1. Project Summary

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Project Title:
LOWER MACKENZIE RIVER WATERSHED PROJECT
(a Proposal to carry out LANDCOVER, WATERBIRD and WATER CHEMISTRY INVENTORIES)

1.3 This continuing project will provide resource managers within the GSA with a vegetation classification, waterbird information, baseline water chemistry and ground based research on scaup and black ducks (scoters) of a 32,000 km^2 area within the GSA. With the ever increasing discussions around pipelines as well as oil and gas development resources managers will need good baseline information to help make more informed decisions. Our aerial based vegetation description of the study area as well as follow up of three years of waterbird surveys on about 150 selected wetlands and water chemistry analysis for another 100 wetlands will help provide our partners with the sound information they need. The baseline research on continentally declining black ducks and scaup will also be an important first step in determining why those species are disappearing.

(Note: No financial information contained in this pdf file due to confidentiality agreements)

2. Background, Rationale, and Objectives

In recent years, increased activity by forestry, oil and gas, mining, hydro-electric, agriculture, recreational interests and climate change has greatly expanded the potential for impacts on the Western Boreal Forest (WBF) ecosystem. The consequences of these impacts on wetland systems remains largely unknown. Ducks Unlimited Canada (DUC) established its Western Boreal Forest Initiative (WBFI) in the summer of 1997 to help begin to address these obvious wetland system needs. Partnerships have been established

with Industry, Government Agencies, Universities, Aboriginal Peoples and others who share DUC's goal of conserving these important boreal wetland systems and sustaining their functions and values. Ducks Unlimited believes this goal is consistent with and complementary to Government and Industry's goal of a developed, yet sustainable forest ecosystem.

The Western Boreal Forest is second only to the Prairie Pothole Region in terms of continental waterfowl production and has been ranked number three in priority of the 26 most important, limiting and threatened waterfowl habitat areas in North America (Ducks Unlimited, 1994). A recent review of over 9 million technical and scientific papers pertaining to wetlands, waterbirds and their habitats in the circumpolar boreal zone revealed that significant regional information gaps exist (Foote, 1998). A large area of the western boreal region is surveyed annually by the U.S. and Canadian Wildlife Services (Ferguson, 1997), including extensive coverage of the Mackenzie River Valley. These surveys have shown that for reasons yet to be determined, populations of prominent boreal nesting species such as lesser scaup and scoters are declining. As a result, these species are currently the emphasis of research projects (Austin, 1998; Pers. Comm. Tom Rothe, Alaska Dept Fish and Game, Anchorage).

The Northwest Territories (NT) portion of the WBF is a great expanse of sub-arctic woodland, crossing four distinct ecozones. Unlike the intensive land-use and cyclical drought conditions found in more southern regions, this area remains relatively unscathed by human activity and provides critical breeding, moulting and staging habitat for significant numbers of the continent's waterbirds.

The recent reopening of the Western Arctic to oil and natural gas exploration has increased the potential for conflict between waterbird habitats and human activities. Many regions of the North, especially the Mackenzie River Valley, are experiencing expanding industrial developments and the talk of a Mackenzie Valley pipeline. Unlike 25 years ago, these developments are now being welcomed by governments and First Nations (Avery 2000). With the settlement of three of six land claims within the NT, Aboriginal and Inuit groups are in a better position and motivated to proactively control and manage development within their own settled areas. Estimates from the National Energy Board of one billion barrels of oil and nine trillion cubic feet of natural gas (Avery 2000) within the Mackenzie Delta and 235 million recoverable barrels of oil at Norman Wells (DIAND 1995) as well as funding formula's for pipeline development being discussed at senior industry, aboriginal and government levels, has raised expectations of large scale development in the near future.

If we are to pursue the conservation of important waterbird areas, as well as other important natural values, within the NT we need large-scale projects to help identify areas of value. This however identifies one of the greatest information gaps across the vast WBF, an accurate inventory of wetlands and riparian areas and their surrounding uplands. Existing landcover inventory and mapping information is unreliable, patchy, incomplete or at too gross a scale to allow for sound management decisions. Other key objectives of Ducks Unlimited's Western Boreal Forest Region include associated

waterbird surveys on different wetland types, establishment of water chemistry values and ecological research on waterbird species of concern. On the Taiga Plain of the Mackenzie River Valley we have the opportunity to acquire a more detailed understanding of some of the key migratory waterbird species habitat before significant development occurs. With the support of communities and others, important waterbird areas may be identified as significant enough to enter into the PAS. This proposal describes a landcover, waterbird and water chemistry inventory project based around Fort Good Hope on the Middle Mackenzie River Valley (Figure 1.). Typified by abundant shallow lakes, ponds and wetlands this area has long been recognized as important breeding habitat for waterbirds (Nettleship and Smith 1975). Results from this comprehensive and integrated project will provide partners and land use managers with accurate, Aboriginal and western science-based information necessary to make wise management decisions. The information gathered for this project will also add to already existing information from similar projects conducted by DUC and her many partners. These projects to date include the Peel Plateau and Lower Mackenzie River Projects to the northwest of this proposed project as well as the Sahtu Project located to the southeast. We feel with the completion of the Middle Mackenzie Valley Project that a large area intercepting critically important waterbird and mammal habitats, proposed pipeline route and other values can help local managers make more informed decision about land use in their respective regions.

3. Methods

I. EARTHCOVER INVENTORY and MAPPING (completed in 2001)

Project Workplan

The project workplan will provide a detailed description of the work to be performed on this project as well as a schedule of completion dates for the major tasks. This plan will also serve as a reference for Ducks Unlimited to complete the tasks in the agreed time frame. As part of the workplan, DU will organize and lead a meeting between interested parties to review all aspects of the proposed project..

Data Acquisition

Recent terrain-corrected, 5.7 million hectare, Landsat TM Scenes acquired during the summer will be purchased to produce the earth cover map. Any available aerial photography for selected areas within the project area will be chosen and acquired to aid in the classification and accuracy assessment. Digital Elevation Models (DEM's) and other ancillary information will also be acquired as necessary (pending availability) to further aid the classification.

Image Pre-processing

Upon receipt of the Landsat TM imagery, it will be checked for quality and proper registration and then archived for permanent storage. Next, Ducks Unlimited will devise a set of classification definitions, decision rules and schemes that are compatible with current standards for the area for use with satellite imagery, field data and other ancillary data. Field sites will be located using an unsupervised classification approach on the satellite data; aerial photographs will be used to supplement field site selection. Once

these sites are selected, they will be plotted over the imagery and their geographic centers calculated which will then be stored in the field GPS unit. A custom data entry form and digital database will be developed by Ducks Unlimited and placed on a laptop computer for inputting field site information while in the field. The digital database program includes a user-friendly interface to maximize efficiency and includes access to digital photographs of each site and the capability to generate statistics.

Field Verification

Field verification will be performed by two five-person crews. Each crew will consist of a pilot, biologist, recorder, navigator and an alternate. The navigator will run the GPS equipment and interpret the field maps. The biologist will possess extensive knowledge of the vegetation in the area. The recorder will verify the vegetation the biologist sees and record those types, percentages and other pertinent information about each field site. The alternate will also handle field logistics and data entry. Initial sampling will be performed by the crews on the ground to verify and standardize the classification and sampling methods. After an initial on-the-ground training session, the rest of the sites will be collected via helicopter to determine the percentage of each species and overall land cover class. Ground verification will be used as needed for sites where the vegetation is difficult to identify and/or species are uncertain.

Image Classification

After completing the field data collection, the field data will be quality checked for errors and entered into a digital database. The field site attributes will then be related to an Arc/Info coverage of the field sites. A subset of the field data will be set aside from the classification for accuracy assessment. A combined supervised/unsupervised technique will be used to classify the imagery into land cover categories.

Accuracy Assessment

If needed, additional accuracy sites will be photo-interpreted to supplement the sites collected in the field. The accuracy assessment sites will then be summarized with the classification to produce and error matrix. Standard accuracy assessment statistics will then be generated from the matrix for each cover type.

Change Detection

Historic Landsat TM pre-1990 images may be used to perform change detection analysis. A proven change detection technique, such as image differencing, will be used to extract areas of change from the imagery. The result will be a map of change areas indicated by a gain or loss of spectral reflectance. The areas of change will be identified using ancillary data such as aerial photography and existing base maps. Using both the historic Landsat TM images and the recent Landsat TM images, fire scars will be identified and mapped. This historic fire scar information will be invaluable in modeling succession and fire patterns for future planning. Other significant changes that may be detected include forest harvest, oil and gas activity, natural succession, and changes due to global warming (e.g.: melting permafrost).

Final Products

The final products will consist of a digital earth cover dataset of the 5.7 million hectare TM Landsat Scenes, hard copy maps, a detailed documentation of the analysis methods and products, metadata, an ArcView project of the products developed and a CD of the final products. Fieldwork will be carried out during summer 2003, with final products delivered by mid 2005 via a comprehensive debriefing workshop with all partners.

II. ASSOCIATED WATERBIRD INVENTORY (entering third and final year)

Complementing the inventory is the proposed evaluation of the use of selected wetland areas by waterfowl and other wetland-dependent waterbirds. This information will be combined with Traditional Environmental Knowledge (TEK) to provide a comprehensive understanding of waterbird and wetland resources in the region. Wetland habitats associated with many of the large lakes in the Middle Mackenzie River Watershed area are important migratory waterbird staging areas. The Hume-Ramparts complex has been identified by Ducks Unlimited as a world class habitat for many waterbirds, including Pacific loons, scaup and others (Kay, pers. comm.). The community of Fort Good Hope have long known the value of this area for waterbirds and other wildlife as it has traditionally been used to train younger hunters and trappers. As well, the numerous post-glacial ponds, fens, bogs, lakes and streams are breeding habitat for a wide variety of species (Ferguson, 1997). This component of the proposal will allow a broad scale analysis of the density and variability of waterbird use of wetland systems at this latitude. Wetland habitats used by COSEWIC listed or locally sensitive species (e.g. swans, cranes, loons, shorebirds) will also be specifically identified through this faunal inventory. This synoptic survey will provide an assessment of wetlands capability within the TM Scene area and an indication of the importance of the various wetland types/riparian areas to breeding and post-breeding waterbirds. An understanding of the variability and range of waterbird use at a variety of sites is complementary to site and landscape scale interpretation of the potential impacts of future resource extraction activities.

Specific intervals of interest include the breeding, brood rearing, molting, and spring and pre-migration staging periods. Identification of the value of various wetland/riparian area types and specific sites will be accomplished using four (4) rotary-wing aerial surveys during spring/summer (breeding and brood surveys) and two (2) fixed-wing aerial surveys in early spring/late summer and early fall (migration/molting/staging surveys).

NOTE: Methods, protocols and SOP's will be similar to surveys carried out on the Peace Athabasca Delta and Ft Nelson wetlands during 1998 and 1999, and endorsed by Parks Canada, CWS and Alberta Fish and Wildlife and the BC Ministry of Forests.

This component of the cooperative agreement will be initiated in 2004 using the supervised classification of the TM Scene for site selection. Waterbird surveys will employ a subset of wetland classes (approximately 300 different basins) across a size gradient. Historical inventory information and aerial photography will assist in site selection.

Species of interest, including all waterfowl, colonial waterbirds (e.g., gulls, terns) and other wetland-dependent avian species (e.g., loons, shorebirds) will be recorded as encountered. Other species of interest will be recorded on surveys of the sites including estimates of beaver use and activity as well as any other species accounts determined to be of interest to the project partners.

Information from a literature review currently underway by DU Canada will be integrated in the analysis of data collected during the habitat monitoring component. The waterbird-wetland database will be incorporated as point data and will be available for inclusion as a digital data layer with the landcover mapping and inventory product previously specified. A detailed technical report summarizing this monitoring effort will be produced in spring 2005, following completion of the first year of the 3-year waterbird survey program.

III. WATER CHEMISTRY SAMPLING (proposed to take place this year)

Accompanying the waterbird surveys, DU in association with Dr. Kevin Devito from the Dept. of Biological Sciences at the University of Alberta is proposing an initial water chemistry survey of a sub-sample of sites selected for the waterbird survey program. Analysis will include characterization of pH, conductivity, salinity, nutrients and dominant ion composition in surface waters across the region. This sampling regime will assist in defining the relative productivity of wetlands within the scene, help to develop the linkages between wetland type, productivity and waterbird use, and determine the range of variability in wetlands located on the scene under investigation. Collection and analysis of samples for isotope analysis will assist in determining the relative importance of ground water versus surface water inputs to these systems. This in turn will allow development of hypotheses on the effects of various land-use practices on wetland water quality and productivity. Collectively, interpretation of these data will provide an indication in determining of how surficial or landscape features (hydrology, relief, till deposits) are linked with regional geology, and how this may affect wetland productivity. If these interactions are occurring, the work should provide evidence at which scale these interactions occur (local versus intermediate or regional versus Ecozone or Western Boreal Forest-wide).

Samples will be taken using a helicopter equipped with fixed floats, and will occur coincidental (during the same week as) with the second brood survey to minimize additional costs associated with travel, meals and lodging. Two individuals from the University of Alberta will be on site to assist with sample collection and to facilitate sample preparation and analysis while on site. Partial sample processing will be undertaken as samples are collected (pH, conductivity, salinity, sample filtration) with the bulk of the analysis occurring at Dr. Devito's facilities at the University of Alberta. Sample volume required will vary from one to two litres at one location per wetland, depending on specific analyses to be undertaken. Sites will be selected from the universe defined by those waterbird sites sampled during the pair and brood periods, in consultation with project coordinators (Bruce MacDonald) and DU GIS Specialists (Al Richard). Sample analysis will include, but will not be limited to, for the following parameters: pH, conductivity, salinity, total and soluble reactive phosphorus, nitrate, total dissolved nitrogen, total nitrogen, chlorophyll *a,* alkalinity, silica, carbonate and

bicarbonate, dissolve organic carbon, dominant ions (e.g., Na, K, Ca, Mg), and oxygen and hydrogen isotopes.

Final products generated and made available in digital format to cooperating agencies will include proofed data files identifying site location (latitude/longitude and UTM) and results of the water chemistry analysis. These products will be cross-referenced to individual basins (using unique basin identifiers) for ease in linking bird use statistics with water chemistry data. Additional work beyond 2001 (e.g., evaluation of inter-annual variability, more precise estimation of within-wetland class variation) may be developed pending data analysis and discussion of the results obtained with the Project Coordinators, DU and the Principle Investigators.

IV. DEMOGRAPHIC RATES AND FACTORS LIMITING BREEDING DUCK POPULATIONS IN THE MACKENZIE VALLEY, WITH SPECIAL EMPHASIS ON SCOTERS (BLACK DUCKS) AND SCAUP (BLUEBILLS)

Populations of some waterfowl breeding in the Mackenzie Valley have been declining over the past 20 years, particularly those of scaup and scoters. The reasons for these declines are unknown. Wildlife managers need biological information on the breeding ecology of waterfowl nesting in the forest if we are to understand why these birds are disappearing and attempt to reverse these trends. However, this basic information is lacking for the Mackenzie Valley.

Our project is the first step towards identifying factors limiting waterfowl breeding in the forest and developing a management tool for those concerned about these birds. We propose to complete the following:

1. Determine the number of breeding, brood-rearing and staging birds per km^2 (i.e. population density)
2. Determine if older females have better nesting success (i.e. nest success rates for females by age class)
3. Determine how often females renest (i.e. renesting rates by age class)
4. Determine how likely different aged birds are to breed (i.e. breeding propensity for young (<2 yrs.) and adult females)
5. Determine how likely it is for a duckling to survive until it can fly and how many of those same birds return to breed (i.e. Duckling survival through fledging (or as close as possible) and rate of recruitment into the breeding population)
6. Determine how many females survive during breeding and throughout the year (i.e. adult female survival during the breeding season and annually)
7. Identify habitat characteristics important for successful nesting and raising young, like vegetation structure and food availability.
8. Begin developing a computer model to help managers determine why lesser scaup and white-wing scoter numbers are declining (i.e. incorporate these values into a population model and develop spatially explicit models to examine multiple stressors to this population). This model will also

incorporate other bird and wetland information being collected by DU and partners within the Gwich'in Settlement Area.

Co-management of waterfowl has been recognized in both the Migratory Bird Treaty Act and land claims settlements. We hope the information we collect will provide the Gwich'in and Inuvialuit with a valuable tool to help make future land use decisions that ensure birds for future generations to enjoy.

4. STUDY AREA

The Lower Mackenzie River Project encompasses a portion of the predominantly spruce forested Taiga Plain (Nettleship and Smith 1975) (Figure 1).

The Taiga Plain extends from northeastern British Columbia and northern Alberta into the southwesterly end of the Northwest Territories and is dominated by Canada's largest river, the Mackenzie. The climate consists of long cold winters followed by short cool summers with a mean annual temperature of –10°C (6.5°C summer mean and –26°C winter mean) and mean annual precipitation levels of 200mm. The Taiga Plain ecozone is characterized by open, slow growing, mainly, black spruce (*Picea mariana*) dominated forests. Shrubs include dwarf birch, willow and Labrador tea (*Ledum spp.*) with bearberry (*Arctostaphylos spp.*), mosses and sedges dominating the understory. Upland areas tend to support both white (*Picea glauca*) and black spruce, lodgepole pine (*Pinus contorta*), tamarack (*Larix laricina*), white birch (*Betula papyrifera*), trembling aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera*) (Ecological Stratification Working Group 1995).

Horizontal sedimentary rock (limestone, shale and sandstone) underlies the level to gently rolling plain. The landscape is underlain by permafrost combined with low slope angles resulting in large tracts of waterlogged land. Cryosolic, Gleysolic and Organic soils are typically found throughout the ecozone (Ecological Stratification Working Group 1995).

Faunal species include caribou (woodland and barren land), grizzly and black bears, wolves, moose, wood bison (*Bison bison*), marten (*Martes americana*) and arctic ground squirrels. Birds commonly found include red-throated loons, gray jays (*Perisoreus canadensis*), common raven (*Corvus corax*), northern shrike (*Lanius excubitor*), bald eagles (*Haliaeetus leucocephalis*), peregrine flacons (*Falco peregrinus*), osprey (*Pandion haliaetus*), sharp-tailed grouse (*Tympanuchus phasianellus*) and fox sparrow (*Passerella iliaca*). This ecozone also represents one of the most heavily utilized migratory corridors for waterfowl in North America (Ecological Stratification Working Group 1995, Ducks Unlimited).

Human activities are scattered throughout the lower Mackenzie River area and include subsistence harvesting (hunting, trapping and fishing) by Aboriginal communities. Mineral and hydrocarbon exploration occur within this region (Ecological Stratification Working Group 1995).

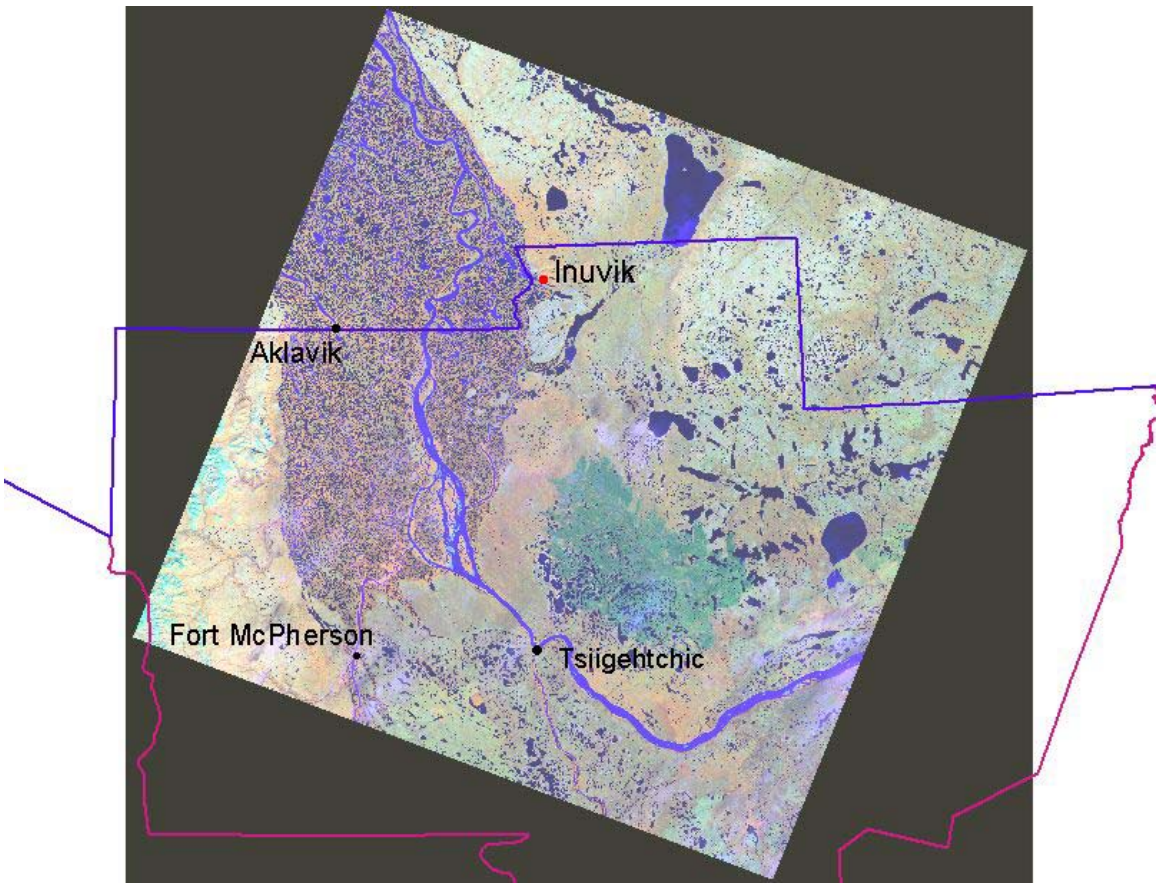

Figure 1: Lower Mackenzie River Project Area

5. Community Involvement

Communities have been involved with consultation and local monitors have been hired through the Gwich'in Tribal Council.

6. Time Schedule

Provide a detailed schedule (month/year) of the entire project from proposal to completion, even if the dates are outside the coming fiscal year (i.e., multiple-year projects). This schedule should include all aspects, including execution of the project itself, community consultation, and creation of products communicating results (reports, posters, etc.).

Vegetation Classification (completed)

Waterbird Surveys

There will be six (6) surveys during this year. Each surveys will take between 5-10 days, with each wetland being visited only once during each survey. The two breeding pair surveys will take place in June 2003, two brood surveys will take place in July and August 2003 and two staging surveys in August and September 2003.

Interim reports and posters are handed out by March 31st, 2004.

Water Chemistry

This portion will be completed in August of 2003. This work will involve about 5-10 days of sampling where the 100 wetlands will be visited only once.

Interim reports are handed out by March 31st, 2004.

Ground Based Research

	2002	2002	2003/4/5				
	Jan-May	Jun-Dec.	April	May	June	July	Aug-Dec
Peer review study of design/methods/analysis	*******						
Site logistics		******					
Acquire Equipment		******	*******				
Hire Crew			*******	******			
Field work				******	*******	******	
Data Analysis							*********
Assimilate data							*********
Final data analysis And sensitivity analysis							********* (2005)
Spatially explicit model development							******** (2004/05)

(Note: This pdf file does not contain financial information)