitive
Belted Kingfisher	*Ceryle alcyon*	Secure
Black Scoter	*Melanitta nigra*	Sensitive
Black Tern	*Chlidonias niger*	Sensitive

Common Name	Scientifc Name	NWT General Status
Black-and-white Warbler	*Mniotilta varia*	Secure
Black-backed Woodpecker	*Picoides arcticus*	Secure
Black-billed magpie	*Pica hudsonia (pica)*	Secure
Black-capped Chickadee	*Poecile atricapillus (atricapilla)*	Secure
Blackpoll Warbler	*Dendroica striata*	Sensitive
Blue-headed (formerly Solitary) Vireo	*Vireo solitarius*	Secure
Blue-winged Teal	*Anas discors*	Secure
Bohemian Waxwing	*Bombycilla garrulus*	Secure
Bonaparte's Gull	*Larus philadelphia*	Secure
Boreal Chickadee	*Poecile hudsonica (formerly Parus hudsonicus)*	Sensitive
Boreal Owl (Richardson's Owl)	*Aegolius funereus*	Secure
Bufflehead	*Bucephala albeola*	Secure
Cackling Goose	*Branta hutchinsii*	Secure
California Gull	*Larus californicus*	Secure
Canada Goose	*Branta canadensis*	Secure
Canvasback	*Aythya valisineria*	Secure
Caspian Tern	*Sterna caspia*	Sensitive
Chipping Sparrow	*Spizella passerina*	Secure
Clay-colored Sparrow	*Spizella pallida*	Undetermined
Cliff Swallow	*Petrochelidon (Hirundo) phyrrhonota*	Secure
Common Goldeneye	*Bucephala clangula*	Secure
Common Grackle (Bronzed grackle)	*Quiscalus quiscula*	Secure
Common Loon	*Gavia immer*	Secure
Common Merganser	*Mergus merganser*	Secure
Common Nighthawk	*Chordeiles minor*	Secure
Common Raven	*Corvus corax*	Secure
Common Redpoll	*Carduelis flammea*	Secure
Common Tern	*Sterna hirundo*	Secure
Common Yellowthroat	*Geothlypis trichas*	Secure
Dark-eyed Junco	*Junco hyemalis*	Secure
Downy Woodpecker	*Picoides pubescens*	Secure
Dunlin	*Calidris alpina*	Sensitive
Eastern Kingbird	*Tyrannus tyrannus*	Secure
Eastern Phoebe	*Sayornis phoebe*	Secure
Evening Grosbeak	*Coccothraustes vespertinus*	Secure

Common Name	Scientifc Name	NWT General Status
Fox Sparrow	*Passerella iliaca*	Secure
Glaucous Gull	*Larus hyperboreus*	Secure
Gray Jay	*Perisoreus canadensis*	Secure
Great Grey Owl	*Strix nebulosa*	Secure
Great Horned Owl	*Bubo virginianus*	Secure
Greater Scaup	*Aytha marila*	Secure
Green-winged Teal	*Anas crecca*	Secure
Gyrfalcon	*Falco rusticolus*	Secure
Hairy Woodpecker	*Picoides villosus*	Secure
Harlequin Duck	*Histrionicus histrionicus*	May Be At Risk
Hermit Thrush	*Catharus guttatus*	Secure
Herring Gull	*Larus argentatus*	Secure
Hoary Redpoll	*Carduelis hornemanni*	Undetermined
Horned Grebe	*Podiceps auritus*	Secure
House Sparrow (English Sparrow)	*Passer domesticus*	Exotic/Alien
Killdeer	*Charadrius vociferus*	Secure
Lapland Longspur	*Calcarius lapponicus*	Secure
Le Conte's Sparrow	*Ammodramus leconteii*	Secure
Least Flycatcher	*Empidonax minimus*	Secure
Least Sandpiper	*Calidris minutilla*	Sensitive
Lesser Scaup	*Aythya affinis*	Sensitive
Lesser Yellowlegs	*Tringa flavipes*	Sensitive
Lincoln's Sparrow	*Melospiza lincolnii*	Secure
Long-eared Owl	*Asio otus*	Undetermined
Long-tailed duck (Oldsquaw)	*Clangula hyemalis*	Sensitive
Magnolia Warbler	*Dendroica magnolia*	Secure
Mallard	*Anas platyrhynchos*	Secure
Merlin	*Falco columbarius*	Secure
Mew Gull (short-billed gull)	*Larus canus*	Secure
Northern Flicker	*Colaptes auratus*	Secure
Northern Goshawk	*Accipiter gentilis*	Secure
Northern Harrier	*Circus cyaneus*	Secure
Northern Hawk Owl	*Surnia ulula*	Secure
Northern Pintail	*Anas acuta*	Sensitive
Northern Shoveler	*Anas clypeata*	Secure
Northern Shrike	*Lanius excubitor*	Secure
Northern Waterthrush	*Seiurus noveboracensis*	Secure

Common Name	Scientifc Name	NWT General Status
Olive-sided Flycatcher	*Contopus cooperi (formerly C.borealis)*	Sensitive
Orange-crowned Warbler	*Vermivora celata*	Secure
Osprey	*Pandion haliaetus*	Secure
Pacific Loon	*Gavia pacifica*	Secure
Palm Warbler	*Dendroica palmarum*	Secure
Parasitic Jaeger	*Stercorarius parasiticus*	Undetermined
Peregrine Falcon	*Falco peregrinus*	Sensitive
Pileated Woodpecker	*Dryocous pileatus*	Secure
Pine Grosbeak	*Pinicola enucleator*	Secure
Pine Siskin	*Carduelis pinus*	Secure
Purple Finch	*Carpodacus purpureus*	Secure
Red Crossbill	*Loxia curvirostra*	Secure
Red-breasted Merganser	*Mergus serrator*	Secure
Red-eyed Vireo	*Vireo olivaceus*	Secure
Redhead	*Aytha americana*	Secure
Red-necked Grebe	*Podiceps grisegena*	Secure
Red-tailed Hawk	*Buteo jamaicensis*	Secure
Red-throated Loon	*Gavia stellata*	Secure
Red-winged Blackbird	*Agelaius phoeniceus*	Secure
Ring-billed gull	*Larus delawarensis*	Secure
Ring-necked Duck	*Aythya collaris*	Secure
Rough-legged Hawk	*Buteo lagopus*	Secure
Ruby-crowned Kinglet	*Regulus calendula*	Secure
Rusty Blackbird	*Euphagus carolinus*	May Be At Risk
Sandhill Crane	*Grus canadensis*	Secure
Savannah Sparrow	*Passerculus sandwichensis*	Secure
Semipalmated Plover	*Charadrius semipalmatus*	Secure
Sharp-shinned Hawk	*Accipiter striatus*	Secure
Sharp-tailed Grouse	*Tympanuchus phasianellus*	Secure
Short-eared Owl	*Asio flammeus*	Sensitive
Snow Bunting	*Plectrophenax nivalis*	Secure
Snowy Owl	*Bubo scandiacus (Nyctea scandiaca)*	Secure
Sora	*Porzana carolina*	Secure
Spotted Sandpiper	*Actitis macularius (Actitis macularia)*	Secure
Spruce Grouse	*Falcipennis canadensis*	Secure
Surf Scoter	*Melanitta perspicillata*	Sensitive
Swainson's Thrush	*Catharus ustulatus*	Secure

Common Name	Scientifc Name	NWT General Status
Swamp Sparrow	*Melospiza georgiana*	Secure
Tennessee Warbler	*Vermivora peregrina*	Secure
Tree Swallow	*Tachycineta bicolor*	Secure
Tundra Swan	*Cygnus columbianus*	Secure
Warbling Vireo	*Vireo gilvus*	Secure
Western Tanager	*Piranga ludovicana*	Secure
White-crowned Sparrow	*Zonotrichia leucophrys*	Secure
White-throated Sparrow	*Zonotrichia albicollis*	Sensitive
White-winged Crossbill	*Loxia leucoptera*	Secure
White-winged Scoter	*Melanitta fusca*	Sensitive
Willow Ptarmigan	*Lagopus lagopus*	Secure
Wilson's Phalarope	*Phalaropus tricolor*	Undetermined
Wilson's snipe	*Gallinago delicata (Galinago gallinago)*	Undetermined
Wilson's Warbler	*Wilsonia pusilla*	Secure
Yellow Rail	*Coturnicops noveboracensis*	May Be At Risk
Yellow Warbler	*Dendroica petechia*	Secure
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Secure
Yellow-rumped Warbler	*Dendroica coronata*	Secure

[a] *Species list is based on information available in Sirois et al. 1995; National Audubon Society 2002 Christmas Bird Count Data 1985-2008; Ecosystem Classification Group 2007; Ecosystem Classification Group 2008; GNWT 2009b; USGS Patuxent Wildlife Research Center 2009 – Breeding Bird Survey Routes 43007 (1988-1993, 1998-2008) and 43006 (1988-1993, 1999); and Latour et al. 2008.*

Appendix C

Potential Rare/Accidental Species in the North Arm Area of Interest

Appendix C

Potential Rare/Accidental Species in the North Arm Area of Interest[a]

Common Name	*Scientifc Name*	NWT General Status
Terrestrial Mammals		
Arctic Fox	*Vulpes lagopus (Alopex lagopus)*	Secure
Arctic Ground Squirrel	*Spermophilus parryii*	Secure
Cougar (Mountain Lion, Puma)	*Puma concolor (Felis concolor)*	Undetermined
Coyote	*Canis latrans*	Secure
North American Porcupine	*Erethizon dorsatum*	Secure
Striped Skunk	*Mephitis mephitis*	Undetermined
White-tailed Deer	*Odocoileus virginianus*	Secure
Birds		
Eared Grebe	*Podiceps nigricollis*	Vagrant/Accidental
Marbled Godwit	*Limosa fedoa*	Vagrant/Accidental
Mourning Dove	*Zenaida macroura*	Vagrant/Accidental
Northern Mockingbird	*Minus polyglottos*	Vagrant/Accidental
Short-billed Dowitcher	*Limnodromus griseus*	Undetermined
Upland Sandpiper	*Bartramia longicauda*	Undetermined
Willet	*Catoptrophorous semipalmatus*	Vagrant/Accidental

[a] *Species list is based on information available in Ecosystem Classification Group 2007; Ecosystem Classification Group 2008 and GNWT 2009b.*