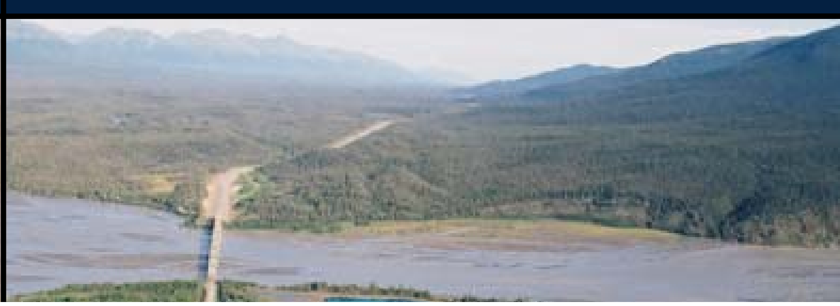
Options for Implementation of a Yukon Wildlife Thresholds Pilot Program: A Scoping Level Review

Prepared for:
Environment Directorate,
Northern Affairs Program DIAND,
Yukon, Whitehorse



AXYS Environmental Consulting Ltd

November 2002

CP1000

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Executive Summary

The basis of a pilot study to incorporate wildlife thresholds into Yukon land and resource use management is described. Thresholds are a tool to make project environmental assessment and land and resource management easier and more responsive to changing land use and ecological conditions. Thresholds in the Yukon are currently in use, although not yet widely so for terrestrial wildlife species.

Key attributes for such a program include selection of an appropriate management species of concern (referred to as a key wildlife indicator), identification of a study area, selection of appropriate thresholds, understanding data requirements and design of study evaluation.

The attributes of a Yukon specific pilot study are then described based on the attributes. This study examines land use effects on the Little Rancheria Caribou Herd in the Liard Basin, using thresholds based on habitat effectiveness. Numerical values of thresholds applied would come from another study, currently in progress.

The pilot program as discussed in *this* report is not one to *derive* thresholds, but to *test* the administrative application of actual thresholds in support of land management practices. Included in these practices are the implementation of practical mitigation measures to manage effects.

An operational workplan is suggested that can to move the pilot study forward by the following five steps: 1) establish scoping meetings, 2) review existing data, 3) finalize threshold parameters and levels, 4) develop performance evaluation protocols and adaptive management strategies, and 5) implement pilot program.

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Abbreviations

ALCES .... A Landscape Cumulative Effects Simulator
CEAA .... *Canadian Environmental Assessment Act*
CEMA .... Cumulative Effects Management Association
DFO .... Department of Fisheries and Oceans
DIAND .... Department of Indian Affairs and Northern Development
GIS .... Geographic Information System
HE .... Habitat Effectiveness
ILM .... Integrated Landscape Management
KWI .... Key Wildlife Indicators
RLUPC .... Regional Land Use Planning Commission
ROW .... Right-of-Way
TK .... Traditional Knowledge
YESAA .... *Yukon Environmental and Socio-economic Assessment Act*
YFA .... *Yukon Final Agreement*
YPA .... *Yukon Placer Authorization*
YTG .... Yukon Territorial Government

1 Introduction

1.1 Project background

1.1.1 Thresholds

The Yukon is a resource-rich region, and extractive resource activities such as mining, forestry, petroleum exploration and development, and recreational and subsistence harvesting have and will continue to place demands on the land base and its wildlife resources. Collectively, these multiple resource activities place cumulative pressures on wildlife, either through habitat loss or alteration, or through the direct removal of animals. Wildlife species have the reproductive capacity to accommodate some level of cumulative change to their natural habitat or mortality characteristics. However, cumulative pressures on habitat and populations can reach levels beyond which wildlife populations can be sustained at desirable levels, either from an ecological or societal perspective. These levels are typical referred to as thresholds.

Once meaningful thresholds are established, these thresholds can be integrated into land use planning and used to manage cumulative effects pressures on resources. The concept of thresholds is not a new one. For example, for many resources such as airsheds and surface waterbodies, standards of quality (e.g., SO_2 concentrations, Total Dissolved Solids [TDS]) have been developed for the protection of human and ecological health. Thresholds are also being considered by DIAND in their assessment of caribou impacts for the Kaska Forest Resources development proposal. However, for most wildlife resources, meaningful thresholds linked to population sustainability and viability have not been developed and, even more importantly, have not been integrated into land use planning.

1.1.2 Project history

In 2000, the DIAND Yukon Environmental Directorate retained AXYS Environmental Consulting Ltd. (AXYS) to review potential thresholds for managing cumulative effects on wildlife and their applicability to the Yukon situation. This work included the development of the report *Thresholds for Addressing Cumulative Effects on Terrestrial and Avian Wildlife in the Yukon* (AXYS 2001a) and delivery of a follow-up workshop in Whitehorse on options for practical threshold implementation, summarized in the report *Wildlife CEA Thresholds: Phase II Summary* (AXYS 2001b). DIAND also retained the services of Applied Ecosystem Management Ltd. (AEM) to review ecologically-relevant thresholds specifically for the management of woodland caribou (AEM 2002).

The present work *Options for Implementation of a Yukon Wildlife Thresholds Pilot Program: A Scoping Level Review* identifies key considerations for establishing a pilot program to implement and evaluate wildlife thresholds as a cumulative effects management tool. It identifies key attributes for such a program, recommends a potential study area and approach for the program, and develops an operational workplan that could be used to move the pilot study forward.

1.2 Purpose and objectives

The purpose of the report is to scope options and opportunities for DIAND to define and incorporate wildlife thresholds into land use management practices at a pilot study level. It is anticipated that the guidance and framework provided in this report could be used to identify other areas with cumulative land use pressures requiring immediate management attention.

The objectives of the report are to:

1. Define and identify suitable wildlife indicators (i.e., species of concern) and threshold measurements for use in the pilot study.
2. Define and identify an appropriate geographic area of study.
3. Identify data requirements, including spatial information (including environmental and land use such as present and future dispositions), sources and any monitoring needs.
4. Identify issues regarding implementation under current and proposed regulatory review and land management process and practices, including likely stakeholders for the candidate program.
5. Provide a high-level outline of a subsequent workplan that could be implemented by DIAND to initiate and undertake the pilot study.

1.3 Thresholds overview

Appendices A and B provide a synopsis (Executive Summaries) of the aforementioned work done by AXYS for DIAND (i.e., AXYS 2001a and AXYS 2001b). The reader is directed to AEM 2002 for further discussion specific to caribou thresholds.

1.4 Report overview

The remainder of this report's chapters are structured as follows:

- ***Chapter 2: Technical attributes***: Provides an overview of key ecological and geographic aspects of a thresholds program, generic to anywhere in the Yukon and for any wildlife indicator.
- ***Chapter 3: Administrative issues***: Provides an overview of key regulatory and land use management issues to be considered, generic to anywhere in the Yukon and for any wildlife indicator.
- ***Chapter 4: Program selection***: Provides a suggested technical focus for a pilot program.
- ***Chapter 5: Next Steps***: Provides an outline of a possible workplan for implementation of the pilot study.

2 Technical attributes

In developing a pilot program for assessing the feasibility of establishing, implementing and evaluating thresholds for the management of cumulative effects on wildlife, there are a number of study variables that must be considered and selected. These include:

1. key wildlife indicators for study
2. an appropriate geographic study area
3. thresholds for managing cumulative effects
4. accessing regional data
5. evaluation parameters for tracking the effectiveness of thresholds (e.g., population-based parameters, such as calf/cow ratios; winter range distributional patterns, etc.)

Suitable attributes for these are discussed in more detail below.

2.1 Key wildlife indicators

From a resource management and/or cumulative effects assessment perspective, key wildlife indicators (KWI) are species or species groups that are of management concern because of their vulnerability to cumulative land use pressures. They may or may not be hunted species, but generally respond negatively to human-related developments on the landscape, and the disturbance or mortality risk associated with such development. They are considered to be early indicators of adverse land use and/or ecological trends.

A large number of species or species groups potentially meet the above criteria, including several ungulate and carnivore species, furbearer species, interior forest bird species and amphibians. However, for the purposes of this pilot program, potential KWIs selected for study should possess the following characteristics:

- **Seasonal habitat requirements of KWIs should be reasonably well understood and relatively specific**. Without a reasonable understanding of the seasonal food and cover requirements of the KWI, it becomes difficult to select either land use or ecological thresholds for managing cumulative effects, as the limiting habitat factors for the KWI may not be known. Similarly, species that are habitat generalists have a greater ability to adapt their habitat use patterns under changing land use pressures than do species with more specific habitat requirements, and are less suited for establishing, implementing and evaluating thresholds for managing cumulative effects than habitat specialists.
- **KWIs should occupy defined, relatively well-understood seasonal ranges**. Highly migratory species that cover large geographic jurisdictions during the year (e.g., migratory passerines) are not particularly well suited for such a study, as their general population status and health may be affected by factors well outside the control of the pilot program. Therefore, while a KWI selected for study may occupy a variety of seasonal ranges, this species or species group should fall within a reasonably localized geographic area where ecological and land use conditions are more homogeneous and/or better understood.

- **KWIs should be sensitive to both human-related habitat change and the disturbance or mortality risk associated with such disturbance**. While many species respond negatively to forest clearing activities, some species show limited avoidance of unaltered habitat immediately adjacent to such clearings while others show reduced use of such areas. For example, while there is little indication that interior forest birds avoid habitats adjacent to the narrow corridors of clearing associated with seismic lines or smaller right-of-ways (RoWs), species such as caribou and grizzly bear will avoid such adjacent habitats, particularly where the corridors are being used by human or natural predators. Consequently, these latter species are a better early indicator of cumulative stresses because of their sensitivity to both physical habitat disturbances and zones of influence surrounding these disturbances (i.e., areas of reduced habitat effectiveness). In addition, managing the landscape for these species may afford adequate protection for those other species considered less sensitive to development.
- **Response to human-related developments and associated disturbances should be reasonably well understood**. To effectively develop thresholds for cumulative effects management that are meaningful from a biological perspective, there must be a reasonable understanding of the response of a KWI to human-related disturbance. For several larger landscape species (e.g., woodland caribou, grizzly bear), recent research has provided some idea of the response of such species to human developments (e.g., within avoidance zones adjacent to the disturbance), particularly with regards to roads and other linear disturbances.

2.2 Study area

An appropriate study area for establishing, implementing and evaluating thresholds for the management of cumulative effects on wildlife must provide a meaningful geographic region for the KWI in question, as well as a workable jurisdictional area for the establishment and enforcement of thresholds. The following should be considered when selecting a study area:

- **Consistent biophysical conditions.** A study area supporting widely varying biophysical conditions may reduce the land manager’s ability to effectively establish and evaluate thresholds. For example, wildlife species whose range extends over varying habitat conditions will almost certainly demonstrate different habitat preferences and use patterns over this range, and may respond differently to land disturbances in different terrain/habitat conditions (e.g., greater avoidance response in open alpine areas vs. wooded lowlands). Selecting a more homogeneous study area will improve ones ability to focus on the identification of key habitat components and the management of cumulative pressures on these components.
- **Consistent land use jurisdiction/objectives**. As thresholds selected for implementation will almost certainly involve land use controls, it is important to ensure the implementation of such controls can be consistently applied across the study area if necessary. If not, then the ability to evaluate the effectiveness of the thresholds becomes increasingly difficult.
- **Potential for existing high levels of land use activity**. There is little value in establishing a pilot program in areas that are likely well below threshold values for the maintenance of sustainable wildlife populations. A better candidate site would support multiple resource activities within designated important wildlife habitat,

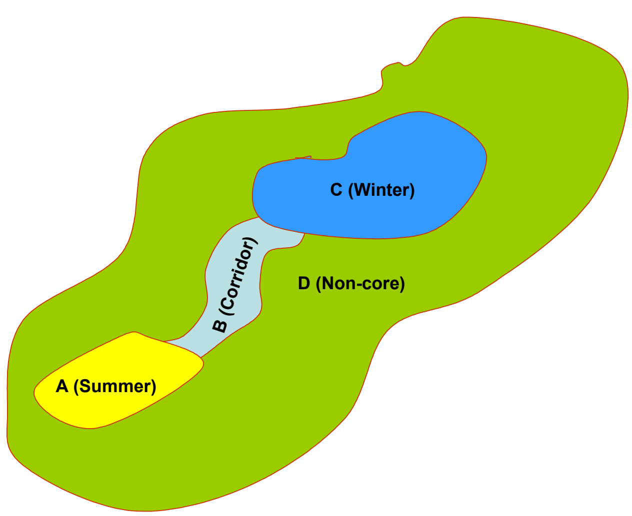
where cumulative pressures from both direct habitat alteration and indirect reductions in habitat effectiveness could adversely affect the KWI. While few areas of the Yukon have been subjected to the high levels of cumulative land use disturbance currently experienced by some other regions in Canada, there are several suitable candidate sites where multiple land uses are potentially affecting or could affect the abundance and distribution of KWIs.

- **Existing accessible biophysical and land use data base**. Any threshold selected to manage cumulative effects on a KWI will require the measurement and tracking of either an ecological or land use parameter or both. In addition, to evaluate the effectiveness of a threshold, one or more biological parameters will also have to be tracked to ensure that the response of the KWI to the threshold is understood. Therefore, the study area should have reasonable baseline data on the necessary parameters or should have the necessary information to generate a measure of baseline conditions.

- **Use of "nested" study area.** To meet the above conditions for a study area, it may not be possible to consider the entire year-round range of the KWI for the pilot study, and a particular seasonal range (e.g., winter range) may have to be the initial focus of attention. If this is the case, it will nevertheless be important to have at least a qualitative understanding of cumulative pressures on the KWI outside of the study area of focus. The identification of potentially confounding effects from cumulative land use pressures outside of the study area will allow for a better segregation and understanding of effects of management thresholds established for the "nested" study area within the year-round range.

  It may also be necessary to consider nested sub-zones within the study area of focus (see Figure 1). For example, within a winter range, a core winter range that supports the majority of activity and critical movement corridors to and from the core winter range may have to be acknowledged and managed independently. Within these sub-zones, data could be collected at a finer spatial resolution than the larger surrounding area, which would be mapped at a coarser scale. In this way data collection can be more efficient and optimize the use of available financial and technical resources by becoming more detailed for smaller areas of greater habitat value.

Figure 1: Example of nested study areas



2.3 Thresholds

With regards to wildlife, a threshold can be defined as a point at which a resource undergoes an unacceptable change or reaches an unacceptable level, either from an ecological or sustainability or social perspective. For the management of wildlife resources, a series of threshold levels may be developed to reflect the nature of management actions required to sustain the resource (e.g., occasional monitoring, focused habitat enhancement, aggressive habitat recovery). Appropriate thresholds for such a pilot program therefore should be:

- clearly linked to the ecological sustainability of the KWI in question
- easily measured to enable the state of the landbase or KWI to be evaluated at any time
- implementable and enforceable from a land use and resource management perspective
- easily modified to adapt to unacceptable trends or changing regional objectives for the KWI in question

2.4 Regional data requirements

As discussed, any threshold selected to manage cumulative effects on a KWI will require the measurement and tracking of either an ecological or land use parameter or both to determine the proximity of the KWI to the selected threshold. In addition, to evaluate the effectiveness of a threshold, one or more biological parameters will also have to be tracked to ensure that the response of the KWI to the threshold is understood.

Ideally, some form of ecological land classification and mapping for the study area should be available or easily generated as a basis for habitat evaluations, resource planning, and/or threshold establishment Such a classification and mapping system can be developed from air photos of the study area or from satellite interpretation, although the latter approach produces a coarse scale of resolution that may not be suitable for this program.

The ability to measure current land use conditions and disturbances across the landscape will also be necessary. Therefore, records on past and existing land tenure holdings (e.g.; borrow sites, logging cutblocks, exploration programs) will be required to assess the levels of cumulative pressures on the landscape. Future pressures can, at least partially, be predicted from ecological land classification and mapping done for the area. Because such a mapping system integrates surficial geology, soils, drainage and vegetation information, it also provides an ideal tool for assessing resource potential and likely future developments over the land base (e.g.; forestry potential, borrow potential, suitable terrain for road development).

2.5 Evaluation

Evaluation parameters are measures undertaken periodically to monitor and evaluate the effectiveness of thresholds established for the KWI in question. They are generally linked to population parameters or distributional patterns of that KWI. Such parameters should:

- provide an early warning of potentially adverse trends in the health/status of the KWI within the study area
- be measurable to reasonably precise levels to ensure that meaningful changes in the health/status of the KWI can be detected
- indicate their potential variability from natural causes to distinguish natural background "noise" from human-related cumulative effects

2.5.1 Ecological monitoring

As discussed above, one or more biological parameters will have to be tracked as part of the pilot program to ensure that the response of the KWI to the threshold is understood and appropriate for local objectives. These parameters should likely be linked to habitat use patterns of the species, reproductive performance, abundance (or some combination of the three) and should be developed in conjunction with YTG Renewable Resource biologists already working in the area. To support the measurement of such parameters, collared animals and a regular tracking routine will likely be required.

2.5.2 Land use monitoring

As discussed above, land uses need to be recorded in a regional database and tracked. Information can be provided from land use referrals and applications for dispositions, such as from the DIAND and YTG permitting processes. Use of a Geographic Information System (GIS) provides the capability to analyze various land use attributes of interest in establishing thresholds, such as access densities (for different classifications of motorized vehicular access) and area cleared from developments.

3 Administrative issues

3.1 The challenge

Implementation of a thresholds pilot program assumes the eventual capability of the land use administrator to integrate such thresholds into their decision making process. This capability must be supported by defensible scientifically based information and by the legal authority of the administrator under their guiding provisions, for project applications, to reject, conditionally accept or fully accept applications in consideration of thresholds. Thresholds must be consistently applied to all land users and should not require onerous new information requirements from applicants except possibly in certain cases (depending on the nature of the project and environmental setting). Land use management incorporating thresholds therefore places considerable onus on government to support, coordinate and implement.

In the absence of regulated thresholds (unlike for some air and water based constituents in Canada), use of thresholds for terrestrial wildlife imposes a unique and as yet unprecedented decision making authority on the land manager. Thresholds by definition imply the acceptance of limits that may be eventually reached on land use, the testing of each application against such thresholds, and the likelihood of eventual rejection of applications until conditions become acceptable. Rejection of applications on the basis of admittedly imprecise information, as is typically the case in interpretation of ecological data, suggests a considerable degree of risk regarding legal challenge to the use of thresholds in cases of rejection of applications. It is questionable if the robustness of thresholds so applied, however scientifically produced, will survive such challenges unless they clearly can be implemented given the breadth and flexibility of authority afforded to the regulator. As such authority often comes with a degree of discretion, uncertainties associated with threshold derivation will undoubtedly be viewed by both the administrator and applicant as opportunities to argue for both the admission or rejection respectively of the thresholds themselves.

To facilitate the acceptance of thresholds and reduce the risk of legal and jurisdictional challenges, the pilot study should incorporate the following principles:

- **Public and Stakeholder Education**. The potential effects of unacceptable cumulative land use pressures on resource sustainability must be clearly identified to stakeholders in the study area and the public in general, using case studies where possible to demonstrate and justify the need for land use controls.
- **Process Transparency**. While the development and implementation of thresholds must be scientifically defensible, their development must also consider societal and land use priorities for the area in question. Therefore, this process must be open to stakeholder and public review and input to gain any level of acceptance. It is recommended that a series of workshops with invited stakeholder participants (i.e., government, First Nations, public and industry) be scheduled at strategic periods throughout the pilot program to discuss threshold development, evaluation feedback, and adaptive management decisions.
- **Adaptive Management and Responsiveness**. The program must incorporate an aggressive feedback mechanism that allows for the evaluation and review of thresholds on a regular basis. Thresholds that do not appear to be meeting the

objectives for the KWI must be identified and modified in a timely fashion to reduce the risk to the KWI. However, to demonstrate a balanced approach to resource planning, it is also important to identify thresholds that appear to be too precautionary, and which possibly can be reduced in stringency.

3.2 Opportunities

3.2.1 Incorporation into decision making processes

Project-specific review, as conducted under the provisions of the *Canadian Environmental Assessment Act* (CEAA) or the pending *Yukon Environmental and Socio-economic Assessment Act* (YESAA) do not explicitly refer to ecological, social or land use thresholds, although their use is implied through the responsibility of either the applicant or the government authority to evaluate the significance of likely residual effects from proposed projects.

Furthermore, land use planning under the provisions of the *Yukon Final Agreement* (YFA) and YESAA through the proposed Regional Land Use Planning Commissions (RLUPC) also suggests opportunities to invoke thresholds as a decision-making tool. Attributes typical of regional land use plans enabled under governing Acts, especially zoned areas of specific allowable uses and level of use, offer an ideal mechanism by which to implement and enforce thresholds.

As previously discussed. the use of thresholds for managing cumulative effects is not a new concept in the Yukon. For example, under the federal *Fisheries Act*, the policy of “no net loss” of productive capacity in fish-bearing waterbodies is a form of biological threshold applied to activities with the potential to alter, disrupt or destroy fish habitat. Similarly, the *Yukon Placer Authorization* (YPA) process uses water quality thresholds to manage cumulative activities on fish-bearing streams. Thresholds are also being considered by DIAND in their assessment of caribou impacts for the Kaska Forest Resources development proposal.

The proposed pilot study will represent an extension to the types of thresholds currently being used in the Yukon. Under the pilot study, thresholds will generally take the form of acceptable levels of cumulative surface disturbance and access potential within the study area. The thresholds will have to consider the following:

- The relationship between cumulative land use disturbance and objectives for the KWI in question
- The effects of past and present, as well as future land use disturbance on the KWI in question
- The capability of the land base to assimilate disturbance (i.e., rate of recovery through natural or enhanced reclamation)

3.2.2 Effects management

When a new project is being proposed within the study area, the ability to accommodate the project without jeopardizing the objectives for the KWI would have to be evaluated. Projects that push the cumulative level of disturbance towards the established threshold would not necessarily be rejected. However, they may be required to implement additional mitigation measures to reduce their contribution to regional cumulative effects. These measures may include initiatives done cooperatively with other operators, such as sharing infrastructure (i.e., roads) with existing operations to reduce their incremental contribution to cumulative disturbance (this effects management technique is referred to as Integrated Landscape Management — ILM). They may also be required to contribute towards recovery initiatives such as off-site reclamation and enhancement of habitat to ensure that their effects can be accommodated with the regional objectives for the KWI. This is not unlike the habitat compensation requirements under the “no net loss” policy of the Department of Fisheries and Oceans (DFO).

4 Program selection

4.1 Key wildlife indicators

For the purposes of establishing a pilot program on thresholds, both woodland (mountain) caribou and grizzly bear are favourable candidates for use as KWIs. The habitat and seasonal requirements of both species are reasonably well understood, both are of management concern because of low reproductive capacity, and both are vulnerable to habitat alteration and indirect losses of habitat effectiveness (HE). In addition, research in recent years has begun to identify the response characteristics of these species to human-related disturbance in terms of habitat avoidance and potential mortality risk, facilitating the development of meaningful albeit tentative thresholds for cumulative effects management.

4.2 Study area

Two regions in the Yukon offer potential candidate sites for a pilot study: Liard Basin and Eagle Plains.

4.2.1 Liard Basin

The Liard Basin region, specifically the lower drainage of the Little Rancheria River, is currently under considerable cumulative development pressure. It is intersected by the Alaska Highway and by the alignment of the proposed Alaska Highway Gas Pipeline. It also supports timber harvesting activities primarily along the major drainages of the area, as well as borrow operations associated with highway maintenance. Gas exploration activities may increase in the region with the development of a major gas transmission line.

This region supports the core wintering area of the Little Rancheria caribou herd. During the winter, the animals are largely dependent on terrestrial lichen communities as a food source. These communities have developed on localized, well drained fluvial deposits that support a pine-dominated overstory. Sedge-dominated wetlands are also used as a food source. Some ecological mapping has been undertaken in the area to highlight the landforms and habitats of particular concern for caribou.

All of the current or potential land use activities in the area could cumulatively alter or alienate large portions of key habitat for the caribou, making the area a multiple resource use area of management concern. The caribou herd summers to the south in more mountainous regions of British Columbia, where it is also subjected to some level of effect from cumulative land use pressures.

While grizzly do occur here, the area is not considered high quality grizzly habitat (predominantly mid-successional, spruce/pine coniferous forest with interspersed wetland communities), and grizzly are of reduced management concern relative to caribou.

4.2.2 Eagle Plains

This region is intersected by the Dempster Highway, and is known to have some potential for oil and gas discovery and development. Initial exploration and drilling activities occurred in the area several decades ago, and renewed activity has again commenced with the increased interest in northern gas development.

The area is dominated by poorly-drained open black spruce stands, with white spruce and paper birch developing on better-drained upper slope sites. The area supports wintering and migratory habitats for the Porcupine caribou, a herd that migrates between Alaskan calving grounds and winter range on the western edges of the Northwest Territories. The area also supports a relatively low grizzly bear density. Renewed exploration activity will alter habitat and potentially alienate additional areas. Given the importance of the Porcupine caribou herd to numerous aboriginal communities, thresholds are required to manage cumulative effects before they adversely affect the herds numbers or distributional patterns.

4.3 Threshold type

Applied Ecosystem Management (AEM) Ltd. has been retained (2002) by DIAND to review practical thresholds for managing cumulative pressures on woodland (mountain) caribou in the Liard Basin. Drawing on recent research completed in northeast Alberta by the Northeast Boreal Caribou Steering Committee and the University of Alberta, AEM (2002) recommends that habitat effectiveness (i.e., realized habitat value/potential habitat value) be adopted as a primary threshold mechanism, and that this mechanism be tested in a case study. To develop habitat effectiveness values, potential habitat values are modeled based on the biophysical conditions on the land base and the habitat requirements of the species in question. Realized habitat values reflect the reduced habitat values falling within the cumulative zones of influence of human developments on the land base. Consequently, both biophysical data and land use data are required to support such a threshold approach.

Core security habitat represents another potential threshold parameter that could be used for managing cumulative effects. Core security habitat represents the proportion of a species habitat supply that falls outside the designated zone of influence of human developments on the land base. It is a coarser approach to managing cumulative effects on wildlife, as it does not factor habitat quality into the assessment. It requires the identification of reasonable buffers around human developments for the species in question, and the ability to accurately map land use disturbances on the landscape. Therefore, it can be done in the absence of ecological land classification and mapping.

4.4 Recommended pilot program

The recommended pilot threshold program is based on habitat effectiveness thresholds (rather than core security) for the Little Rancheria Caribou Herd in the Liard Basin. This KWI and study area, which were also proposed during the thresholds implementation workshop (AXYSb 2001), are considered suitable because of:

- relatively high levels of cumulative development (i.e., timber harvesting, oil and gas exploration and development, hunting, off-road vehicle use, public roads and communities)
- highly important, identifiable habitats for caribou (i.e., fluvial land forms with lichen)
- existing ecological mapping
- relatively limited geographic extent of annual movement, thereby providing a better study control (unlike highly migratory herds such as the Porcupine that is subject to a many land use pressures over its range)

While the core winter habitat can serve as the primary study area, a cursory knowledge of land use issues in the remainder of the winter and summer ranges of the herd in British Columbia is required to help interpret any changes in herd characteristics over time.

Distinguishing between these respective areas can be accomplished through application of the aforementioned “nested” study area approach.

Habitat effectiveness as a threshold’s indicator has the advantage of reflecting human use but in the context of an ecological attribute. Although it’s derivation and monitoring can be more data intensive and time consuming (due to need for an ELC) than those required to support other land use thresholds (i.e., core security habitat), its use offers a compromise between data requirements and ecological relevance (therefore, more defensible and meaningful).

Candidate habitat effectiveness values would be identified (based on review of similar applications elsewhere in Canada, particularly as done in Alberta on which AEM is basing their work) prior to implementation of the program. These values would be modified in an adaptive fashion based on the availability of further ecological and land use data specific to the Liard Basin region and the Little Rancheria Caribou Herd.

It is important to note that the pilot program as discussed in *this* report is not one to *derive* thresholds, but to *test* the administrative application of actual thresholds in support of land management practices. Therefore, it is assumed that suitable thresholds will be identified earlier on which to initiate the program, subject to change as monitoring information is reviewed. Such thresholds must be quantitative (i.e., numerical).

4.4.1 Monitoring of Results

Table 1 provides an example of how annual monitored results of realized habitat values may be tracked over time and compared to the corresponding potential habitat value, resulting in an annual estimated habitat effectiveness. Habitat effectiveness thresholds (i.e., minimum acceptable effectiveness) are provided for each study area, reflecting a coarse average over a large area that should be acceptable for the purposes of land and resource management.

Numbers are shown only for the likely area of highest management concern; namely, core overwintering range (numbers shown are provided only as examples). The habitat effectiveness provides a trend indicator as shown in Figure 2 that can provide a warning of an HE trend approaching threshold. In the figure, continuing development pressures contribute to progressive (cumulative) decreases of realized habitat values due to alienation and direct loss of habitat. Eventually, caution is warranted at some level close to threshold (in this case, 0.8 or about 7% above threshold) before the threshold (0.75) is reached in 2006. The later increase in HE reflects the beneficial results of management response to address this threshold exceedance (e.g., through reclamation and road closures).

Specific management actions would be defined for each of the three management response levels, sequentially becoming more comprehensive, incorporating the concept of “tiered management response” as, for example, currently implemented in Alberta’s Athabasca Oil Sands region under the Cumulative Effects Assessment and Management Association (CEMA) initiative. This approach utilizes a series of management steps based on a thresholds range.

In the case of this example, the tiered approach would be as follows, interpreted in the context of managing a species of concern in the Yukon (the type of management response can be modified to be most appropriate to specific land use, regulatory and ecological conditions):

- ***Acceptable***: HE > 0.8. Caution required in the approval and management of new land use developments.
- ***Cautionary***: 0.8 > HE > 0.75. No further development allowed until land use pressures decrease or acceptable mitigation options are implemented. The use of a cautionary threshold, some percentage of the actual threshold, serves to buffer the actual threshold with the intent of allowing for sufficient time to provide an effective management response.
- ***Exceedance***: HE < 0.75. No further development allowed until recovery following a species recovery program.

This approach also allows for the use of anticipatory modelling (such as with A Landscape Cumulative Effects Simulator — ALCES) to predict possible future changes in land use and habitat, thereby supplementing monitored data with future scenarios (forecasting) to establish possible trend lines long before monitored results confirm unacceptable change, typically only discovered after the threshold has been exceeded.

Figure 2: Example of herd trends and management response levels

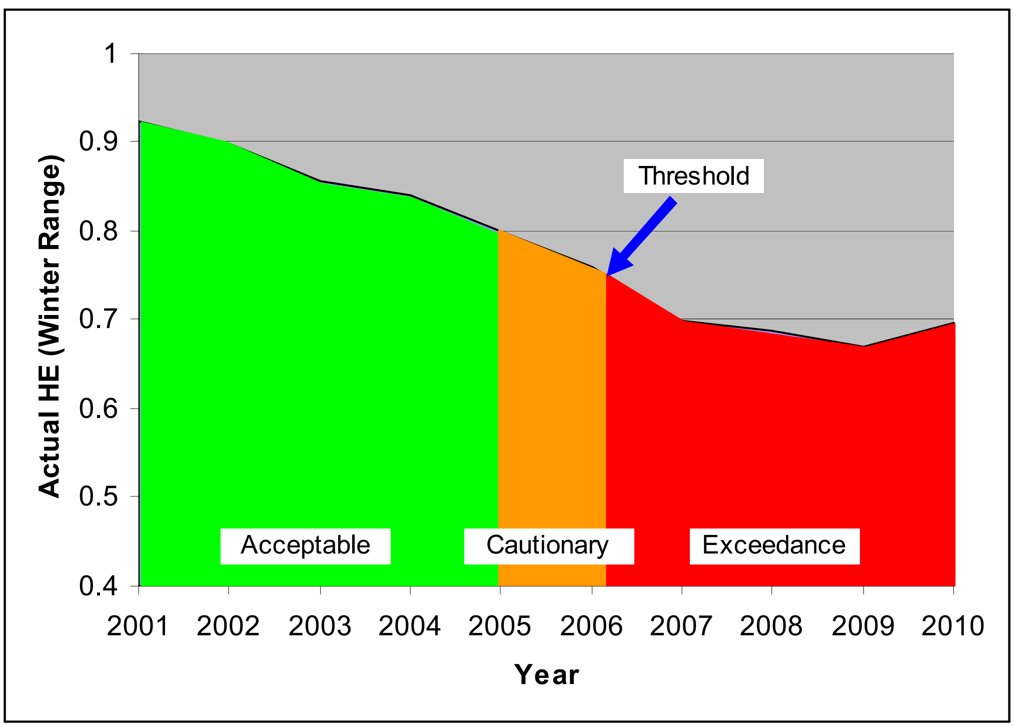


Table 1: Example of thresholds and monitored results

Year	Habitat type								Trends	
	A (Summer)		B (corridor)		C (Winter)		D (non-core)			
	Potential HU	Threshold (HE)	Potential HU	Threshold (HE)	Potential HU	Threshold (HE)	Potential HU	Threshold (HE)		
	1000	0.65	2000	0.5	1000	0.75	5000	0.45		
	Realized HU	Actual HE	Realized HU	Actual HE	Realized HU	Actual HE	Realized HU	Actual HE	Population	Land Use
2001					923	0.92				
2002					900	0.90				
2003					856	0.86				
2004					840	0.84				
2005					800	0.80				
2006					759	**0.76**				
2007					700	0.70				
2008					687	0.69				
2009					670	0.67				
2010					696	0.70				

Notes:

- numbers provided as examples only for Type "C" area (see Figure 1)
- "Trends" columns provided for written observations on changes in species population and land use during the year
- darkened cell in Winter Threshold column indicates proximity to critical thresholds level (0.75)

5 Next Steps

The following is an outline for a recommended workplan to design and implement the pilot program.

Step 1: Establish Scoping Meetings	
Convene a pilot study kick-off meeting (DIAND and YTG)	Establish preliminary objectives and geographic scope for the study
	Review land use, jurisdictional and regulatory policies potentially affecting the pilot study
	Review public consultation requirements and make-up/role of Stakeholder Advisory Committee
Convene a public consultation meeting	Identify resource concerns
	Introduce objectives of pilot study
	Identify interested stakeholders
Convene a stakeholder advisory committee meeting	Introduce objectives of pilot study
	Review role of advisory committee
	Discuss schedule for advisory committee meetings, review and input, and for general public disclosure
Step 2: Review Existing Data	
Within the primary study area boundaries	Review existing ecological land classification/habitat information
	Review existing and future potential land disturbance information
	Identify known extractive resource potential (i.e., borrow, timber, oil/gas, etc.), based on ecological land classification and geological data
	Identify caribou demographics and seasonal distribution patterns
	Identify critical habitat subzones (e.g., movement corridors, core winter range) requiring special management consideration
	Identify external factors outside the primary study area potentially affecting the caribou
Discuss integration of Traditional Knowledge (TK)	Identify key data gaps and steps to fill gaps
	Develop digital mapping of habitat and land disturbance
Step 3: Finalize Threshold Parameters and Levels	
Establish mapping and models	Finalize habitat supply model that integrates biophysical variables and land disturbance factors into habitat effectiveness calculations
	Clearly identify categories of land disturbance severity (e.g., seismic line vs. resource road), and their differential effects on habitat values
	Review the capability of the land base to assimilate disturbance (i.e., rate of recovery through natural or enhanced reclamation)
	Identify natural processes that change habitat values over time (i.e., forest succession)
Establish thresholds	Review AEM (2002) threshold document and recommendations, and establish preliminary HE thresholds for caribou

	Consider need for different threshold levels in different study area subzones (i.e., core winter range vs. key movement corridors)
	Consider need for coarse-filtered threshold parameters (e.g., core security habitat) for portions of study area or surrounding area where ecological land classification and habitat mapping is not available
Step 4: Develop Performance Evaluation Protocols and Adaptive Management Strategies	
Monitor progress	Develop monitoring parameters and procedures for evaluating the effectiveness of thresholds (e.g., population parameters such as calf/cow ratios, distributional patterns, herd response to land disturbance)
	Establish funding mechanisms and task responsibilities for long term monitoring plan
Manage change	Develop principles for management responses to observed monitoring trends, and allowances for natural variability within the monitored parameters
	Define process to integrate monitored results into regulatory, land and resource use administrative decision making
Step 5: Implement Pilot Program	
	Initiate pilot program with adaptive review of progress and lessons learned. Continue to respond to and learn from key stakeholder issues and concerns
	Review project applications and resource plans against thresholds (but not as part of formal administrative review process)
	Apply appropriate response to applications and plans, including graduated effort of effects management (management options would be identified; e.g., Integrated Landscape Management, Low Impact Exploration)

6 Bibliography

AEM. 2002. *Development of a Threshold Approach for Assessing Industrial Impacts on Woodland Caribou in Yukon (Draft)*. Prepared for the DIAND Yukon Environmental Directorate by Applied Ecosystem Management, Whitehorse, Yukon.

AXYS. 2001a. *Thresholds for Addressing Cumulative Effects on Terrestrial and Avian Wildlife in the Yukon*. Prepared for the DIAND Yukon Environmental Directorate by AXYS Environmental Consulting Ltd., Calgary, Alberta.

AXYS. 2001b. *Wildlife CEA Thresholds: Phase II Summary*. Prepared for the DIAND Yukon Environmental Directorate by AXYS Environmental Consulting Ltd., Calgary, Alberta.

Appendix

Appendix A: Thresholds overview

(from AXYS 2001a)

The definition, concept and practical application of terrestrial and avian wildlife thresholds are discussed for the purposes of regional land use planning and assessment of cumulative effects. Three major types of thresholds are identified: ecological (including habitat availability and population thresholds), land and resource use, and social.

Specific ecological and land and resource use thresholds suggested in the literature or as applied in the Yukon and elsewhere are discussed in detail for three terrestrial species (grizzly bear, woodland caribou and moose); and, for two bird classifications (landbirds and waterbirds). Administrative opportunities for developing and applying the thresholds are proposed. Candidate thresholds are recommended based on information availability and suitability. All thresholds and approaches for determining each type of threshold are summarized (see Table A1).

Terrestrial Wildlife

Considerable opportunity exists in the Yukon for developing thresholds for large terrestrial wildlife. Recommended thresholds for grizzly bear include minimum habitat effectiveness, maximum human-caused mortality, maximum road density, and minimum core security areas. Recommended thresholds for caribou include minimum calf/cow ratio, minimum habitat availability or effectiveness, and maximum energetics loss. Recommended thresholds for moose include minimum calf/cow ratio or population size, ratio, and minimum habitat availability or effectiveness.

Avian Wildlife

There are currently no readily implementable thresholds for landbird or waterbird species. The development of appropriate thresholds will require more detailed information on land and resource use and on species-specific responses to disturbance.

Table A1: Summary of Thresholds

Type	Thresholds
Ecological	
Habitat Availability	minimum patch size minimum corridor width maximum gap distance between patches core security areas carrying capacity maximum tolerable energy expenditure maximum disturbance factors and zones of influence maximum surface water level drawdown
Populations	minimum desired population size minimum viable population size (MVP) optimum calf/cow ratio optimum natural mortality/natality rates
Land and Resource Use	
Physical Works and Associated Activities	maximum road density for specific traffic levels maximum zone-of-influence for specific disturbances (e.g., noise from aircraft) exposure rate
Human Activity	maximum level of visitation maximum hunting mortality rate maximum defense-of-life-and-property (DLP) mortality rate maximum acceptable extent of development that cause sensory disturbances (e.g., to light, dust, sound, smell and vibration)
Social	
Aesthetic	maximum tolerable extent of perceived visual change
Perceived Acceptable Limits	maximum perceived acceptable changes to habitat, species distribution or level of human disturbance

Appendix B: Follow-up workshop results

(from AXYS 2001b)

The Environmental Directorate of DIAND in Whitehorse sponsored a workshop in Whitehorse during two-days in November, 2000. The purpose of the workshop was to identify and refine wildlife thresholds for cumulative effects in the Yukon, and identify means of implementing those thresholds. The workshop was attended by 30 participants, mostly federal and territorial government, and was facilitated by AXYS Environmental Consulting Ltd.

This workshop is part of a four-phased approach to implementing thresholds. The first phase involves the completion of a background report on types of thresholds. The second phase, of which this workshop is a part, develops and refines the thresholds for practical application in the Yukon by resource managers and project application reviewers.

This report describes the workshop and summarizes the results of discussions. Background information on thresholds was presented and discussed. Participants were queried on what they considered as the most important attributes of thresholds and the most practical and implementable thresholds. A case study application of thresholds, based on a caribou herd, was used to promote discussion on these issues within the context of actual ecological and land use conditions.

Measurable, practical and realistic were identified as the most desirable attributes of thresholds. Maximum road access densities and minimum core security habitat were identified as the most practical types of thresholds. Generally, thresholds based on land use/activity controls were considered the most feasible for implementation, followed by habitat based controls.

Some participants strongly recommended that a pilot program be immediately established in which thresholds would be incorporated into the land use administrative and regulatory process. Such a program would test the feasibility of implementing thresholds as a resource management tool. This initiative would reflect the objectives of Phases III and IV in the proposed threshold implementation process. A suitable geographic area for such a pilot would include various land use pressures and a key natural resource of management concern. Caribou in the southeast Yukon was proposed as the most suitable candidate. Stakeholder involvement in establishing this program was recognized as vital.

Participants expressed hope that thresholds would be seriously considered and treated as a major component of land use decision making in the Yukon, and expressed a commitment to furthering such initiatives. Mechanisms for accomplishing this could be pursued both at the project approval and regional land use planning levels of land use administration.

Figure B1 summarizes the above and illustrates their linkages that collectively form a framework for the implementation of thresholds.

Figure B1: The Thresholds Implementation Framework