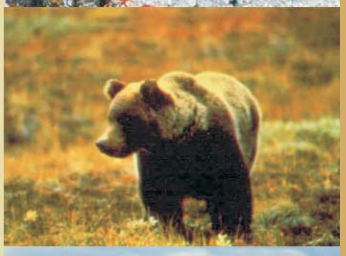
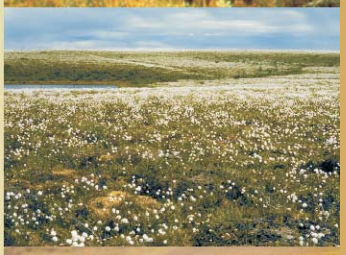
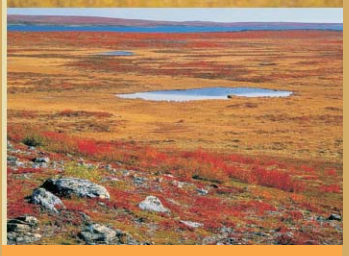
PLAIN LANGUAGE SUMMARY







WEST KITIKMEOT SLAVE STUDY STATE OF KNOWLEDGE REPORT - 2007 UPDATE

Prepared For:

West Kitikmeot Slave Study Society

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SENES Consultants Limited

December 2008

www.nwtwildlife.com/wkss/

Contents

1: Introduction

This is a Summary Report of a bigger report - the 'State of Knowledge Report of the West Kitikmeot and Slave Study (WKSS) Area 2007 Update'. The 2007 Update is the third State of Knowledge Report. The report's objective is to help readers develop a 'big picture' of the area and its people, and understand what and how changes take place.

The WKSS area extends across boreal forest and tundra, from Great Slave Lake to the Arctic Ocean. It includes the communities of Łutsel K'e, Yellowknife, Ndilo, Dettah, Behchokǫ̀, Whatì, Gamètì, Wekweètì, Kugluktuk, Cambridge Bay, Umingmaktok, and Bathurst Inlet. A map showing the area is on the next page.

This summary report gives very basic information about WKSS ecosystems – natural and human environments. It focuses on:

- Forms, causes, and effects of stress that affect the WKSS area.
- Tools to help achieve sustainable development.
- Information needs.
- Priority research areas.

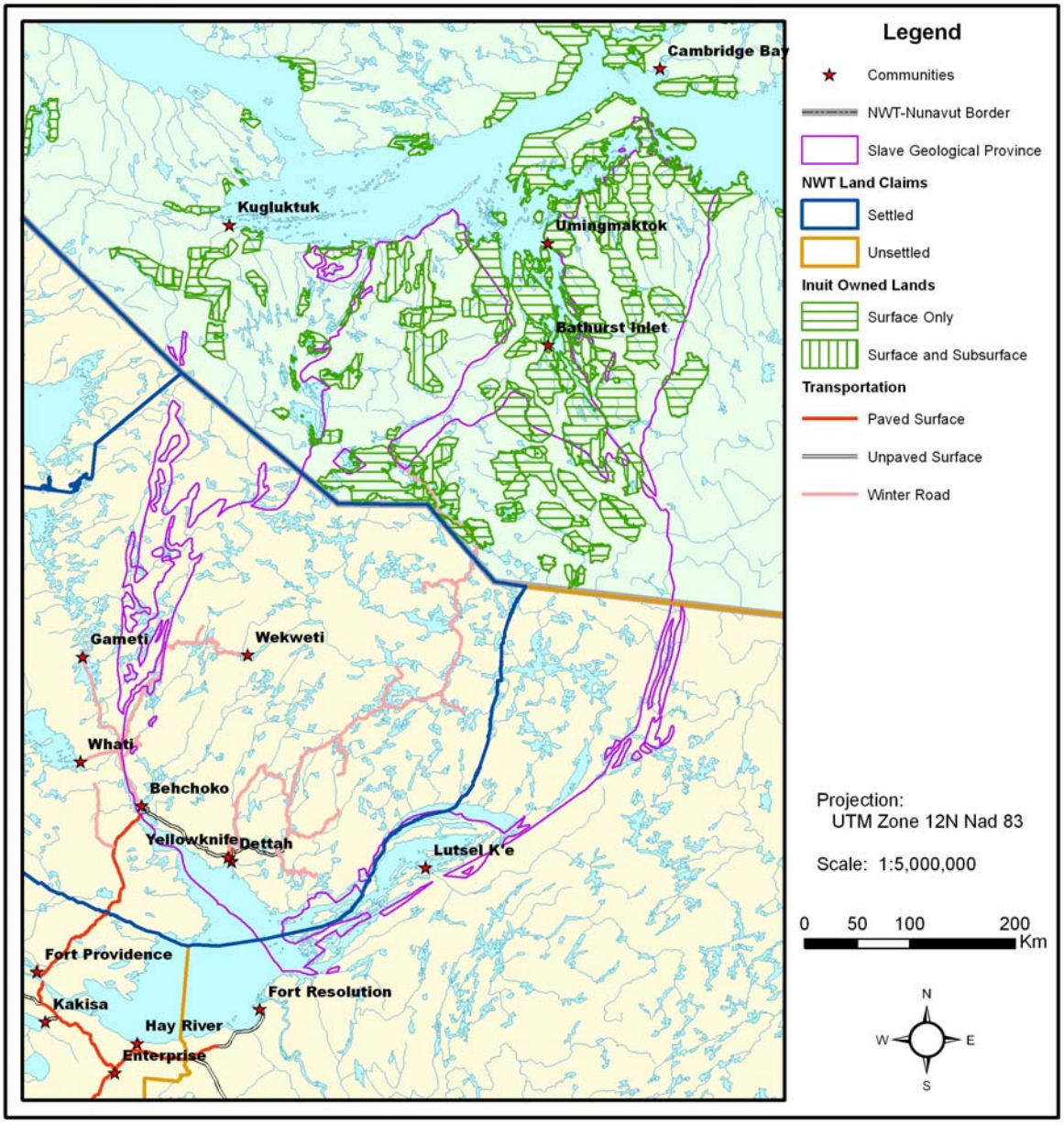
Background to the WKSS Society

The WKSS Society was set up to collect and provide information about sustainable development in the WKSS area. The WKSS Society formed in 1994 and the partners included:

- Tłı̨chǫ Treaty 11 Council.
- Łutsel K'e Dene First Nation.
- Inuit organizations.
- Nunavut co-management organizations.

- Environmental non-government organizations.
- The NWT and Nunavut Chamber of Mines.
- Governments of Canada, the NWT, and Nunavut.

Map of the West Kitikmeot Slave Study (WKSS) area



Source: NWT Digital Atlas [CD-ROM]. 2002. World Wildlife Fund (WWF) – adapted from

The Society finished their initial five-year research program in 2001. Since 2001 the WKSS Society funded more than 20 traditional knowledge and scientific research projects. Projects covered topics related to: habitat, community-based monitoring, water and water quality, caribou, moose, wolverine, grizzly bears, and wolves. You can find all the research reports on the website: www.nwtwildlife.com/wkss/.

Traditional knowledge and science

The WKSS Society gives equal value to science and traditional knowledge (TK) and asks that research projects link them where possible. Traditional knowledge and science both help people understand things, and why and how they happen.

The WKSS Society defines TK as "… knowledge that elders hold from experience and is passed down to them through the generations. It is continuous and grows. Interpretation of knowledge is important. Traditional knowledge is not just the past, but the future combined with the past."

Two recent trends in TK research are to:

- Use TK for policy decisions, environmental impact assessments, and monitoring.
- Focus on participatory research, where Aboriginal people and communities define and control the research and results.

Publicly available, documented TK about the WKSS area is only a small fraction of the knowledge within the oral traditions of Aboriginal people.

Science collects and measures specific information based on repeated experiments. It tries to show that ideas are false, and people accept the ideas when they can no longer prove them wrong. Science first studies things in more and more detail, and then brings together different pieces of information to construct a greater whole.

We have little or no science about many parts of the north and how various parts of the ecosystem link together.

Definitions and acronyms

Adaptation: To adapt means to adjust to new conditions. Plants or animals, including humans, change in ways that reflect their ability to survive and thrive in a changing environment.

Bioaccumulate: A process where the amount of contaminants in an animal builds up or increases. Animals store toxins in their fat and liver, and the toxins build up over time. Animals that eat other animals build up more toxins more quickly than animals that eat just plants.

Climate: Describes year-to-year conditions of wet / dry, warm / cold, sun / clouds, and wind / calm. Information about climate helps people know about large-scale change in the environment.

Community or biological community: All the populations of the different species living and interacting in an area.

Critical habitat: A place that an animal or plant species must have to maintain life and survive different seasons. Usually related to food, breeding and reproduction, migration, and / or shelter. Examples: Denning habitat for wolves, calving habitat for caribou, and spawning habitat for fish.

Cumulative effects: The combined effects of several forms of stress that happen over time, often in different places.

Distribution or range: The area over which we find a species.

Ecosystem: An ecosystem is all living things interacting with one another and their physical environment. Complex or diverse ecosystems have many

different plant and animal communities. Northern ecosystems are simpler and have a small number of plant and animal species. Ecosystems respond to change and evolve, and we can't always predict how they respond. Ecosystems like those in the WKSS area usually cope less well with change than more complex ecosystems.

Ecozone: An ecozone is an area within an ecosystem that has similar land features, vegetation, and climate. We subdivide each ecozone into ecoregions and ecodistricts to further define common characteristics.

Eskers and kames: Eskers and kames are ridges and hills made of sand, gravel and boulders formed by the action of glaciers. These are the most significant glacial features of the WKSS area. Many of them continue over several tens of kilometres.

Food web and food chains: The food web is the connections in an ecosystem between and among plants and animals for food. Plants are at the bottom of the food web. Predators like Polar Bears and wolves are at the top.

Each food web has many food chains. Northern ecosystems have short food chains. Examples: Lynx eat snowshoe hares, who eat plants. Wolves eat caribou, who eat lichen.

Geological province: A geological province is a part of the Earth's surface where the rocks formed at a particular time in geological history, starting over four billion years ago.

Greenhouse gases: Gases that absorb direct or reflected heat from the sun and cause the temperature on Earth to rise. Carbon dioxide is the most common greenhouse gas.

Ground ice: Ground ice is frozen soil moisture or old ice preserved in the ground from glaciers.

Habitat: Habitat is a place where the characteristics of the environment support special needs associated with particular animal activity. Plant and animal species each need a certain physical and chemical environment to survive. The number and distribution of plants and animals depends on what habitat an ecosystem offers.

IBAs – Impact Benefit Agreements: A project-specific, private agreement between an Aboriginal community and a resource company that provides local people with economic, financial, and other benefits.

Indicators: Characteristics of the ecosystem, including people, which get studied over time to learn about change. Example: To study change in community wellness we may consider these and other indicators:

- ✓ Aboriginal language use.
- ✓ Volunteerism.
- ✓ Family violence.
- ✓ Community-based programs.

Monitoring: A process to get information about change in the ecosystem: what things change, how and why do they change, how quickly? People often define and use a group of indicators to monitor change.

POPS – Persistent organic pollutants: Contaminants that last a long time in the environment. Two examples: PCBs and most pesticides.

Polynyas: Polynyas are areas of open ocean water surrounded by sea ice. Currents, tides, upwellings, and winds keep the water open.

Radionuclides: Radiation elements found in nature and also released through human activity.

Species: A group of the same kind of plants or animals.

Stress: A stress is something that causes change in the ecosystem. Stress can affect any part of an ecosystem, including people. Stress can come from nature or from human activity, from something local or from far away. Ecosystems can adapt to change. But if a stress is too strong or sudden some plants or animals may not be able to adapt and may die.

Sustainable development: Sustainable development is development that meets the needs of the present without decreasing the ability of future generations to meet their own needs.

Threshold: A point where the effects of one or more stresses lead to more permanent change. For example many young Aboriginal people don't speak their language and probably never will.

TK - Traditional knowledge: The WKSS Society defines TK as "… knowledge that elders hold from experience and is passed down to them through the generations. It is continuous and grows. Interpretation of knowledge is important. Traditional knowledge is not just the past, but the future combined with the past."

UV-B radiation: Ultra-violet-B radiation is one type of energy that comes from the sun.

VC – Valued Component: A part of the ecosystem that people consider important for economic, social, cultural, ecological, legal, political, or other reasons. VCs can be part of the natural environment, such as caribou herds or part of the human environment, such as Aboriginal language use.

Weather: Weather is the day-to-day conditions of wet / dry, warm / cold, sun / clouds, and wind / calm.

2: WKSS Ecosystems

Everything in the WKSS environment is connected - as in all places around the world. People, plants, animals, land, water, and air affect each other over long periods of time and sometimes from great distances.

Connections can be direct and simple, but more often they are complex. When Aboriginal people talk about 'the land' they are talking about these connections. We use the word ecosystem to describe all the living things and their environment, and the connections between plants, animals, people, and the physical world.

The WKSS area has marine, freshwater, and land ecosystems. These ecosystems share some general features of weather and climate, geology and landform, soil and permafrost, water, wildlife and plants, and people.

Weather and climate

- Most of the weather in the WKSS area comes from air flowing across the Arctic Ocean. Moving air picks up moisture and carries it south.
- Average summer temperatures range from 6°C at Cambridge Bay to 14°C at Yellowknife. Daily sunlight in July ranges from 24 hours north of the Arctic Circle to 20 hours at Yellowknife.
- The climate is generally dry. Total precipitation ranges from 141 millimetres per year at Cambridge Bay to 267 at Yellowknife.
- During winter the land and water are frozen and there is no rain and little snow, and little evaporation. Average winter temperatures range from -31°C at Cambridge Bay to -22°C at Yellowknife. Daily sunlight in December ranges from 0 hours north of the Arctic Circle to 6.5 hours at Yellowknife.

Geology and landform

- The WKSS area is part of the Canadian Shield - a large area of very old rocks. The rocks contain valuable minerals and other resources: gold, silver, base metals, rare earths, uranium, and diamonds. The WKSS area probably doesn't contain any oil and gas resources.
- Rocks and past glaciers affect the shape of the land and flow of water. The last glacier melted away about 8500 years ago.
- Most of the land in the WKSS is less than 600 metres above sea level. The land has large areas of bare rock or rock covered with only a thin layer of soil.
- The land has lots of features such as eskers and kames - ridges and hills made of sand, gravel, and boulders formed by glacial action. They are important habitat for many plants and animals.

Soil and permafrost

- Rocks, climate, and water flow affect soil development. The WKSS area generally has little soil and it develops very slowly - a few millimetres per century. Peat materials may build up more quickly. Available soil and nutrients affect plant distribution and growth.
- Permafrost is permanently frozen ground. The WKSS area has continuous permafrost north of a line that extends from Artillery Lake to the Dease Arm of Great Bear Lake and discontinuous permafrost in the rest of the area. There usually is no permafrost under large lakes and rivers. Permafrost depth varies from up to 90 metres at Yellowknife to about 540 metres at Contwoyto Lake.
- Soil moisture in permafrost exists in the form of ground ice. Soil with ground ice contains more moisture than the soil would hold if the ice thawed. Ground becomes unstable if permafrost thaws and ground ice melts.

- Soil develops in the active layer of permafrost where things thaw every summer. The thickness of the active layer ranges from 15 to 120 centimetres and generally decreases the further north you go.

Water

- Water covers much of the WKSS area: marshes and bogs, many lakes and rivers, and one large lake - Great Slave Lake. The headwater lakes of some rivers may not flow out every year; some only flow for a few days. This affects the water and nutrients available downstream.
- About 5% of the WKSS area is muskeg.
- The WKSS area has little rain and snow. Fifty to 60% of total annual rain and snow falls from June to October. Evaporation can be high from spring to late summer.
- Fifty to 75% of the rain and snow runs off the surface of the land. Water can't sink in because the ground is often frozen and there is a lot of bare rock. More water goes into the ground if there is soil or large cracks in the rock. Water in the ground helps plants grow.

Plants and animals

- WKSS area ecosystems have few nutrients. This limits plant growth at the bottom of the food web.
- Food webs are simple and food chains are short. There are few species.
- The growing season is short. Plants and animals grow slowly. They may reproduce less often or have fewer offspring than similar plants and animals in southern ecosystems.
- Many plant and animal species have made special adaptations to survive and thrive in this climate.

- Reproduction, feeding, and breeding depend on critical habitat. For many species this includes the space and time for migration between and among habitats.

People

WKSS communities have young, growing populations. The area is the new home for non-Aboriginal peoples from many parts of the world, and the traditional homeland of Aboriginal people. See the map on page 2.

- Qitirmiut who live in Kugluktuk, Cambridge Bay, Bathurst Inlet, and Umingmaktok in the West Kitikmeot region of Nunavut.
- Tłı̨chǫ Dene who live in Gamètì, Wekweètì, Whatì, and Behchokǫ̀ in the Treaty 11 or Tłı̨chǫ region of the NWT.
- Dene Sųłiné who live in Łutsel K'e and T'atsaoti'ine who live in N'dilo and Dettah in the Treaty 8 region of the NWT.

Inuit and Dene people lived a nomadic lifestyle until just a few decades ago. They travelled long distances; followed the seasonal cycle of the plants and animals they needed, and survived extreme seasonal change. Contact between Aboriginal and non-Aboriginal people caused a lot of rapid change. Most Aboriginal people now live in communities – they no longer live on the land for long periods or travel long distances in order to live. The land and subsistence harvesting still play a large role in Aboriginal peoples' lives, although the way they express these values may have changed.

Government and communities

Government is in a state of transition. Nunavut and the NWT each have territorial and municipal public governments. The federal government maintains control over some things. NWT Aboriginal groups are negotiating and implementing land claim and self-government agreements.

The WKSS area has 12 communities. Yellowknife is the largest and the capital of the NWT, and has a mixed Aboriginal and non-Aboriginal population of about 19,000. All other communities have an Aboriginal majority. Cambridge Bay, Kugluktuk, and Behchokǫ̀ are regional centres, each with 1000 to 2000 people. Gamètì, Wekweètì, Whatì, Dettah, Ndilo, Łutsel K'e, Umingmaktuk, and Bathurst Inlet are smaller, more traditional Aboriginal communities.

Social, economic, and cultural security

In simple terms social security means that people feel personally safe, in family and community. Economic security means people have access to and an adequate supply of food, clothing, and shelter. Cultural security means people can freely express their values and beliefs in social, economic, political, intellectual, and spiritual activities. Social, economic, and cultural securities are connected and interdependent.

For more than a century WKSS area Aboriginal people have experienced acculturation and efforts to alienate and remove people from the land – game legislation, harvesting regulations, treaties, community and settlement efforts, taking land and resources for mineral development, residential schools, missionary efforts, etc.

WKSS communities have high rates of suicide, crime, family violence, drug and alcohol addictions, and other high-risk behaviours. Individual, family, and community life is changing rapidly – people are less active, spend less time on the land, eat less country food, and participate more in the dominant, English, consumer society.

The WKSS area has a mixed economy that includes wage employment, land-based activities, and government payments. Government payments include subsidies and income support. The relative importance of each part of the mixed economy varies among WKSS communities. Income support is more important in smaller communities and it is harder to get than in the past. Increased wage employment hasn't reduced the need for income support. In a mixed economy

economic security means people have access to land and harvestable resources, and paid employment or other cash inputs.

Most people now desire wage employment over making a living from the land. Whether or not a person has a job, and the type of job they have, depends on their skills and education, what jobs are available, and personal choice. Aboriginal people participate less and get fewer benefits from wage employment than non-Aboriginal people. Many Aboriginal people lack literacy and education skills that people need to get a job. Research shows people want jobs, and the education and training that lead to jobs. Despite trends towards higher education, youth unemployment is high, mostly due to a lack of employment skills and poor self-esteem. In WKSS communities 78% of the adults that don't work and that want a job don't have grade 12.

Subsistence harvesting occurs throughout the WKSS area. Caribou is a major source of food for Aboriginal people. People hunt and trap seals, caribou, birds, wolves, Lynx, and other animals and fish. Commercial hunting and fishing activities include some Muskoxen and caribou, Arctic Char at Cambridge Bay, and fishing on Great Slave Lake.

Much research suggests that a healthy traditional economy restores a cultural connection among Aboriginal peoples. The land provides economic security, and social and cultural strength.

3: Forms, Causes, and Effects of Stress in the WKSS area

This section outlines the main forms of stress in the WKSS area, and some causes and effects. Stress is something that produces change in the ecosystem.

The main characteristics of stress include the following:

- An ecosystem usually has several forms of stress acting at the same time, causing multiple effects. It can be difficult, if not impossible, to separate the effects of one form of stress from another.
- Stress can come from the natural environment and from human activity, from local sources and from far away.
- Causes and effects can last a short or very long time, or be continuous.
- Stress can affect a small or large part of an ecosystem, or the whole planet. It can affect any part of the ecosystem, including people.
- Site conditions affect stress. For example the effects of a hydro development depend on the environmental setting, and the type and size of development.
- Cumulative effects happen when many stresses act together to cause change. The combined effects are usually greater than the sum of the effects of individual stresses. For example we can expect cumulative effects in an area that has many mines grouped together or where they combine with the effects of more global stresses such as climate change.
- The effects of stress depend on the ability of different parts of the ecosystem, including people, to successfully adapt to change.
- A threshold is the point where one or more stresses lead to more permanent change – the size, speed, number, and / or variety of change is too much at once. For example many young Aboriginal people don't speak their language and probably never will.

- Different people may judge the effects of stress as positive or negative, and not everyone agrees.
- Sustainable development seeks to keep the effects of stress within certain limits – to not alter or impair future generations' access to and use of renewable resources.

Forms of stress

Change in WKSS area ecosystems is usually related to one of more of the following forms of stress.

Nutrient stress

Nutrient stress is change in the quantity or quality of nutrients available for plants to grow, at the bottom of the food web. Too much or too little nutrients can cause nutrient stress. Land, freshwater, and saltwater ecosystems in the WKSS area naturally have few nutrients and any change can have a strong effect.

Causes of stress from too much nutrients include: domestic sewage or animal waste, wetland storage due to drainage changes, soil erosion, organic waste from mining and other human activity, or soil loss. Causes of stress from too little nutrients can include: less nutrient recycling because of a decrease in grazing animals such as Muskoxen.

Exploitation stress

Exploitation stress is a change in food web structures, when an ecosystem has fewer or no top predators. Causes of exploitation stress include:

- Better equipment and transportation make is easier to hunt and trap, to store and process food, and to move people and products.
- More roads, off-road travel, lodges, and camps mean increased access to fish and other wildlife resources.

- Wasteful practices such as leaving behind meat or other resources, or poor storage or processing facilities.
- Commercial interest or fashion that leads to periodic extreme demand. People want to buy furs or wild meats or fish.
- Subsistence harvesting. The effects of this harvesting, including trapping, are probably low.

Exotic stress

Exotic stress is a change in the food web when new animals, plants, or other living things move into an area - by chance or on purpose.

Two examples of causes of exotic stress: By chance a new species moves into the area as the climate and habitat change. On purpose people bring in a certain insect to fight against another, more harmful insect.

Toxic stress

Toxic stress is a change in the quality of food, water, and / or air because they contain persistent, toxic contaminants that bioaccumulate. Persistent contaminants don't break down in the environment; toxic contaminants are poisonous. Contaminants bioaccumulate as they build up in the liver and fat of animals, especially animals that eat other animals.

Causes of toxic stress include: persistent organic pollutants, heavy metals, and radionuclides. Many pollutants come to the WKSS area on global air currents, from more industrialized parts of the world. Local and regional sources of contaminants include mining operations, and municipal and military waste sites and spills.

Habitat stress

Habitat stress is change or loss of habitat on land or water, or the connections between different habitats in space or in time. When human activity disturbs habitat it may take a long time to recover.

Some causes of habitat stress include:

- Logging, roads, and other activities remove forest and destroy habitat.
- Increased vehicle access reduces many forms of preferred habitat.
- Forest fires destroy habitat.
- Development for municipal water supply or for hydro electricity can change water flow and level, which changes habitat.

UV radiation stress

UV radiation stress is a change / increase in the amount of ultraviolet light from the sun that reaches the earth's surface. The Earth's upper atmosphere contains the ozone layer that filters out UV radiation.

Causes of UV radiation stress: decrease in the ozone layer caused when manufacturing gases react with ozone and destroy it. Most of these gases travel on global air currents to the WKSS area from far away. Ozone depletion is greatest at high latitudes.

Climate stress

Climate stress is a change in temperature and / or rain and snow. Global greenhouse gas emissions cause climate stress and carbon dioxide is the main greenhouse gas. Emissions in the WKSS area are part of global emissions but they are small compared to industrial areas of similar size. In many parts of the world, including Canada, greenhouse gas emissions continue to rise.

Human stress

Human stress is a change in the relationships between and among people or between people and other parts of the ecosystem. Human stress may reflect participation and / or non-participation in various social, economic, and / or cultural activities.

Future industrial development in the WKSS area has potential to increase stress. Efforts to ensure Aboriginal people participate in and have access to benefits may reduce stress. Some studies link social and economic security for Aboriginal people to a healthy traditional economy and to land claim agreements. Land claim agreements can give people more local control and a land base, with more secure access to country foods.

We need accurate indicators to clearly understand the causes and effects of human stress. Effects of stress are dynamic and variable, perceptual and real, expected and unexpected. Some effects only occur after multiple changes, others result from a single event. Effects may be different at different times and affect people in different ways.

Potential indicators of wellbeing include things such as:

- Income and social status.
- Social supports and networks.
- Levels of education, physical health, and social wellbeing.
- Employment and work conditions.
- Physical environments including housing.
- Family relations and child development.
- Mental health and coping skills.
- Culture and language use.
- Gender equality.
- Local / community control.

Community wellness indicators suggest that not all 'solutions' fall totally within the powers of an affected community. Communities must themselves agree on the ways of life that are important to them. They must work together to achieve sustainable responses to unacceptable change / lack of wellness. Support to deal with complex, interrelated, and deep-rooted wellness issues must be holistic, consistent, and long-term.

Some causes of human stress include:

- Lack of opportunities and services that people need to make choices, participate in life, and reach their full potential economically, socially, mentally, spiritually, emotionally, and physically.
- Powerlessness and multi-generational trauma associated with racism, residential schools, and other forms of oppression.
- Learned dependence on agencies and relationships outside the extended family and community.
- Alienation from Aboriginal language and culture.

Some effects of stress include:

- Loss of identity, self-sufficiency, self-worth, and wellbeing.
- Breakdown of culture, family, and / or community. Lack of connection with cultural history and a set of values and beliefs.
- Poverty and a lack of ability to meet basic needs: food, housing, clothing.
- Lack of physical and mental health.
- High levels of risky behaviours such as youth crime, suicide, alcohol and drug addictions, sexual abuse, and family violence.
- Bigger gaps between people who have resources and those who don't. Rising rates of homelessness and marginalized people in large and small communities.
- Loss of language and TK, and less appreciation of the contribution these traditions make.

Effects of human activity and development

Many forms of development have potential to cause significant effects for plants, fish, birds, and mammals, including people. In the WKSS area the main causes of stress from human activity include:

- Global greenhouse gas emissions / climate change.
- Long range pollutants.
- Mining and mineral exploration.
- Communities and their infrastructure.
- Transportation.
- Hydro development.
- Tourism and recreation.
- Hunting, fishing, and trapping.

Other forms of development may cause stress in the future: pipeline corridors, ranching, and aquaculture. Agriculture and forestry probably cause little or no stress or have only very local effects.

Global greenhouse gas emissions / climate change

Global climate warming is not the same in all parts of the north. The WKSS area has modest warming, but less than the Mackenzie River valley and Yukon regions.

We expect climate change to have a profound effect on the WKSS region. Greenhouse gas emissions and air temperatures will continue to rise, as they have during recent decades. Changes are likely to be greatest at high latitudes and potential effects include all parts of the ecosystem:

- Changes in the flow of global air and ocean currents.
- Melting polar ice caps and rising sea level.

- More precipitation, more freezing rain, and changes in snow cover and runoff.
- Less permafrost and changes in distribution. Soils thaw and cause increased slope failure and ground settlement. Southern limit of discontinuous permafrost shifts north. In the continuous permafrost zone the thickness of the active layer increases and permafrost thickness gradually decreases.
- Increased erosion of freshwater and marine shorelines.
- Delayed freeze-up, earlier break-up, and changes to sea and freshwater ice – the quality, how long it lasts, how thick it is, and how far it spreads.
- More wave activity and more frequent extreme weather events such as storms, coastal surges, and drought.
- More variable climate. Many Aboriginal people find it harder to predict weather and ice conditions, and more difficult and dangerous for hunters and others to travel on the land.
- More evaporation and less soil moisture.
- More forest fire, more severe burning, more areas burned, and a longer fire season that starts earlier.
    - ✓ Major changes in species composition and distribution.
    - ✓ A short fire interval and unfavourable climate can rapidly change boreal forest to taiga.
    - ✓ Fire reduces carbon storage and peat accumulation, and increases potential of permafrost melt.
- Changes in types and distribution of plants and animals on land, freshwater, and marine environments. Plant responses are sensitive to water balance, difficult to predict, and lag climate warming.
- More mobile nutrients.
- More mobile organic and inorganic pollutants.
- Changes in the quality and availability of country foods.

- Damage to infrastructure, human health, and local livelihoods.
- Lower winter mortality and decreased heating needs.
- Increased potential for tourism and agriculture.
- Increased potential for the spread of infectious diseases and parasites in fish, wildlife, and people.

Long range pollutants

Long-range pollutants include UV-B radiation, persistent organic pollutants (POPs), mercury, and radionuclides. Global air currents carry long-range pollutants to the WKSS area and they enter the food chain. Long-range transport of pollutants is the main cause of toxic stress.

Increased UV-B radiation may cause a wide range of health related problems for plants and animals: skin cancer, sunburn, cataracts, immune system dysfunction, impaired growth, and less ability to reproduce. We anticipate more cataract and skin cancer in humans and other animals, and less efficient photosynthesis in all plants.

The atmosphere over northern Canada contains lower levels of POPs than the atmosphere over other circumpolar countries. These contaminants have potential to cause a wide range of defects, particularly during early stages of embryo development. Present levels are below thresholds that affect health. In the near future we expect that concentrations of most POPs won't increase much above present levels. This depends to a large extent on control and regulations in many developing countries.

Global loadings of mercury have increased over the past two centuries and during the early 1990s, and will probably rise to some extent over the next several decades. Slow growing animals high in the food web accumulate most mercury. Muscle and organ tissues generally have higher mercury content than skin and blubber. Present levels of mercury in WKSS area fish and wildlife are within consumption guidelines, although some marine country foods are close to

critical levels for unlimited consumption. We expect mercury contamination to be a concern for the foreseeable future, particularly in some freshwater and marine species.

Radioactivity levels in fish and land animals show that radioactivity in not a concern. Some mining activities produced local 'hot spots' and locally elevated levels are connected with uranium mining and processing.

Mining and mineral exploration

The WKSS area has experienced mining activity since 1921. Mining has been a major part of human activity for over 50 years. We expect current levels of mining in the WKSS area to maintain or increase.

Modern mining techniques are less disruptive than in the past but mining can cause many kinds of stress for decades or more: nutrient, toxic, habitat, and exploitation. Cumulative effects are possible over wide areas.

Mining exploration and staking disturbs the ground and vegetation, often over wide areas and for long periods of time. Mine development can involve a range of things such as heavy equipment, supplies and storage, ore processing, camps for workers, transportation and other infrastructure, organic and other kinds of waste, and decommissioning.

Ongoing and new development brings a mix of hope and fear for local people. Hope for real and lasting benefits, jobs for young people, increased income, new training and education, and business opportunities. Fear about adverse effects of development on the land, wildlife, water, and on the beliefs, values, and identity of Aboriginal people. These contradictions create stress. The speed of change makes it hard to predict how these stresses will play out.

Socio-economic monitoring reports show that diamond mine workers spent less time on the land, less time with elders, and less time teaching traditional skills to their children. Many Aboriginal mine workers work in entry-level or semi-

skilled positions. Many of these workers don't benefit from on-site training and/or career advancement opportunities due to low literacy and education levels. Turnover is high.

More mining activity increases potential land and resource conflicts, and poses challenges for economic security. Reduced harvesting activities affect the capacity of people to meet basic needs and potentially threaten individual identity, cultural expression, and physical and emotional health and wellness. Economic security directly affects social security and changes in diet, health, and overall wellbeing.

Communities and infrastructure

All communities in the WKSS area have increasing needs for housing, access roads, supplies and storage, power, water, waste treatment and disposal, and transportation facilities. The most common forms of stress connected with growing communities include: nutrient, toxic, and habitat stresses.

Inadequate housing contributes to the risk of transmitting infectious diseases, personal injury, interpersonal stresses, family violence, and access to the basic supports people need to function and thrive in modern society. Overcrowding is declining in some communities but it is clear that industrial activity has not had the positive impact on housing that people expected. We also see a rising incidence of homelessness in larger WKSS communities, particularly Yellowknife.

Transportation

Winter roads link many WKSS communities and mining sites. Other mine development may expand the winter road system and stimulate other transportation infrastructure such as a deepwater port near Kugluktuk or Bathurst Inlet. Air transport is an essential service and every community and mining camp has an airstrip. Government has proposed upgrades to improve operations and support larger aircraft. Floatplanes serve many communities, tourist lodges, and other facilities.

Transportation infrastructure directly changes habitat. Roads in particular make areas more accessible for recreation, trapping, hunting, and fishing. Other effects include noise, fuel and other spills, and increased potential for fire. Transportation infrastructure adds to habitat stress when it changes water levels or flow.

Hydro development

Right now the WKSS area has hydro development on the Taltson, Snare, and Yellowknife rivers. Proposed or potential development includes Indin Lake, and several rivers: Lac la Martre, Taltson, Back, Burnside, Coppermine, Lockhart, and Hood. Much of the proposed development is to support possible mine development. Hydro development is not viable for an individual mine but future development might take place if it could serve a group of mines together.

Hydro development usually involves diversion and barriers that change water flow and levels. Transmission corridors that carry power from generation sites to user sites create many of the same stresses as road transportation. Changes to land and water habitat can cause long-term effects – some more or less permanent.

Tourism and recreation

Recreation and tourism activities happen throughout the WKSS area. Tourism is the third largest industry and has grown rapidly, though only a small percent of visitors travel beyond Yellowknife. Wildlife viewing and wilderness travel are locally as important as tourist fishing or hunting. Road improvements aid tourism. Noise and disturbance add to habitat stress, and local exploitation of fish or wildlife may be a concern.

Subsistence hunting, fishing, trapping

Several studies state that subsistence harvesting is the cornerstone of the northern economy and the health of Aboriginal communities. Harvesting

activities provide basic economic security, shape social relationships and cultural expression, and individual identity and security.

Country foods are generally superior to store-bought foods and provide a significant source of vitamins, minerals, and protein. The extent to which each food source yields its maximum value depends on how fresh it is, how people prepare it, and what part they consume. Muscle tissue and organs are significantly different, depending on the species.

There is an ongoing debate about the relative benefits and risks of depending on country foods for a major part of a healthy diet. There is potential for positive and negative effects. Right now the contaminant levels in most sources of country food in the WKSS area are 100 to 1000 times less than levels considered critical for human health.

Changes resulting from a reliance on store-bought food and increased sedentary lifestyle have compounded problems of health and wellness in many Aboriginal communities. These changes increase the likelihood of obesity, diabetes, high blood pressure, and tooth decay.

4: Tools to Help Achieve Sustainable Development

This section outlines some tools that can help achieve sustainable development. WKSS Society partners' vision is to achieve sustainable development "… which respects Aboriginal cultural values, so that the land is protected, culture is preserved and community self sufficiency and, or, reliance is enhanced."

Tools can help ensure that people participate in decision-making about sustainable development. But lack of skills and training, low literacy and education, and health and wellness issues often limit how much people participate. WKSS communities need coordinated, community-based, holistic approaches to build human capacity.

Concept of stewardship

Stewardship means that people have an opportunity to use the environment in ways that support and please them, and that they transfer this opportunity from one generation to the next. People don't own the environment.

Today in the WKSS area human activity has the ability to greatly change the environment and we need to use a high degree of stewardship. Sustainable use of resources is not just a biological issue – it involves social, economic, legal, cultural, and many other factors.

Cumulative impacts

Cumulative impacts are environmental impacts from multiple activities that overlap in space and time. They are changes to the environment caused by the combination of past, present, and likely future activities. The WKSS area is coping with increased non-renewable resource development. Cumulative impacts assessment is a good tool to measure whether or not we should allow new development to occur, and if so under what conditions.

Environmental monitoring provides information to help measure cumulative effects. We need lots of good quality, accessible information, in a consistent format. People need skills and analytical tools to effectively interpret the information and to accurately identify the historic, current, and future potential impacts.

To accurately describe change and the effects of change we must choose indicators that match the level within the ecosystem where the effect occurs. For example: to measure effects in a community we need indicators suited to the community level within the ecosystem.

Many responses to stress are non-linear and we may not easily discover the effects until after some part of the ecosystem crosses a threshold and has a new state of being. It is important to recognize early warning signs for a range of thresholds. We can't reverse change, although we may establish something similar to a pre-existing condition. This applies to people as much as to other parts of the ecosystem.

Planning for sustainable development

Sustainable development seeks to create positive conditions that benefit people and limit the extent of environmental impacts. To achieve sustainable development we need a plan that responds to activities as they occur and directs development towards an objective.

The process that we use to develop a plan has a major influence on how much people are willing to support sustainable development. People need to help formulate the overall vision for sustainable development and to form objectives from that vision.

Everyone needs:

- Good and complete information they can understand and use.

- Expert support to help analyze more complex, technical information.
- Enough time for public discussion.
- Transparent decision-making.

The clearer the vision and the more people share it, the stronger it becomes. A plan for sustainable development should meet three essential and equal objectives:

- Economic: to produce goods and services.
- Social: to maintain and enhance quality of life, including culture.
- Ecological: to maintain and enhance environmental conditions.

Climate change and POPs agreements

Global climate change is likely the greatest environmental threat that the WKSS area faces. And we can only deal with greenhouse gas emissions at international levels.

Many developed countries committed to the 1997 Kyoto Agreement - to cut greenhouse gas emissions by 2012. Some countries (Canada) haven't fulfilled their commitments. Other countries (US) didn't commit in the first place. Many countries including Canada have rising greenhouse gas emissions.

The 2001 Whitehorse Declaration on Northern Climate Change focused on key northern issues. It shows the need for local, regional, and global actions among policy and decision-makers.

Northern information and lobbying can affect global action on climate change and POPs. Studies under the Northern Contaminants Program (NCP) provided information to support calls for action to control contaminants, POPs, and heavy metals. Since 1998 thirty-six countries, including Canada, have signed United Nations protocols for POPs and heavy metals. NCP projects provide quality

information to the Arctic Monitoring and Assessment Program (AMAP). AMAP monitors and assesses human sourced pollution in the circumpolar Arctic.

Environmental management

Environmental management and ways to improve community wellbeing evolve through different programs and processes. These include negotiating and implementing Aboriginal land claims and self-government agreements.

Responsible management only happens when people have good information and understand it well enough to make good decisions. All interested parties must get involved for effective management. In the WKSS area this includes Aboriginal and non-Aboriginal peoples.

CEAMF

The process to develop a NWT Cumulative Effects Assessment and Management Framework is ongoing (now called the Environmental Stewardship Framework). The purpose is to define a process to assess and manage cumulative effects. A regional plan of action for the Slave Geological Province was developed in 2002, and is being updated. More information about CEAMF can be found at www.ceamf.ca.

CIMP

Since 1999 the NWT Cumulative Impact Monitoring Program has funded 54 environmental monitoring and capacity building initiatives. For the past three years they produced an annual state of knowledge report for each valued component. More information about CEAMF can be found at www.nwtcimp.ca.

NGMP

Nunavut General Monitoring Plan doesn't yet exist. Indian and Northern Affairs Canada held a workshop in 1997 as a first step to set up a program. Since then

little progress has been made to create the NGMP. An NGMP Working Group was established in 2007. A workshop was held early in 2008 and a business case is under development.

Land use planning

Land use planning is a central tool to manage any public or private land. It sets out a future vision to protect, conserve, and develop land and resources. Land use plans connect responsible development and stewardship, and protect natural resources and the environment. They give information to the public, industry, and government about what areas can and can't be developed, and under what conditions and processes.

Nunavut and NWT legislation set out the need for land use planning. To date a draft West Kitikmeot Regional Land Use Plan is the only one for the WKSS area. Lack of land use plans for the area makes the regulatory processes more complex and uncertain.

Project oversight agencies

Three diamond mines each have their own agency that monitors company activities, and reviews environmental plans and reports. The agency does no primary research and doesn't monitor social or economic conditions.

The NWT has socio-economic agreements among the territorial government, Aboriginal governments, and three mining companies: BHP, Diavik, and DeBeers. The GNWT produces an annual report 'Diamonds and Communities' based on a variety of indicators of social, economic, and cultural wellbeing in affected NWT communities.

IBAs

An Impact and Benefit Agreement is a project-specific, private agreement between an Aboriginal community and a resource development company. IBAs can provide economic benefits (jobs and business), financial benefits (cash and

profit-sharing), and may help diversify the local economy. IBAs may not be the best way to build capacity and monitor and mitigate environmental, social, and cultural impacts and mine abandonment.

Other tools to secure Aboriginal participation include: tenure instruments such as surface leases, regional agreements, and cooperative multi-stakeholder initiatives.

Round tables

The NWT and Nunavut have no territorial round table. The National Round Table on Environment and Economy released a report in 2001 that included recommendations specific to the north - about cumulative effects assessment and management, sustainable Aboriginal communities, and capacity building in Aboriginal communities.

Partnerships

Partnerships can involve public and Aboriginal governments, voluntary groups, and individuals. Partners share authority, risk, responsibility, accountability, investment, and benefits. The WKSS Society is one example of a partnership.

Co-management bodies

Co-management bodies have responsibility and authority for specific resources. Here are a few Nunavut examples:

- Nunavut Planning Commission: responsible for land use planning and regulation.
- Nunavut Wildlife Management Board: responsible for wildlife policy and management. Some species such as caribou have their own management boards.
- Nunavut Impact Review Board (NIRB): responsible for environmental assessment and review of projects in Nunavut.
- Nunavut Water Board: responsible for water use.

- Surface Rights Tribunal: deals with entry and compensation to people that hold surface rights.

The Mackenzie Valley Resource Management Act sets up co-management boards in all NWT regions of the WKSS area. Within each settlement region co-management boards are responsible for land use planning, land and water management, and environmental assessment and review.

Environmental and cumulative effects assessment, review, and monitoring

Environmental assessment has moved from a regulatory process that DIAND led to a multi-stage process. In the first stage regional land and water boards screen each proposal.

If a proposed project meets certain criteria it goes to a territorial board: Mackenzie Valley Environmental Impact Review Board or Nunavut Impact Review Board. If a proposed project meets other criteria it may go to a full, territorial environmental review panel.

The Canadian Environmental Assessment Act and / or the National Energy Board get involved with projects that have broader impacts. For example, projects that cross territorial borders or energy projects.

5: Information Needs

We need much more information about many features of WKSS area ecosystems and about the causes and effects of different forms of stress. Most information needs fall into one of three general types:

- Baseline: covers topics with little or no current information.
- Bridging: builds links between existing sets of information.
- Trend: shows change over time.

All parties need to support different ways to share information. They need to use consistent forms of data to describe trends over time and changes in space. The CIMP and NGMP will contribute significant information once the NWT and Nunavut fully implement them. Certain tools can make it easier to search for and find information – tools such as meta-data and GIS systems that define the types of information available, the areas and topics, and when and where people can get the data.

Social and economic security

- Identify the effects of development and wage employment at the community level.
  - ✓ Impacts on individuals, families, community life, Aboriginal cultures, and the mixed economy.
  - ✓ Impacts on renewable resource harvesting – participation and practices, and the implications for sustainable communities.
  - ✓ Impacts on socio-economic security of traditional Aboriginal populations, including impacts on social cohesion and resiliency.
  - ✓ Update and re-evaluate effects of rotational work on individual, family, and community. Focus on family cohesion and harmony.

  - ✓ More clearly understand negative social behaviours such as gambling, prostitution, organized drug activities, and youth crime.
- Identify the effects of development and wage employment at a regional level. Development may affect segments of the population differently and changes in one community may affect another.
  - ✓ Identify socio-economic impacts of Aboriginal involvement in / authority over land and resource use.
  - ✓ Document and communicate the benefits and disbenefits of mining and other development activities.
  - ✓ Gather more information about things that most often help people cope with and positively adapt to change.
- Document and communicate TK in ways that reach new generations, enhance wellbeing, and help build community capacity and wise decision-making. TK research issues include: where to get funding, community control and ownership of information, and 'outsider' access to information.

Human health

- Monitor fish and marine mammals to make sure that intake levels of mercury and organic pollutants don't exceed health guidelines.
- Better understand the process of storing mercury in body organs of marine mammals.
- Pay attention to alcohol, smoking, and diabetes. How do they reflect social, economic, and cultural conditions? Monitor change that results from things such as public awareness campaigns.
- Gather good quality baseline information.
- Expand on the idea of the 'Diamonds and Communities' reports. Encourage other WKSS communities to monitor socio-economic effects of development and to communicate the results.

- Monitor contaminants from local sources:
  - ✓ Sewage discharge: nutrients, heavy metals, and microbes at sites that receive sewage from communities, camps, and lodges.
  - ✓ Mining activities: acid drainage, metals, radioactivity at waste rock sites and tailings and treatment ponds.
  - ✓ Dumps and disposal sites: metals and organic contaminants at municipal dumps and military disposal sites.
  - ✓ Slave River: metals and several organic contaminants that come from the Slave River and drain into the WKSS area.
- Gather trend data about long-range pollutants, to provide background and comparative information, and ensure that people can safely consume country foods.
  - ✓ Trend sampling: sample selected fish and marine mammal species and look for certain contaminants.
  - ✓ Snow sampling.

Climate change

- Gather data about the physical effects of climate change without significantly increasing the number of recording stations in the area.
  - ✓ Permafrost: Monitor trends and change in permafrost and vegetation at select sites. Remote sensing data can provide other information about uniformity and extent of change.
  - ✓ Water balance: Need better information about relationships between snow and rain, seepage, run-off, evaporation, and the potential contribution of permafrost melt to the water balance.
  - ✓ Proxy data: Record data every year about things such as temperature depth relationships in lakes and deep groundwater wells, ground

temperatures, ice thickness in freshwater and marine environments, freeze-up and break-up.

Wildlife

- Gather data about habitat change and range use:
  - ✓ Continue surveys and observations to better understand habitat fragmentation effects of human activities, including halo effects. We need this information to construct better models of environmental and cumulative impacts.
  - ✓ Identify indicators to show habitat change and range use. It may be easier to track habitat change from remote sensing information than to rely on locating individual species.
  - ✓ Identify changes in the freshwater food web, especially changes in fish stocks. Warming could reduce water levels and flow, cause fish to spawn earlier, increase the need for food, and favour some species but create less favourable habitat for others.
  - ✓ Identify impacts from dams, diversions, and water control especially for Aboriginal communities that depend on local resources for traditional food.
- Gather sample information and monitor the condition of birds, fish, and other wildlife in relation to nutrition and disease.
- Need more and better information about different caribou herds.
- Need better information about the role predators play to maintain the health of prey, the effects of climate change on predator / prey relations, and the effects of large-scale killing on wolves' behaviour.
- Need good information about how hunting, trapping, and fishing affect target species. Include impacts on certain parts of a population, based on things such as gender or age. Fisheries particularly need good information about stock size, condition, and catch.

Interactions between land, freshwater, and marine ecosystems

- Need to know more about things such as nutrient cycling, roles of microbes, and the limiting effects of temperature and moisture.
- Need to know more about taiga and tundra stream ecology: food webs, distribution, behaviour, and migratory and anadromous fish.
- Need to know more about marine environments around Victoria Island, Bathurst Inlet, Kugluktuk, and Cambridge Bay.

Cumulative impacts

Set up holistic systems to provide information about impacts of multiple mine developments.

- Need environmental information such as water and air quality, changes to habitat and range use, wildlife avoidance, increased natural resource use, and impacts from roads and other infrastructure.
- Need socio-economic information such as use and understanding of Aboriginal languages and cultural practices, changes in family relationships and structures, and changes in skills and knowledge.
- Use TK to help link global effects with more local and regional effects, and to integrate environmental and social change.

6: Priority Research Areas

Research priorities focus on the most critical topics and issues.

Climate change

- Monitor specific components of the WKSS area environment.
- Develop policies to manage effects as they occur - through education, communication, and resource protection.
- Set up programs to continually monitor populations of major species, using trapping and harvesting records or direct measurement.

Community wellness

- Do research to answer these questions:
  - ✓ What do we know about social, cultural, and economic indicators, thresholds, and limits of acceptable change?
  - ✓ What challenges / opportunities do we face to study social and cultural effects of development, and apply available information?
  - ✓ What are the cumulative effects on families and communities: social, cultural, and economic; positive and negative?
  - ✓ How does the two-week rotational work schedule affect families and communities?

Declining caribou herds

- Estimate herd conditions every year.
- Provide more support for research into better ways to assess herd condition and to expand the research program.

Wildlife

- Research the effects of new development on wildlife behaviour, movement, and condition: linear features such as roads and increased traffic.
- Continue to support monitoring and research programs for waterfowl and shorebirds: US Fish and Wildlife and Canadian Wildlife Service.
- Set up survey routes and start monitoring land birds and songbirds.

Cumulative effects assessment and management

- Develop and fully implement CIMP and NGMP.
    - ✓ Identify potential organizational models.
    - ✓ Set up valued component (VC) advisory groups.
    - ✓ Use sample VCs to help design and develop the program.
    - ✓ Identify possible ways to design and operate a cumulative impact information management system.
- Finalize and implement the West Kitikmeot Regional Land Use Plan.
- Develop a land use plan for the rest of the WKSS area.
- Do research on thresholds and limits of acceptable change to find out:
    - ✓ What is the current state of knowledge about resilience, carrying capacity, thresholds, and limits of acceptable change?
    - ✓ How can we apply this knowledge in the WKSS area?
    - ✓ How can we standardize and track water quality data to detect changes? When do changes become unacceptable? Do we know enough about 'end use' to decide this?