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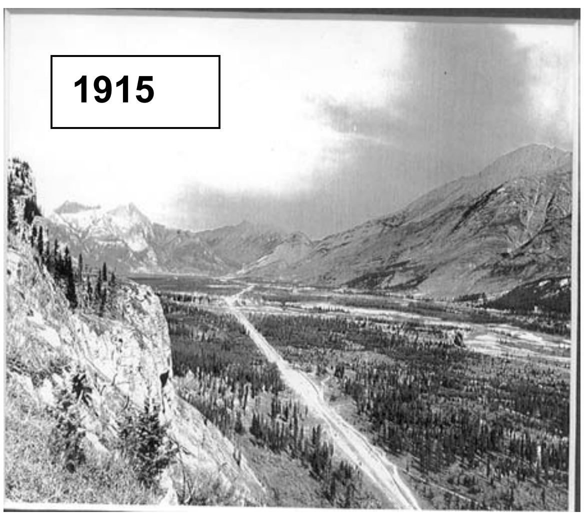
ENVIRONMENTAL SCREENING REPORT

FIRESMART – FORESTWISE COMMUNITY PROTECTION AND FOREST RESTORATION PROJECT

FOOTHILLS MODEL FOREST JASPER NATIONAL PARK



Park Registry File J03–004
Jasper National Park
April, 2003

Parks Canada Parcs Canada

Canada

FIRESMART – FORESTWISE
COMMUNITY PROTECTION AND FOREST RESTORATION PROJECT
J03-004

APPROVAL DECISION

With implementation of the defined operating practices, mitigations, communications strategy and direction from the Department of Fisheries and Oceans, it is the conclusion of this screening report that Parks Canada may approve the project as per Section 20 (a) of the Canadian Environmental Assessment Act:

"Where, taking into account the implementation of appropriate mitigation measures, the project is not likely to cause significant adverse environmental effects, the RA may exercise any power that would permit the project to proceed, and shall ensure that the mitigation measures are implemented;"

Screening Prepared by: ____________________ Date: ____________
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EXECUTIVE SUMMARY

Introduction

Parks Canada is initiating a project to reduce the risk of wildfire losses to the town and adjacent developments, and to improve the ecological health of Jasper National Park by restoring a more natural structure to Montane forests.

To achieve these objectives, manual and mechanical vegetation treatments such as selective thinning, pruning and burning will take place on about 350 hectares of forest that surround the Town of Jasper and the nearby Lake Edith Cottage development. These treatments will reduce forest density and decrease fuel accumulations on the forest floor. Unique prescriptions have been developed for each of the distinct vegetation types found within the project area in order to sustain ecosystem processes like nutrient flow and ensure critical habitat elements such as habitat trees.

The project assessed in this screening is also the Jasper component of the Foothills Model Forest *FireSmart – ForestWise Communities Project*. The goal of the Foothills Model Forest project is to develop, implement and assess innovative, ecologically-based methods for managing forest fuels in ways that reduce wildfire risk but also optimize or improve ecological conditions, wildlife habitat and aesthetic qualities in the narrow fringe of forest lands located immediately adjacent to the Town of Jasper and other major developments.

This project will help achieve three objectives that are stated in the Jasper National Park of Canada Management Plan and echoed in other park strategies and plans. These are: 1) to effectively reduce the risk of wildfire losses and increase fire protection for the town of Jasper and surrounding developments; 2) to contribute to ecological restoration directly by improving ecological conditions regarding forest structure and landscape pattern; and 3) to indirectly contribute to ecological goals by facilitating the restoration of fire as an active natural disturbance process in surrounding areas of the park. Essentially, the project merges the management actions required for community wildfire protection and ecological restoration in the Athabasca valley of Jasper National Park.

The purpose of this environmental impact assessment is to provide information sufficient for the general public to understand and comment on the project and for Parks Canada to determine the effectiveness of the proposed impact avoidance and mitigation strategies, and the significance of the project's impact on park ecosystems.

Background

Natural disturbances, particularly fire, played fundamental roles in shaping the pattern, structure and function of Jaspers ecosystems over thousands of years. This is particularly true in low elevation "Montane" areas where, frequent low intensity surface fires periodically consumed a portion of the vegetation thus maintaining non-forest habitats such as grasslands, shrub lands and open forest communities like Douglas fir forest. In the absence of fire, these ecosystems are becoming increasingly rare as trees choke open spaces and increase their density on forested sites. It is suspected that plant, insect and animal species characteristic of open forests and grasslands are being lost as a result.

At the same time factors such as constricted mountain terrain, prevailing weather patterns and highly flammable coniferous fuels combine to produce conditions for extremely intense and fast moving wildfires that could seriously threaten or destroy the Town of Jasper and/or surrounding developments. The degree of risk to Jasper's facilities and residential areas by wildfire is well documented and widely recognized.

Past fire management policies (1930 – 1980) led to over half a century of "successful" fire control in the Montane of Jasper National Park. Ironically, the exclusion of fire only exacerbated the problem of protecting communities from wildfire by allowing massive accumulations of living and dead forest fuels to build up. The risk of large, uncontrollable wildfires increased as a result. In addition, fires burning under such conditions would exhibit abnormally high intensity/severity and cause long lasting ecological damage to soils, plant communities and watershed values.

More recent Park policy also supports management actions to restore fire to park ecosystems through planned or random ignition prescribed fire. However, this initiative is effectively blocked in large areas of the park (e.g. Miette, middle Athabasca and lower Maligne watersheds) until measures to limit fire spread into populated areas and protect the public are implemented.

The problems noted above are the cumulative effect of modern human interventions. Now, Parks Canada and other partners in the Foothills Model Forest including the Municipality of Jasper, propose implementing a science-based approach to community wildfire protection founded in knowledge of ecosystems, wildlife and fire behaviour.

These issues provide the basis for the *FireSmart – ForestWise* Communities project.

Project Scope

The project is located within Jasper National Park at lower elevations of the Athabasca valley that are dominated by continuous coniferous forest. More specifically, forests to be treated extend outwards from the perimeter of the Town of Jasper and the Lake Edith subdivision for distances of approximately 100 to 400 metres in width. Respectively, the total areas to be treated are about 250 hectares and 100 hectares. The project will be conducted over a span of three years beginning in October 2003. All mechanical work will be conducted during periods of frozen ground between October 01 and March 31 by crews and contractors working under constant supervision by knowledgeable Parks Canada personnel.

Prescribed treatments are based on knowledge of the dynamic range of ecological conditions that existed in the past, and also on published standards for modifying fuels such that advancing "crown" fires drop to the ground, and the risk of convective building ignitions due to direct contact with flames is reduced.

Assessment Methods

Preparation of this screening followed an extensive process for scoping and evaluating environmental and social impacts, and for identifying environmental mediations to be conducted during and after project implementation. Scoping entailed a process for narrowing the comprehensive list of all potential effects to a shorter list of key social, cultural and economic elements that may sustain impacts which are important enough to make a difference to the decision about the project.

These key elements are termed "valued ecosystem components" and are the focal point for much of this screening. The valued ecosystem component resulting from this process were:

Restoring Natural Process
Restoring forest structure and composition
Wildfire protection for people, property and facilities
Reduce wildlife/human conflicts
Restore landscape patterns and abundance of scarce ecosystems
Increase grizzly bear habitat effectiveness and habitat connectivity for wide-ranging wildlife
Maintain the "natural" setting and vegetation screening for the town
Respect confidentiality and character of cultural sites
COSEWIC listed species

A description of the current environmental setting with respect to valued ecosystem components is provided in Section 2 of the screening. Section 3 gives a detailed description of all major project activities including treatments directed at living and dead vegetation, operation of crews and equipment, fire applications, timber salvage, access and transportation and essential adjustment to the Pyramid Bench community fireguard. These descriptions also include details of the "primary" impact mitigation measures incorporated into project operations.

The potential impacts associated with project activities (as originally proposed) are then forecast and "secondary" mitigations specified to further reduce or eliminate the negative impacts identified. Effects are categorized as either positive or adverse; adverse effects were subsequently rated as minor or major. Adverse effects that are predicted to persist (i.e. residual impacts) despite implementation of primary and secondary mitigations are then described in terms of their nature and importance.

Assessment Results

Overall, the majority of potential effects to valued ecosystem components from this project are positive in terms of ecological and social benefits. No major adverse effects were identified. Virtually all of the forecast adverse effects can be reduced or eliminated by feasible mitigations that will be incorporated into project operations or adaptation of proposed project methods.

Similarly, the majority of residual ecological effects resulting from the project were also deemed to be positive. For example, a favourable project legacy will result with regards to restoration of natural process, forest structure and composition, landscape patterns and rare eco-sites; improvements to wildfire protection; avoidance of wildlife/human conflicts; and maintenance of a natural setting for the Town of Jasper. With regard to other valued ecosystem components such as improving grizzly bear habitat effectiveness and protection of COSEWIC listed species, the net project effect was forecast to be neutral.

Adverse residual effects were evaluated in accord with Parks Canada criteria. Generally, they were found to be temporary in duration or limited in extent and thus not threatening to local populations, significant features or long term land use. A notable exception was identified for cultural resources, in which case a zero tolerance for adverse effects was established.

Finally, cumulative effects, or the effects of this project when combined with other past, existing and future projects or activities within the vicinity, were considered. Due to its focus on ecological restoration actions, this project is forecast to reduce adverse cumulative effects by counter-acting or reversing many of the negative trends or impacts that have resulted from past policies or the actions of modern humans on the Montane landscape. Key long term social and ecological benefits will accrue as a result of emulating natural disturbance processes, restoring ecological conditions, enhancing wildfire protection for people and property, maintaining a natural, aesthetic environment for the Municipality and encouraging appreciation and respect for traditional aboriginal values.

Follow-up to the Environmental Screening

Upon approval of this screening, procedures and mitigations specified by the responsible authority (Parks Canada) will be incorporated into an Environmental Management Plan (EMP) and into contracts issued for project works. The EMP will guide implementation phases of the project including surveillance, impact monitoring and incident reporting.

A rigorous, science-based monitoring program is proposed in order to track environmental impacts, benefits, or responses to this project; to ensure that community wildfire protection measures and ecological restoration requirements are effectively merged within this project; and to make certain that the ecological benefits that may accrue from this project, are actually realized.

ACKNOWLEDGEMENTS

Numerous people provided essential information and assistance during the preparation of this environmental screening. Their contributions are gratefully acknowledged.

Dr. William Ross, Faculty of Environmental Design at the University of Calgary provided useful refere3nce material, critical review, and constructive suggestions at several key junctures during the planning and preparation of this environmental screening.

Mr. Herb Hammond of Silva Ecosystem Consulting also reviewed a draft of the screening and conducted an on-site inspection of the project area. He contributed knowledge regarding forest ecosystems and forest management techniques that led to a more thorough understanding of environmental sensitivities, and ways of avoiding or further reducing potential impacts.

Dr. Peter Francis and Jack Porter of the Parks Canada archaeological team and Mr. Jimmy Ochiese, a native elder, provided invaluable insights and key information about cultural resources and their protection.

Park Wardens Brian Low, Ian Pengelly, and Jeff Weir provided technical information during on-site visits to fuel management projects in Banff and Prince Albert National Parks. Hugh Lougheed of Weldwood of Canada provided information about equipment and commercial thinning operations during a tour of the Weldwood forest management area near Hinton, Alberta.

Thanks are also due to the many Parks Canada specialists, local naturalists, citizens of Jasper and residents of the Lake Edith cottage subdivision who offered information, constructive comments and ideas during preparation of this screening.

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1.0 INTRODUCTION

Parks Canada is initiating a project that will substantially reduce the risk of wildfire losses to the town and adjacent developments, and significantly improve the ecological health of Jasper National Park by restoring a more natural structure to local forests. The project will also facilitate future actions to restore the park's natural fire regime. To achieve these objectives, manual and mechanical vegetation treatments such as selective thinning and burning will take place on approximately 350 hectares of forest that surround the Town of Jasper and the nearby Lake Edith Cottage development. These treatments will reduce forest density and decrease fuel accumulations on the forest floor. The project assessed in this screening is the Jasper component of the Foothills Model Forest *FireSmart – ForestWise Communities Project*. (Figure 1-1)

This project triggers the Canadian Environmental Assessment Act (CEAA). In accordance with CEAA, the environmental assessment for this project has been conducted at the level of "Environmental Screening". The purpose of this document is to provide information sufficient for Parks Canada to determine the effectiveness of the proposed impact avoidance and mitigation strategies, and the significance of the project's impact on park ecosystems. Parks Canada (Jasper) operates in accord with standardized guidelines for implementation of the Canadian Environmental Assessment Act (1992). This project takes place within Jasper National Park and Parks Canada is the R*esponsible Authority* for the project.

As the lead Foothills Model Forest partner in this project, Parks Canada is the *Project Proponent* and is responsible for preparation of the environmental screening. This screening was prepared in accordance with the terms of reference developed by Parks Canada (Parks Canada 2003) and agreed to by representatives of Parks Canada and the Foothills Model Forest.

Project Goal and Objectives

The overall goal for this project is to develop, implement, and assess innovative, ecologically-based methods for managing forest fuels in ways that reduce wildfire risks but also optimize or improve ecological conditions, wildlife habitat and aesthetic qualities in wildland/urban interface areas. Community protection and ecological restoration requirements are being merged within this project.

Primary objectives for the *FireSmart – ForestWise Communities Project* are:

1) That management actions will effectively reduce the risk of wildfire losses and increase fire protection for the Town of Jasper and the Lake Edith cottage subdivision;

2) That management actions will contribute to ecological restoration directly through improvement of local ecological conditions with regards to forest structure and landscape pattern (i.e. conditions within historical ranges of variability);

3) That management actions will contribute to ecological restoration indirectly by facilitating the restoration of fire as an active natural process on the larger park landscape.

This project is being implemented under the auspices of the Foothills Model Forest. As a result of that affiliation, two secondary objectives have been developed:

4) To help resolve knowledge gaps regarding the relationships and response of various wildlife and habitat elements to fuel management treatments;

5) To convey information and ideas for engaging citizens and stakeholders in similar ecologically-based community protection projects to communities elsewhere in the Foothills Model Forest and across Canada.

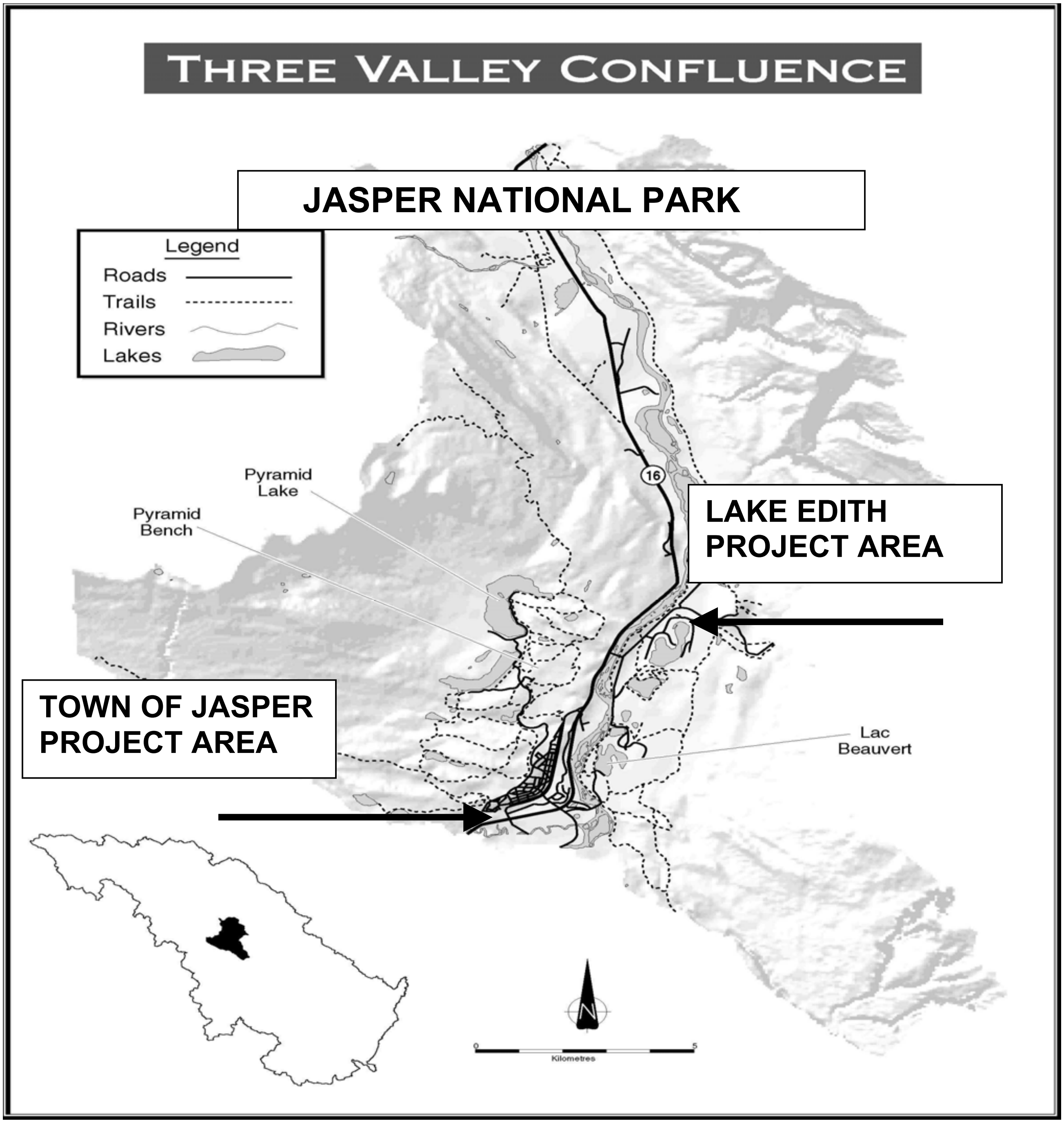

Figure 1-1. Location of FireSmart – ForestWise Project Areas within Jasper National Park.

1.1 <u>Project Background</u>

Reducing the Risk of Wildfire Losses and Increasing Fire Protection

Protecting urbanized areas and human populations in a wilderness landscape dominated by fire is a significant challenge. The issue has spawned numerous internal and external studies and action plans to address wildfire hazards and conduct risk assessments (Carnell 1974, Haney 1978, Fenton 1986, FireLine Consulting 1997, Mortimer 1998, Mortimer 1999). Each concluded that local topography, regional weather patterns and the nature of forest fuels that surround the town of Jasper and the Lake Edith cottage subdivision create conditions for extremely intense and fast moving wildfires that threaten developed areas. Combined with high probability of fire ignition from human, natural and industrial sources, these communities are at significant risk from wildfire events (Mortimer 1997, Mortimer 1999).

Decades of "successful" fire control have <u>further</u> exacerbated this situation by allowing massive accumulations of living and dead forest fuels to build up. Ordinarily, these fuels would have been periodically reduced - had fire been allowed to continue burning within this landscape at historic levels. Now, Parks Canada and the Municipality of Jasper propose implementing a preventative approach to community wildfire protection, rather than continuing to risk catastrophic socio-economic impacts or the severe impacts often associated with last-ditch fire control measures.

Correctly defining the problem of community wildfire protection is critical to resolving it. Wildfires spread by two mechanisms. The first is by convection, that is, pre-heating and burning of fuels as the actual fire front moves forward. The second process is one whereby burning embers lofted up to 2000 metres ahead of the fire front by winds ignite new fires which then join with the main fire (Ferguson et al 2002). Ember lofting occurs under very intense *crown fire* conditions when the fire moves rapidly through the upper canopy of the forest. Under dry conditions nearly 100% of falling embers can ignite a bed of forest fuels - or flammable building components. More often than not, this is the component of wildfire spread that overwhelms fire suppression forces and is the cause of major wildland/urban interface fire disasters (Coen 2003). The presence of general winds or slopes accentuates fire spread by convection and ember transfer.

To be effective, interface fire protection measures must guard against ways that forest fires spread into communities. Generally speaking, convective ignition of homes or businesses can be prevented by achieving a degree of separation from forest fuels (e.g. creating a 10 metre fuel free zone). However, the only way to prevent generation and lofting of embers is to create extensive areas of less hazardous fuels between communities and areas where crown fires are burning. This requires that forest fuels be reduced such that an advancing crown fire drops to the ground and/or an ignition within the treated area cannot develop into a crown fire and perpetuate the process of ember transport further downwind (Ferguson et al 2002). Treated fuel areas provide locations where wildfires can be safely and effectively suppressed.

This project prescribes manual and mechanical measures to reduce density of the forest canopy and to remove excessive accumulations of surface fuels to lessen danger to residents, visitors, homes and park infrastructure. Concurrent with forest thinning activities, minor adjustments to the configuration of the Pyramid Bench Fireguard will be made to ensure its effectiveness.

Restoring Rare Ecosystems, Forest Structure and Landscape Pattern

There is widespread understanding and appreciation for the important roles that natural disturbances, particularly fire, have played in the evolution of park ecosystems. These roles are especially important in low elevation Montane valleys where frequent, low intensity fires periodically consumed a portion of the young woody vegetation thus maintaining non-forest habitats such as grasslands, shrub communities and open forest communities like Douglas fir.

The cumulative effect of past human interventions to prevent natural disturbance (i.e. periodic fire) has resulted in the artificial process of forest “in-growth”. In-growth gradually closes the forest canopy, alters internal stand conditions and eliminates habitat elements required by native species. Consequently, ecosystems that depend on fire have significantly declined in number, density in the landscape, and individual patch sizes. As a result of this process certain ecosystems are becoming rare. It is also suspected that plant, insect, and animal species characteristic of open forests and grasslands are being lost.

In the areas immediately surrounding the Town of Jasper and the Lake Edith Cottage subdivision, this project will help counteract previous cumulative effects by implementing measures to actively restore the extent and physical structure of ecosystems (ecosites and vegetation types) that are becoming scarce or rare within Jasper National Park.

Facilitating the Restoration of Fire as an Active Natural Process

Park management policies and plans call for the restoration or duplication of natural processes. There is potential to achieve this through careful management of random ignition wildfires or prescribed burning operations. However, two circumstances block this initiative. First, the artificially dense forest structure and heavy fuel accumulations that presently exist in many Montane forests would cause most fires to burn with abnormally high intensity. Under these conditions, fire could cause long lasting ecological damage to soils, plant communities and watershed values. Second, without adequate measures to protect populated areas, any fire in the area could pose a significant threat to people and property.

This project will help to resolve the blockages noted above. It will re-establish conditions such that fire can be successfully and safely re-introduced to adapted forest types immediately adjacent to the town site and to set the stage for much more widespread fire use in the watersheds that extend outwards from the vicinity of Jasper town site. In this way, both natural process and patterns can be restored to Jasper at the ecosystem and landscape scale.

Resolving Knowledge Gaps

Anticipating the potential effects (positive or negative) to wildlife and wildlife habitat caused by fuel management activities and devising procedures to maintain or enhance current habitat attributes is a relatively new area that has not been fully researched. This is an important knowledge gap. Resolving the knowledge gap would benefit current efforts within Jasper National Park and also has the potential to help advance community wildfire protection programs in hundreds of communities across Canada.

Through partnerships with the Foothills Model Forest and the University of Calgary, research activities have been incorporated into this project to evaluate the relationships and response of flora and fauna to fuel management activities in a variety of forest types. As a result, this project will help derive ecologically based guidelines for conducting future fuel management actions (in this project and elsewhere) in ways that optimize or improve the diversity of habitats and wildlife. Resolving knowledge gaps is one basis for the follow-up program outlined in Section 9.

Technology and Information Transfer

This project affords a unique opportunity to transfer knowledge and techniques that combine ecological restoration and fuel management solutions to other communities and individuals. This is an important mandate of the Foothills Model Forest. As a result, an extensive framework for communicating project information and results to the public and other agencies has been devised and implemented concurrent with this project. As well, many opportunities for direct public input and involvement with project activities are being provided.

1.2 Scope of Assessment

This screening is comprehensive in nature. However, it is primarily focused on aspects of the social, economic and ecological environment, termed *valued ecosystem components*, which may sustain impacts that are important enough to make a difference to the decision about the project.

Section 1.5 contains the details of how valued ecosystem components were determined. Valued ecosystem components determined specifically for this project were:

1	Restoring Natural Process
2	Wildfire protection for people, property and facilities
3	Restoring forest structure and composition
4	Reducing wildlife/human conflicts
5	Increase grizzly bear habitat effectiveness and habitat connectivity for wide-ranging wildlife
6	Restoring landscape patterns and abundance of scarce ecosystems
7	COSEWIC listed species
8	Respecting confidentiality and character of cultural sites
9	Maintaining the “natural” setting and vegetation screening for the town

This screening describes the existing “site” environment and its relationship to the surrounding landscape, valued ecosystem components and the project area. The screening also describes how the project will be operated to avoid and/or mitigate impact to (or from) the ecological and commemorative integrity of the area. Project effects are discussed in terms of benefits as well as adverse effects. Residual and cumulative impacts, both on and off site, are described as well as their importance. Geographically, the screening involves Montane forests immediately around (i.e. mostly within 300 metres of) the Town of Jasper and the Lake Edith subdivision in JNP.

This screening also details the manual and mechanical operations required to remove, reduce, or alter vegetation for the purposes of fire protection and ecological restoration objectives. The specifics of prescribed fires that will be subsequently introduced will be assessed in amendments to this screening and in individual prescribed burn plans as they are developed.

Temporally, the scope of assessment covers activities that will take place in the next 3 – 5 years. However, it also examines implications of the project with regards to adverse impacts and ecological or social benefits over the next decade or longer. Of necessity, much of the assessment is based on knowledge about historical ranges of variation that span centuries.

1.3 Scope of Project

This project is designed to restore ecological conditions and reduce the risk of catastrophic wildfire around the Municipality of Jasper and the Lake Edith cottage subdivision. Figures 1-2 and 1-3 illustrate the spatial extent of these treatments and their location within the Athabasca valley, a total of approximately 350 hectares.

The major activities involved in the project and assessed within this screening are:

1) Manual and mechanical thinning of live mature trees and understory trees;
2) Pruning lower limbs and treatment of coarse woody debris on the forest floor;
3) Removal of dead standing (snags) and wind-thrown trees;
4) Management of coniferous regeneration;
5) Manual reduction of highly flammable shrubs (i.e. juniper);
6) Burning of excess foliage, slash and forest floor litter in piles and windrows;
7) Forwarding of logs to decks, loading and transport of logs;
8) Operation of timber harvesting equipment on public right of ways and in forested areas;

9) Maintenance of harvesting equipment and vehicles;
10) Operation and maintenance of power saws;
11) Temporary closure of trail segments for safety and operational reasons;
12) Rehabilitation of haul roads, log decks and burn pile sites.

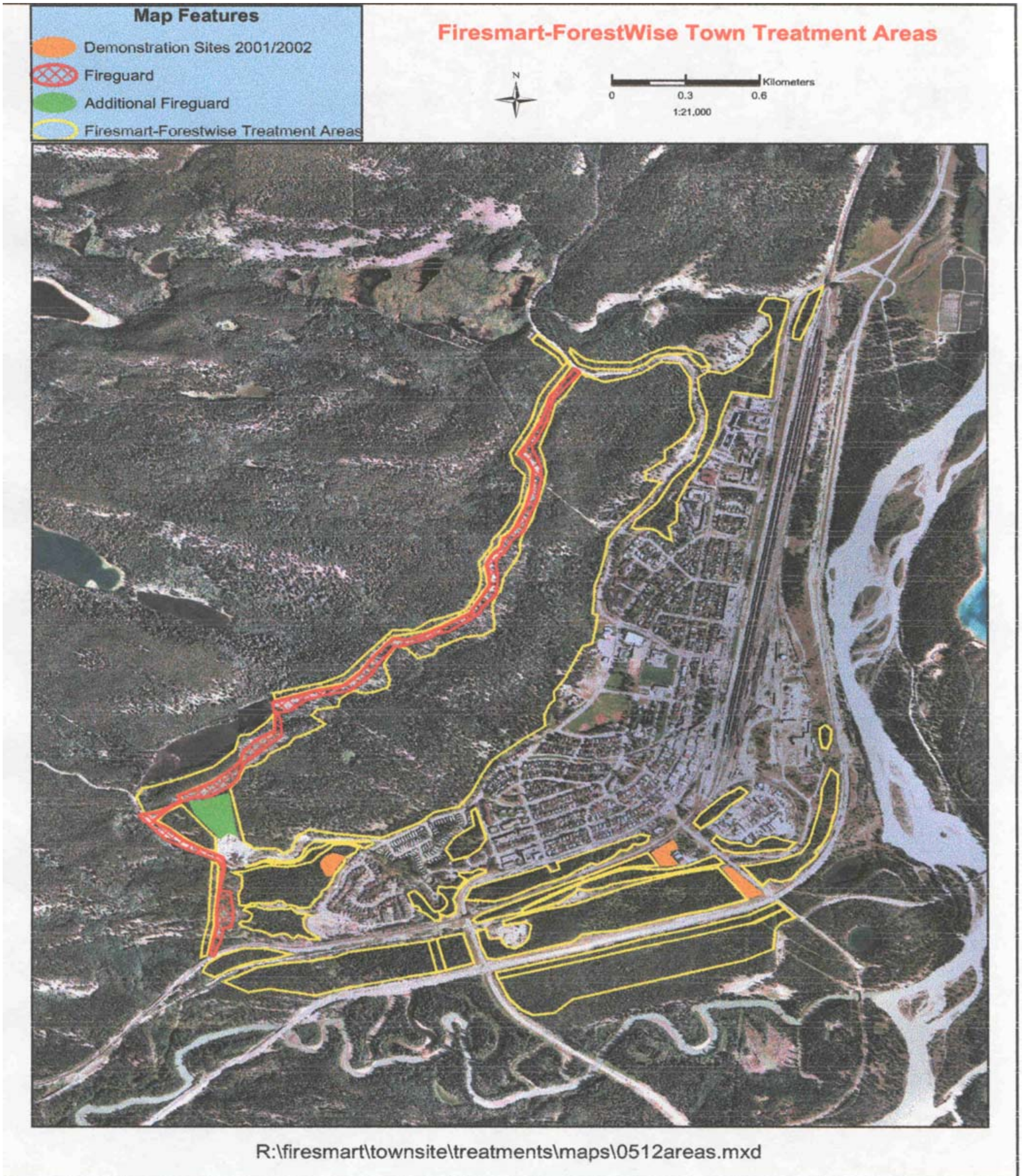

Figure 1-2. Town site fuel management /forest restoration areas.

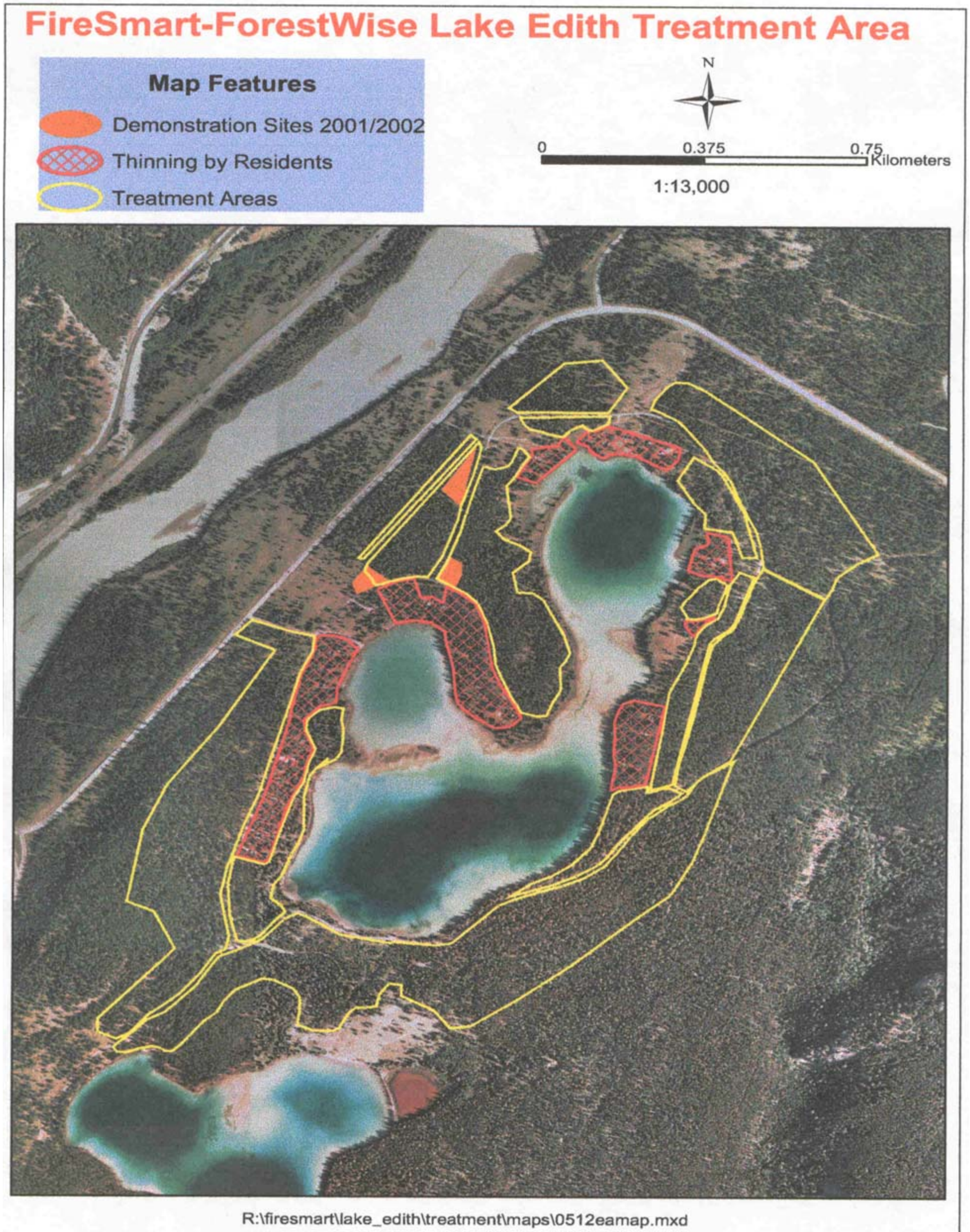

Figure 1-3. Lake Edith fuel management /forest restoration areas.

Project activities will be implemented progressively throughout the prescribed treatment areas over the next 3-5 years. The rate of project implementation (i.e. area treated each year) will be governed by the ability to do careful work that meets environmental standards set out in this assessment. It is projected that only 25 - 30% of the area may be treated in 2003 (i.e. up to 35 hectares of treatment adjacent the town and 50 hectares at Lake Edith) and that the size of treatment areas will increase in subsequent years. Project work will take place between October 01 and March 31 of each operational year but mechanical work will be restricted to periods after freezing of the soil and before spring thaw.

The project will be managed and supervised in the field by Parks Canada staff dedicated fully to this program. Equipment will operate under contract terms developed by Parks Canada and based on decisions taken pursuant to this environmental assessment.

1.4 Parks Canada Policy and Management Direction

Guidance set out by Parks Canada in policy and management plans provides an important context for assessing the effects of this project. Four key documents provide this information:

- Jasper National Park of Canada Park Management Plan (Parks Canada 2000),
- Jasper Community Land Use Plan (Parks Canada 2001),
- Three Valley Confluence Recovery Framework (Parks Canada 2002a),
- Terms of Reference for preparation of the Environmental Screening for the *FireSmart – ForestWise* Project (Parks Canada 2003).

Key guiding statements extracted from documents that have bearing on the project are summarized in the sections below.

Park Management Plan

- "Maintain the ecological structure and functions of the Montane ecoregion"
    - "Monitor, evaluate and, where possible, restore vegetation, appropriate behavior, and the population size and distribution of herbivores and carnivores"
    - "Restore appropriate fire regimes and evaluate their effect"*;*

- "Protect facilities, communities and adjacent lands from unwanted fires through suppression and fuel management ";

- "When vegetation must be removed, protect ecosystem functions and retain as much organic material and as many nutrients as possible"

- "Restore priority habitats, identified through ongoing research and monitoring, as closely as possible to the composition, structure and dynamics of native communities";

- "Continue working with government agencies and the resource industry to maintain or restore regional connectivity for wide-ranging species" (note local corridors contribute to the effectiveness of regional corridors);

- Implement approved recommendations to reduce elk/human conflicts in the community area and reduce bear/human conflicts;

- "Specific guidelines governing development, operation and management of the community will follow decisions arising from the approval of the Community Plan and will be considered part of this plan."

Jasper Community Land Use Plan

The Jasper Community Land Use Plan emphasizes that “residents and visitors to Jasper have long recognized that the community possesses a distinct character, which is drawn from the town’s natural setting and its significant history” and that “this forest contributes to a blending of the urban environment with the surrounding park”. Management direction for Town of Jasper and surrounding area includes the following key statements:

- “Residents value and promote… environmental integrity”, and “Jasper is a leader in sound environmental practices”;

- ”The principle of no-net-negative environmental impact will be achieved by ensuring that wildlife, plants, water, air and soil qualities will be better or no worse tomorrow than they are today*”;*

- Regarding open spaces: “wildlife corridors adjacent to the community will be protected, maintained and enhanced in order to encourage wildlife to travel around rather than through the community”;

- Regarding the wildland/urban interface*: “*a community-based strategy for protecting against wildfire that both restores forest structure in the Three Valley Confluence Area and improves public safety will be developed “.

Three Valley Confluence Recovery Framework

This document presents a strategy for ecological recovery in the area of the park that experiences the greatest amount of human use yet is arguably the most ecologically important. Four types of recovery actions are proposed: habitat connectivity, wildlife-human conflicts, ecosite and habitat diversity and aquatic health. Key concepts relevant to this screening are:

- Maintenance of regional wildlife corridors so habitat connectivity is assured (Signal Mountain, Lower Miette, Lower Maligne and Pyramid Lake corridors);

- Reduction of human/wildlife conflicts in terms of aggressive encounters between people and animals, and direct mortality due to collisions with vehicles or trains;

- Implement an integrated program of reducing fuel loads to protect facilities from wildfire concurrent with actions that restore natural disturbance (fire) wherever possible and reverse the impacts of past fire suppression on forest structure and habitat diversity.

Screening Terms of Reference

Within the Terms of Reference, Parks Canada established three priorities for the project *FireSmart – ForestWise* that contribute to identification of VEC’s:

- That management actions effectively reduce the risk of wildfire losses and increase fire protection for the communities;

- That management actions contribute to ecological restoration directly, through improvement of ecological conditions (i.e. within historical ranges of variability) with regards to forest structure and landscape pattern;

- That management actions contribute to ecological restoration indirectly, by facilitating the restoration of fire as an active natural process on the larger surrounding landscape (i.e. within its historical range of variability);

1.5 Methods

To help ensure the quality of this screening, a detailed methodology outlining steps for its preparation was prepared by the author and subjected to peer review by Dr. William Ross, University of Calgary, Faculty of Environmental Design. The methodology included an extensive process for scoping and evaluation of environmental and social impacts as well as environmental follow up activities to be conducted during and after project implementation. The methodology is summarized in Figure 1-4.

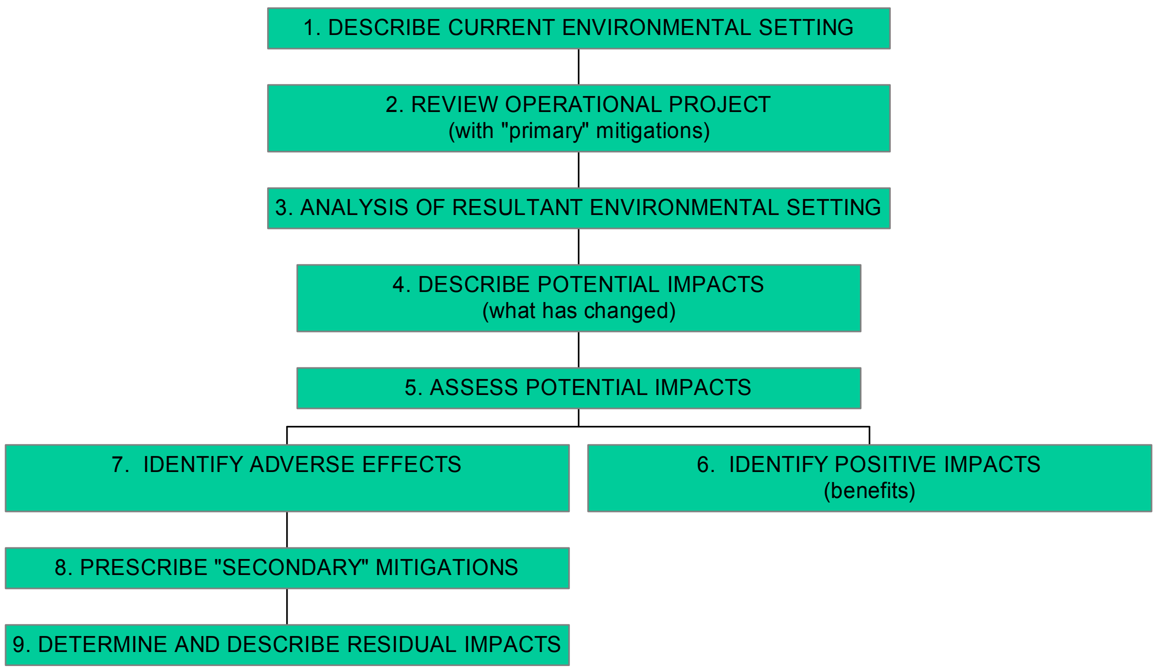

Figure 1-4. **Schematic of impact prediction process.**

In addition, a process for identifying and selecting valued ecosystem components was developed to help focus the task of impact evaluation on key issues, problems and concerns. This process was refined following peer review at the University of Calgary, Faculty of Environmental Design and then implemented. Although it was experimental, the process succeeded in adding further structure and greater objectivity to the standard Parks Canada approach. The methods for identifying valued ecosystem components are outlined below.

1.5.1 Methods for Scoping Project Impacts and Valued Ecosystem Components

Scoping entails the process of identifying the environmental issues regarding the project and determining their priority within the assessment process (Ross 2002). The objective of scoping is to identify "*valued ecosystem components*". That is, elements that may sustain impacts which are important enough to make a difference to the decision about the project. The term valued ecosystem component (VEC) is used broadly here and may include social, cultural and economic elements as well as biological and ecological elements of the project environment.

Parks Canada Policy and Plans

Parks Canada (PC) is both the Responsible Authority in regards to the CEAA process and the agency with primary jurisdiction over the land and resources involved. Guidance set out by PC in four key policy and planning documents was central to determining valued ecosystem components and their degree of importance. Key statements were extracted from the Jasper National Park Management Plan, the Jasper Community Land Use Plan, the Three Valley Confluence Recovery Plan and the Screening Terms of Reference and are listed in section 1.4.1

Scoping Methods for Determination of Ecological Components

Scoping inputs obtained from Parks Canada sources were augmented by canvassing a wide range of other external sources to gather additional information on potential issues and candidate VEC's. A variety of methods were utilized during the scoping process including:

- Discussions and on-site inspections with managers of similar projects in other Nat'l. Parks;
- Discussions and onsite inspections with managers of similar projects in other jurisdictions;
- Personal observations or related project activities inside and outside park lands;
- Focus meetings with Parks Canada managers, biologists and specialists in JNP;
- A survey mailed to seasonal occupants of Lake Edith;
- On-site consultations and focus sessions with park residents, special interest groups and members of the Jasper Interface Steering Team *;
- Round-table discussions and site visits with Parks Canada cultural resource specialists and representatives of the aboriginal and Metis people;
- Consultation and on-site visits with external resource management experts and contracted specialists;
- Contracting a private sector consultant specialized in forest ecology and harvesting techniques (i.e. Mr. Herb Hammond of Silva Ecosystem Consultants);
- Off-site visits and consultations with operational foresters and forest contractors involved in silvicultural thinning practices;
- Conducting extensive literature review of scientific and technical literature.

* The Jasper Interface Steering Team is a group of residents concerned with protecting the community against fire and restoring ecological health to surrounding forests. It includes representatives from the Municipality of Jasper, Jasper Tourism & Commerce, Lake Edith Cottage Association, Outlying Commercial Accommodation Association, Jasper Hotel Association, Jasper Volunteer Fire Brigade, Jasper Environmental Association, Town of Hinton, ATCO Electric, Fairmont Jasper Park Lodge, RCMP, Foothills Model Forest, Alberta Sustainable Resource Development and Parks Canada.

Scoping of Cultural Resource Components

Due to the specialized nature of this subject, it was necessary to employ a different scoping approach for cultural resources. Consequently, the services of JNP Cultural Resource Specialist Rod Wallace and Dr. Peter Francis, an archaeologist with Parks Canada, Calgary were engaged to assist in identifying the location and nature of historic and pre-historic resources, and in determining potential impacts and mitigations.

Mr. Jimmy Ochiese, an aboriginal elder representing the Foothills Ojibwa, provided invaluable traditional ecological and cultural knowledge. As a result, project managers gained insights into a number of significant cultural sites within the area.

Scoping Methods to Assess Public Attitudes and Social Issues

The scoping process was extended to include issues from the social and economic spheres as well as ecological/cultural issues. For example, it was essential to incorporate issues like maintaining aesthetic qualities (i.e. the "natural" setting of the town site environment) and reducing public safety risks. To gather information specific to these issues several additional methods were used:

- Review of working files and minutes of meetings held during development of the Jasper Community Land Use Plan to locate details as to citizen attitudes and values regarding landscape aesthetics;
- Attend meetings held by the Municipality of Jasper regarding the preservation of "green spaces" within the town site to generate discussion and gather additional insights about public attitudes;
- Consultation with members of the Jasper Interface Steering Team who represent major stakeholder groups in the community. These representatives participated in field tours specifically to discuss the issue of aesthetic qualities afforded by various combinations of forest structure and composition;
- Numerous public presentations about the *FireSmart – ForestWise* project were made by the project manager in the period leading up to completion of the Screening; these were effective opportunities to solicit further views on public values and concerns.

Evaluation of Scoping Inputs – Selecting Valued Ecosystem Components

For this particular screening, a "matrix" approach was devised to present results of efforts to evaluate the importance of potential problems, issues and concerns identified during the screening process. Problems, issues and concerns were rated against a set of defined considerations. Of necessity, many of the considerations parameters (e.g. park guiding statements) are based on human values. The considerations used were:

- Degree of agreement with priorities within the screening terms of reference,
- Degree of agreement with Park guiding statements,
- Degree of agreement with relevant statements from Jasper Community Land Use Plan,
- Risk to threatened or endangered species identified by COSEWIC,
- Benefit to human health and/or safety
- The seven attributes suggested by the Canadian Standards Association for evaluating impact significance. These attributes are societal value, ecological value, duration, frequency, geographic extent, magnitude, and reversibility.

In accord with criteria outlined in Table 1-1, numerical ratings of 0 to 3 were assigned to each cell in the matrix with "3" implying higher importance. Since all considerations were not of equal importance, they were weighted by multiplying more important considerations by a factor of 1.5. Finally, rating values were summed and the highest-ranking issues given "VEC" status. These VEC's were then assessed in detail throughout the remainder of this Screening document.

1.5.2 Scoping Results

Key Statements From Park Guidance

Each of the four major guiding documents provided important information or context for determining what should be considered as valued ecosystem components or impacts, and their degree of importance. These were summarized in section 1.4.1 "Parks Canada Policy and Management Direction" and are not duplicated here.

Table 1 - 1. Criteria for rating importance of problems, issues and concerns (next page)

CONSIDERATION	CONSIDERATION DEFININTION AND NUMERICAL RATING	
TERMS OF REFERENCE - 3 PRIORITIES	Degree of agreement with 3 priorities in screening Terms of Reference	
	Strongly supportive (closely related to 2 or more priorities)	3
	Moderately supportive (closely related to at least one, somewhat to others)	2
	Weakly supportive (somewhat related to one or two priorities)	1
	Not directly linked to any of the three priorities	0
PARK MGMT PLAN/ 3VC	Degree of agreement with statements in the Park Management Plan and the Three Valley Confluence Recovery Framework	
	Strongly supportive of key actions and stated objectives	3
	Moderately supportive of key actions and stated objectives	2
	Weakly supportive of key actions and stated objectives	1
	Not directly linked to stated goals or key actions	0
HUMAN HEALTH AND SAFETY	Degree of potential benefit to human health and safety	
	Likely to be strongly beneficial	3
	Likely to be moderately to weakly beneficial	2
	Likely to have a neutral effect	1
	May have a negative effect	0
COSEWIC LISTED SPECIES	Degree of potential benefit to COSEWIC listed species	
	Likely to be strongly beneficial	3
	Likely to be moderately to weakly beneficial	2
	Likely to have a neutral effect	1
	May have a negative effect	0
COMMUNITY LAND USE PLAN	Degree of agreement with statements in the Jasper Community Land Use Plan	
	Strongly supportive	3
	Moderately supportive	2
	Weakly supportive	1
	Not directly linked to Land Use goals	0
ECOLOGICAL VALUE	Degree of potential ecological value	
	Likely to be highly beneficial	3
	Likely to be moderately to weakly beneficial	2
	Likely to have a neutral effect	1
	May have a negative or adverse effect	0
DURATION	The duration and nature of impacts are:	
	Long term/positive or short term (<1 yr.) if adverse	3
	Moderate term positive or adverse (1 – 25 years)	2
	Short term positive	1
	Long term adverse	0
FREQUENCY	The frequency and nature of impacts are:	
	Frequent or continuous positive or rare (<1/year negative) impacts	3
	Sporadic (1/year to 1/week) positive or adverse impacts	2
	Rare positive (<1/year) impacts	1
	Frequent (>1/week) adverse impacts	0
EXTENT	The geographic extent and nature of impacts are:	
	Regional or greater scale positive impacts	3
	Localized scale positive or single point adverse impacts	2
	Single point positive impacts or localized adverse impact	1
	Regional adverse impacts	0
MAGNITUDE	The magnitude of and nature of impacts are:	
	Greatly enhanced function or no measurable disturbance	3
	Moderately enhanced function	2
	Measurable disturbance with no loss of function	1
	Measurable disturbance with loss of function	0
REVERSIBILITY	The adverse impacts are reversible in the:	
	Short term (<1 year)	3
	Moderate term (1 – 25 years)	2
	Long term (>25 years)	1

Other Issues and Candidate VEC's Suggested through Consultation

Consultations with citizens, park staff, interest groups and others have resulted in another list of potential problems, issues and concerns regarding possible impacts and candidate VEC's. These were sorted into three categories as listed below:

Ecological

- Desirable to restore ecological structure of forests without increasing artificiality;
- Important to avoid increases in berry production that would attract bears to town;
- Predator and ungulate mortality on highways adjacent developed areas;
- Preference for decreasing the amount of elk calving habitat adjacent to developed areas (attracts large carnivores);
- Long-term increase in grizzly bear habitat effectiveness at landscape level;
- Actions that will favour predators and predator access in predator/prey interactions, or make elk more vulnerable are desirable;
- Wind throw may accelerate after thinning;
- Measures will be required to avoid conflicts with amphibians;
- Erosion of stream banks and lake shores to be avoided;
- Protection of woody debris (in stream) habitat structure;
- Retention of course woody debris for amphibians, insects and small mammals;
- Avoidance of municipal storm water outflow channel to ensure water absorption;
- Wetlands at Little Cabin outflow area and black spruce bog areas on bench;
- Great blue heron nesting site at Lake Edith;
- Air quality, smoke concerns;
- Toxic material or petroleum spills.

Social

- Widespread concerns regarding the need for risk reduction;
- Concern for protection of cultural resources (historic and pre-historic);
- Need for preservation of 3 known cultural sites in the Lake Edith area;
- Must respect the need for confidentiality with regard to fragile cultural sites;
- Concern that more open forest may encourage increased mountain biking use;
- Open forest desirable as it would allow detection of wildlife at greater distance and decrease probability of dangerous encounters;
- Aboriginal people share park concerns regarding changes due to fire exclusion;
- Maintaining a variety of stand diversity (different forest types, structures and compositions) is aesthetically important to residents and recreationists;
- Multi-layered forest are more visually appealing and more of a recreational resource than single-layered (less diverse) pine monocultures – increased biodiversity correlates well with aesthetic values;
- Active management to augment natural tree replacement would be an acceptable mitigation in areas where wind throw and sound/visual screening is a concern;
- Noise from machinery
- Visitor/residence experience and potential for area closures;
- Public safety.

Economic

- Assurance that revenue from sale of timber is retained within the project for operational and environmental protection measures;
- Providing adequate vegetation for visual screening and sound buffering between commercial/residential areas and transportation corridors is very important;
- Costs due to wildfire losses and fire suppression costs.

Consolidated List of Problems, Issues and Concerns (PIC's)

From all sources, a consolidated list of problems, issues and concerns that could potentially arise within this project was developed. This list was prepared without consideration for mitigations that could eliminate or reduce them. Each of these PIC's are candidates to become a "valued ecosystem component".

Table 1 - 2. Consolidated list of problems, issues and concerns

#	PROBLEMS, ISSUES OR CONCERNS
	ECOLOGICAL
1	Restore the composition and ecological structure of Montane forests to within the historical range of variation (HRV); reverse the effects of fire suppression
2	Restore the natural process of fire and ecosystem functions to within HRV
3	Threatened, endangered or listed species
4	Restore dynamics between predators and prey
5	Improve the abundance/ extent of scarce ecosystems
6	Restore landscape patterns
7	Maintain or restore habitat connectivity for wide-ranging wildlife species; encourage wildlife travel around, not through, the town site
8	Take measures to reduce wildlife/human conflicts (i.e. bears and elk) and limit wildlife mortality
9	Increase grizzly bear habitat effectiveness at the landscape level
10	Excessive wind-throw
11	Protection of riparian areas and wetlands
12	Protection of amphibian populations
13	Retention of coarse woody debris in forest and aquatic habitats
14	Apply the principle of "no-net-environmental impact"
15	Soil or water contamination
16	Non-native plant species
17	Knowledge gaps regarding wildlife responses to fuel management activities
	CULTURAL
18	Confidentiality regarding location of aboriginal cultural sites
19	Respecting the character of aboriginal cultural sites
20	Protection of historic sites
	SOCIAL
21	Increase the level of protection for people, property and public facilities from wildfire
22	Maintain the "natural" setting of the town
23	Encourage community involvement and stewardship
24	Short and long term implications for recreation (recreationists)
25	Resident and visitor safety
26	Smoke
27	Noise
	ECONOMIC
28	Reduce the risk of wildfire losses
29	Revenue from sale of surplus timber is utilized as per Parks Canada directive
30	Adequate vegetation for screening commercial and residential areas is retained

Evaluation Matrix for Problems, Issues and Concerns

The matrix in Table 1- 3 contains information about the relative “importance” of the problems, issues and concerns listed as a result of the scoping process.

All evaluation considerations were not deemed to be of equal importance. For example considerations pertaining Parks Canada direction, human health and safety, legislated (COSEWIC) species and ecological value were given more importance than attributes such as duration, frequency, magnitude and reversibility since they reflect extensive public input and policy decisions. Rating values for considerations with greater importance were multiplied by a factor of 1.5 and added into the total scores shown in Table 1 – 3.

Table 1- 3. Matrix for evaluation of problems, issues and concerns (next page)

EVALUATION CRITERIA >>>>

MATRIX FOR EVALUATION OF PROBLEMS, ISSUES AND CONCERNS

RANK	PROBLEMS, ISSUES AND CONCERNS	TERM OF REF - 3 PRIORITIIES	PARK MGMT PLAN/ / 3VC	HUMAN HEALTH AND SAFETY	COSEWIC LISTED SPECIES	COMMUNITY LAND USE PLAN	ECOLOGICAL VALUE	DURATION	FREQUENCY	EXTENT	MAGNITUDE	REVERSIBILITY	TOTAL SCORE
	Weighting:	1.5	1.5	1.5	1.5	1.5	1.5	1.0	1.0	1.0	1.0	1.0	
	ECOLOGICAL												
2	Restoring forest structure and composition	3	3	2	2	2	3	3	0	2	1	2	30.5
1	Restoring Natural Process	3	3	2	2	1	3	3	2	3	1	2	32.0
11	COSEWIC listed species	1	3	0	3	1	2	1	0	3	1	2	22.0
	Benefit predator-prey dynamics	0	2	1	2	1	2	2	1	2	1	2	20.0
6	Abundance of scarce ecosystems	2	3	0	3	2	3	3	0	2	1	2	27.5
7	Restore landscape patterns	3	3	0	1	1	3	3	0	3	1	2	25.5
10	Habitat connectivity for wide-ranging wildlife	2	3	0	1	1	2	2	2	2	1	2	22.5
5	Reduce wildlife/human conflicts	1	3	2	2	2	2	2	3	2	1	2	28.0
7	Increase grizzly bear habitat effectiveness	1	3	0	1	1	3	3	3	3	1	2	25.5
	Excessive wind-throw	0	0	1	0	1	1	2	2	1	2	2	13.5
	Protection of riparian areas and wetlands	1	2	0	2	1	3	1	0	1	1	2	18.5
	Protection of amphibian populations	1	2	0	2	1	3	1	0	2	1	2	19.5
	Retention of course woody debris	2	2	0	2	0	2	2	0	1	1	2	18.0
	Principle of "no-net-environmental impact"	0	0	0	0	2	3	2	0	2	1	2	14.5
12	Soil or water contamination	1	3	1	0	2	3	1	1	1	1	2	21.0
13	Non-native plant species	2	3	0	0	1	3	2	1	1	1	2	20.5
	Knowledge gaps regarding wildlife/fuel mgmt actions	1	1	0	1	0	3	2	0	3	0	2	16.0
	CULTURAL												
12	Confidentiality of location of aboriginal cultural sites	0	3	0	0	3	0	3	0	3	3	3	21.0
12	Respecting the character of aboriginal cultural sites	0	3	0	0	3	0	3	0	3	3	3	21.0
12	Protection of historic sites	0	3	0	0	3	0	3	0	3	3	3	21.0
	SOCIAL												
3	Wildfire protection for people, property and facilities	3	3	3	0	3	0	3	3	2	1	2	29.0
11	Maintain the "natural" setting of the town	1	2	0	0	3	2	3	2	2	1	2	22.0
9	Encourage community involvement and stewardship	2	3	0	0	2	3	2	1	2	1	2	23.0
	Implications for recreation (ists)	1	2	1	0	1	0	1	1	2	2	2	15.5
	Resident and visitor safety during operations	1	2	3	0	2	0	1	2	1	1	2	19.0
	Smoke and Noise	1	1	2	0	2	0	1	2	2	2	2	18.0
	ECONOMIC												
4	Reduce the risk of wildfire losses	3	3	3	0	3	0	3	3	2	1	2	29.0
	Timber revenue utilized as per PC directive	1	0	0	1	2	2	2	0	0	0	2	13.0
8	Vegetation screening for commercial/ residential	2	1	2	1	2	2	2	2	2	2	2	25.0

Summary of Valued Ecosystem Components

As a result of the approach described above, nine key issues surrounding the project were identified and are referred to as valued ecosystem components throughout the remainder of this screening. In several cases the nature of individual PIC's overlapped and were, therefore, combined. See Table 1- 4 for the results of this process.

TABLE 1- 4. Valued ecosystem components relevant to the *FireSmart – ForestWise* project.

RANK	VALUED ECOSYSTEM COMPONENT
1	Restoring Natural Process
2	Restoring forest structure and composition
3	Wildfire protection for people, property and facilities
4	Reduce wildlife/human conflicts
5	Restore landscape patterns and abundance of scarce ecosystems
6	Increase grizzly bear habitat effectiveness and habitat connectivity for wide-ranging wildlife
7	Maintain the "natural" setting and vegetation screening for the town
8	Respect confidentiality and character of cultural sites
9	COSEWIC listed species

Table 1- 5 lists remaining, lesser issues. These issues were rejected as VEC's because, while they were raised in the scoping process, they were not deemed important enough in terms of influencing a decision about the project. Nonetheless, they have received consideration during project design and mitigations to deal with these problems will be implemented during operational phases of the project.

TABLE 1- 5. Other problems, issues and concerns relevant to the *FireSmart – ForestWise* project.

OTHER	PROBLEMS, ISSUES AND CONCERNS CONSIDERED IN THE SCREENING
	Benefit predator-prey dynamics
	Excessive wind-throw
	Protection of riparian areas and wetlands
	Protection of amphibian populations
	Retention of course woody debris
	Principle of "no-net-environmental impact"
	Soil or water contamination
	Non-native plant species
	Knowledge gaps regarding wildlife/fuel mgmt actions
	Encourage community involvement and stewardship
	Implications for recreation (recreationists)
	Resident and visitor safety during operations
	Smoke
	Noise
	Timber revenue utilized as per PC directive

2.0 ENVIRONMENTAL SETTING

This project consists of manual, mechanical and fire treatments to vegetation for the dual purposes of protecting the community from wildfire and improving ecological conditions.

The project area is located within Jasper National Park at lower elevations of the Athabasca River valley that are dominated by large tracts of continuous coniferous forest. The two areas that comprise this project are centred on the town of Jasper and the Lake Edith Cottage subdivision. More specifically, the project areas extend outwards from the perimeter of these urban developments for distances that range from 100 to about 400 metres in width. The project areas involve approximately 250 hectares in the case of the Town of Jasper and 100 hectares at Lake Edith.

The following description of the environmental setting for this project is focussed on elements that have direct bearing on one or more of the selected VEC's, project impacts to VEC's and/or mitigations that pertain to them.

2.1 Climate

Although it will not be impacted by this project, directly or indirectly, climate regulates all of the valued ecosystem components considered in this project. In particular, climate is a major determinant of vegetation structure, local fire regimes and, on a shorter time frame, fire danger.

The project is located within the "Montane" ecoregion (Holland and Coen 1982) that lies between the elevations of 1000 and 1350 metres. Although the Montane forms less than 7% of the park total land mass (i.e. about 80,000 hectares), it hosts a great diversity of wildlife and contains much of the critical wildlife habitat within the park. The Montane ecoregion is subject to highly variable seasonal and annual precipitation and temperature patterns typical of the continental macroclimate within the Canadian Rockies of this latitude (Janz and Storr 1977). Overall, annual precipitation is low (average is <40 cm) due to northwest-southeast trending mountain ranges that provide a rain shadow effect from westerly winds aloft and frontal ranges that frequently block upslope precipitation from the east. Mean annual temperature is +3 degrees Celsius; the summer mean is +16 degrees Celsius (Janz and Storr 1977).

2.2 Landforms and Soils

Variability in landforms and soils also has direct bearing on the type of vegetation that develops on specific sites. Landform creates limitations for the types of treatment and equipment that may be used in the project by its influence on erosion potential. Certain soil conditions effect the rate of vegetation growth and have implications for the resistance of trees to being toppled by wind.

Landforms within the study area are primarily level glacio-fluvial plains (Athabasca 1 and 3 ecosites), gently sloped alluvial fans (Fireside 1 and Hillsdale 4 ecosites), lesser areas of rolling moraine (Patricia 1 and 3 ecosites), and narrow inclusions of inclined, gullied stratified drift (Norquay 3 ecosite) (Holland and Coen 1982). With exception of Hillsdale 4, all ecosites are dominated by calcareous brunisolic soils that are well to very well drained. An area of luvisolic soils (i.e. soils with an impervious clay horizon) are located above the water reservoir.

In a recent analysis of current conditions in the Athabasca Valley, AXYS Consulting (2001) stated that current "fuel accumulations would generate wildfires of size and intensity beyond natural ranges of variation with consequent damage to ecological and edaphic (soil) conditions".

2.3 Landscape Patterns and Distribution/Abundance of Eco-sites

Landscape patterns are an expression of native biodiversity at many scales and analysis of them is essential to meeting park ecological goals through this project. Eco-sites are repeating entities that are used to classify and man the landscape. They reflect a unique combination of climate, landform, soil and vegetation conditions (Holland and Coen 1982). The relative distribution, abundance and pattern of ecosites across the landscape and within the project area are important measures of ecosystem health.

In order of their approximate spatial coverage, the dominant ecosites in the project area are Athabasca 1 (55%), Patricia 1 (15%), Norquay 3 (10%) and Athabasca 3, Patricia 3, Fireside 1 and Hillsdale 4 each with 5%.

By mere virtue of their location in the Montane zone, these ecosites are inherently rare within the park. Further analysis (see Table 2-1) of the Ecological Land Classification and work by Dobson (2000) reinforces the relative rarity of several Montane ecosites in terms of number and aerial extent within the park, particularly the Athabasca 3 and Hillsdale 4 ecosites. In addition, the high level of human use associated with the montane significantly reduces the habitat effectiveness (Dobson 2000) of these ecosites and further increases their importance.

Table 2-1. Ecosite frequency, relative area and effectiveness

ECOSITE	# POLYGONS	TOTAL AREA	% OF JNP	EFFECTIVENESS*
Athabasca 1	56	68.8 km2	0.63	56%
Athabasca 3	5	5.74 km2	0.05	55%
Fireside 1	56	24.12 km2	0.22%	75%
Hillsdale 4	17	8.25 km2	0.07%	46%
Norquay 3	71	104 km2	0.95%	91%
Patricia 1	111	148 km2	1.3%	95%
Patricia 3	47	81 km2	0.74%	98%

* Habitat effectiveness for breeding birds

2.4 Vegetation

The composition and structure of vegetation are important factors in determining the wildfire risk and habitat value of an area. Both attributes will be altered by project activities designed to reduce fuels and restore vegetation to within historic norms.

2.4.1 Vegetation Composition

Vegetation of the project areas is primarily (now) closed coniferous forest with minor enclaves of remnant grassland and trembling aspen. The coniferous forest is largely composed of mature sub-xeric lodgepole pine with lesser areas of Douglas fir forest and mixed conifer forest. Smaller components of white spruce and aspen forest are also present.

Dominant vegetation types (VT's) of the project area are summarized by ecosite in Table 2-2 as per the classification developed by Achuff and Corns (IN: Holland and Coen 1982). These data show a dominance of lodgepole pine forest types but also illustrate the importance of Douglas fir forest types and grassland elements. As a result of the forest structure problems described in 2.4.2, it is suspected that there are significant deviations in the diversity and mix of forest species not present from historical conditions.

Table 2-2. Dominant vegetation types of the project area

ECOSITE	VT1	VT2	VT3	VT4
Athabasca 1	C3	C6	C19	C1
Athabasca 3	H6	C3		
Fireside 1	C6	C19		
Hillsdale 4	H6	C3		
Norquay 3 (south facing slopes)	C1	L1		
Norquay 3 (north facing slopes)	C5	C19	H6	H7
Patricia 1	C6	C19	C3	
Patricia 3	C3	C6	C19	C1

Table 2-3 provides information on the dominant species of each vegetation type. Vegetation type O5 is not listed as a component of the mapped ELC ecosites but is present in patches too small to map separately.

Table 2-3. Dominant plant species by vegetation type in the project area

VEG TYPE (VT)	SPECIES 1	SPECIES 2	SPECIES 3	SPECIES 4
C1	Douglas fir	Hairy wild rye		
C3	Lodgepole pine	Juniper	Bearberry	
C5	White spruce	Douglas fir	Feather moss	
C6	Lodgepole pine	Buffaloberry	Showy aster	
C19	Lodgepole pine	Buffaloberry	Twinflower	
05	Douglas fir	Juniper	Bearberry	
L1	Shrub cinquefoil	Bearberry	North. bedstraw	
H6	Junegrass	Pasture sage	Wild blue flax	
H7	Wheatgrass	Pasture sage		

2.4.2 Forest Structure

Vegetation types with thick understories or co-dominant, intermediate or suppressed understories of lodgepole pine or Douglas fir are characteristic of the area. Stand age studies indicate that these dense understories have established and survived in the absence of periodic disturbance by fire. This is an overwhelmingly significant cumulative impact of past management interventions. A more detailed discussion of this problem is provided in Section 2.5.1. As a result, much of the current Montane forest structure is largely artificial and the result of past management practices rather than natural process (Herb Hammond Pers Com).

Studies in other North American locations document similar concerns with regard to this process of structural change. Covington and Moore (1994) described how once frequent low-intensity surface fires served to clean the forest floor of fine fuels and kill regenerating conifers. Mutch (1994) outlined that a lengthy period of fire exclusion resulted in widespread increases in stand densities and crown fire potential. Altered fire regimes throughout the Pacific Northwest resulted in concerns for forest health and a structural condition known as forest “ingrowth”. That is, when woody vegetation takes over grasslands and open forest stands (Risbrudt 1995).

The Government of British Columbia reports that over 3000 hectares of open forest and grassland are converted annually to closed forest (Walker 2002). As a result, they have developed management guidelines for fire-maintained ecosystem restoration (Gayton 1997) in response to tree establishment in previously treeless openings (encroachment) and excessive recruitment by Douglas fir in open forests (ingrowth). AXYS Consulting (2001) expressed concern for loss of landscape heterogeneity (e.g. coarse filter) in JNP as a result of this process.

2.5 Natural Disturbance

Disturbance regimes and the vegetation conditions that arise from them are at the crux of current issues of fire protection and ecological restoration. Project actions will attempt to reverse the impacts of past management interventions which altered natural disturbance regimes.

2.5.1 Fire History

The Montane ecoregion is notable, even within the Rocky Mountain parks, for its remarkably active fire history. Few areas in North America have been studied in more detail with regard to fire history than the Athabasca valley. Tande (1979) conducted the most intensive of these studies while others have contributed to the information and its analysis (Andison 2000).

The longterm fire regime of the area is characterized by frequent low intensity (stand maintaining) surface fires and less frequent high intensity (stand replacing) crown fires. Historically, low intensity, “stand maintaining” fires predominated in former grasslands, Douglas fir stands and open canopy pine forests of Montane valley bottoms and lower slopes. Higher intensity, stand replacing crown fires prevailed in moister continuous pine stands on the valley sides. Both humans and lightning contributed ignitions to these ecosystems for over 10,000 years.

A compilation of multiple fire history studies in the Alberta Rocky Mountains based on dendrological data from the 1500’s to present (Achuff et al. 2001) provides an overall picture of expected annual area burned for Jasper National Park. Park wide, a long-term average annual burn area of nearly 42 square kilometres (4,163 hectares) was calculated. In the Montane, mean historic fire cycles ranged from 50 years for Montane pine and Douglas fir dry forest (i.e. C1, C3, C6, O5 and C19 vegetation types) to 10 years for Montane shrub lands and grasslands (i.e. H6, L1 and some C3 vegetation types) within the study area. From these data, it is conservatively calculated that the long-term average annual area burned in the Montane should be about 1,500 hectares, or about 2% of the Montane each year.

Early park policies promoted fire suppression – and were effective. Park records show that less than 42 square kilometres (the historical average annual area burned) has burned in ALL wildfires since 1930 under this policy. Theoretically, this results in a fire cycle of almost 3000 years during the suppression era of fire management (Westhaver 2002) and, therefore, a considerable deficit in terms of area burned. Andison (2000) reached a similar conclusion by conducting a “rollback” analysis of stand age distributions in the Montane zone. He determined that less than 0.5% of the total Montane area has burned since 1931. This represents a low rate of burning that is historically unprecedented, whereas the natural range of variability for burning is between six and 54% of the Montane forests in a single 20-year period). Analysis of all available data from Rocky Mountain fire history studies by Van Wagner (1995) determined that the 1930-1995 “fire free” period was unique in the 500-year dendrological fire record. After studying 100+ years of weather data (Heathcott 1996) showed that this fire free period is not the result of reduced fire weather conditions.

The impacts of the recent “fire free” period are significant. This is especially evident when the relative amounts of older forest from 1930 are compared to that of today. Andison (2000) documents that over the past 65 years the amount of Montane forest older than 100 years has nearly quadrupled from 21% to 78%.

This shift in vegetation (habitat) heterogeneity was analysed in more detail in an area surrounding the Palisades by Rhemtulla (1999). She documented a loss of 60 percent of grasslands and conversion of more than 70 percent of open forest to closed forest during the fire suppression era between 1915 and 1995. (Figures 2-1 and 2-2)

In a similar, but much more extensive analysis of vegetation change Mitchell (2003) has concluded that large shifts in montane vegetation pattern and spatial heterogeneity occurred between 1949 and 1997. Grassland, forb, and wetland vegetation cover types decreased in total area, proportional representation, and number of patches. The spatial extent and proportion of the study area occupied by grassland vegetation decreased by just over 50%. Patch density (no. patches/100 ha) of grasslands similarly decreased by 58%. A 30% decrease in patch density was also noted for coniferous forest cover.

Spatial extent of sparse and open coniferous canopy closure patches[1] decreased by 64% and 42%, respectively. Mean patch size of the higher density closed and dense canopy closure classes also increased significantly ($p<.001$ and $p=0.02$, $\alpha= 0.05$ respectively). Total area of closed canopy forest increased by 91%. Moreover, a 79% increase was seen in the proportional representation of this class relative to the other canopy classes (Mitchell 2003).

Fewer, larger, and more dense coniferous forest patches, coupled with decreases in total area, number of patches, and proportional representation of relatively rare grassland, forb, and wetland vegetation types over the past 50 years indicated a considerably more uniform and homogeneous montane landscape (Mitchell 2003).

Overall, the analyses by Rhemtulla and Mitchell indicate a significant ecological shift in forest structure and composition has taken place as a result of impacts on historic fire regimes as a result of cumulative effects of human activities in the modern era.

Footnote: [1] Coniferous canopy closure classes used by Mitchell were as follows: sparse (6-20%), open (20-40%), closed (40-60%), and dense (>60%).

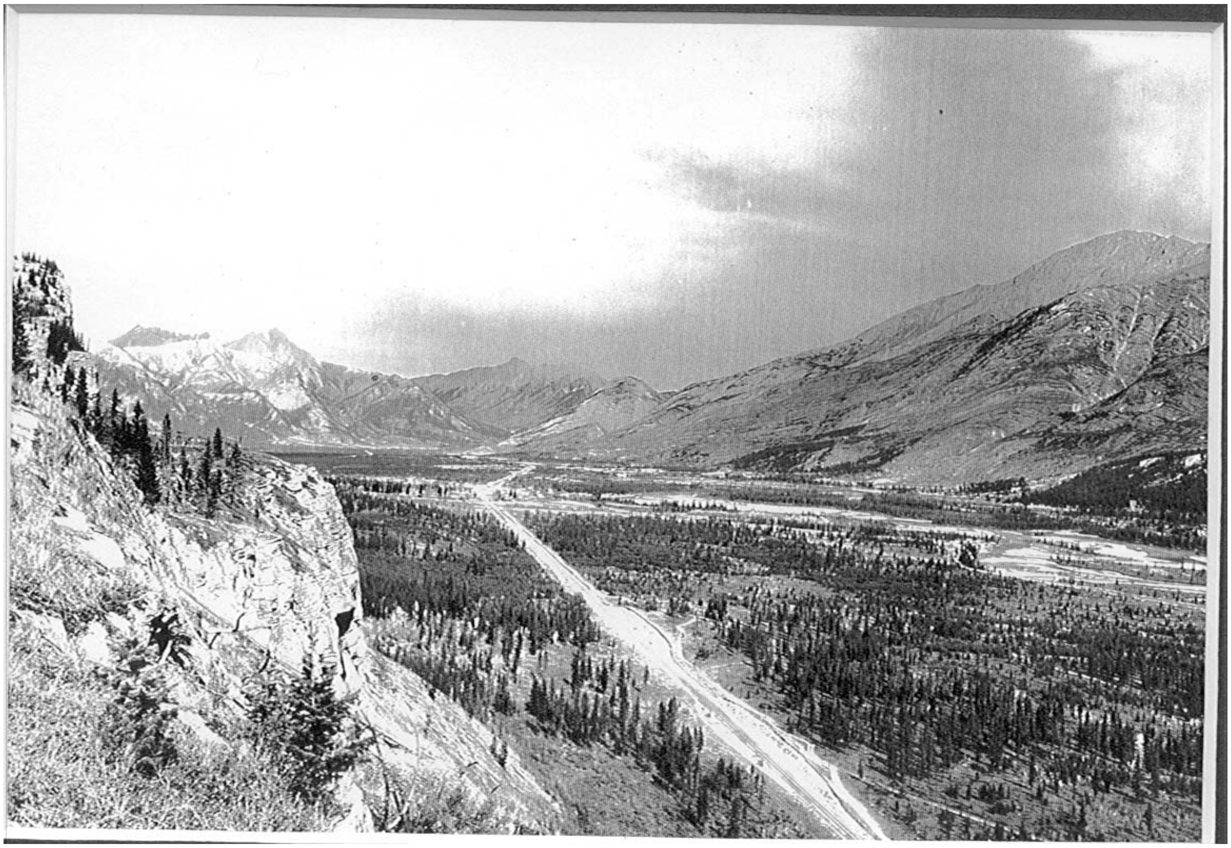

Figure 2- 1. 1915 photo of Athabasca Valley taken by James Bridgeland

Figure 2- 2. 1995 Re-photograph of same scene by J. Rhemtulla (1999)

In summary, habitat types dependent upon low intensity, stand maintaining fire events, such as open Douglas fir, grassland/pine savannah and grasslands have declined and are in need of active restoration efforts to recover from the effects of past management philosophies that lacked in ecological understanding.

Aspen forests are also in decline but this issue is complicated by the heavy browsing of elk (Bartos and Campbell 1998, Kay 1997). The Three Valley Confluence Restoration Framework (2001) cited “a near absence of natural disturbance processes in fire adapted and dependent ecosystems” and “subsequent loss of habitat for many species dependent upon early seral stages and open structured “old growth” forests”.

2.5.2 Fire Management

Despite the modernization of park policies to favor restoring the role of fire, the concentration of park amenities in the Three Valley Confluence continues to influence natural disturbance processes on surrounding landscapes and ecosystems. In order to protect the Town of Jasper and nearby developments from wildfire, managers have designated, and still designate, a large area surrounding urban “values at risk” as fire exclusion zones (Fenton and Wallace 1978, Kubian 1999).

To help quantify this impact, this suppression zone extends to include portions of three major watersheds thus depriving fire from an area of approximately 114,000 hectares. Theoretically, this area would experience an average of 875 hectares of fire per year under the historic fire cycle. When considered over a longer planning timeframe, the ecological and economic costs of maintaining this fire suppression zone are substantial. This influence on fire management options is being felt as far west as Mt. Robson Provincial Park in British Columbia (Wayne Van Velzen Pers Com). Simply put, unprotected human developments continue to block fire restoration in large sections of Jasper’s landscape.

Consequently, as outlined in its management plan (Parks Canada 2001) Parks Canada has concluded that the current fire regime (and subsequent conditions of forest vegetation) are significantly outside the historical ranges of variation. Parks Canada has also decided that fire must be actively restored to park lands but that risks to developed areas must be ameliorated.

2.6 <u>Wildlife</u>

Many of the valued ecosystem components selected during the scoping process for this project involve wildlife-oriented issues. Understanding these is vital to determining and mitigating project impacts.

An exhaustive eight-year inventory of wildlife, wildlife habitat and habitat use was conducted in the mountain parks as part of the ecological (biophysical) land classification. The two volumes that resulted provide detailed species accounts, watershed accounts and relationships between wildlife species, ecosites and vegetation types (Holroyd and Van Tighem 1983). All major species and species groups were sampled. Worthy of note, researchers developed “breeding bird communities” and described their affinities to major vegetation associations. Although these volumes are dated, wildlife-habitat relationships are relatively constant factors, and the information within them adequately describes current wildlife conditions within the project area.

2.6.1 Wildlife/Human Conflicts

There are two main categories of conflicts between people and animals: aggressive encounters (generally with elk or bears) and direct mortality of wildlife due to collisions with vehicles.

Aggressive encounters can occur in circumstances where people have limited control (e.g. surprise encounters) and in circumstances over which there is more control (e.g. purposely approaching wildlife). Elevated populations of elk and attraction of bears to human food sources are contributing factors that lead to aggressive encounters in Montane areas.

The presence of national highway and railway corridors within the project area account for many collisions with wildlife. These result in concerns for public safety, considerable property losses and significant wildlife mortality. Of greatest concern is the loss of top carnivores such as bears and wolves.

The Community Action Plan for Elk Management in Jasper National Park (Elk Action Working Group 1999) and the Bear/Human Conflicts Management Plan (Ralf and Bradford 1998) are community-based strategies that have been developed to reduce these types of conflicts.

Several forest attributes will change as a result of this project. In particular, the density of forest understory cover may decrease and the amount of preferred forage available may increase. Both attributes may be contributing factors in terms of future wildlife/human conflicts.

2.6.2 Grizzly Bear Habitat Effectiveness

The concept of grizzly bear habitat effectiveness is used throughout the park as a tool to estimate the impact of human use on sensitive wildlife species - one indicator of ecological integrity. Habitat effectiveness is a comparison between potential of an area to support grizzly bears and the actual value of the areas as bear habitat, after accounting for the impact of human disturbance (Parks Canada 2000).

The model predicts that habitat effectiveness for the Three Valley Confluence (where this project is located) is 61%, but that grizzlies will not use areas as home range if effectiveness is below 80%. Therefore, Parks Canada's objective is that the project area shall retain qualities that allow it to function as a link between areas that <u>are</u> effective grizzly bear habitat.

Similarly, the project area falls too far below the *security area* threshold of 68% for practical recovery to be possible. Rather than restoring habitat quality, the goal for this area is to prevent further erosion (Parks Canada 2000).

2.6.3 Habitat Connectivity – Wildlife Corridors

It is essential that wildlife, particularly wary carnivores, can avoid contact with people so that their movements through the landscape, between patches of important habitat, are not blocked (Parks Canada 2001). Monitoring has shown that several important corridors exist adjacent to the wildland/urban interface areas that will be treated by this project (Mercer and Purves 2000). These are illustrated in Figure 2-3.

The Signal Mountain corridor includes the bench lands on the lower slopes of Signal Mountain. This corridor lies to the east and upslope of the Lake Edith forest restoration/fuel management area but does not overlap with it (Mercer, Pers. Com).

The forest restoration/fuel management areas adjacent to the Town of Jasper immediately border both the Lower Miette corridor that lies to the south, and the Pyramid Bench corridor to the northwest.

The Three Valley Confluence Restoration Framework (2001) sets out management actions to maintain or improve the effectiveness of these corridors. Road closures, facility closures, improved maintenance of designated trails and reduction of informal trails and off-trail use are proposed as key actions to achieve improvements.

2.6.4 COSEWIC Listed Species

The Committee on the Status of Endangered Wildlife in Canada lists two species known from the project area as species of “special concern”. These are the grizzly bear (*Ursus arctos*) and the western toad *(Bufo boreas*).

2.6.4.1 Grizzly Bear

Grizzly bears are known to pass through the project area when travelling to portions of their home range. Occasionally, they are attracted to human food sources but systematically visit the area during spring elk calving. They are not known to den in the study area. Management actions actively discourage grizzlies from frequenting the area. (Bradford, Pers. Com)

2.6.4.2 Western Toad

The western toad is Jasper’s most common and widespread amphibian (Hughson Pers. Com). There are no known population centres within the project area but it is likely that the species ranges throughout mesic portions of the area during it’s active period (i.e. the frost-free period from mid-April to mid-September). The western toad is less likely to be found in the dry pine and Douglas fir portions of the project area (Hughson Pers. Com).

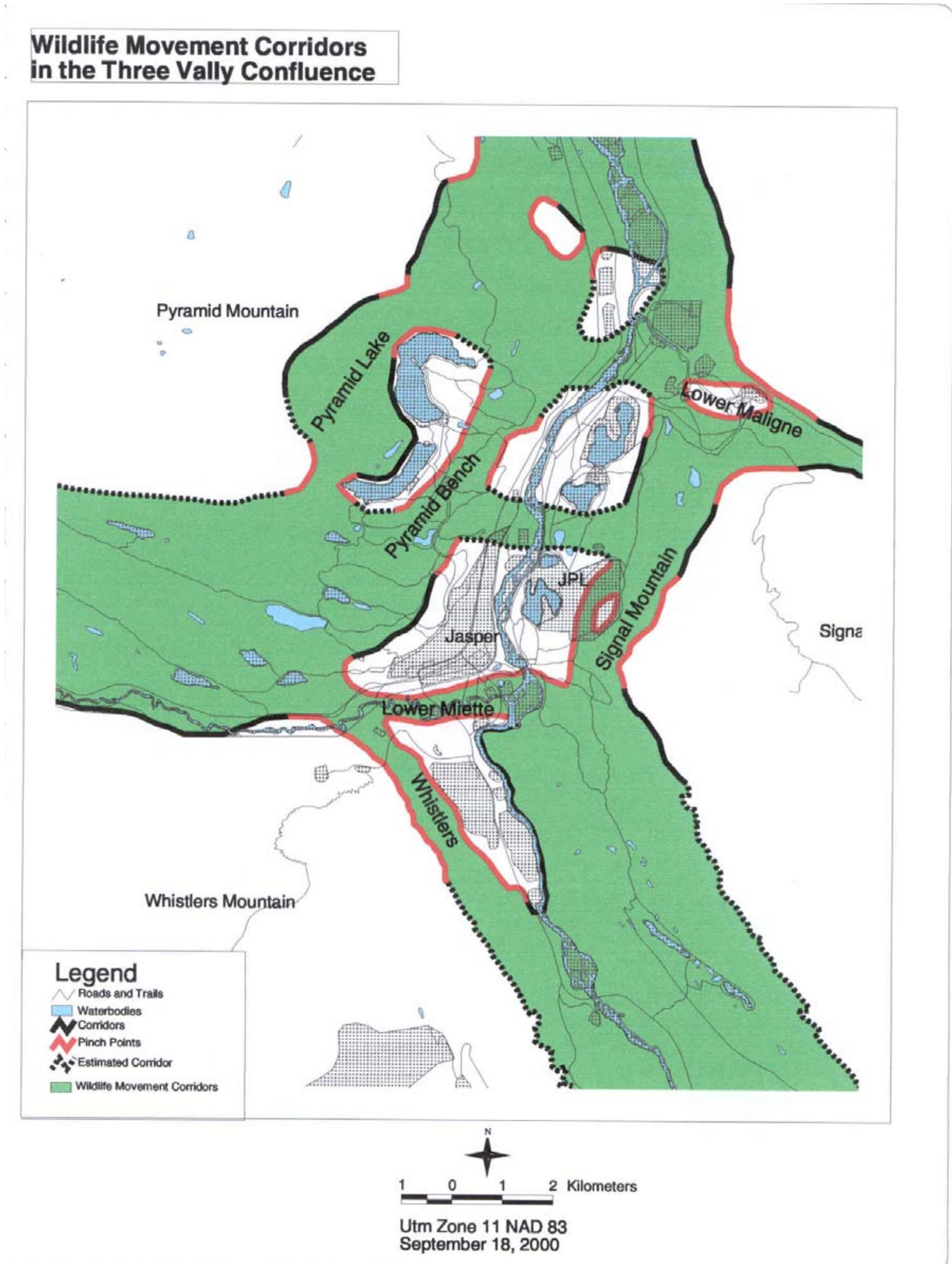

Figure 2- 3. Wildlife movement corridors in the Three Valley Confluence, JNP.

2.7 Aquatic/ Hydrological Resources

Aquatic resources in the project area are limited. Aside from the shoreline of Lake Edith itself, there are no other bodies of water or streams within the Lake Edith project area. No work will be conducted within 20 metres of any shoreline zone and shore gradients are very gradual. A sink-hole feature that is approximately 25 metres in diameter is located outside the work area, adjacent the Maligne road opposite a paved trail that will be used as a log haul route.

Project areas adjacent to the town of Jasper will encounter several aquatic features and riparian areas:

- The "wetland" at the northeast end of Little Cabin Lake (aka "No-Name Slough");
- The shoreline of Little Cabin Lake;
- Cabin Creek as it exits Little Cabin Lake and flows through the fireguard and into the town;
- Cabin Creek as it exits the town and flows towards the Miette River;
- The storm water outflow channel west of the Government Compound;
- Several black spruce "bog" sites on the Pyramid Bench;
- Several mesic gullies (no running water) descending from the Pyramid bench towards the town site;
- A spring located on the SW quadrant of Lake Edith and a 30 M stream that connects it to the lake.

It will be necessary to cross Cabin Creek with equipment and vehicles at a location opposite the town of Jasper water reservoir. The creek is known to contain rainbow trout. It is approximately 1.5 metres wide and 20 cm deep at this point and the banks are gradual.

2.8 Air Quality/ Air Shed

Air quality issues in the Three Valley Confluence are limited to periodic heavy summer concentrations of campfire smoke in the vicinity of nearby Whistler and Wapiti campgrounds and occasional winter concentrations of fossil fuel emissions around the town site (Parks Canada 2000). Winter time inversions that could trap smoke from debris burning do occur. Prevailing wind flow is from the west to southwest. However, during inclement weather an easterly flow does occur. At night time, cool air regularly descends the upper elevations and pools in the valley bottom.

2.9 Aboriginal People and Cultural Resources

People have been influencing montane ecosystems for over 10,000 years (Heitzmann 2001). However, in the post-European era, the type and rate of these influences have changed dramatically (White 2002). Prior to the influence of European man, aboriginal peoples appear to have ignited the majority of documented Montane fires and therefore played a significant evolutionary force in establishing ecosystem patterns and composition through their deliberate use of fire (Heitzmann 2001) (Wierzchowski et al 2002). Early park management efforts concentrated on prohibitions against traditional native practices of fire use (Murphy 1985) and placed a high priority on fire suppression beginning in the 1930's (Murphy 1985, White 1985). That form of fire management has now been rejected (Parks Canada 1989, USDA 1993) but effective elimination of the historic cycle of frequent disturbance by fire has left a legacy of altered ecological conditions.

2.9.1 Archaeological Resources Survey

Dr. Peter Francis of Parks Canada carried out a detailed archaeological resource impact assessment in the areas affected by the project during the summer of 2002 (Francis 2003). The survey inspected previously known sites and located several new, but minor, features. Features near Lake Edith include modern refuse pits (circa 1930), early survey markers, a potential pre-contact aboriginal activity loci, and three historic aboriginal cermonial sites. The most significant features (aboriginal ceremonial sites) at Lake Edith are largely outside forested areas and not part of designated work areas. The report recommended that the project proceed with appropriate mitigations.

Five previously known archaeological resources occur within areas affected by the project adjacent the town of Jasper. These features include an abandoned rail grade, two pre-contact aboriginal sites, a remnant of an early dairy and the important historic site of "Snape's Hill". According to Francis (2003), only the latter is considered a "very sensitive site" and only this site will require mitigations other than those standardized in previous fuel demonstration site projects. No significant new discoveries were made during the 2002 investigations.

2.9.2 Traditional Knowledge

A local member of the Foothills Ojibwa was the original informant regarding the aboriginal ceremonial sites noted in 2.9.1. As part of the environmental scoping process, that informant, Mr. Jimmy Ochiese, also guided park personnel to these sites in order to discuss their significance and measures for their protection. As well, he provided confidential information regarding several other ceremonial sites located within the project area but previously unknown to Parks Canada personnel. As a condition of receiving this information, and to ensure that the physical and spiritual characteristics of these new sites are fully respected, the author has agreed not to reveal the sites (Ochiese Pers. Com.)

Following inspection of forest restoration and fuel management demonstration sites constructed in 2000 and 2001, it is the opinion of Mr. Jimmy Ochiese, that the type of forest work being proposed will not harm but rather benefit these sites if done with respect. He stated that "what you are proposing, is a good thing". Mr. Ochiese will continue to work with project managers to develop mitigations to avoid impacts to the artefacts and special features of the sites that could be harmed by the project.

2.10 <u>Modern Human Use and Development</u>

Knowledge of local human use is key to avoiding conflicts with people during the project, and to understanding and evaluating the cumulative effect of the project with other activities.

Holroyd and Van Tighem (1983) report that low elevation Montane is the most productive and biologically diverse habitat found within Banff and Jasper National Parks, yet accounts for only 3 – 7% of the area. For management purposes, the portion of the Montane positioned at the crux of the Athabasca, Miette and Maligne valleys in Jasper is known as the "Three Valley Confluence" (3VC).

This area also receives the vast majority of JNP's human development and use, and is therefore subject to intensive cumulative effects. Many of JNP's most significant resource management issues are concentrated in this relatively small area. Consequently, an integrated management plan known as the "Three Valley Confluence Recovery Strategy" (Parks Canada 2001) was prepared to manage cumulative impacts. The strategy recommends a suite of ecological restoration actions that include restrictions on human use, restoration of impaired aquatic

regimes, carnivore conservation efforts, a non-native plant control program and the *FireSmart – ForestWise* initiative to restore forest structure and reduce the risk of wildfire losses.
The modern era of park development has resulted in dense concentrations of people, property and facilities in locations where they are now threatened by wildfire. For instance the town of Jasper, a community of 4700 permanent residents, has been established as a service node for park visitors and the administrative centre for Parks Canada and Canadian National Railways. The town area commonly hosts an additional 20,000 overnight visitors. Over one million visitors use the developed core of JNP each year replete with it's modern amenities and services (Parks Canada 2000). As such, Jasper figures heavily in the provincial and national tourism industry.

This project is focused on two nodes of human activity. Although the town of Jasper is well known, the Lake Edith cottage subdivision area is not. This area is a group of about 50 seasonally occupied homes comprised of about 50 individual leases surrounding Lake Edith. It was established in the 1920's and remains an accepted feature in the park.

2.11 Aesthetics and Natural Setting

Section 1.4 outlines the importance placed by residents and the business people on maintaining a "natural' backdrop for the community of Jasper. In essence, these are quality of life issues that are widely held within the community and largely reinforce the ecological concerns of Parks Canada.

Aside from its pleasing visual qualities, vegetation surrounding the town site is important in providing visual screening between residential and commercial accommodations and the industrial area, railway and highway corridors. Similarly, it functions as an effective noise buffer from industrial and transportation activities.

2.12 Economics

2.12.1 Wildfire Risk

According to the sustainability model developed by Haufler et al. (2002), wildfire risk is an important factor in the economic sphere. As outlined in sections 2.4 and 2.5, changes in forest density due to fire exclusion have resulted in extraordinary accumulations of live and dead forest fuels and, consequently, the development of extreme fire hazards. Protection of human life and property are the leading fire management priorities for the small urbanized portion of Jasper National Park comprised of the Municipality of Jasper, the Lake Edith cottage subdivision and various outlying commercial accommodations and developments. These concentrations of residents, visitor facilities, cultural resources and investments are permanently fixed on the landscape and exposed to a high degree of threat from wildfires (Mortimer 1998, 1999).

While residents of Jasper are taking important preventative actions to mitigate risk, their efforts are primarily directed towards infrastructure improvements, structural modifications and fuel reduction activities immediately adjacent to their own homes (Jasper Interface Steering Team 2002). However, the bulk of wildfire risk emanates from heavy forest fuels on park lands that surround such developments and the probability that these fuels will be accidentally ignited.

The present configuration of topography, climatic factors dictated by location and combustible fuels place these installations at extreme risk from wildland fire. Neither topographic (i.e. slope, elevation, aspect) or climatic variables (i.e. prevailing winds, low precipitation) can be altered by humans to reduce risk. Only the amount and arrangement of forest fuels is subject to management control. Accordingly, it is the primary factor in the risk equation that can be manipulated to reduce fire intensity – and the associated probability of wildfire losses.

3.0 DETAILED PROJECT DESCRIPTION (WITH PRIMARY MITIGATIONS)

As required by the Terms of Reference for preparation of this Screening (Parks Canada 2003), this section provides a detailed description of manual, mechanical, and fire operations required to remove, reduce or alter vegetation as required to achieve the fire protection and forest restoration objectives of the Foothills Model Forest *FireSmart – ForestWise* Communities project. "Primary" mitigations are integral to the project and have been incorporated into this description of project implementation. Additional, "secondary" mitigations are included in Section 4.0.

3.1 Risk Reduction Standards

Project actions being implemented to prevent or reduce the risk of ignition and loss of structures located in the wildland/urban interface are guided by prescribed standards. These standards require the removal, reduction or conversion of forest fuels to create less flammable conditions. Most recently, these were summarized by Partners in Protection (1999) but are based on a more universally accepted code produced by the National Fire Protection Association, NFPA 299 – Standard for Protection of Life and Property from Wildfire (1997) and on work in similar terrain by Arbor Wildland (1991).

The generic actions prescribed by these standards are summarized below. However, the application of standards will vary on a site-by-site basis depending on (1) the variation of physical factors that regulate fire behavior such as topography and prevailing winds, (2) the distance to values at risk and, (3) the need to minimize adverse environmental impacts across a complex, heterogeneous landscape.

In the case of the Foothills Model Forest *FireSmart – ForestWise* project, prescribed standards for risk reduction were the starting point for ecosystem - based prescriptions that are being developed to better incorporate habitat, wildlife and aesthetic concerns. Trees and forest patches removed during treatments will be chosen to mimic the effects of low intensity, stand maintaining forest fires and re-create a forest cover pattern and forest structure that resembles historic habitat types.

3.2 Fuel Management and Forest Restoration Activities

This project consists of treating forest vegetation by manual, mechanica,l and fire methods for the dual purposes of protecting the community from wildfire and improving ecological conditions. Achieving these goals requires that management actions be directed to all layers of the forest (i.e. overstory and understory trees, shrub layers, surface vegetation and debris) through treatments such as thinning to reduce stem density and pruning to eliminate lower branches.

3.2.1 Overstory Trees

Prescribed treatments will not remove all the forest cover. In order to discourage high intensity "crown" fires, whole coniferous trees will be selectively reduced (thinned) to achieve an average spacing between trees of 6 metres (or 1-3 crown widths). Spacing of 3 crown widths will be applied in areas of greater risk (e.g. 10 – 100 metres from structures, fireguards and access roads, and on steep slopes) whereas a spacing of 1 – 2 crown widths will be applied in areas that involve less risk. In Jasper, the average crown width of mature lodgepole pine is about 2.5 metres. Therefore spacing of 1-3 crown widths translates to a distance between stems of 4 to 10 metres in treated stands. For Douglas fir, the larger average crown width results in a distance between stems of 7 to 20 metres in treated stands. See Figures 3-1 and 3-2 for illustrations of pre and post-treatment stand conditions.

Total canopy cover is generally reduced to 30 – 40% in thinned areas. Deciduous trees are much less flammable and, generally, are left in place unless too abundant within the 0 – 10 m zone. Although spacing standards provide a useful guide, “geometric” thinning practices will be discouraged in this project. Instead, variability in spacing will be encouraged in order to achieve overall density targets while providing a variety in habitat characteristics.

As well, thinning will be selective:

- To preserve Douglas fir trees greater than 50 cm diameter at breast height (DBH);
- To allow for a range of tree ages, long-term replacement of canopy veterans and replacement snags;
- To leave older, open-grown pine with low branches that are more wind-firm and provide more cover (i.e. “wolf” trees) versus pine with high branches only;
- To leave lodgepole pine and Douglas fir with fire scars and stem irregularities that make them more valuable to wildlife;
- To favour removal of smaller diameter trees and retention of larger trees in single species stands (e.g. pure, dense lodgepole pine stands);
- In mixed species stands the order of preference for removal of conifers will be pine, spruce, balsam fir and Douglas fir;
- To preserve all live and dead trembling aspen and balsam poplar.

The practice of “cluster thinning” will also be applied in several situations. For example, in young dense stands of conifers, clusters can be preserved to provide further habitat diversity. In this practice clumps of 2 or more trees (not to exceed 10 m in diameter) are spaced from each other using the diameter of the cluster as the spacing measure instead of individual crown width. In areas of older “upland” pine, clusters simulate fire “skips” which are part of historic forest patterns.

During the project, minor adjustments to the configuration of the Pyramid Bench Fireguard will be made to complete the fireguard (a 100 metre section at the north-western corner was never finished) and to increase uniformity of width in short sections where it is less than 50 metres wide. In these areas, with exception of 150+ year-old Douglas fir, all trees will be removed so that fires burning into the fireguard can be more readily controlled and the safety of fire fighters assured.

3.2.2 Understory Trees

Coniferous understory trees contribute significantly to the initiation of crown fire behavior and also help sustain high intensity surface fire. As with overstory trees within 10 metres of structures, young conifers will generally be removed. Beyond this zone, standards (Partners in Protection 1999) also call for removal of most of understory conifers (including all small conifers growing under the canopy of larger trees) so that remaining understory trees are thinned to at least 4 metres apart, but not left in clumps.

In the *FireSmart – ForestWise* project, Douglas fir stands will generally be treated to this standard (i.e. the majority of coniferous regeneration will be removed) in order to replicate the role of fire and restore more forest structure to within the historic range of variability. In areas with suitable soils, hyper-abundant Douglas fir seedlings may be taken and transplanted to other locations for rehabilitation purposes.

Conversely, in pine stands with white spruce, balsam fir or Douglas fir regeneration, the younger trees will be preferentially left and the overtopping mature pine tree will be removed. This will achieve the spacing objective required for fire protection but also accentuate the natural process of forest succession and provide increased habitat diversity. In both stand types, treatments will vary in order to mimic the natural variability and “patchiness” of fire events. For example, clumps of regeneration or younger trees will be left sporadically thereby providing elements of habitat diversity and additional screening for wary wildlife species. As in the overstory, deciduous trees in the understory will generally be left in place.

3.2.3 Pruning of Trees

Low-lying branches of coniferous trees transmit surface flames into upper layers of the forest canopy via the "ladder" effect. Standards prescribe that the lower branches of <u>all</u> conifers, except those less than 8 metres tall, be pruned at least 2 metres from the ground. Smaller trees may be left un-pruned but additional space should be provided around them.

In this project, mature conifers will be pruned but in accord with surface fuel loads and expected flame length (i.e. in some cases, less than the standard 2 metres). As well, young conifers less than 8 metres in height will be will be left un-pruned but provided with additional clearance from surrounding mature trees to reduce laddering potential.

Figure 3 -1. Typical in-grown Douglas fir forest prior to prescribed treatments, JNP.

Figure 3 -2. Douglas fir forest following prescribed treatments, JNP demonstration site.

3.2.4 Tall Shrub and Shrub Layers

Young conifers in the tall shrub (2 – 5 metre) and shrub (0 – 2 metres) layers contribute to crown fire initiation and propagate surface fire. In this project, coniferous shrubs and tall shrubs will be treated as prescribed in section 3.2.2. Where they exist in clearings, thickets may be thinned, reduced in size or left alone to duplicate the natural "gap replacement" process.

Deciduous shrubs rarely present a fire concern and are exempted from treatments. Highly flammable junipers will be targeted for removal if dictated by their density, location under mature conifers or unfavourable topographic conditions.

3.2.5 Herbaceous Surface Fuel (Grasses and Forbs)

No treatments to reduce grasses or forbs are included in this project.

3.2.6 Coarse Woody Debris (fallen trees)

Medium surface fuels (e.g. branch wood) and heavy fuels (logs) contribute to surface fire spread and help generate the heat required to trigger crown fire activity. Standard guidelines state that downed tree trunks and smaller branches should be removed. On the other hand, fallen trees of all sizes and stages of decay are natural components of fire dependent forests and provide essential habitat for wildlife species ranging from small mammals and amphibians, to insects and soil microflora. They are also vital in terms of long-term nutrient flow in forest ecosystems.

In this project, most debris created from thinning and pruning of other forest layers will be removed by raking and burning in piles. Scattering of branches will be utilized in areas with low surface fuels or lower potential for crown fire, at the discretion of the Project Officer. In cases where accumulated branches and twigs are continuous on the forest floor, or nearly so, they will also be piled and burned or merely piled (the latter to provide habitat). Burn piles will be numerous and small in order to maximize the dispersion of nutrients and minimize the adverse impact of extreme soil heating.

Subject to fire protection considerations, special measures will be taken during this project to monitor, preserve and/or restore the variety sizes and decay classes of fallen trees that would be expected in natural Montane forest situations. For example up to 50 downed and decaying logs per hectare will be left in place as key habitat features for insects, small mammals and other wildlife. Operational guidelines and flagging will be used to avoid compaction of heavily decayed logs (highly valuable features) and ensure that fallen trees of all size and decay classes are provided in treated stands. Depending on the existing density of downed logs, additional stems > 10 cm may be limbed and randomly distributed on the forest floor, or left un-limbed and moved to open areas within the stand to further mimic natural disturbances. Placement of these trees will also be guided by an objective to deter increased activity by off-trail cyclists in treated areas. As an example of the latter, some veteran Douglas fir trees killed by Douglas fir beetle will be felled perpendicular to the slopes above town to discourage cyclists and protect soils from erosion.

Snags, legacy trees and other residual trees that fall due to old age or wind events will continue to add to the amount of course woody debris over the long term.

3.2.7 Snags (Dead Standing Trees)

Dead standing trees (snags) are highly important wildlife resources. Their importance is generally proportional to their diameter with snags less than 25cm DBH having little value except as temporary food sources. Coniferous snags < 25 cm will be left in locations where larger trees are not available. Coniferous snags >25 cm DBH will be left intact unless deemed necessary for safety reasons following consultation between the faller and Project Officer.

All deciduous snags will be left standing unless deemed to be unsafe. Douglas fir and aspen snags have the greatest potential for wildlife use and will be managed accordingly.

In event of large hazardous snags, mechanical topping will be given first consideration rather than tree removal. Dead, leaning trees or fallen trees not in contact with the ground will be removed.

3.2.8 Habitat Trees

Live or dead trees with cavities, nests or dens in the crown or bole are called *habitat trees*. Habitat trees of any species or diameter shall be retained in this project, except for those that must be removed for safety reasons. Prior to removal of hazardous habitat trees there must be consultation between the faller and the Project Officer. An area of un-thinned forest cover 5 – 10 metres in diameter shall be left surrounding habitat trees. More rigorous thinning adjacent to these enclaves will be required to compensate in terms of fire behavior but will also help emulate the natural micro scale variability of fire.

3.2.9 Legacy Trees

Legacy trees are living, large diameter trees that have high potential to become habitat trees. Examples are Douglas fir over 50 cm diameter at breast height, trembling aspen, balsam poplars, low-branched (“wolf-tree”) lodgepole pine and any conifer >30 cm DBH with fire scars, bole defects or obvious signs of disease or decay.

Not all stands have legacy trees but where they do occur at least 10 to 15 legacy trees per hectare will be left untouched. Where legacy trees do not occur naturally, up to 10 dominant canopy trees per hectare should be topped or “stubbed” at the maximum safe reach of the wood processor to create legacy trees for wildlife use.

3.2.10 Measures to Prevent Excessive Wind Thow

Toppling of trees by strong winds, either individually or in groups, is a natural process. However, treatments must account for this process and take measures to limit the potential for excessive wind throw. The major mitigations to limit wind throw are to:

- Identify and preserve the most wind-firm trees in multi-aged stands (these are generally the dominant or tallest trees with the greatest amount of living crown) as they have the largest existing root systems and are most able to resist wind by further expanding their roots;
- Focus on removal of co-dominant (shorter) individuals in multi-aged stands that are less stable and less able to grow new roots;
- Recognize that even-aged conifer stands have less defence against strong wind and leave periodic 30 – 40 metre wide strips of un-thinned trees, oriented diagonal to prevailing winds, as buffers to reduce wind pressure on thinned portions of the stand;
- Wherever possible, thin to greater densities in wind susceptible stands in recognition that wind will continue the thinning process after treatments are completed;
- Identify soils with clay horizons that cause water puddling and make trees more susceptible to wind throw (e.g. the area above the town water reservoir);
- Take special precautions to protect regenerating conifers in wind susceptible stands (where it occurs) and to augment natural regeneration with planting of seedling and sapling conifers where it does not and screening is important.

3.3 Fuel/Forest Conversion Actions

Conversion strategies promote replacement of flammable species with less combustible plants. Generally, this means management actions that favour fire-resistive plant species (i.e. those with higher moisture content and lower fuel volume). Standards recommend replacement of coniferous with deciduous species.

In this project, the primary potential for conversion lies with selective removals that will shift mixed-wood stands (i.e. mixed stands of aspen and conifer) back towards stands dominated by deciduous species. Therefore, selective removal of conifer regeneration will take place in the very few aspen stands within the project area. This will support the park's priority to favour rare and highly valuable aspen habitats.

3.4 Methods for Fuel Treatment

The primary methods of forest restoration and fuel management proposed in this project are manual, mechanical and prescribed burning techniques. Extent of these treatments is shown in Figures 1-2 and 1-3. Mechanical methods followed by manual treatments will be used in the majority of stands. Manual treatments will be used exclusively in a minority of areas where environmental conditions or sensitivities preclude mechanized work. Prescribed burn treatments will either follow mechanical/manual treatments or be the primary treatment as appropriate.

3.4.1 Manual Treatment Methods

Manual clearing using power saws, hand tools or by hand is an efficient, cost-effective method of achieving prescribed protection/restoration standards in areas where removal of significant numbers of large diameter trees is not required. Manual treatment methods will be applied in relatively open forests, very dense stands of young pine, old Douglas fir with thickets, mixed-wood stands and areas considered too steep for mechanized harvesting equipment.

During the Jasper project trained crews working under supervision of the Project Manager will accomplish this work. Crews will be provided with written guidelines and maps outlining the extent of treatments. On occasion, motorized chippers may be used to reduce large woody debris to more easily disposable or compostable particles.

Manual crews and methods will also be deployed as follow-up treatments in areas previously treated using mechanical treatments. This will ensure clean up and removal of limbs, non-merchantable trees and other debris and placement of large woody material where required to meet human use management objectives.

3.4.2 Mechanized Treatment Methods

Most fuel management projects employ traditional harvesting approaches such as hand falling aided by cable or grapple skidders to drag trees to decking areas, or large "feller-buncher" harvesters in combination with on-site de-limbers and skidding.

For this project contract specifications will favor the use of smaller, more manoeuvrable *wood processors* for use on level and gently sloping terrain. This type of machinery was developed in Europe and is designed for selectively removing target trees while protecting adjacent trees. Consequently, it can be used in specialized forest thinning treatments resulting in significantly less impact to the forest floor and residual vegetation. Generally, these machines travel on high flotation tires that place very low pressure on the ground surface.

Rather than requiring fallen trees to be skidded along the ground to central areas for de-limbing and processing, these machines process trees at the stump. This causes limbs to be spread on the ground in their own path of travel. This creates a vegetation matt that further reduces the potential for soil exposure of compaction. Sawn wood is then machine stacked and sorted for pick-up by mobile “forwarding” units or *forwarders* that also travel on flotation tires. This system eliminates damages due to skidding (dragging) of whole trees and concentration of debris at landings. It also reduces damage to soil and vegetation since as few as two passes over the same point on the ground are required during the entire operation. These are called cut-to-length logging systems.

De-limbing of trees at the stump increases the work required to rake and burn debris (as opposed to concentrating it at the landing sites) but also facilitates better dispersion and recycling of nutrients in the forest. That is, through ash from burned debris and longer-term decomposition of unburned organic materials.

Less than 5% of the project area involves steep slopes. If prescriptions call for removal of large trees in these areas, even more specialized logging techniques will be used. For example, on the steep scarp that descends from the Pyramid Bench to the town site margin, systems of cable yarding that lift cut trees off the ground and move them to accessible points at the top or bottom of the slope on a suspended cables would be deployed. In smaller areas with good access, hand falling and winching of trees down slope to level ground would create the least impact.

Also for this project, contract specifications will restrict the use of machinery to periods when the soil is frozen in order to minimize soil and vegetation impacts.

Figure 3-3. **Typical wood processor machine operating in frozen-ground conditions that minimize terrain impacts to thin pine forest.**

Figure 3-4. Typical self-loading log forwarder.

With exception of moist riparian areas, all forested areas between the town site and the Pyramid Bench fireguard will be thinned as part of this project. Treatment standards will ensure that the area can absorb burning embers from upwind areas but not develop crown fire intensities and become a further source of embers that would ignite structures within the town site or allow intense flames to impinge directly on homes.

3.4.3 Fire Methods

Fire has several applications within the *FireSmart – ForestWise* project. Since fire is an essential element of these ecosystems, efforts to maximize the use of fire will be made.

3.4.3.1 Debris Disposal

On-site piling and burning will be used as the primary means of disposing of woody debris and nutrient recycling on this project. Excessive woody debris (either pre-existing or slash resulting from tree removal) will be piled mechanically or manually then burned under continuous supervision by properly equipped and trained crews.

For practical reasons and to encourage nutrient dispersal, burn piles will be kept small (less than 4 metres in diameter), frequent in number and scattered in forest openings and along forwarding trails. In areas with abundant juniper, burn piles will be located on top of juniper clumps to reduce crown fire potential in these stands. Scorching of adjacent trees is to be minimized. As much as practical, ash piles will be dispersed to limit aesthetic impacts and increase nutrient cycling.

Experience in Jasper indicates that native vegetation quickly recolonizes burn pile areas. However, provision has been made to monitor these sites and actively reclaim them with native grass seed mixtures if re-vegetation is not progressing satisfactorily after two growing seasons. Experimentation has shown that burning racks or bins do not significantly reduce burning impacts on the ground and cause other forms of damage during transport (Pengelly Pers. Com); they will not be used in this project.

Detailed guidelines for burning forest debris have been developed by the Warden Service (Westhaver 1998) and applied successfully to previous projects to minimize the amount of smoke generated and avoid public concerns. These guidelines will be applied to this project. Key elements of these guidelines are:

- Debris burning should be restricted to the hours of 0900 to 1600 prevent overnight smoke drift and pooling at lower elevations;
- Requirements for deferring pile burning activities or extinguishment when smoke dispersal conditions or fire hazard dictate;
- Safety precautions.

Time of year reduces the probability of fire escape but monitoring will be conducted to ensure that hold-over fires do not develop.

3.4.3.2 Prescribed Burning

The prescribed burn component of this project will be discussed in general terms only. Specifics of prescribed fire as it relates to the *FireSmart – ForestWise* project will be assessed as individual prescribed burn plans are developed.

Prescribed fire is another viable technique for achieving forest restoration and fuel management objectives. It may be used in several ways depending on site-specific ecological conditions. First, there is some potential to use prescribed fire in the few areas within the interface (i.e. certain Douglas fir stands and former open pine stands) where local fuel accumulations have not exceeded dangerous threshold levels. This can occur after fuels have been treated in adjacent areas or, if fire containment within the unit can be achieved with suppression crews. Second, fire can and will be re-introduced safely to significant areas of the wildland/urban interface to fulfill many of its historic roles, after excessive fuels have been removed or reduced and the potential for extreme fire intensity abated. In these instances, prescribed fire serves both to further reduce fuel loads and as a long-term tool for maintaining historical stand conditions (i.e. duplicating natural disturbance). Prescribed fire could be particularly helpful on steep slopes where mechanical means could increase erosion potential.

3.4.4 Protection of Roads and Evacuation Routes

Public roads and designated evacuation routes play key roles in times of fire emergency. They must provide access for emergency fire fighters and equipment and allow simultaneous evacuation of persons from facilities and major developments. In the case of Jasper, national highway and railway transportation corridors also traverse the interface area thus reinforcing the need for adequate protection. Fuel thinning treatments prescribed in this project for protection of roads and evacuation routes are based on standards developed by the U.S. National Wildfire Coordinating Group as adapted by Arbor (1991).

In this project, areas where values at risk are significant and strong upslope winds can be anticipated, a total treatment width of 200 metres (consisting of 100 meters on each side) will be applied to essential transportation routes. Areas 0 – 50 metres below roads will be thinned more aggressively (i.e. 3 crown widths between stems) whereas areas from 50 – 100 metres below roads will be thinned to two crown widths. Treatment areas above such roads and those on level terrain will be thinned to two crown width density.

3.5 Salvage of Timber

All green timber removed by this project that is greater than 2.43 metres (eight feet) with a minimum (top) diameter of 10 cm inside the bark is considered as salvageable timber and will be removed for sale during this project. Recently fallen timber that is sound and has most of the branches and needles intact and is longer than 2.43 metres (eight feet) with a minimum (top) diameter of 10 cm inside the bark is also considered salvageable.

Sale of timber is permitted in accord with the Parks Canada Alberta Region Directive (1994). The directive specifies that timber cut as a result of crown initiated projects (e.g. highways, fireguards, etc.) may be sold but revenue generated shall be used to offset direct project costs including mitigation, rehabilitation and environmental research. A unique accounting system, separate from other government accounts, has been established to ensure open and accurate tracking of revenues within this project. Project accounts will be open to the public for scrutiny.

Total project cost is estimated to be about $1.5 million. It is expected that the sale of surplus timber will fund about $1.2 million of project costs and that the remainder will be covered by project sponsors. Analysis by Parks Canada indicates that revenue and partner funds will balance the costs of timber removal and environmental mitigations. If additional revenue is generated, in accord with the Directive, it will be invested in environmental research, monitoring, or projects that further maintain or restore the ecological integrity of the area.

3.5.1 Main Access (Haul) Routes

Throughout the project area existing public roads, abandoned paved roads, trails and unpaved right of ways specified by Parks Canada will provide adequate main haul routes for timber removal. Examples of these are the Lake Edith road, the water reservoir access road, municipal streets, the Pyramid Bench Fireguard road, horse trail “4F” near Lake Edith and the Lake Edith emergency exit routes (paved) that connect with the Lake Annette and Maligne Lake roads.

Several of the main haul routes will be used exclusively by highway log transport vehicles, others will be used only by log forwarding units and some by both; this will depend on contract bid proposals. Measures to protect improved public roads and motorists are noted below:

- Only routes designated by Parks Canada and the Town of Jasper will be used;
- Removal of early season snow to promote deep freezing;
- Minimize sharp turning on pavement by providing “flow-through” routes;
- Moberly bridge becomes one-way route when occupied by highway transport vehicles but is certified for highway loads;
- Permits are required for use of municipal roads;
- No special measures for maintenance of municipal roads or public highways are anticipated to accommodate this project;
- Seasonal weight restrictions will be respected;
- Measures to avoid travel by machinery fitted with chains on asphalt surfaces will be taken;
- Flag persons and speed controls will be implemented as required for public safety.

3.5.1.1 Cabin Creek Stream Crossing

A single temporary stream crossing is required during this project. The crossing is located on Cabin Creek as it crosses the Pyramid Bench Fireguard immediately below the water reservoir. Cabin Creek is approximately 1.5 metres wide at this location and no more than 20 cm. deep.

The same method that was successfully employed during the winter of 1998/99 (Parks Canada 1999) to construct a stream crossing for machinery at this location will be used for this project. As described in the Handbook of Forest Stewardship (Logan 1999) 2-3 logs will be placed in the stream parallel to the banks to allow continued water flow and form a base. Additional logs will be placed in layers of alternating direction on top of these and packed with snow to form a stable bridge. Logs and snow will be removed prior to run-off. See Section 4.0 for additional mitigations. Alternatively, the creek will be bridged to avoid any direct contact damage.

Figure 3-3. Proposed location of Cabin Creek stream crossing (full flow conditions)

3.5.2 Internal (Secondary) Access Routes

Two types of secondary forest access routes are required. These are called *forwarding trails* and *ghost trails*. Unlike traditional harvesting road systems, the use of more versatile commercial thinning equipment will limit the total number of vehicle passages over internal access routes to as few as two passes. It will also prevent establishment of identifiable (worn) "trails" resulting from vegetation damage and compression or exposure of soils caused by larger harvesting equipment.

Most commercial wood processors and forwarders are less than three meters in width and operate effectively on trails that are 3.0 to 4.5 metres (or less) in width. In most cases this is less than the prescribed distance between trees in the treated stands, therefore the trails will be almost imperceptible once the project is complete.

Forwarding trails are relatively straight and are regularly spaced 25 or more metres apart throughout the treatment areas. These are initially travelled by the wood processor as it makes it's first pass through the forest to selectively cut trees by reaching out 6.5 metres to remove trees on either side of the trail. Later they are used by the log forwarding unit (a wheeled tractor/trailer unit that loads logs into itself with a crane). Forwarding trails will "dog-leg" at least thirty degrees within the first 25 meters of intersections with haul routes to avoid creating noticeable sight lines that could invite future recreational use.

Ghost trails meander between the forwarding trails. These allow the processor to selectively thin the remaining stand area between forwarding trails. As with forwarding trails, these are then travelled by the log forwarder to pick up cut wood.

Measures to reduce soil compaction or exposure and vegetation damage on forwarding and ghost trails are:

- Packing of snow to pad soil and vegetation and accelerate frost penetration;
- Hauling of additional snow, branches or chips and icing unpaved trails to further insulate and pad the ground where required;
- Avoidance of wet areas (e.g. black spruce "bogs");
- Filling holes with sand or gravel;
- Stump removal will NOT be permitted on any routes used in this project;
- Maintenance of main and secondary haul routes will be the responsibility of the contractor (Parks Canada will provide early season snow removal and continue routine maintenance of the Pyramid Bench Fireguard and Reservoir roads);
- Route selection to avoid crushing decayed fallen trees wherever possible.

3.5.3 Log Landings

Log landings are areas where logs are temporarily deposited by forwarding units before being loaded onto highway transport vehicles. In order of preference, landings will be located in existing disturbed areas, along existing right-of-ways, and in existing forest openings and openings created as part of forest restoration. Landings will be chosen by Parks Canada to avoid all ecologically and culturally significant sites.

Landings need to be within 250 metres of source areas and will be located strategically throughout the project area. By specifying that logs shall be cycled quickly from landings to mill, the number of landings will be minimized. Suitable sites should hold at least 500 cubic metres of wood; minimum sizes are 5 by 35 metres.

3.5.4 Protection of Public Roads

These activities and measures are described in sections 3.5.1 and 3.5.2.

3.5.5 Log Loading and Transport

Log loading onto highway transport vehicles will take place at approved landings located adjacent main haul routes only. Loading from landings adjacent to public highways (e.g. Maligne Lake Road) will require cautionary traffic signs and a flag person.

Transport of logs on public highways will be in accord with the Provincial Highway Traffic Acts (Alberta and British Columbia) and applicable forestry regulations.

3.5.6 Equipment Maintenance and Servicing

Contracts will specify equipment be inspected daily for leaks and stressed hoses, that preventative repairs be performed, appropriate spill kits are kept on-site and that any spills are reported immediately to Parks Canada (911or 852-6155). Repairs requiring draining or replacement of petro-chemical based fluids will be conducted over impervious containment or on paved surfaces.

Re-fuelling of machinery from approved slip-tanks (i.e. tanks equipped with automatic shut-off nozzles and break-away couplings) is permitted in the field over impervious spill containment mini-berms located more than 100 metres from any water body or wetland. Fuel storage in greater quantities is not permitted in the field. Fuel for chainsaws (25 litre jugs or less) may be kept on site but within spill containment *mini-berms*.

In the event of fuel or lubricant spills, absorbent material will be used for clean-up and any contaminated soils removed to an approved landfill. Equipment will be parked on tarps overnight to detect leaks.

3.6 Adjustments to the Pyramid Bench Community Fireguard

The Pyramid Bench community fireguard was constructed in the mid-1980's as a means of fire defence for the town of Jasper. It arcs between the CN Rail line west of Stone Mountain subdivision, past Little Cabin Lake and connects to the paved Pyramid Lake Road. It is approximately 4 kilometres long, discontinuous and varies from 15 to 110 meters in width. Anticipated wildfire scenarios indicate that the westerly portion of the fireguard would be the area most heavily challenged by advancing head fire intensities.

In its present condition the fireguard is a potentially important asset, but significantly flawed. Due to its discontinuous nature and variable width it is likely that several portions of the guard would be readily breached by fire spreading via convective means, particularly in areas of complex or moderate to steep slopes, thus making it ineffective. In order to provide a safe and effective location for launching fire suppression tactics, a minimum width of 50 metre is required (Partners in Protection 1999).

Therefore, to reduce the probability of convective fire spread across the fireguard and to establish an effective, safe area to implement either direct or indirect fire control tactics, several actions will be taken:

- Widen constricted portions of the cleared fireguard to 40 - 50 metre;
- Complete the western section of the fireguard by clearing 2.43 hectares of dense pine forest immediately upslope of the town site water reservoir;
- Thin a 50 - 60 metre strip of forest on the outside of the fireguard to spacing of 2-3 crown widths;
- Continue to maintain the Pyramid fireguard road as a mineral soil fuel break that is impenetrable by ground fire (i.e. fire creeping underground in roots or organic matter)*;*

- Retain large diameter Douglas fir in the cleared and thinned areas to mimic the open savannah-like Douglas fir habitat consistent with the structure of fire-maintained stands.

3.7 Hours of Operation

In order to minimize impacts on night time movements of wildlife, the contractor may work between 0600 and 2100 hours. Seven day a week operations are allowable at Lake Edith since the cottages are not occupied during the winter season. However, Sunday work adjacent to the town of Jasper will be restricted in work areas close to residential areas in order to avoid noise conflicts.

3.8 Operations Adjacent to Power Lines

Fire protection and forest restoration activities adjacent to power lines require special precautions. Through an agreement with ATCO Electric, certified *power line faller*s will be contracted by ATCO to fall trees in portions of working sectors that occur within critical distances of primary, secondary and tertiary power lines. ATCO will instruct FireSmart – ForestWise workers in safe work practices during a formal training session.

3.9 Operations Near Riparian Area

As noted in the project description, equipment buffer zones of 20+ metres from lakes will be observed within this project. Similarly, 20+ metre buffers will be applied to the majority of Cabin Creek and the spring at Lake Edith. Where buffers are less than 20 metres, it is in locations where gradients are low and with the approval of the JNP Aquatic Specialist (Hughson 2003). The extent of thinning work on the slopes adjacent to Cabin Creek immediately west of the reservoir is minor and will be conducted by hand to avoid creation of erosion potential.

As previously noted, several small depressions on Pyramid Bench provide more mesic, riparian-like habitats. Open water is absent but species such as black spruce and willow are locally abundant. These areas will be flagged as "no go" zones and will not be treated to project standards.

3.10 Other Primary Mitigations

Aside from the mitigations incorporated into the above operations, other primary mitigations are standards with Jasper National Park (Jasper National Park, 2003a) and required as part of the project to avoid or reduce other potential impacts. These are listed in Table 3-1.

TABLE 3 – 1: Summary of additional primary mitigations built into operational methods

CONCERN	MITIGATION
Garbage	No on-site disposal allowed; store and remove to approved containers.
Public Safety	The FireSmart – ForestWise Communications Strategy covers a full range of informational signing and education approaches to address this. Area closures will be required during tree-falling operations but will be of temporary nature. Public will be informed of closures through the Jasper Booster.
Discovery of significant wildlife or cultural features	Work will stop, feature will be reported (e.g. dens, artefacts, carcasses) to the Surveillance Officer and work not resumed until an appropriate response is taken.
Work Perimeter Boundaries	Industry protocols for flagging the outer perimeter of work sectors and areas that are not to be entered will be followed in this project.
Off-road Vehicle Use	All primary and secondary equipment routes and access routes will be agreed upon and mapped; only essential vehicles and equipment will be permitted to undertake off-road use.
Hazardous wastes	Used fluids and other hazardous wastes will not be disposed of on site
Elk calving	Work will not be conducted during calving season
Introduction on non-native plants	Prior to deployment on the project, all equipment and trucks will be thoroughly washed at the car wash. Work sites will be monitored for 3 years after treatments to detect and remove any new infestations.
Spring run-off	Operations will be suspended on sloped terrain in the event of heavy rainfall and thawing temperatures; and when spring thaw occurs.
Emergency reporting	Contractors will be briefed regarding emergency procedures and provided with 24-hour park contact numbers (i.e. 852-6155).
Toxic Spill Response	Responses will be outlined in contractor briefings and responsibilities for co-ordinating and conducting responses identified.
Soils	The work shall be carried out when the soil is frozen.
Snags + Habitat trees	Forwarding and ghost trails shall be laid out to avoid habitat trees and snags > 25 cm DBH wherever possible.

4.0 POTENTIAL IMPACTS AND SECONDARY MITIGATIONS

4.1 Methods

The purposes of this section of the screening are: 1) to predict changes to valued ecosystem components and other aspects of the ecosystem that will take place as a result of implementing this project, inclusive of the primary mitigations described in Section 3.0; 2) to develop additional (i.e. secondary) mitigations to further reduce or eliminate impacts wherever possible and; 3) to describe residual impacts of this project. Impacts to valued ecosystem components are evaluated in Section 4.2. Impacts to other ecosystem components are evaluated in Section 4.3.

Predictions are based upon: 1) direct observation of similar projects and their impacts in similar environmental settings; 2) knowledge of impacts from similar activities in JNP and other jurisdictions: 3) expert opinions or predictions from other resource specialists; and 4) review of scientific literature and other environmental assessments. Citations are available from Parks Canada for predicted effects.

As per the Terms of Reference for this screening, impact ratings are made in accord with published Parks Canada technical guidelines (2003c) and described in terms of direction, magnitude and persistence. Parks Canada impact rating categories are:

- Positive effect: interactions that enhance natural resources, features or land use;
- Adverse effect: interactions that diminish natural resources, features or land use;
- Negligible effect: interactions that may not require mitigation;
- Minor effect: adverse impact that requires mitigation; local effects that do not threaten populations, do not alter significant features or do not alter long term land use;
- Major effect: an adverse impact that requires mitigation, regional effects that do threaten integrity of local populations, do alter significant features or do alter long term land use.

Secondary mitigations were derived from Parks Canada guidelines and practical assessment of the identified impacts. Residual adverse effects, (i.e. those that will likely remain after primary and secondary mitigations are applied) are then outlined. Residual impacts are evaluated in terms of importance using the criteria established by Canadian Standards Association as outlined by Ross (2003).

4.2 Valued Ecosystem Components

Earlier analysis of issues, problems and concerns resulted in identification of nine “valued ecosystem components”, or elements of the environment, that may sustain impacts important enough to make a difference to the decision about the project. Predicted effects, mitigations for these, residual impacts and the importance of these are described below.

4.2.1 Restoring Natural Process

Predicted Effects:

Positive

- Thinning practices will simulate the natural function of fire as closely as possible by removing small diameter individuals and leaving larger, fire resistant trees in Douglas fir and lodgepole pine forests; thus restoring forest structure, composition and patterns;
- Restored forest structure will facilitate re-introduction of stand-maintaining fire to a significant portion of the open Douglas fir and some pine forests within the project area;
- This project will provide the opportunity to restore fire to Montane ecosystems immediately surrounding the project area;
- The potential for landscape scale restoration of fire to montane and sub-alpine ecosystems is significantly enhanced by this project;

- Long-term improvements to ungulate distribution and grazing dynamics are likely to be a secondary benefit of restoring fire/natural disturbance to local and regional ecosystems;
- Current high levels of mortality caused by Douglas fir beetle (Dendroctonus pseudotsuga) will likely abate as thinning will reduce the susceptibility of remaining mature Douglas fir;
- The susceptibility of lodgepole pine stands to mountain pine beetle (Dendroctonus ponderosae) will decrease as the beetles ability to colonize and multiply in open stands is significantly less than in dense stands.

Negative
- There are no obvious negative impacts on natural processes of this project.

Rating: Positive effect

Mitigations: Given that impacts are positive, no mitigations are required. In order to quantify predicted benefits, monitoring of Douglas fir beetle populations and surveys to detect presence of mountain pine beetle will be continued.

Residual Impacts: Long term benefit to ecological conditions and fulfillment of park management objectives are predicted. No negative residual impacts anticipated.

Importance: Impacts are likely but not adverse. The societal and ecological benefits pertaining to the restoration of natural disturbance are long lasting and regional in nature.

4.2.2 Wildfire Protection for People, Property and Facilities

Predicted Effects:
Positive
- The probability of high intensity crown fire adjacent to developments and consequent building ignitions will be significantly reduced;
- The risk of catastrophic wildfire losses is greatly reduced;
- Public safety and the safety of structural and wildland firefighters is considerably enhanced;
- Managers are provided with additional fire control, containment and confinement options as a result of this project;
- Safe evacuation routes are provided in case of interface fire emergencies.

Negative
1. Periodic maintenance of stand conditions will be required. These will include removal of some windfall, use of prescribed low-intensity surface fire and manual thinning of future coniferous regeneration. Some windfall will be retained for ecological and human use management purposes.

Rating: Positive

Mitigations:
1. It is expected that maintenance practices that utilize fire will be applied to all appropriate forest stands (i.e. about 40% of the total treated area). Elsewhere, manual maintenance activities will continue to emphasize ecologically based practices developed in this project.
2. Approved prescribed burn plans and environmental assessments will be prepared to ensure that maintenance burns achieve desired objectives that complement this project.

Residual Impacts: Although periodic maintenance of stand conditions will be required, the mitigations are expected to emulate natural disturbance wherever it is possible to do so and negative residual effects are unlikely. Long-term socio-economic benefits and fulfillment of park management objectives are anticipated.

Importance: Impacts identified are likely but not adverse. The societal benefits pertaining to wildfire protection are of considerable magnitude and long lasting. Direct benefits are local in nature but technology transfer will allow widespread benefits by other communities with similar problems.

4.2.3 Restoring Forest Structure and Composition

Predicted Effects:
Positive

- Selective thinning will restore the vertical structure and density (physiognomy) of tree and shrub layers in open Douglas fir, aspen and open lodgepole pine forests to historical norms;
- Increased sunlight on forest floor will reverse current trends and cause an of increase in grasses and forbs (forage) while reducing cover of moss and shade tolerant species;
- Habitat for plant and wildlife species characteristic of these relatively rare plant communities will be enhanced by this project while habitat loss will be of habitat that is unnaturally abundant;
- Forest micro-climate changes such as increased temperature, rainfall and windflow and reduced relative humidity at the forest floor;
- Long term increase in diversity and cover of woody shrubs and buffaloberry production (important bear food);
- Grassland areas and the potential for increased aspen reproduction will be expanded;
- Retention and enhancement of snags, habitat trees, legacy trees and fallen trees will enhance long term nutrient flows and the supply of specialized habitat features.

Negative

1. Short term damage to woody stems of trees, shrubs and coniferous regeneration (in stands where they occur) as a result of tree falling and passage by forestry equipment may decrease screening for humans and increase horizontal sight distances for wary wildlife;
2. Trees remaining after the thinning may be more susceptible to wind throw;
3. Large decaying logs may be compressed by equipment leading to reduced ecological value;
4. Elk browsing may exceed threshold levels and prevent reproduction of preferred forage like aspen.

Rating: 90% positive
10% adverse – minor effect (see additional mitigations below)

Mitigations:

1. Although unintended damage to shrubs and young conifers should be minimal due to the type of logging system, equipment type and season of activity, additional mitigations are possible to further reduce impacts. For example, guidelines specifying avoidance of regeneration will be included in contracts and training will be held for equipment operators.
2. In areas more prone to windthrow, trees will be left in clumps and individuals or species with greater wind tolerance will be designated as leave-trees. In exceptional cases (e.g. Connaught Avenue opposite Mount Robson Hotel), active transplanting or planting of additional trees will be considered to augment successional processes and provide interim vegetation screening. Legacy trees (large living trees to eventually replace snags) will be left in the stand.
3. A combination of operator training, operational guidelines and visual flagging markers will be used to reduce the probability of damage to large decaying logs by equipment or burning.
4. Measures to manage herbivory levels and facilitate the health and reproduction of vegetation types susceptible to high levels of ungulate foraging are beyond the scope of this project but are being contemplated in the forthcoming Ecosystem Conservation Strategy. An ongoing program of aspen stand condition monitoring will be continued and data analysed to determine changes in elk foraging subsequent to this project.

Residual Impacts:
Mitigations 1 – 3 are expected to be effective in reducing the majority of potential negative impacts. However some impacts are inevitable (e.g. breakage of woody shrubs and damage to some coniferous regeneration by falling trees and forestry vehicles). Shrubs will re-sprout and conifers will be replaced by future natural regeneration. Long-term (10+ year) increases in shrub density as a result of increased sunlight on the forest floor are expected and will reduce horizontal sight distance for wary carnivores. Wind throw due to root decay and extreme weather events is a normal process in park forests.

Importance: Adverse effects to local forest structure and composition are expected to be infrequent, of moderate duration and will be localized in distribution. No functional losses are anticipated. Effects are reversible in 1-10 years. The societal and ecological benefits to forest structure are long lasting, local and of large magnitude.

4.2.4 Reducing Wildlife/Human Conflicts

Predicted Effects:
Positive
- Reduction of elk calving sites (associated with forest thickets) and subsequent reduction in aggressive encounters involving cow elk adjacent the town site and Lake Edith;
- Reduced elk calving in urban areas will reduce seasonal predation by bears in urbanized areas and potential for bear/human conflicts during calving season;
- Increased ability for animals and hikers/cyclists to make early visual contact and avoid "surprise" encounter situations (bears and cow elk);
- Reduction of elk bedding areas (associated with thick forest with high thermal cover value) may reduce the attraction of elk to developed areas;
- Increased visibility of animals to motorists as they approach highway right-of-ways should reduce vehicle collisions;
- Decreased forest cover may reduce the difficulty of hazing elk from town site margins.

Negative
1. Increased production of buffaloberries (Shepherida canadensis) in 5-15 years may attract increased bear foraging activity to developed areas;
2. Increased forage in treated areas may become an attraction to elk in fall, winter and spring.

Rating:
80% positive
20% adverse – minor effect (see additional mitigations below)

Mitigations:
1. Female (berry producing) buffaloberry shrubs will be selectively cut back with a brush saw to reduce the berry crop in treatment areas located immediately adjacent to developed areas (e.g. Connaught Avenue, Snape's Hill) and adjacent designated trails as identified by the JNP Wildlife Conflicts Specialist.
2. Conduct prescribed burns adjacent to the fuel management/forest restoration zone (i.e. on the Pyramid Bench, Lower Miette wildlife corridor and west of the town), or in more remote locations, to provide alternative, larger areas of high quality forage production for herbivores thus drawing them away from urbanized areas.

Residual Impacts:
The mitigations above are practical expected to eliminate residual impacts. There is good evidence from studies of herbivory in Jasper (Amiro et al 2001) as to the effectiveness of prescribed burns in displacing grazing pressure. Control of berry production to decrease bear activity in certain areas has been applied successfully in the Minnewanka area of Banff National Park (Pengelly Pers. Com.) However, continued monitoring of wildlife/human conflicts and ungulate distributions is recommended to identify and respond to conflict situations if required.

Importance: Residual impacts are possible but not likely. If they do occur, they are localized and reversible in the short to moderate term. The societal and ecological benefits of reducing wildlife conflicts are long lasting and regional in nature.

4.2.5 Increase Grizzly Bear Habitat Effectiveness/ Habitat Connectivity for Wide-ranging Wildlife

Predicted Effects:

Positive/Neutral

- No change in grizzly bear habitat effectiveness is predicted as a result of this project since the over-riding influence of intense human use adjacent to and within the townsite and nearby developments already exceeds threshold values and will not change;
- No change in the grizzly security area index is predicted as a result of this project;
- No direct change (short or long term) in the value of the Signal Mountain, Lower Miette or Pyramid Bench wildlife corridors for wolf movement is predicted since thinning methods will maintain vertical and horizontal vegetation cover (except within the cleared fireguard);
- Long-term increases in the diversity of seral communities in treated areas may result in an increased prey/ forage base, and increased value of treated areas as travel corridors;
- Linkages between important habitat patches used by other wildlife will not be fragmented since vegetation cover will be retained.

Negative

1. Daytime activity by workers and machinery may deflect wolf activity away from the project area at Lake Edith but not from the nearby Signal Mountain corridor;
2. Daytime activity by workers and machinery may deflect wolf activity to more distal portions of the adjoining Lower Miette and Pyramid Bench wildlife corridors;
3. Removal of tree stems in stands with little or no understory vegetation will decrease present levels of hiding cover for wildlife in the short and medium term. However, expected increases in understory vegetation resulting from opening of the forest canopy should compensate for this effect in the medium to long term.

Rating:

75% Positive/neutral
25% adverse – minor effect (see additional mitigations below)

Mitigations:

1. Restricted hours of equipment operation should allow night time travel by wolves in both of the major project areas;

2a. Wherever possible, work will be scheduled into small units that can be completed in less than ten days to reduce the duration of disturbance to wary carnivores at any given point;

2b. Lake Edith units will be scheduled for treatment earlier than Pyramid Bench units to further reduce the probability of impacts to wildlife corridor use by wolves in the event of early or deep snow years;

3. Data on collared wolves will be analyzed to determine if there are correlations between thinning activities and wolf travel patterns.

Residual Impacts:

Potential, temporary diversion of wolf travel patterns in the Lower Miette and Pyramid Bench wildlife corridors, but no blockage. Wolves are likely to avoid areas undergoing treatment during daylight hours (10 – 20 hectares in the Athabasca valley at any given time) but monitoring adjacent active work centres at the Jasper Park Lodge indicates that night time use will continue (Wesbrook, Pers. Com.)

Importance: The impacts to wolf travel in any given corridor will be of short duration, localized and will not likely result in functional loss.

4.2.6 Restoring Landscape Patterns and Abundance of Scarce Ecosystems

Predicted Effects:
Positive

- Mechanical and manual treatments will assist in restoring landscape heterogeneity (i.e. the former complex pattern of various different ecosystems);
- Treatments will help restore patch size and the density of patches (i.e. number of patches/100 hectares) of scarce ecosystems such as grasslands/forb communities, aspen stands and open coniferous forests;
- Treatments will help restore the spatial extent and proportional representation of relatively rare ecosystems that have declined steadily during the past ½ century;
- Treatments will lay a foundation for more widespread and significant progress towards Parks Canada landscape pattern objectives and restoration of additional areas of rare ecosites (e.g. aspen and open Douglas fir and pine) through the use of prescribed fire.

Negative
No negative impacts upon landscape patterns or the abuncance of scarce eco-sites is expected.

Rating:
Positive

Mitigations:
Not required.

Residual Impacts:
Because these treatments cannot perfectly replicate natural process or patterns created by fire, a minor degree of "artificiality" will result. However, this issue will gradually decrease as natural process (i.e. fire) is re-introduced over time to the restored community and landscape structure.

Importance: The societal and ecological benefits of increasing the extent of scarce ecosystems and initiating actions to restore landscape patterns are large in magnitude and long lasting. Direct benefits are local in extent however, project actions do set the stage for more widespread benefits.

4.2.7 COSEWIC Listed Species

Predicted Effects:

- No direct adverse impacts on grizzly bears are predicted;
- Increases in buffaloberries, a grizzly diet staple, are predicted in thinned pine stands as noted in section 4.2.4;
- No direct adverse impacts on the western toad are expected as they are dormant at this time of year and impacts to hibernation sites are highly unlikely;

Rating:
Negligible effect.

Mitigations:

1. Female buffaloberry bushes in areas subject to bear/human conflicts may be controlled if supported by routine monitoring and analysis conducted by the JNP Warden Service.

Residual Impacts:
The long term maintenance of specific ecosites and ecological patterns and process at the larger, landscape level within historic norms (i.e. historic range of variation) will benefit COSEWIC listed native wildlife adapted to these ecosystems.

Importance:
Adverse impacts on COSEWIC species are not likely.

4.2.8 Respecting Confidentiality and Character of Cultural Sites

Negative
Predicted Effects:

1. Although the three previously known cultural/ceremonial sites described by Francis (2003) near Lake Edith are <u>mostly</u> outside the treatment areas, associated equipment use and log landings could impact surface features and spiritual attributes of these sites;
2. Two previously known historic sites (Milner Dairy and abandoned rail grade) in the town site area could be further disturbed by equipment use; the Snape's Hill historic site is outside the project area and will be addressed in a separate screening;
3. Minor historic features (i.e. iron survey markers) could be damaged by (or do damage to) thinning equipment;
4. Three additional, previously unreported, cultural/ceremonial sites were described to the project manager during the course of the scoping process by an Elder of the Foothills Ojibwa, Mr. Jim Ochiese. It is the initial opinion of this informant that the planned activities could proceed without impacting these sites but that precautions must be taken.
5. Two previously known pre-historic sites (1025R and 1055R) in the town site area are underground and thus securely protected. They will not be affected by the project as currently planned (P. Francis, Pers. Com) and mitigations are not required.

Rating:
adverse – minor effect (see additional mitigations below)

Mitigations:
1a Vehicle travel in the vicinity of the two known ceremonial areas will be restricted or prohibited. The majority (90%) of the areas will be visibly marked as "no go" zones for equipment. In areas (10%) where treatments are required, all haul, forwarding and ghost trails will be pre-flagged and off-trail travel prohibited;
2 Features adjacent to the Milner Dairy site are visible and will be flagged so they can be totally avoided by equipment, crew and falling trees;
3 Survey markers in the Lake Edith area will be covered with a fluorescent highway traffic cone to prevent contact with equipment and avoid damage to survey markers;
4a To maintain the integrity of the three "new" ceremonial or gathering sites the specific location and significance of them will be kept in confidence by the Project Manager and JNP Cultural Resource Specialist and not extended to others without the consent of the Foothills Ojibwa.
4b The Project Manager will work with members of the Foothills Ojibwa to develop effective and appropriate methods for achieving project objectives in ways that respect artefacts and the special characteristics of these cultural sites; these methods may involve direct participation by the Foothills Ojibwa;
4c If both objectives cannot be achieved, then the cultural site will be set aside within an appropriate buffer zone;

Residual Impacts:
A zero tolerance approach to impacts on cultural sites has been adopted. If impacts are not fully avoided through the above mitigations then the area in question will be set aside and not treated. Therefore no residual impacts are anticipated.

Importance:
The societal and ecological benefits of maintaining the character of aboriginal cultural sites are large in magnitude and long lasting. Direct benefits are regional in extent. The partnership established through this project may have more widespread benefits.

4.2.9 Maintaining the Natural Setting and Vegetation Screening for the Town

Predicted Effects:

Positive

- Project activities will result in park-like woodlands with more open meadows and a greater variety of plant species. Residents have expressed a preference for such open stands over current conditions (i.e. treated stands will have fewer dead standing stems, fewer dead, leaning trees and multi-aged regeneration/ vertical complexity) for recreational walking and as a scenic backdrop to life in Jasper;
- There will be continued presence of a natural, green backdrop for the local tourism economy; thinning of the forest canopy will open up scenic vistas previously blocked by denser forests.

Negative

1. An estimated short to medium-term decrease of 20% in visual and sound screening characteristics of pine stands located between Connaught Avenue and CN Rail lines is expected due to removal of tree boles (i.e. 10 – 15 years);
2. Temporary annoyance to residents due to passage of highway transport vehicles on municipal streets;
3. Tree stumps will be visible following the project.

Rating:
50% positive
50% adverse – minor effect (see additional mitigations below)

Mitigations:

1. Extensive precautions (Section 4.2.3) will be taken to avoid damage to conifer regeneration in areas where it is scarce;

1a Consistent with fire protection goals, planting or transplanting of seedlings/saplings of successional species such as white spruce, balsam fir and Douglas fir will be undertaken to accelerate natural processes and replace lost screening value;

2. Two designated routes for log hauling will be established to avoid disruption to normal traffic flow. Restrict times for log hauling through town (permit required);
3. The contractor will be required to reduce stumps to the minimum that can be achieved by his equipment (i.e. 10 – 15 centimeters); further manual reduction of stump heights will be prescribed in some areas.

Residual Impacts:
In conjunction with stand-specific prescriptions, mitigations 1 and 1a are expected to very effective in reducing visual impacts where be vegetation screening is an issue for people. Although the amount of biomass will be reduced, a more natural and visually appealing setting will be maintained for the town of Jasper and it's tourism economy. Visual screening will be reduced in some lodgepole pine stands for 10 – 15 years. Each of the designated transport routes traverse residential areas for less than 100 metres, avoid the town core and school areas, and are easily negotiated by large vehicles without any special measures. Residents along each route could expect to experience 3– 5 transport vehicles per day during peak hauling periods and 20 – 30 hauling days between October and April of each year. Stumps will be visible until covered by vegetation, organic matter or decayed.

Importance:
The temporary reduction of visual screening is estimated to be low (~20%) in magnitude, localized and is reversible in the moderate term (e.g. 10 – 15 years or less). The additional traffic resulting from this project is not expected to present a safety hazard to the public or a measurable inconvenience to motorists or pedestrians. Societal and ecological values will be restored in the moderate term.

4.3 Other Ecosystem Concerns

In keeping with the Terms of Reference for this screening, potential impacts to ecological components other than specified "valued ecosystem components" have been evaluated. This analysis follows in the remainder of Section 4.3

4.3.1 Soils and Landforms

Predicted Effects:
Positive

- Short and long-term enhancement of nutrient cycling on the forest floor due to burning of forest debris in piles and in situ;
- Edaphic conditions suited to expansion or re-colonization by plant species characteristic of open Douglas fir or grassland communities;
- Average or deep snow conditions will further buffer soil, landforms and vegetation from potential impacts.

Negative

1. A temporary shortage of soil nitrogen due to increased decomposition of woody debris;
2. Potential exposure of additional bare soil along the existing access road under the ATCO main-line east of Lake Edith as a result of off-road equipment use (other main access (haul) routes such as the Pyramid Lake Fireguard access road and approximately horse trail #4f north of Lake Edith are already bare soil to a width of about 2.5 metres and this will not change);
3. Due to snow cover and frozen soils only sporadic exposure of mineral soil is expected along internal access routes (i.e. <1 metre square of bare ground per 100 metres of route) as a result of ground contact by trees and equipment;
4. Removal of organic soil layer and exposure of mineral soil at burn pile locations;
5. Depending on the location, dry, south-facing slopes of the Pyramid Bench scarp above town presently have 30 – 75% cover of bare soil and dead organic matter; this may temporarily increase as a result of manual and mechanically aided thinning;

Mitigations:

1. Thorough cleaning of debris in stands that have thin soil and show evidence of initially poor nutrient conditions;
2. Raking of bare soil areas during the following spring and re-seeding with a native grass seed mix if follow-up monitoring shows that self-seeding is not progressing satisfactorily after two growing seasons or non-native species are beginning to establish themselves;

2a JPL Stables will be advised of plans for use of trail "4F" in advance, no mitigations anticipated;

2b Routine summer maintenance of the Pyramid Bench Fireguard takes place;

3. Follow-up monitoring of all forwarding and ghost trails and re-seeding with "dry Montane" or "Mesic Montane" native seed mixes if natural re-colonization is <50% after two growing seasons;
4. Follow-up monitoring of all burn piles and re-seeding with "dry Montane" or "Mesic Montane" native seed mixes if natural re-colonization is <50% after two growing seasons;

5a Harvesting machinery will not encroach more than 10 meters onto the scarp from top or bottom, all other work on the slope will be manual or aided by winch; no mechanical thinning will be permitted on slopes > 35 degrees;

5b Directional falling techniques will be used on the scarp to reduce dragging of trees, trees will be bucked to reduce the impact of removing them, bole lengths will be moved up or down to reduce distances, snow and limbs will be used to further minimize soil impacts; logs will not be repeatedly skidded over the same route. Aerial tree "yarding" systems will be investigated as a means of eliminating tree skidding on slopes as recommended by Mr. Herb Hammond;

Residual Impacts:
Recovering areas of bare soil will be evident for 3-5 years before full re-vegetation occurs.

4.3.2 <u>Aquatic Resources</u>

Predicted Effects:

1. An improperly constructed ice bridge on Cabin Creek could impact stream flow, cause limited bank erosion or introduce deleterious materials into the water; project timing does not coincide with spawning or invertebrate hatch;
2. There is potential for slope erosion or siltation of Cabin Creek as it drops down slope on the face of Pyramid Bench;
3. Potential loss of water absorption due to disturbance adjacent to the storm water outflow channel south of industrial compound;
4. Potential damage to other wetland areas.

Mitigations:

1a A location where the approach grade and stream width (<1.5m) are minimal will be chosen as the crossing point; existing bank vegetation will be protected; bridge span may be up to 2.5m, width 3.5m

1b The stream bank shall not be cut or modified;

1c Construct snow bridge with clean snow, no slash or soil will be used;

1d Logs may be used to strengthen the ice bridge but these must be limbed and topped, and placed (not pushed) into the stream;

1e Soil or other deleterious material will not be deposited into or onto the ice of Cabin Creek during installation or use of the watercourse crossing;

1f The ice bridge will be pulled prior to spring break-up to prevent flooding. Prior to removal, the bridge will be cleaned of soil or debris tracked onto the bridge surface by equipment;

1g If required, the approaches will be hand raked and re-seeded with native species (Parks Canada mesic site mix) in spring;

1h In the event of a low snow year, slash will be used to pad approaches from erosion but these will be raked up upon removal of the ice-bridge;

1i If there is doubt regarding the contractors ability to implement 1c – 1h, then a wooden bridge will be constructed to ensure protection of Cabin Creek;

2a No mechanical thinning will occur within 40 metres of this section of Cabin Creek or anywhere immediately upslope of this reach;

2b No manual thinning will occur within 25 meters of this section of Cabin Creek;

3a. Thinning equipment shall not encroach within 15 meters of the storm water outflow channel or 20 M of the Lake Edith spring and its outflow;

3b. Machinery shall not cross wetlands or streams (other than at the single designated crossing at Cabin Creek).

Residual Impacts:
None anticipated.

4.3.3 Air Quality / Smoke

Predicted Effects:

- Smoke from debris burning will be visible from various vantage points within the town site, along highway #16 and from the Maligne Lake;
- The smell of smoke from burning debris will likely be detected on occasion by residents of the town site and park visitors during daytime (Lake Edith is unoccupied during winter);

Mitigations:

1. Signs advising of “forest restoration work” and “smoke in the area” will be placed in prominent locations near project work to advise and inform the public;

2. The FireSmart – ForestWise Communications program will address this issue pro-actively in it's public information and outreach program;
3. Debris burning will follow guidelines outlined in Section 3.4.3.1;
4. Burning will cease during unfavourable atmospheric conditions.

Residual Impacts:
None, smoke is unlikely to obscure scenic views.

4.3.4 Recreational Use and Public Safety

Predicted Effects:
Positive
- As experienced in other jurisdictions, illegal camping and campfire problems may decrease immediately adjacent the town site due to increased visibility of these activities resulting from stand thinning, and due to increased public awareness and reporting;

Negative
1. There will be temporary restrictions on public use of trails that traverse areas of active tree falling due to Occupational Health and Safety Regulations;
2. There are concerns that un-regulated off-trail bicycle use may increase in treated stands and along tree forwarding trails thus resulting in chronic site disturbances.

Mitigations:
1. Designated trails will remain open to the public unless tree-falling activities are underway in an area traversed by the trail or within three tree lengths from the trail, in most cases trail users can be re-routed around the work area;

1a Closures will be as short as possible (most will be no more than 1 to 5 days in length) and signed in accord with accepted practices;

1b Informational signing will be placed on all trails connecting to or adjacent work areas to provide appropriate public information and safety precautions;

2. Fine and coarse woody debris of all size classes will be arranged after stand treatments to discourage travel by cyclists and present visual or physical barriers to travel, particularly on erosion prone slopes;

2a. Parks Canada and the Wild Trails stakeholder group should will need to continue their vigilance and co-operation n finding acceptable means of regulating the impacts of off-trail cycling in conjunction with project mitigations.

Residual Impacts:
Public safety is mandatory therefore restrictions to public use can be minimized but not eliminated.

4.3.5 Pollution and Noise

Predicted Effects:
1. The probability of hydraulic line rupture and spillage of up to 4 liters of fluid can be greatly reduced (see Section 3.5.6) by proper maintenance, but not eliminated;
2. Small amounts of petroleum-based chainsaw lubricant will escape to the environment;
3. When working within 150 metres of the town boundary (about 30% of the time) harvesting equipment may be audible to residents, under certain atmospheric conditions this distance may increase to 200 meters;
4. Chainsaw noise is audible for longer distances.

Mitigations:
1. As per "Standard Mitigations" (Jasper National Park 2003), all potentially toxic spills will be contained, cleaned up and reported; a spill kit will be kept on site and all personnel will be properly briefed regarding spill response procedures;

2. Except when made impractical by weather conditions, petroleum-based chainsaw lubricants will be replaced with vegetable-based lubricant;
3. No activities will be conducted adjacent the town of Jasper on Sundays; working hours will be restricted to 0600 to 2100 hours;
4. *FireSmart – ForestWise* messaging will reference noise.

Residual Impacts:
Some project activities will be audible to Jasper residents and visitors.

4.3.6 Wildlife

Predicted Effects:
Positive

- Habitat diversity and quality for characteristic wildlife, bird and insect species of scarce Montane grasslands, aspen habitats, open forests and Douglas fir forests will be enhanced by this project and their populations may increase;
- Key habitat elements will be protected or enhanced by prescribed treatments specific to each major forest type (e.g. tree selection, snag retention, preservation of coarse woody debris);
- Through a partnership between the FMF and the University of Calgary, wildlife research is being conducted as an integral part of this project and will improve the understanding of wildlife, wildlife habitat and their relationships to fuel management treatments in the wildland/urban interface;
- Thinning methods and equipment employed will allow the majority of shrubs and coniferous regeneration to be retained thus minimizing concerns for reducing horizontal sight distance at 1 metre above ground, thereby retaining security for wary carnivores;
- Habitat losses resulting from project activities will be of habitats that have become unnaturally abundant as a result of previous management interventions that restricted natural disturbance processes. Habitat gains will be of habitats that are rare and have decreased over the past half century.

Negative

1. Short-term displacement effects on wildlife should be minimal given the seasonal timeframe of the thinning (i.e. October to March);
2. There is an expectation of temporary daytime displacement of wildlife such as elk, deer and resident birds from active project areas (see 4.2.5 regarding wolf movement) although previous experience has shown that some wildlife (e.g. granivores, ungulates, woodpeckers and nutcrackers) may be <u>attracted</u> to treated sites even during the operation;
3. Previously unknown but important habitat elements may be encountered by workers during the project (e.g. bear dens, cavity nests, raptor nests);
4. Some natural elements of wildlife habitat may be less abundant following treatments than would be expected if natural processes had prevailed in past decades.

Mitigations:

1. Project work will cease prior to return of migratory song birds and spring breeding activities of small mammals, ungulates and bird life;
2. Project scheduling will ensure that the duration of thinning activity on any given hectare does not exceed 2-3 days; activities leading to direct displacement will be confined to less than 5 hectares on any given day;

3a Project areas will be surveyed for significant wildlife features (e.g. trees with cavities, suitable snags). These will be flagged or noted for preservation;
3b Workers will be briefed regarding protection of special wildlife and habitat features. Work will stop if they are encountered; the Environmental Surveillance Officer will be contacted and decisions made to re-schedule or modify work activities to avoid impacts to special habitat elements;

4a. Research being conducted, as part of this project, will result in enhanced ability to recognize and mitigate wildlife implications of fuel management;
4b. Contract specifications will stress the importance of retaining visual screening for security cover and implementation will be monitored daily by the Surveillance Officer;
4c. Operating prescriptions will specify retention of snags, habitat trees, legacy trees in the canopy and woody debris on the forest floor to mimic natural processes and ensure the presence of essential habitat elements.

Residual Impacts:
No long-term displacement of wildlife species adapted to open coniferous forest, deciduous habitat or grasslands are expected. These are currently rare and will benefit. Wildlife adapted to more closed forest habitats will continue to have more habitat than was historically available. Cavity trees and snags deemed unsafe due to Occupational Health and Safety concerns must be removed however, replacement snags will be created by "stubbing" other suitable trees or leaving whole replacement snags.

4.3.7 Non-Native Plant Species

Predicted Effects:
- Introduction or establishment of non-native plant species is not an anticipated outcome of this project but preventative measures are in order.

Mitigations:
- All forestry equipment will be thoroughly cleaned prior to entering the park and washed at the local car-wash before engaging in project activities;
- All known non-native plant sites within the project area will be treated during the 2003 growing season to reduce risk of spreading current infestations;
- Project areas, landings, trails, burn pile locations and haul roads will be monitored annually for presence of invasive alien plants and treated according to the JNP Integrated Pest Management Plan.

Residual Impacts:
None expected, some current non-native plant populations may persist.

5.0 CUMULATIVE EFFECTS

Cumulative effects are the effects of a project when combined with other past, existing and future projects or activities within the vicinity. Cumulative effects consider interactions with other projects or activities that exceed the direct temporal and spatial extent of the project. They include changes that the environment may cause to the project itself. As with other impacts, the primary concern in this screening is with cumulative effects related to valued ecosystem components. Social, ecological and aesthetic cumulative effects are addressed in this section.

The major projects and activities (past, present and future) that must be considered when assessing the cumulative effects of this project centre upon the urban nature of the town site itself, intense levels of human use and the range of human activities and development that result. These issues are well described in the Park Management Plan (2000) and the Three Valley Confluence Recovery Framework (2002).

Important examples of cumulative impacts relating to the project area are: 1) creeping development at the town margin; 2) expanding or intensified services and increasing levels of human use that directly alienate land or lead indirectly to conflicts with wildlife; 3) new outdoor pursuit activities that spread use and human impacts outwards from the town boundary; and 4) past park management practices that impacted the patterns and processes of natural disturbance such as the suppression of all fires.

By definition, this project is designed to have beneficial, long lasting cumulative effects.

5.1 Social and Economic

Wildfire Protection for People, Property and Facilities
Catastrophic wildfires have immense negative social and economic impacts. The presence of a sizeable municipality in the midst of a fire prone landscape creates significant risk potential. The inherent level of risk has been increased further by the use of flammable building materials and the pattern of urban development. From the perspective of reducing wildfire risk, the fire protection aspects of this project combine favourably with prevention-oriented “FireSmart” actions now being taken by Jasper fire officials, residents and business people to reduce the risk of wildfire losses in the community of Jasper and nearby developments. Examples of such ongoing cumulative actions are: improvements to wildfire planning and road infrastructure, implementation of more stringent architectural guidelines, enhancements to emergency response training and programs to raise public awareness through effective communications.

The measures outlined in this project also combine with the existing Pyramid Bench Fireguard to form a synergistic effect in terms of community fire protection. Future prescribed burns implemented adjacent to the treated fuel areas, as part of the ongoing Landscape Fire Assessment project (Parks Canada 2003c), will further reduce wildfire concerns. Taken together, past, present and future actions yield positive cumulative effects (i.e. benefits) that reduce fuel loads and potential fire behavior and function to achieve risk reduction objectives.

Respecting the Confidentiality and Character of Cultural Sites
As long as the confidentiality of site locations is maintained, no adverse cumulative effects on cultural resources are anticipated as a direct result of this project. Intensified human use in sensitive cultural areas would increase the potential for adverse impacts to these features regardless of the proposed project.

Other
This project combines with other fire and ecosystem management initiatives to help resolve concerns expressed by adjacent jurisdictions about spread of the mountain pine beetle by accelerating an appropriate response (i.e. use of prescribed fire) by park managers.

5.2 Ecological

The nature of cumulative effects in the central core of Jasper National Parks Montane zone is highly complex and involves interactions between humans, carnivores, large ungulates, vegetation and humans. While the overall effect of this project is positive (i.e. the project will counteract or reverse many of the serious cumulative impacts of modern human interventions, activities and policies such as fire control), the cumulative effects of current and future human use and management will largely go on regardless of this project.

Most importantly, this project operationalizes part of a larger strategy of ecological recovery within the Three Valley Confluence area. The Three Valley Confluence Restoration Framework is a pragmatic plan developed and supported by park staff, community stakeholders and expert consultants; it was approved by Jasper National Park in 2001. Ecological integrity of the Three Valley Confluence is being restored and improved as a result of activities in this project combined with other recommendations of the Framework regarding habitat connectivity, human use, eco-site diversity and aquatic resource integrity.

Positive, negative and neutral cumulative ecological effects of this project are evident:

Positive

Restoring Forest Structure and Composition/ Restoring Scarce Ecosystems
In terms of forest structure, composition and abundance scarce ecosystems the ecological restoration/recovery aspects of this project will help reverse the consistent “nibbling” or additive effects of many past projects and human activities that have cumulatively acted to degrade ecological conditions and wildlife habitat quality in the Three Valley Confluence – the situation that has spawned concerns in the Park Management Plan and the Three Valley Confluence Restoration Framework.

Restoring Natural Process
The cumulative effect of this project and subsequent application of prescribed fire to thinned Douglas fir and open pine communities will increase the magnitude and duration of ecological benefits realized by this project and allow natural disturbance processes to be very closely replicated.

Restoring Natural Process and Landscape Patterns
Areas restored and reduced in fuel as a result of this project will serve as “anchors” for future prescribed burns in adjacent areas. As a result, positive cumulative effects will be expanded to the regional scale and increased in magnitude. The integrity of landscape processes and patterns will benefit significantly.

Reducing Wildlife/Human Conflicts
The cumulative potential for wildlife/human conflicts involving elk and bears is likely to be reduced as a result of this project because of reductions to elk calving habitat close to developed areas and better sighting distances for residents and recreationists thus allowing conflicts with bears to be reduced. Prescribed burns facilitated by this project will likely serve to provide suitable or more attractive habitat alternatives in areas less frequented by humans thus further reducing the potential for conflicts.

Abundance of Scarce Ecosystems (Habitats)
Habitat loss due to project activities will be of habitats that are unnaturally abundant, whereas habitat gains will be of habitats that are rare and have decreased over recent decades due to human interventions.

Neutral

Grizzly Bear Habitat Effectiveness
Viewed in tandem with all other human activities and projects in the area, the value of Montane habitat effectiveness for grizzly bears or as travel corridors that connect more important habitat patches will not change as a result of this project. This is a result of efforts to mitigate increased human use (e.g. off trail cycling) that could result.

COSEWIC Listed Species
No adverse cumulative effects on COSEWIC species are anticipated as a result of this project.

Negative

Habitat Connectivity for Wide-Ranging Wildlife
Activity and noise created by crews and machinery during this project will combine with the already high levels of human disturbance in the town site and nearby vicinity. However, known thresholds for wary carnivores have already been exceeded in these locations and the additive effect of this impact is not likely to be appreciable.

Restoring Natural Process/ Habitat Connectivity
Forest conditions will generally revert towards communities with greater amounts of deciduous shrubs and trees, grasses and forbs as a result of project activities. The effect of high numbers of wintering elk on post-treatment vegetation is not fully known. However, it can be anticipated that intense grazing and /or browsing by ungulates would suppress some of the vigorous regeneration by grasses, forbs, shrubs and deciduous trees that can be anticipated with opening of the forest canopy. This would produce a cumulative effect on the value of resultant vegetation as cover for wary wildlife and as screening for aesthetic purposes.

Operational monitoring and scientific research associated with this project, as well as other ongoing wildlife monitoring (e.g. tracking of wolf movements in the Three Valley Confluence), will help to determine and document the cumulative effects of this project and of the interactions between restored habitats, wildlife and humans.

Cumulative ecological effects also include changes that the environment may cause to the project itself. In that respect, the potential effects of global climate change upon this project must be considered. The likely impacts resulting from a trend toward global warming would be to: 1) increase the probability of wildfire occurrence and, 2) to increase the potential extent of the Montane eco-region within Jasper National Park. Both potential consequences add to the urgency of the current project but would not change its fundamental nature.

5.3 Aesthetic

Maintaining the Natural Setting And Vegetation Screening for the Town
From the perspective of aesthetics, and given the subjective nature of evaluating aesthetic qualities and "natural" settings, it is likely that people will hold differing views regarding the cumulative visual effects of this project. Overall, there will be little physical evidence of the project once operations have ceased and two to three growing seasons have passed.

It can be anticipated that the cumulative effects of forest insects and disease, wind, damage incurred by wildlife (e.g. antler rubbing) and the accumulation of road salt in forest soils will be to cause continued mortality of individual trees in treated (thinned) stands. These losses can, and will be, mitigated by purposely leaving trees to accommodate these losses or augmenting natural tree replacement processes with plantings.

5.4 Summary

In summary, this project is expected to have a positive net impact on the adverse cumulative effects that presently concern managers in the Montane zone of Jasper National Park. When viewed in conjunction with other pro-active measures being taken by residents and Parks Canada, the cumulative effects of this project on wildfire protection and ecological restoration are positive. The project will contribute in several significant ways to long term ecological and social conditions in Jasper National Park and the communities of Jasper and Lake Edith. These contributions include:

- Emulating natural disturbance processes through careful application of manual and mechanical treatments designed to replicate the effects of periodic fire at the stand and landscape level;
- Restoration of forest structure, composition and scarce eco-sites;
- Achieving wildfire protection for people, property and facilities;
- Restoration of natural disturbance processes and landscape patterns;
- Maintaining an aesthetic, natural environment for urbanized portions of JNP;
- Appreciation and respect for cultural and traditional aboriginal values;
- Contributing to management of existing human use impacts by incorporating prescriptions to discourage off-trail travel by vehicles and bicycles.

6.0 OFFSITE AND TRANS-BOUNDARY IMPACTS

Ecosystem and landscape scale impacts off-site but within bounds of Jasper National Park have already been evaluated in this screening. However, this project will also cast positive influences beyond park boundaries.

The *FireSmart – ForestWise* Communities project is being implemented under the auspices of the Foothills Model Forest. As such, project objectives include development and transfer of new knowledge and technology, demonstration of these, and providing templates for successful implementation of ecologically-based community fire protection methods to hundreds of other Alberta communities that share similar fire protection problems. To achieve this, the project has developed a network of contacts with fire officials in other jurisdictions and a formal public communications and outreach program. Through these approaches, this project will have positive influences beyond park boundaries. These trans-boundary effects are potentially very significant in terms of socio-economic and ecological benefits. No mitigations are required.

In a more traditional sense this project will have influences outside of the park in both British Columbia and Alberta. Regarding British Columbia, adequate protection of the Municipality of Jasper from wildfire means that Mount Robson Provincial Park can proceed with greater confidence in its own program to restore fire to ecosystems situated upwind of Jasper. This is important since fires ignited for ecological purposes in that park would have a tendency to spread towards populated areas of Jasper. For Alberta and the neighbouring timber industry, this project is a keystone element in efforts to retard development of epidemic populations of mountain pine beetle and their spread towards merchantable timber in the Province.

7.0 PUBLIC INVOLVEMENT AND COMMUNICATIONS

This project is part of the overall Jasper National Park Fire Management program. The fire management program is a highly visible program and has, for many years, placed special emphasis on educating and informing the public about forest ecology, the importance of natural disturbance and the problems associated with past efforts to exclude fire from park ecosystems. As a result, the informational basis for the *FireSmart – ForestWise* program has already been laid and a large degree of public acceptance is in evidence as witnessed by largely positive response to the prescribed fire program.

Regardless, from it's inception the *FireSmart – ForestWise Communities* program has been heavily focussed on effective communications with the multiple publics and stakeholders that have interests in this particular project. As a result, the project has operated under a number of preliminary "Communication Strategies" for the past 24 months to create greater awareness of the issues, to build support for the project and to foster community stewardship. These strategies were developed and guided with assistance by a team of expert communicators. A more formalized strategy was approved by park managers in early May 2003 and is now being implemented.

Throughout the early stages of the project, there has been an active program of public information and consultations. As well, community "work bees" have allowed over two hundred citizens to become engaged through direct, hands-on involvement in the project. Information, education, public relations, consultation, demonstration and anticipation of potential issues management have been the mainstays of the communication strategy.

The fostering of two citizen action groups are a unique aspect of the *FireSmart – ForestWise* communications program. The Lake Edith Fire Prevention committee is comprised of seasonal residents from this area and was activated in 1998 in response to resident concerns about wildfire risk and interest in environmental stewardship. The Jasper Interface Steering Team (JIST) was initiated in 2002 and involves representatives of almost 20 different community groups including residents, businesses, tourism industry, utility companies, governments and emergency response units. Both groups function to guide project initiatives, provide ideas and support, assist in communication efforts and provide on-going consultation feedback to program managers.

As a means of furthering public involvement and communication, a notice to advertise the availability of this environmental screening for public review was published in the Jasper Booster for a two week period from June 11-25th. There were 8 enquiries for copies of the assessment, only one response was received, it was positive.

The assessment was also provided to the Department of Fisheries and Oceans for review with respect to the Cabin Creek winter crossing. DFO determined the project would not result in the harmful alteration, disruption or destruction of fish habitats (HADD). However, if future plans identify the potential for harmful effects to fish or fish habitat DFO requested the opportunity to re-evaluate the project.

8.0 KNOWLEDGE GAPS

Stand and landscape level programs to abate wildfire hazards are relatively new concepts. Although there is much information that can be applied from the fields of forest ecology and silviculture relating to the environmental effects of fuel management projects, there are knowledge gaps pertaining to the response of treated stands, changes in habitat value and the response of wildlife species to fuel management activities. As in all projects or management actions these knowledge gaps lead to some degree of uncertainty, in this case uncertainty regarding impact predictions.

A concerted effort towards filling these knowledge gaps, and reducing management uncertainty, is central to fulfilling the overall goal for this project (i.e. to develop, implement and assess innovative, ecologically-based methods for managing forest fuels in ways that reduce wildfire risks but also optimize or improve ecological conditions, wildlife habitat and aesthetic qualities in wildland/urban interface areas).

Therefore, decreasing these knowledge gaps is the subject of research studies * being conducted concurrent with, and as part of, the *FireSmart – ForestWise* project. As a key component of project follow-ups (Section 9.6), information to fill these gaps will be actively gathered, incorporated and evaluated. This process reflects the active adaptive management approach advocated by Walters and Holling (1990).

The early stages of the process to fill important knowledge gaps have already begun. For example, the results of preliminary literature reviews and directed investigations are currently reflected in the methods and primary mitigations outlined in Section 3 and the secondary mitigations proposed in Section 4 of this screening. Operational prescriptions (i.e. actions customized to the stand level) will also reflect these advances, and will be included in the Environmental Management Plan.

* This research is supported by the Foothills Model Forest and is being conducted as part of a Master of Science program at Faculty of Resource and the Environment, University of Calgary. Key objectives of the Foothills Model Forest include creation of new knowledge, dissemination of knowledge, technology transfer to other users and demonstration of results.

9.0 FOLLOW UP TO PROJECT IMPLEMENTATION

9.1 General

Upon completion and approval of this screening, a follow-up program should be required to ensure that:

- Defined mitigations are implemented;
- Predictions of environmental impacts and effectiveness of mitigations are correct;
- Project implementation methods are adapted based on actual observation of impacts so that further reductions of impacts or increases in project benefits can be realized during subsequent phases of this multi-year project;
- Unpredicted impacts are detected and dealt with to ensure protection of valued ecosystem components;
- Important knowledge gaps relating to the project are resolved.

9.2 Inclusion of Environmental Protection Measures in Contracts

Measures to ensure that environmental protection measures are taken will begin prior to actual project implementation. For example, to ensure that the intent of the Canadian Environmental Assessment Act and this screening are followed, primary and secondary mitigations outlined in this document will be incorporated into all contracts issued for project work. In addition, project objectives and environmental standards will be reviewed with potential contractors at a pre-tender site meeting in Jasper so that these requirements are well known, and incorporated into work proposals (i.e. bids submitted by interested contractors). Contracts will be evaluated and awarded, in part, based upon contractor ability and innovation to implement mitigations identified in this screening.

Further, Parks Canada or contracted crews engaged to implement manual fuel reduction/forest restoration treatments will be trained in ecological issues and implementation of environmental mitigations.

9.3 Follow Up Activities During Project Implementation

During project implementation, a systematic approach to monitoring, evaluating and responding adaptively to environmental impacts and variable circumstances is required. This is to ensure that adverse environmental impacts are minimized and the intent of the environmental assessment is met. Some degree of management uncertainty is attached to every project. However, follow up activities also help to reduce these uncertainties by resolving important knowledge gaps.

Follow-up actions will be outlined in an E*nvironmental Management Plan,* essentially a guide to project implementation. The Environmental Management Plan will be prepared separate from the environmental screening, subject to approval of this screening.

9.4 The Environmental Management Plan (EMP)

The EMP for the *FireSmart – ForesWise* project will be based on formats of successful EMP's previously developed by Parks Canada and industry. Aside from describing operational prescriptions and environmental mitigation measuress, the four objectives of the EMP are compliance with mitigations, monitoring of predicted impacts, detection of unpredicted impacts, and adapting project management according to the monitoring results.

Key elements of the EMP will be:

- A summary of “valued” and “other” ecosystem components;
- A concise summary of all mitigations identified throughout this screening document;
- Defined protocols for monitoring compliance by contractors with required practices, standards and mitigations;
- A list of environmental indicators to measure expected residual impacts including the response of vegetation, fuels, wildlife and habitat to prescribed treatments;
- Defined protocols for monitoring these indicators (frequency, personnel, thresholds etc.);
- Clear reporting relationships between contractors, crews and Parks Canada to facilitate active adaptive management;
- Scientific methods to guide data collection and management during monitoring so that ecological responses are recorded and knowledge gaps resolved concurrent with the project;
- Methods for incorporating monitoring results into project practices and mitigations to further reduce adverse impacts and maximise benefits (i.e.active adaptive management).

9.5 Project Surveillance and Compliance

The primary components of compliance monitoring and surveillance for this project will be:

- Well–defined environmental standards and operating guidelines (focussed on valued ecosystem components) that are agreed upon and incorporated as part of contracts;
- Appointment of a designated Project Surveillance Officer who will be present in the field on a daily basis to monitor project activities, detect problems and provide direction respond to contractor requests on an ongoing basis (24 hour cell-phone availability);
- Authority provided to the Project Surveillance Officer (a Parks Canada employee) to stop project work or forfeit bond in cases of non-compliance;
- In-house personnel with previous silvicultural experience and experience in operation of timber harvesting equipment;
- Periodic consultation with specialists from Ecosystem Services – JNP and other relevant agencies or parties (e.g. Department of Fisheries and Oceans).

As of March 2003 Parks Canada personnel for monitoring and surveillance have been identified and adequate funds secured to staff this function.

9.5.1 Surveillance Protocols and Roles of the Surveillance Officer

Predicted impacts will be monitored simultaneous with daily project surveillance duties. Preliminary methods are outlined below but will be refined in the EMP:

- Develop and use checklists based on the Environmental Screening to systematically look for predicted impacts during the field operating season;
- Use similar checklists to compare operational results against the “prescriptions” developed for each major forest type;
- Conduct post-operational site inspections at intervals appropriate to the selected indicators to describe, photograph and document impacts that may not become obvious until after the operating season ends in late March or early April (i.e. soil erosion).

Key roles of the Surveillance Officer are:

- Developing good initial rapport with contractors and Crew Foremen, and maintaining this through frequent daily field contacts to facilitate immediate problem solving and improvements;

- Scheduled weekly review meetings between the Project Manager/Surveillance Officer and the contractor, equipment operators and Crew Foremen to explore and implement innovative, effective solutions;
- Developing a stable Parks Canada Fuel Management Crew that is knowledgeable about project/park objectives, well trained, skilled and carefully supervised (as opposed to transient contract crews);
- Negotiating contract amendments as required.

Applying interim research results to inform subsequent phases of this project and similar projects elsewhere.

9.5.2 Reporting of Monitoring/Surveillance Results

An annual monitoring report that summarizes surveillance activities, documents operational problems, evaluates predicted adverse impacts versus actual impacts and makes recommendations for reducing them further will be completed by July of each operating year. The report will be presented to JNP Environmental Services and discussed with personnel from program with a view of incorporating revised standards or practices into contracts for the subsequent year. Report highlights will be summarized in public communications.

9.5.3 Detection of Unpredicted Impacts

During all surveillance and monitoring activities park personnel will also look for and document unpredicted adverse impacts. Minor unpredicted impacts will be dealt with immediately by modifying work practices in consultation with the contractor or Crew Foreman without a resultant stoppage of work. Impacts of a more serious nature will require a stoppage in work or other avoidance measures.

Problems requiring longer-term solutions will be addressed in subsequent contracts. Unpredicted impacts will be included in the annual monitoring report.

9.5.4 Estimated Schedule of Surveillance Actions

#	TASK	RESPONSIBILITY	DUE DATE
1	Prepare the EMP	A. Westhaver	Sep. 15, 2003
2	Staffing of surveillance position	A. Westhaver	Jun. 30, 2003
3	Pre-contract site meetings with operators	A. Westhaver	Aug. 2003
4	Surveillance checklists prepared	A. Westhaver	Sep. 15, 2003
5	Operational surveillance program	A. Westhaver	09/2003 – 03/04
6	Post-operation surveillance	A. Westhaver	04/2004 – 07/04
7	Prepare surveillance report and recommend’s	A. Westhaver	Jul. 30, 2004/05/06
8	Revision of operating contracts for 04/05	A. Westhaver	Aug. 30, 2004
9	Research design completed	A. Westhaver	Apr. 30, 2003

TABLE 9 - 1: Schedule of monitoring and surveillance actions

9.6 Active Adaptive Management through Monitoring and Research

Active adaptive management is an approach to facilitate effective management in the face of uncertainty by ensuring that monitoring results are quickly incorporated into day-to-day operations. Adaptive management requires the setting of quantifiable objectives and careful monitoring to measure whether or not objectives are being met. The objectives of this project are to reduce the risk of intense wildfires, to restore ecological condition of montane vegetation (wildlife habitat), and to maintain the aesthetic/screening qualities of vegetation in the wildland/urban interface.

Detailed monitoring activities are also and inherent part of fulfilling the overall project goal "*to develop, implement and assess innovative, ecologically-based methods for managing forest fuels in ways that reduce wildfire risks but also optimize or improve ecological conditions, wildlife habitat and aesthetic qualities in wildland/urban interface areas*." Scientifically accepted methods will be used to collect, record, and analyse monitoring data that describe the environmental effects and responses of this project. A science-based approach will also help ensure that community wildfire protection measures and ecological restoration requirements are truly merged within this project, and that the ecological benefits that may accrue from this project, are actually realized.

To fulfil these requirements, a unique partnership between Parks Canada, the Foothills Model Forest and the Faculty of Resources and the Environment at the University of Calgary has been developed and integrated into this project. It will be conducted concurrent with operational components of the *FireSmart – ForestWise* project. Information on baseline ecological and fuel conditions will be collected in 2003/04 for comparison to post-treatment conditions in 2004/05.

Project monitoring will be supported, in part, by funds from the sale of surplus timber created as a direct result of this project in accord with the approved Parks Canada Directive.

Specific research and research methodologies are not part of this Environmental Screening nor do they form a condition for project approval. Since the research is also part of the Foothills Model Forest program, research results will be widely distributed to other practitioners, the research community and the general public.\

10.0 DETERMINATION OF SIGNIFICANCE

The proposed project was initiated to reduce the potential risk of wildfire losses to the town of Jasper and adjacent developments, and improve the ecological health of Jasper National Park by restoring a more natural structure to Montane forests. The project is a joint venture with the Foothills Model Forest to develop, implement and assess innovative, ecologically-based methods for managing forest fuels in ways that reduce wildfire risk but also optimize or improve ecological conditions, wildlife habitat and aesthetic qualities in the narrow fringe of forest lands.

Because the prescribed treatments are based on knowledge of the dynamic range of ecological conditions that existed in the past and published standards for modifying fuels, the majority of potential effects to valued ecosystem components from this project are positive in terms of ecological and social benefits. Parks Canada believes that with implementation of the proposed mitigation measures and adaptive management practices the potential for significant adverse environmental impacts is minimal.

The residual ecological effects with respect to restoration of natural process, forest structure and composition, landscape patterns and rare eco-sites; improvements to wildfire protection; avoidance of wildlife/human conflicts; and maintenance of a natural setting for the Town of Jasper are considered positive. Potential residual impacts on grizzly bear habitat effectiveness, protection of COSEWIC listed species and cultural resources are forecast to be neutral.

Cumulatively, the potential for increased human use in the treated areas is real and could negatively impact wildlife movement and displacement. But the project will reduce other human induced cumulative effects by emulating natural disturbance processes, restoring ecological conditions, enhancing wildfire protection for people and property, maintaining a natural, aesthetic environment for the Municipality and encouraging appreciation and respect for traditional aboriginal values.

A rigorous, science-based monitoring program will be implemented to track environmental impacts, benefits, or responses to the project; to ensure community wildfire protection measures and ecological restoration requirements are effectively merged; and to ensure the ecological benefits that may accrue from this project, are realized.

<u>Additional Mitigations:</u>

1. On approval of this screening, the procedures and mitigations specified by the responsible authority (Parks Canada) will be incorporated in an Environmental Management Plan (EMP) for contractors working on the project. The EMP will guide implementation phases of the project and include listed mitigations, surveillance, impact monitoring, emergency response and incident reporting requirements.

2. The project manager is responsible to ensure compliance by all contractors and employees with the environmental protection mitigations and requirements identified for the project.

3. Implementation of a tree salvage program to transplant young trees, which may be damaged during project implementation, will be offered to local residents.

10.1 Conclusion

With implementation of the defined operating practices, mitigations, communications strategy and direction from the Department of Fisheries and Oceans, it is the conclusion of this screening report that Parks Canada may approve the project as per Section 20 (a) of the Canadian Environmental Assessment Act:

“Where, taking into account the implementation of appropriate mitigation measures, the project is not likely to cause significant adverse environmental effects, the RA may exercise any power that would permit the project to proceed, and shall ensure that the mitigation measures are implemented;”

11.0 REFERENCES CITED

Achuff, P. L. 1996. Fire in the Rocky Mountain National Parks. Unpublished Parks Canada Paper presented at the National Prescribed Fire Workshop, La Maurice National Park. 19pp.

Achuff, P.L., A.L. Westhaver and M. Mitchell. 2001. Fire/vegetation groups, fire cycles, fire behavior prediction fuel types and annual burn areas in Jasper National Park. Unpublished Parks Canada Report. 20pp.

Amiro, B, B. DeGroot, P. Bothwell, A. Westhaver, P. Achuff. 2001 Impacts and interactions of fire and elk herbivory in the Montane region of Jsper National Park, Alberta, Canada. IN: Proceedings of the Tall Timbers 22nd Fire Ecology conference. In preparation.

Andison. D.W. 2000. Landscape level fire activity on foothills and mountain landscapes of Alberta. Bandaloop Landscape-Ecosystem Services. Foothills Model Forest. Ecology Research Series, Report No. 2

Alberta Infrastructure. 1999. Fish habitat manual – Guidelines and procedures for watercourse crossings in Alberta. ~200pp.

Arbor Wildland Management Services. 1991. Wildland-urban interface forest fire potential and fuel reduction plan for Banff townsite and surrounding area. Internal report to Banff National Park Warden Service. Banff, Alberta. 170pp.

AXYS Environmental Consulting Ltd. 2001. Evaluation of ecological recovery options for the Three Valley confluence landscape management unity in Jasper National Park, Alberta. Report prepared for Parks Canada. 81pp.

AXYS Environmental Consulting Ltd. 1998. Best available methods for common leaseholder activities. Prepared for Line Leaseholders Working Group, Jasper National Park. 142pp.

Bartos D. and R.B. Campbell. 1998. Decline of quacking aspen in the interior west – examples from Utah. Rangelands, Society for Range Mgmt. (20)1:17-24.

Bradford, W. 2003. Personal Communication, Jasper National Park Problem Wildlife Specialist.

Carnell, D. and G. Anderson. 1974. Proposal for the development of a fire protection zone around Jasper town site. Jasper Warden Service. Unpublished.

Covington, W.W. and M.M. Moore. 1994. Post-settlement changes in natural fire regimes and forest structure: ecological restoration of old-growth ponderosa pine forest. In: Sampson, R. Neil: Adams, David L., eds. Assessing forest ecosystem health in the inland West. New York: The Haworth Press Inc. 153 – 181.

Dobson, B. 2000. Ecologically-based planning tools for managing cumulative effects in Jasper National Park: the ecosite representation and breeding bird habitat effectiveness models. M. Sc. Thesis, University of British Columbia.

Elk Action Working Group. 1999. The Community Action Plan for Elk Management in Jasper National Park. Parks Canada working document. 11pp.

Fenton, Greg. 1986. Pyramid Bench Fire Protection Action Plan. Jasper Warden Service. Unpublished.

Ferguson, C. I. Adams, B. Low, and I. Pengelly. 2002. Environmental Assessment of Fire Management in the Cascade/Bow Ecological Management Area, Banff National Park. General Editor. 298 pp.

Fenton, G. and B. Wallace. 1978. Preliminary fire management plan for Jasper National Park. Internal report. Jasper National Park.

FireLine Consulting and Instruction. 1997. Interpark hazard evaluation project: Prairie and Mountain Parks. Report to Parks Canada – Western Fire Management Centre.

Francis, Peter, D. 2003. Personal communication. March 24, 2003.

Francis, Peter, D. 2003. Final Report: Archaeological resource impact assessments conducted in 2002 :Lake Edith and Jasper town site facility protection project. Parks Canada internal report, Cultural Resource Services, Western Canada Service Centre, Calgary. 12pp.

Haney, B. and G. Anderson. 1978 Proposal for reduction of forest fire fuel hazards bordering Jasper townsite. Jasper Warden Service. Unpublished.

Haufler, J. B., B.J. Kernohan, R.K. Baydack, C. Miller, H. Campa, L.J. O'Neil and L. Waits. 2002. Performance measures for ecosystem management and ecological sustainability. The Wildlife Society. Technical Review 02-1. Edited y W.M. Healy.

Heitzmann, R.J. 2001. IN: Collection of Papers from the 33rd Meeting of the Canadian Archeological Assoc. Edited by Jean-Luc Pilon. Ontario Archeological Society.

Holland, W.D. and G. M. Coen General Editors. 1982. Ecological (Biophysical) Land Classification of Banff and Jasper National Parks. Volume II: Soil and Vegetation Resources. Alberta Institute of Pedology. Publication No. SS-82-44.

Holroyd, G.L. and K.J. Van Tighem. 1983. Ecological (Biophysical) Land Classification of Banff and Jasper National Parks. Volume III, Parts A and B: The wildlife inventory. Canadian Wildlife Service. Edmonton. 667pp.

Hughson, Ward. 2003. Personal Communications, JNP Aquatics Specialist.

Janz, B. and D. Storr. 1977. The climate of the of the contiguous mountain parks: Banff, Jasper, Yoho, and Kootenay. Env.Canada, Amos. Env. Serv., Met. Applic. Branch. Project Re. No. 30.

Jasper Interface Steering Team. 2002. Unpublished meeting minutes of the residents wildland/urban interface advisory group. Monthly meetings. Jasper, Alberta.

Jasper National Park. 2003. Standard mitigations for environmental assessments. JNP Environmental Assessment Services. 11pp.

Kay, C.E. 1997, The condition and trend of aspen, Populus tremuloides, in Kootenay and Yoho National Parks: Implications for Ecological Integrity. Canadian Field-naturalist 111(4):607-616.

Kubian, R. 1999. Fire suppression zones – Jasper National Park. Internal working map. Jasper National Park, Warden Service, Vegetation/Fire Program.

Logan, Robert. F. 1999. A handbook of forest stewardship for 21st century workers. Developed for Weldwood of Canada Limited, Hinton Forest Resources by Montana Stare University Extension Forestry. Hinton, Alberta. 100pp.

Mercer, G. 2003. Personal Communication.

Mercer, G. and H. Purves. 2000. An initial assessment of wildlife movement corridors in the Three Valley Confluence of Jasper National Park. Warden Service Report. Unpublished. November, 2000. 32pp.

Mitchell, Michael P. 2003. Meso-scale vegetation change across the Montane landscape in Jasper National Park (1949-1997). MSc. Thesis [in progress], University of Northern British Columbia, Prince George, British Columbia.

Mortimer, D. 1999. Lake Edith Cottage Development facility protection project, Jasper National Park. Fireline Consulting and Instruction. Report prepared for Parks Canada. 65pp.

Mortimer, D. 1998. Town of Jasper interface protection project, Jasper National Park. Fireline Consulting and Instruction. Report prepared for Parks Canada. 65pp.

Murphy, P.J. 1985. History of forest and prairie fire control in Alberta. ENR Report T/77. Alberta Energy and Natural Resources, Forest Service. Edmonton, Alberta. 408 pages

Mutch, Robert W. 1994. Fighting fire with prescribed fire: a return to ecosystem health. Journal of Forestry. 92(11): 31-33.

National Fire Protection Association. 1997, NFPA 299 – Standard for Protection of Life and Property from Wildfire. NFPA. Batterymarch Park.

Ochiese, Jimmy. 2003. Personal Communication, Elder of the Foothills Ojibwa.

Parks Canada. 2003. Terms of reference: Environmental screening for the *FireSmart – ForestWise* Community Protection and Forest Restoration Project. Ecosystem Secretariat/ Warden Service, Jasper National Park. February 27, 2003. 12 pp.

Parks Canada. 2003a. Standard mitigations for environmental assessments. Jasper National Park Environmental Assessment Services. February, 2003. 11pp.

Parks Canada. 2003b. A technical guide to preparing environmental assessment screenings. Jasper National Park Environmental Assessment Services. February, 2003. 17pp.

Parks Canada. 2003c. Landscape Fire Assessment project – terms of reference. Warden Service. 9pp.

Parks Canada. 2002. Three Valley Confluence Recovery Framework. Internal working paper. Jasper National Park. ~65 pp.

Parks Canada. 2001a. Jasper community land use plan, Jasper National Park of Canada. Ottawa, Ont. 51pp.

Parks Canada. 2000. Jasper National Park of Canada management plan. Minister of Public Works and Public Services Canada. Department of Canadian Heritage. Ottawa Catalogue Number R64-105/28-2000E. 78pp.

Parks Canada. 1999. Environmental screening report: Pyramid Bench community fireguard blowdown removal project. Park Registry File J99-02. JNP Warden Service. 25 pp.

Parks Canada – Canadian Heritage. 1994. Alberta Region Directive: Disposal of surplus timber from approved developments. April 28, 1994. 3pp.

Partners in Protection. 1999. FireSmart: Protecting your community from wildfire. Quality Color Press. Edmonton, Alberta, Canada. ISBN 0-662-27920-4.

Pengelly, Ian. 2003. Personal Communications with Fire/Vegetation Specialist, Banff Nat. Park.

Ralf, R. and W. Bradford. 1998. Bear/Human Conflict Management Plan, Jasper National Park. Internal Report, Warden Service. 65pp.

Rhemtulla, J.M. 1999 Eighty years of change :The Montane vegetation of Jasper National Park. University of Alberta. M.Sc. Thesis.

Risbrudt, C.D. 1995. Ecosystem Management: a framework for management of our national forests. Natural Resources and Environmental Issues. Vol. V. pp. 91-96.

Ross, W.A.. 2003. University of Calgary, Class Notes, Environmental Impact Assessment (EVDS 649), Significance and Thresholds as adapted from the Canadian Standards Association.

Ross, W. A. 2002. Environmental impact assessment. Pages 231 – 245. IN: D. Thompson, Editor. Tools for environmental management – a practical introduction and guide. New Society Publishers. Gabriola Island, British Columbia.

Tande, G. F. 1979. Forest fire history around Jasper townsite, Jasper National Park, Alberta. MSc. Thesis, University of Alberta. 169 pp.

United States Department of Agriculture, Forest Service. 1993. Fire related considerations and strategies in support of ecosystem management. Staffing paper. Washington. 30pp.

Van Velzen, Wayne. 2003. Personal Communication. Manager, Mt. Robson Provincial Park. British Columbia.

Van Wagner, C.E. 1995. Analysis of fire history for Banff, Jasper, and Kootenay National Parks. Unpublished Parks Canada Report. Ottawa. 28pp.

Walker, R. 2002. Environmental Screening for the Redstreak ecological restoration in Kootenay National Park. Unpublished Warden Service Report. Radium Hotsprings, B. C. 35pp.

Walters, C. and C.S. Holling. 1990. Large-scale management experiments and learning by doing. Ecology 71: 2060-2068.

Weldwood of Canada. 2002. Harvest Planning and Operating Ground Rules. Weldwood of Canada Limited, Hinton Forest Resources. Hinton, Alberta. 100pp.

Wesbrook, Mike. 2003. Personal communication with coordinator of Jasper Park Lodge wildlife corridor monitoring program.

Westhaver, A. L. 2003. Methods for preparation of the environmental screening for the Foothills Model Forest FireSmart – ForestWise Project, Jasper National Park. Review paper submitted to the University of Calgary, Faculty of Environmental Design. 16pp.

Westhaver, A.L. 2002. Summary of prescribed burns (completed and planned) in Jasper National Park. Internal working paper. Jasper National Park. 4pp.

Westhaver, Alan. 1998. Guidelines for pile burning in JNP. Internal memo. Warden Service. 1pp.

White, C.A. 2001. Aspen, elk, and fire in the Canadian Rocky mountains. Ph. D Thesis. Faculty of Graduate Studies. Department of forestry. University of British Columbia.

White, C. A. 1985. Wildland fires in Banff National Park 1880 – 1980. Occasional Paper 3. National Parks Branch, Parks Canada, Environment Canada. Ottawa, Ontario, Canada. 106pp.

Wierzchowski, J., M. Heathcott and M.D. Flannigan. 2002. Lightning and lightning fire, Central Cordillera, Canada. Int. Journal of Wildland Fire. 11, 41-51.