Environmentally Significant Areas of Alberta

Volumes 1, 2 and 3

Prepared by:

Sweetgrass Consultants Ltd.
Calgary, AB

for:

Resource Data Division
Alberta Environmental Protection
Edmonton, Alberta

March 1997

Environmentally Significant Areas of Alberta

Volume 1

Prepared by:

Sweetgrass Consultants Ltd.
Calgary, AB

for:

Resource Data Division
Alberta Environmental Protection
Edmonton, Alberta

March 1997

EXECUTIVE SUMMARY

Large portions of native habitats have been converted to other uses. Surface mining, oil and gas exploration, forestry, agricultural, industrial and urban developments will continue to put pressure on the native species and habitats. Clearing and fragmentation of natural habitats has been cited as a major area of concern with respect to management of natural systems.

While there has been much attention to managing and protecting endangered species, a consensus is emerging that only a more broad-based ecosystem and landscape approach to preserving biological diversity will prevent species from becoming endangered in the first place.

Environmentally Significant Areas (ESAs) are important, useful and often sensitive features of the landscape. As an integral component of sustainable development strategies, they provide long-term benefits to our society by maintaining ecological processes and by providing useful products. The identification and management of ESAs is a valuable addition to the traditional socio-economic factors which have largely determined land use planning in the past.

The first ESA study done in Alberta was in 1983 for the Calgary Regional Planning Commission region. Numerous ESA studies were subsequently conducted through the late 1980s and early 1990s. ESA studies of the Parkland, Grassland, Canadian Shield, Foothills and Boreal Forest Natural Regions are now all completed while the Rocky Mountain Natural Region has been only partially completed.

Four factors regarding the physical state of the site were considered when assessing the overall level of significance of each ESA: representativeness, diversity, naturalness, and ecological integrity. Each ESA was assigned a significance level: provincial, national or international.

Areas of provincial significance in Alberta include relatively undisturbed and sizable remnants of undisturbed upland and valley habitats; important waterfowl production and shorebird staging areas; and some of the most critical wildlife ranges (e.g. deer, Pronghorn, Caribou, Moose, Grizzly Bear) in Alberta.

Areas of national significance include staging habitats with nationally high concentrations of waterfowl and shorebirds, national parks, habitats for endangered species and concentrations of nationally rare plant and animal species.

Areas of international significance include sites of globally endangered species (e.g. Whooping Crane), RAMSAR wetlands; geological type localities; and extremely diverse grassland-valley complexes on international waterways (e.g. Writing-on-Stone).

ESAs, viewed in the context of protected areas, are anticipated to be the most cost-efficient and, in many cases, the only means available for maintaining adequate levels of biological diversity at appropriate scales. It is important at this time to note that ESAs are not characterized by protectionist policies. A site designated as an ESA is not a legislatively mandated protected area. However, the designation of an ESA does indicate the value of both biotic and abiotic resources within a site. By identifying ESAs prior to the development of land-use plans, biodiversity conservation can be incorporated into both private and public land management. The overall goal of employing ESA inventories into land use plans is to maintain viable populations and natural distributions of native species and communities in the landscape.

Various national and international programs and agreements commit Canada to completing a network of protected areas and to conserving biodiversity in the overall landscape. Special Places 2000 is the strategic plan which has been established by the Alberta government to provide direction for the identification and establishment of protected areas in the province.

ESAs have become a useful tool in the implementation of Special Places 2000, a strategic plan for identifying and protecting diverse and representative landscapes in Alberta. ESA inventories serve as a valuable source of information for future protected area selection and designation. ESAs of provincial or

greater significance are considered the most likely sites for identifying landscapes suitable for a provincial protected areas program like Special Places 2000.

The primary purpose of this ESA study was to evaluate and provide an overview of all ESA inventories completed to date in Alberta and to determine which areas were of provincial, national or international significance. An analysis of Level 1 Natural History Theme occurrence in each of the ESAs was a significant component of this project. From an analysis of aerial photographs and dominant surficial themes identified from the literature, surficial landform units were mapped and the percentage occurrence of the 20 Level 1 Natural History Themes defined by Alberta Parks Services was determined for every surficial landform unit within each ESA.

Each ESA is described in checksheet format, identifying:

1. name of the ESA study from which the information is derived;
2. name of the area;
3. general location;
4. NTS map sheet;
5. municipality in which it occurs;
6. natural subregions in which it occurs;
7. level of significance (provincial, national or international) and background for determining level of significance;
8. a description of the major features which characterize the area;
9. management considerations; and
10. references which will provide more scientific or detailed information should the user require it.

All information is stored in digital database and ARCINFO spatial files so it can be used in a variety of ways.

A set of 1:250,000 scale maps showing the location of ESAs and Natural History Theme (Surficial) units within each ESA accompanies this report.

TABLE OF CONTENTS

VOLUME 1

Executive Summary i

Table of Contents iii

List of Tables vi

1. INTRODUCTION 1
   - 1.1 The Value of Environmentally Significant Areas (ESAs) 1
   - 1.2 History of ESA Identification in Alberta 1
   - 1.3 ESA Classification Criteria 2
   - 1.4 Levels of Significance 4
   - 1.5 ESAs and Biodiversity Conservation 5
   - 1.6 Protection Targets, Special Places 2000 and ESAs 7
   - 1.7 Outline of this Study 8

2. DATA COLLECTION METHODS 10
   - 2.1 Review of ESA Reports and Data 10
   - 2.2 Workshop on ESAs 12
   - 2.3 Literature Review and Aerial Photograph Interpretation 12
   - 2.4 Digital Map Production 14

3. OVERVIEW OF NATURAL REGIONS AND SUBREGIONS 15
   - 3.1 Grassland Natural Region 15
     - 3.1.1 Dry Mixedgrass Subregion 16
     - 3.1.2 Mixedgrass Subregion 17
     - 3.1.3 Northern Fescue Subregion 18
     - 3.1.4 Foothills Fescue Subregion 19
   - 3.2 Parkland Natural Region 19
     - 3.2.1 Central Parkland Subregion 20
     - 3.2.2 Foothills Parkland Subregion 21
     - 3.2.3 Peace River Parkland Subregion 21
   - 3.3 Foothills Natural Region 22
     - 3.3.1 Lower Foothills Subregion 23
     - 3.3.1 Upper Foothills Subregion 23
   - 3.4 Rocky Mountain Natural Region 24
     - 3.4.1 Montane Subregion 25
     - 3.4.2 Subalpine Subregion 25
     - 3.4.3 Alpine Subregion 26
   - 3.5 Boreal Forest Natural Region 27
     - 3.5.1 Dry Mixedwood Subregion 28
     - 3.5.2 Central Mixedwood Subregion 29
     - 3.5.3 Wetland Mixedwood Subregion 30
     - 3.5.4 Boreal Highlands Subregion 30
     - 3.5.5 Peace River Lowlands Subregion 31
     - 3.5.6 Subarctic Subregion 31
   - 3.6 Canadian Shield Natural Region 32
     - 3.6.1 Athabasca Plain Subregion 33

3.6.2 Kazan Upland Subregion 33

4. NATURAL HISTORY THEME ANALYSIS 35
4.1 Protected Area Targets 37
4.1.1 Level 1 Natural History Theme Targets 37
4.2 Targets - Level 1 Natural History Themes - Dry Mixedgrass Subregion 39
4.3 Targets - Level 1 Natural History Themes - Mixedgrass Subregion 39
4.4 Targets - Level 1 Natural History Themes - Northern Fescue Subregion 39
4.5 Targets - Level 1 Natural History Themes - Foothills Fescue Subregion 40
4.6 Targets - Level 1 Natural History Themes - Central Parkland Subregion 40
4.7 Targets - Level 1 Natural History Themes - Foothills Parkland Subregion 40
4.8 Targets - Level 1 Natural History Themes - Peace River Parkland Subregion 41
4.9 Targets - Level 1 Natural History Themes - Lower Foothills Subregion 41
4.10 Targets - Level 1 Natural History Themes - Upper Foothills Subregion 41
4.11 Targets - Level 1 Natural History Themes - Montane Subregion 41
4.12 Targets - Level 1 Natural History Themes - Subalpine Subregion 41
4.13 Targets - Level 1 Natural History Themes - Alpine Subregion 42
4.14 Targets - Level 1 Natural History Themes - Dry Mixedwood Subregion 42
4.15 Targets - Level 1 Natural History Themes - Central Mixedwood Subregion 42
4.16 Targets - Level 1 Natural History Themes - Wetland Mixedwood Subregion 42
4.17 Targets - Level 1 Natural History Themes - Boreal Highlands Subregion 43
4.18 Targets - Level 1 Natural History Themes - Peace River Lowlands Subregion 43
4.19 Targets - Level 1 Natural History Themes - Subarctic Subregion 43
4.20 Targets - Level 1 Natural History Themes - Athabasca Plain Subregion 43
4.21 Targets - Level 1 Natural History Themes - Kazan Upland Subregion 43

5. OVERVIEW OF ENVIRONMENTALLY SIGNIFICANT AREAS 44
5.1 Grassland Natural Region Sites 44
5.1.1 Dry Mixedgrass Subregion 44
5.1.2 Mixedgrass Subregion 45
5.1.3 Northern Fescue Subregion 46
5.1.4 Foothills Fescue Subregion 47

5.2 Parkland Natural Region Sites 48
5.2.1 Central Parkland Subregion 48
5.2.2 Foothills Parkland Subregion 50
5.2.3 Peace River Parkland Subregion 50

5.3 Foothills Natural Region Sites 51
5.3.1 Lower Foothills Subregion 51
5.3.1 Upper Foothills Subregion 52

5.4 Rocky Mountain Natural Region Sites 52
5.4.1 Montane Subregion 52
5.4.2 Subalpine Subregion 53
5.4.3 Alpine Subregion 54

5.5 Boreal Forest Natural Region Sites 54
5.5.1 Dry Mixedwood Subregion 54
5.5.2 Central Mixedwood Subregion 56
5.5.3 Wetland Mixedwood Subregion 59
5.5.4 Boreal Highlands Subregion 60
5.5.5 Peace River Lowlands Subregion 60
5.5.6 Subarctic Subregion 61

5.6 Canadian Shield Natural Region Sites 61
5.6.1 Athabasca Plain Subregion 61
5.6.2 Kazan Upland Subregion 61

5.7 ESAs Sorted by Size 61
5.7.1 Sites Larger Than 10 Sq. Km. 61
5.7.2 Sites Less Than 10 Sq. Km. 70

6. DATA GAPS AND RESEARCH NEEDS 74

REFERENCES 75

GLOSSARY OF LEVEL 1 NATURAL HISTORY THEME TERMS 93

VOLUME 2

Executive Summary i

Table of Contents iii

List of Tables vi

ENVIRONMENTALLY SIGNIFICANT AREA CHECKSHEETS 1

REFERENCES 564

VOLUME 3

Executive Summary i

Table of Contents iii

NATURAL HISTORY THEME REPRESENTATION IN ESAs 1

GLOSSARY OF LEVEL 1 NATURAL HISTORY THEME TERMS 2

LIST OF TABLES

Table 1. Natural Diversity Classification Hierarchy for Protected Areas Planning in Alberta.....35

Table 2. Natural Regions and Subregions of Alberta 36

Table 3. Differences among the Subregions of the Grassland Natural Region.....36

Table 4: Level 1 Natural History Theme Targets by Subregion.....38

1. INTRODUCTION

Large portions of native habitats have been converted to other uses. Surface mining, oil and gas exploration, forestry, agricultural, industrial and urban developments will continue to put pressure on the native species and habitats. Clearing and fragmentation of natural habitats has been cited as a major area of concern with respect to management of natural systems.

While there has been much attention to managing and protecting endangered species, a consensus is emerging that only a more broad-based ecosystem and landscape approach to preserving biological diversity will prevent species from becoming endangered in the first place.

1.1 The Value of Environmentally Significant Areas (ESAs)

Environmentally Significant Areas (ESAs) are important, useful and often sensitive features of the landscape. As an integral component of sustainable development strategies, they provide long-term benefits to our society by maintaining ecological processes and by providing useful products. The identification and management of ESAs is a valuable addition to the traditional socio-economic factors which have largely determined land use planning in the past. The social and economic benefits which ESAs and other natural areas provide are major and are being recognized (Butler 1983; Power 1985; Wallis 1985; World Wide Fund for Nature 1988; Keddy 1989). A few of the functions and uses of ESAs are defined by Eagles (1984) and Coté (1989):

1. protection of gene pools for future use, including reclamation of disturbed lands, breeding of genes into commercial species or development of new commercial products such as antibiotics;
2. protection of rare or endangered species and their habitat;
3. provision of travel corridors and resting places for migratory species;
4. preservation of mature, stable climax ecosystems with their constituent complete ecological complexity;
5. providing benchmarks against which man-altered areas can be compared;
6. conservation of large blocks of habitat for species that require extensive areas for breeding and survival;
7. conservation of representative samples of different plant and animal habitats characteristic of each natural region;
8. maintenance of habitat for wildlife and plants that require undisturbed natural areas;
9. research areas for earth and life science studies;
10. sources of groundwater recharge, low stream flow supplementation, flood peak reduction and headwater protection for hydrological systems;
11. filtration and cleaning of air and water flows;
12. conservation of soil and protection from erosion;
13 protection of significant geological features;
14. identification of lands with severe development constraints such as those on floodplains, steep and unstable slopes, or permanent wetlands;
15. provision of areas for public education of resources and their management;
16. maintenance of aesthetically pleasing environments; and
17. provision of commercial products such as outdoor recreation.

1.2 History of ESA Identification in Alberta

Environmentally significant areas (ESAs) are generally defined as landscape elements or places which are vital to the long-term maintenance of biological diversity, soil, water, or other natural process, both on-site and in a regional context (Jennings and Reganold 1991). Much of the early work in Canada concerning the development of criteria for identifying ESAs was borne out of numerous studies undertaken in southern Ontario by Guelph University's Centre for Resource Development. Eagles (1980, 1984) updated and further developed much of this work and documented various identification criteria.

Studies by Eagles have formed the basis for criteria used in ESA studies in various jurisdictions in Alberta.

The first ESA study done in Alberta was by Lamoureux and Associates in 1983 for the Calgary Regional Planning Commission region. Numerous ESA studies were conducted through the late 1980s and early 1990s, starting with Cottonwood Consultants', D.A. Westworth and Associates' and Infotech's work in the Oldman River Regional Planning Commission region, Strathcona County and Edmonton Metropolitan Regional Planning Commission in 1987.

Subsequently, ESAs were conducted by Geowest Environmental Consultants, Cottonwood Consultants, Sweetgrass Consultants and D.A. Westworth and Associates in the Crowsnest Pass (1988), Red Deer Regional Planning Commission region (1988-1991), David Thompson Corridor (1989), Eastern Boreal Forest (1990), Barrhead (1990), Southeast and Palliser Regional Planning Commission regions (1991), Lower Red Deer River 91991), Bow Corridor (1991), Brazeau (1992), Foothills Model Forest (1994) Birch Mountains (1994), Canmore (1994), Foothills (1995), Lloydminster area (1995), Montane (1995), Grassland and Parkland (1996), Dry Mixedwood Boreal Forest (Peace River and Central Alberta, 1996). The remainder of the Boreal Forest was completed in 1997. ESA studies have also been done within the cities of Calgary and Edmonton, and the towns of Lacombe and Canmore.

ESA studies of the Parkland, Grassland, Canadian Shield, Foothills and Boreal Forest Natural Regions are now all completed. The Rocky Mountain Natural Region has been only partially completed. These studies were done at the regional, provincial, national and international levels of significance. Some mapping of locally significant ESAs was also undertaken.

1.3 ESA Classification Criteria

Eagles (1984) stresses the need to have a standardized set of criteria for evaluating Environmentally Significant Areas (ESAs). These criteria fulfill several functions:

1. they allow a relatively systematic comparison of different sites and allow ranking schemes to be developed;
2. they help to outline the importance of sites to decision makers;
3. they stimulate research efforts towards refinement of definitions and concepts of significance;
4. they help to ensure similar approaches in other jurisdictions; and
5. they aid in the process of boundary delineation as only those features that fulfill the criteria are included.

ESAs include areas meet the following criteria:

1. areas which provide an important linking function and permit the movement of wildlife over considerable distances, including migration corridors and migratory stopover points.
2. areas which perform a vital environmental, ecological or hydrological function such as aquifer recharge;
3. areas which contain rare or unique geological or physiographic features;
4. areas which contain significant, rare or endangered plant or animal species;
5. areas which are unique habitats with limited representation in the region or are a small remnant of once large habitats which have virtually disappeared;
6. areas which contain an unusual diversity of plant and/or animal communities due to a variety of geomorphological features and microclimatic effects; and
7. areas which contain large and relatively undisturbed habitats and provide sheltered habitat for species which are intolerant of human disturbance.
8. areas that are excellent representatives of one or more ecosystems or landscapes that characterize a natural region;
9. areas with intrinsic appeal due to widespread community interest or the presence of highly valued features or species such as game species or sport fish; and

10. areas with lengthy histories of scientific research.

Each site examined during the ESA inventory process has been classified in a way that highlights its value or significance to the Special Places 2000 initiative. ESAs occur in all landscapes but are relative to surrounding land-uses. Site-specific biophysical conditions influence and are influenced by land-uses which may degrade a valued ecosystem process, for example. As a result, four factors regarding the physical state of the site must be considered when assessing the overall level of significance of any given potential ESA: representativeness, diversity, naturalness, and ecological integrity.

The concept of **representativeness** forms the fundamental approach to identifying and evaluating areas for environmental significance. The premise of the Special Places 2000 program is to provide representative examples of the full range of Alberta's natural diversity. Thus, features or sites are evaluated according to the degree to which they represent that type of feature within a given biogeographic region.

While other criteria such as naturalness, diversity or ecological integrity focus site assessment on the condition of the land base itself, the representativeness criterion is intended to provide context; that is, to demonstrate how a particular site is related to the surrounding region, the province, or other explicitly assigned land unit. The term "representativeness" implies that a subset of the land base is taken such that all, most, or critical characteristics of that land base are present (Mackey et al. 1988).

Varied interpretations of the term **diversity** result in a dual application of the term to conservation and protected area management. Ecological diversity, the interpretation being considered here, usually correlates with physiographic diversity. In practical terms, areas with dramatic relief, varied exposures, and heterogeneous substrates usually exhibit greater ecological diversity than areas of comparable size that are more homogenous in nature and possess narrower ecological gradients (Beechey 1989).

Diversity may also be applied more broadly to express the variety of different thematic categories within a given ESA site. Such an interpretation would define diversity as a measure of the variety, concentration, and abundance of values in a given site. While this definition of "diversity" has been advocated by some authors (Austin and Margules 1986, Mondor 1990, Peterson and Peterson 1991), the Special Places 2000 program has made special reference to "Natural History Theme representation" which specifically addresses this facet of diversity. Therefore, our working definition of "diversity" will concentrate on ecological diversity.

Naturalness is determined by considering the degree of human-caused disturbance in a site. This is important in determining the suitability of a site for inclusion as an ESA. In order to effectively protect representative natural, biological, and recreational values, protected areas should be located in areas that have experienced a minimal degree of development or disturbance.

The concept of **ecological integrity** has been in use for some time. Aldo Leopold introduced the concept in 1949 as follows: *"A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community."* Even though this concept has existed for decades, there remains considerable ambiguity regarding the definition and application of the term. A more recent (and more quantitative) definition proposed by Karr and Dudley (1981) is relevant to ESA identification:

> *Biological integrity is the capability of supporting and maintaining a balanced, integrated adaptive community of organisms having a species composition and functional organization comparable to that of the natural habitat of the region.*

The ecological integrity of each potential ESA site is integral to ensure the incorporation of whole viable systems into the protected areas network, thereby minimizing potentially negative impacts of extrinsic biophysical processes and anthropogenic activities.

The concept of ecological integrity, as applied to an ESA inventory, should include the stability and resilience of the chosen, representative ecosystem. As with many other ecological concepts, this one is also open to broad interpretations and applications. Colinvaux (1986) defined ecosystem stability simply as an ecosystem where the chance of a species becoming extinct is low. For an ecosystem to be stable, it must exhibit both resistance, or the power to withstand stress, and resilience; that is, the ability to return to its original state after being subjected to stress. These interpretations of ecological integrity are the ones most commonly applied. Specific factors which contribute to ecological integrity include size, distribution, shape, compatibility of adjacent land uses, watershed completeness, replication, and intended use and manageability.

Although they have been used in other jurisdictions, **aesthetic factors** were not used as a primary criteria for evaluating sites in the study area. However, many of the diverse landscapes and habitat areas are aesthetically pleasing to many people and add to the value of the ESAs.

1.4 Levels of Significance

The environmental significance of each potential ESA site is assessed with reference to several criteria-endangered, threatened, rare, limited, disjunct, or relict populations or features at three levels: international, national, and provincial. The following categories originally identified by Eagles (1984) and adopted by resource management agencies in Alberta (Braidwood 1987, Nordstrom 1987, Nelson et al. 1989) were used in this study:

international	-	features which are unique in the world
national	-	features which are limited in distribution at a national level or which are the best and only representatives in Canada
provincial	-	features which are of limited distribution in Alberta or are the best examples of a particular feature in Alberta

Evaluating areas in terms of their levels of significance requires considerable knowledge of significant features outside the jurisdiction under study. In some cases, this is facilitated by lists of rare, threatened, and endangered species (for example, COSEWIC 1996, Alberta Fish and Wildlife Division 1996, Packer and Bradley 1984) or evaluations of natural ecosystem complexes or landscapes (Achuff et al. 1988) that are available at provincial, national, and international levels. In some fields, notably geology, there have been very few attempts to summarize the significance or distribution of features. In these cases, professional judgement by several researchers has been used to determine the levels of significance. The history of assigning significance levels shows that areas are generally under-rated. As more information and methods of evaluation become available, then levels of significance can be altered accordingly.

For this study, areas of provincial significance include relatively undisturbed and sizable remnants of undisturbed upland and valley habitats; important waterfowl production and shorebird staging areas; and some of the most critical wildlife ranges (e.g. deer, Pronghorn, Caribou, Moose, Grizzly Bear) in Alberta.

Areas of national significance include staging habitats with nationally high concentrations of waterfowl and shorebirds, national parks, habitats for endangered species and concentrations of nationally rare plant and animal species. "Significant populations" of rare plants or animals generally refers to populations which are self-sustaining. Occurrences of individuals or single nest sites are not considered significant unless they are one of very few localities for the species.

Areas of international significance include sites of globally endangered species (e.g. Whooping Crane), RAMSAR wetlands; geological type localities; and extremely diverse grassland-valley complexes on international waterways (e.g. Writing-on-Stone).

1.5 ESAs and Biodiversity Conservation

Recently, public concern regarding land use issues has been staked to the concept of biodiversity, its threats, and its potential conservation. The concept of biodiversity, or biological diversity, has become the driving force behind modern conservation biology and also represents the blanket term underlying basic protected area management. Therefore, two questions concerning biodiversity must be clarified:

- what is biodiversity and why is it important?
- can a network of environmentally significant areas contribute to the preservation of biodiversity?

Biodiversity is simply defined as "*the variety and variability among all living organisms and the ecological complexes in which they occur*" (Probst and Crow 1991). It has, however, been difficult to define biodiversity in a practical management context because the concept reflects an interrelatedness of individuals, species, populations, communities, and ecosystems. Quantification of biodiversity can be a complex undertaking due to the various types of biodiversity and levels of organization and spatial scales at which it can be measured. Commonly recognized types of diversity are compositional diversity, which includes numerous levels of organization such as diversity of genes, species, and ecosystems; structural diversity, pertaining to the spatial arrangement of physical units; and functional diversity, representing variation in ecological processes such as nutrient cycling and predator-prey interactions (Allen 1992).

Theoretically, biodiversity can be maintained and managed at all levels. However, the most commonly referenced measure of biodiversity is "species diversity", expressed as the total number of species inhabiting a given parcel of habitat. The presence of individual species is a tangible, measurable indicator of at least one level of diversity and attracts a majority of the attention in the biodiversity arena. Our knowledge of species, although the most advanced of all measures of diversity, is nonetheless fairly rudimentary. Practical conservation programs have traditionally focused on individual species, primarily game species and, secondarily, rare and endangered species. Concerns arise because the loss of such species could mean the loss of entire ecosystems through a cascade effect. Species, however, exist as functional components of larger systems and management aimed at particular species will affect other species within the system. For this reason, many conservation biologists feel that landscape and ecosystem - level management is a more prudent approach and that this approach also inherently protects the components of the system (Harris and Noss 1985, Noss and Harris 1986).

The concept of biodiversity conservation represents more than simply maximizing "species richness"; it implies the conservation of whole processes. Genes, species, and other components of diversity are inseparable from the processes of life that they give to rise to (Reid and Miller 1989). Together, biodiversity (genes, species, habitats, communities, ecosystems) and the ecological and evolutionary processes (nutrient cycling, water cycling, photosynthesis, predation, mutualism, speciation) it maintains define the biosphere.

The compositional, structural, and functional attributes of ecosystems determine their biodiversity at all levels. These three attributes of biodiversity have been nested in a hierarchy by Noss (1990), acknowledging their interdependency and boundedness. This hierarchy theory suggests that higher levels of organization incorporate and constrain the behaviour of lower levels. Thus, biodiversity must be monitored at multiple levels of organization and at multiple spatial and temporal scales. The ranking of significance levels (i.e. provincial, national, or international) for ESAs emphasizes the different levels of resolution that are required to adequately maintain all levels of biodiversity.

Selecting indicators of biodiversity is often difficult because it is unlikely that any single indicator will possess all of the desired properties. Therefore, measurable indicators must include a set of tangible resources that adequately manifest themselves at various levels of biological organization and multiple spatial and temporal scales. The use of biological indicators to reflect ecosystem health, however, is a process that is proving to be increasingly fallible (Cairns 1983, Landres et al. 1988). Nonetheless, the concept of indicators is useful in defining biological entities which guide inventory, planning, evaluation, and management processes. The criteria for selection of these biodiversity indicators have been summarized by Salwasser (1990):

Genetic Resources
- Variation
- Fitness

Species Populations
- Recovery
- Viability
- Productivity

Ecosystems
- Structure
- Richness
- Ecological Processes

Landscapes - Regions
- Variety
- Biogeography
- Linkages

Salwasser (1990) presents a list of the major factors that influence biotic change:

- conversion of wilderness areas to agriculture and other human uses,
- fragmentation of habits and populations, which results in small and often isolated populations which are prone to local extirpation,
- human exploitation, which exceeds the ability of species and communities for regeneration and recovery,
- introduction of toxics and pollutants, which kill individuals outright or impair natural functioning, and
- alterations in the structure and function of ecosystems, which emphasize production of a limited number of commercially valuable species.

Most of these changes are the direct result of human activity and their impacts can be softened through the implementation of a protected area network based on ESAs.

ESAs, viewed in the context of protected areas, are anticipated to be the most cost-efficient and, in many cases, the only means available for maintaining adequate levels of biological diversity at appropriate scales. For certain groups of plants or animals, *ex situ* preservation techniques can be useful supplements to the *in situ* preservation provided by protected areas. However, *ex situ* methods such as captive breeding, arboreta and botanical gardens cannot be expected to meet most biological conservation needs. *Ex situ* methods cannot preserve the numerous ecological relationships and processes that characterize natural systems and that encourage the evolution of new species.

It is important at this time to note that ESAs are not characterized by protectionist policies. A site designated as an ESA is not a legislatively mandated protected area. However, the designation of an ESA does indicate the value of both biotic and abiotic resources within a site. By identifying ESAs prior to the development of land-use plans, biodiversity conservation can be incorporated into both private and public land management. The overall goal of employing ESA inventories into land use plans is to *maintain viable populations and natural distributions of native species and communities in the landscape.* By managing for biodiversity through an ESA network, land managers are able to cultivate a responsible land ethic which does not preclude development, habitat alteration, or even loss of certain species from a given area. Biodiversity conservation is all too often called upon as a crisis intervention tool when, in reality, the designation of ESAs can incorporate a "no net loss" (National Wetlands Policy Forum 1988) principle, and avert crises. The philosophy underlying no net loss is characterized by the flexibility to allow development while maintaining present or increasing levels of diversity within the context of a regional landscape. ESAs play an integral role in the future of biodiversity conservation in Alberta by providing the inventory of biological and physical resources and ecological processes which represent the province's biodiversity.

1.6 Protection Targets, Special Places 2000 and ESAs

In 1987, the Brundtland Commission or World Commission on Environment and Development indicated approximately 12% of the landscape should be in some form of protection but did not specify how it should be distributed or what level of protection it should be afforded (Brundtland 1987). This report, known also as the Brundtland Commission, recommended that each nation designate at least 12 percent of its land under protected area status. The target of 12 percent has been adopted by Parks Canada (Environment Canada 1990) and by World Wildlife Fund Canada (Hummel 1989) as necessary in order to adequately conserve critical natural areas. Provincial governments have also followed suit as Canada's federal and provincial governments signed on November 25, 1992 a "Statement of Commitment to Complete Canada's Network of Protected Areas". Helliwell (1975) has suggested that 20% of all lands should be dedicated to some form of protection. Most authors indicate the need for large protected areas, replicate protected areas, and diversity within each protected area; however, the guidelines for optimum biological design still have many limitations (Shaffer 1985).

The Global Biodiversity Strategy (World Resources Institute 1992) suggests that all jurisdictions should review their existing and proposed protected areas to evaluate their status, needs and effectiveness to ensure that they are part of a carefully designed network of protected areas that can encompass the diversity of local and national conservation goals. A well-designed protected area system review should provide:

- a comprehensive statement of objectives and future directions for an evolving network of protected areas
- an assessment of the existing system's viability and completeness
- a procedure for systematically identifying additional areas required for meeting conservation objectives
- a clear statement of priorities and a plan of action for achieving conservation objectives

The Convention on Biodiversity (UNEP 1992), of which Canada is a contracting party, states that each contracting party shall:

- develop plans or programmes for the conservation and sustainable use of biological diversity
- identify components of biological diversity important for its conservation and sustainable use
- establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity
- develop guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity

The Canadian Environmental Advisory Council (1992) outlined five steps that can be used to identify and establish a network of protected areas:

- identify major natural regions and establish a system of parks and protected areas that represents the natural features in each region
- establish as a priority, large, major ecosystem reserves within each natural region, including a continuum of many habitat types and preserve the most biologically productive and diverse examples
- establish smaller protected areas that supplement and complement the major conservation reserves by protecting additional habitat types or by covering regional variants of habitat
- include areas that provide recreational, educational or research facilities, or that protect special interest, scenic or wilderness landscapes
- include some small reserves to protect specific sites such as nesting areas of important species, caves, wetlands or special geological features

Alberta Environmental Protection has identified four program objectives related to natural resource conservation and use within the ministry's conservation-outdoor recreation system:

Protection - preservation and protection of a system of representative, special and outstanding natural landscapes and features.
Outdoor Recreation - provision of a variety of intensive and dispersed outdoor recreation opportunities.
Heritage Appreciation - provision of opportunities to explore, understand and appreciate the natural heritage of Alberta.
Tourism - encouragement of residents and visitors to discover and enjoy the natural resources of the province.

This report outlines protected area targets for each Level 1 Natural History Theme that are designed only to meet Alberta's protection objective -- other rationales and approaches will be required for setting targets for Outdoor Recreation, Heritage Appreciation and Tourism.

Special Places 2000 is the strategic plan which has been established by the Alberta government to provide direction for the identification and establishment of protected areas in the province. Protected areas have been identified as key components of a sustainable environment which, in turn, provides the cornerstone for sustainable development in Alberta. The realization that the environment, the economy and human health are interdependent has resulted in action being taken to develop, protect, and mange our natural lands.

As part of a world-wide strategy for the conservation of natural heritage, the Special Places 2000 program supports similar initiatives occurring at the provincial, national, and international levels. The Special Places 2000 program supports efforts at the international level (e.g. Biodiversity Convention, Ramsar Convention on Wetlands, World Heritage Convention), national level (e.g. World Wildlife Fund's Endangered Spaces Program, National Parks, National Wildlife Areas), and provincial level (Provincial Parks, Ecological Reserves, Natural Areas, Wilderness Areas, Toward 2000 Together - the Premier's Conference on Alberta's Economic Future). Sustainable development has been recognized at all levels as a key to the future. Maintaining biodiversity and representative ecosystems are critical objectives that must be achieved in working toward sustainable development. Protecting landscapes is a key strategy to achieve these objectives. Protected areas are special places that are explicitly legislated and managed to protect Alberta's natural heritage (Achuff and Wallis 1992).

ESAs have become a useful tool in the implementation of Special Places 2000, a strategic plan for identifying and protecting diverse and representative landscapes in Alberta. ESA inventories serve as a valuable source of information for future protected area selection and designation.

While Special Places 2000 is focused on protecting representative areas of Alberta's natural regions and subregions, some unique sites are also being identified. ESAs include both representative and unique features and, often, the linking corridors and buffers that are needed to maintain the ecological integrity and overall biodiversity of an area. The Public Advisory Committee on Special Places 2000 has recommended:

> *Environmentally significant areas studies (ESAs) and similar research, along with local interest, should be the basis for identifying potential new Special Places.*

ESAs of provincial or greater significance are considered the most likely sites for identifying landscapes suitable for a provincial protected areas program like Special Places 2000. Regionally significant sites may be important for municipal government protected area programs and for maintaining the overall integrity of all ESAs.

1.7 Outline of this Study

Sweetgrass Consultants Ltd. was contracted in 1996 by Alberta Environmental Protection to undertake a study of provincially, nationally and internationally significant ESAs in Alberta. The primary purpose of the study was to evaluate and provide an overview of all ESA inventories completed to date. The specific objectives of the study were to:

1. produce a report that provides a provincial overview of the ESAs program and summarizes the results of the ESA inventory program for each of the Province's Natural Regions;
2. evaluate the significance levels assigned to previously identified ESAs to ensure that classification criteria are consistently applied and to assign significance levels based on consistent criteria;
3. to edge-match ARCINFO polygons from previous ESA inventories;
4. to analyse, at a scale of 1:250,000, the total area of provincially, nationally and internationally significant ESAs greater than 10 sq. km by level 1 Natural History Themes as identified by Alberta Parks Services (1994).
5. to produce 1:250,000 scale maps showing all provincially, nationally and internationally significant ESAs and the level 1 Natural History Themes included within the boundaries of each ESA.

The report is organized so that the user can get an overview of the major biophysical resources, Natural History Themes, and future study needs as well as more detailed information on each environmentally significant area.

Each of the environmentally significant areas is described in outline form so the reader can, at a glance, determine the following:

1. name of the ESA study from which the information is derived;
2. name of the area;
3. general location;
4. NTS map sheet;
5. municipality in which it occurs;
6. natural subregions in which it occurs;
7. level of significance (provincial, national or international) and background for determining level of significance;
8. a description of the major features which characterize the area;
9. management considerations; and
10. references which will provide more scientific or detailed information should the user require it.

All information is mapped on 1:250,000 map sheets corresponding to NTS map sheet numbers and is also stored digitally in ARCINFO format.

Where available, more detailed location data for sites within each significant area are provided in background reference material or in area descriptions.

2. DATA COLLECTION METHODS

The following methods of collecting environmental data were employed:

1. reviews of published ESA information in government data files and consultant reports;
2. a workshop with other ESA researchers; and
3. review of published reports and surficial geology maps and interpretation of aerial photographs to determine Natural History Themes.

2.1 Review of ESA Reports and Data

All available ESA reports and associated digital spatial and data files were reviewed for this study. The following is a listing of the source reports used in this study. While POSTON is not strictly an ESA study, it forms the basis for evaluating the significance of a large number of ESA sites. A few ESA studies have been excluded since no provincially, nationally or internationally significant ESAs were identified therein, e.g. County of Mountain View, Town of Lacombe, City of Edmonton, City of Calgary.

ACADIA	Cottonwood Consultants Ltd. 1991. Environmentally significant areas in the Palliser Region: MD of Acadia. Prepared by Cottonwood Consultants Ltd. for the Palliser Regional Planning Commission, Hanna.
BARRHEAD	Wallis, C. and L. Knapik. 1990. Environmentally significant areas of the County of Barrhead. Prepared by Cottonwood Consultants Ltd. for the Agriculture Services Board, County of Barrhead, Barrhead.
BIRCH MOUNTAINS	Westworth and Associates Ltd. 1994. An inventory of significant natural features in the Birch Mountains -- Firebag River Integrated Resource Planning Area. Prepared by Westworth and Associates Ltd. for Resource Information Branch, Alberta Environmental Protection, Edmonton.
BOREAL	Geowest Environmental Consultants. 1997 (in prep.). Environmentally significant areas inventory of the Boreal Forest Natural Region of Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton
BOW CORRIDOR	Sweetgrass Consultants Ltd. 1991. Environmentally significant areas in the Bow River Corridor. Prepared by Sweetgrass Consultants, Calgary, for the MD of Bighorn, Exshaw.
BRAZEAU	Patriquin, D. and R. Ellis. 1992. Environmentally significant areas study: Municipal District of Brazeau, White Zone. Prepared by Westworth and Associates, Edmonton for Yellowhead Regional Planning Commission.
CALGARY	Lamoureux, R. G. Chow and B. Reeves. 1983. Environmentally significant areas of the Calgary region. Prepared by Lamoureux and Associates, Calgary for Calgary Regional Planning Commission, Calgary.
CANADIAN SHIELD	Alberta Parks Services. 1995. Natural history overview and theme evaluation, Canadian Shield (Athabasca Plain and Kazan Upland). Parks Services, Alberta Environmental Protection, Edmonton.
CANMORE	Cottonwood Consultants Ltd. 1994. Environmentally significant areas in the Town of Canmore. Prepared by Cottonwood Consultants Ltd. for the Town of Canmore, Canmore.
CARDSTON	Cottonwood Consultants Ltd. 1987. Environmentally significant areas in the Oldman River Region: MD of Cardston. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
CLEARWATER	Sweetgrass Consultants Ltd. 1991. Environmentally significant areas of the MD of Clearwater. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
CROWSNEST PASS	Sweetgrass Consultants Ltd. 1988. Environmentally significant areas of the Municipality of Crowsnest Pass. Prepared by Sweetgrass Consultants, Calgary, for Alberta, Forestry, Lands and Wildlife, Edmonton.
CYPRESS	Cottonwood Consultants Ltd. 1991. Environmentally significant areas of the MD of Cypress. Prepared by Cottonwood Consultants Ltd. for the Southeast Regional Planning Commission, Medicine Hat.
DAVID THOMPSON	Sweetgrass Consultants Ltd. 1989. Environmentally significant areas of the David Thompson Corridor. Prepared by Sweetgrass Consultants, Calgary, for Alberta, Forestry, Lands and Wildlife, Edmonton.
DRY MIXEDWOOD	Bentz, J., V. Chisholm, and A. Saxena. 1996. Environmentally significant areas inventory of the Boreal Dry Mixedwood Subregion of Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton.
EASTERN BOREAL	Westworth and Associates Ltd.. 1990a. Significant natural features of the eastern Boreal Forest Region of Alberta. Prepared by Westworth and Associates for Alberta Forestry, Lands and Wildlife, Edmonton.
FOOTHILLS	Bentz, J., A. Saxena and T. Normand. 1995. Environmentally significant areas inventory, Foothills Natural Region, Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Land Information Division, Alberta Environmental Protection, Edmonton.
FORTY MILE	Cottonwood Consultants Ltd. 1991. Environmentally significant areas of the County of Forty Mile. Prepared by Cottonwood Consultants Ltd. for the Southeast Regional Planning Commission, Medicine Hat.
GRASSLAND	Saxena, A., V. Chisholm and J. Bentz. 1996. Environmentally significant areas inventory, Grassland and Parkland Natural Regions, Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton.

KNEEHILL	Cottonwood Consultants Ltd. 1991. Environmentally significant areas in the Palliser Region: MD of Kneehill. Prepared by Cottonwood Consultants Ltd. for the Palliser Regional Planning Commission, Hanna.
LACOMBE	Sweetgrass Consultants Ltd. 1988. Environmentally significant areas of the Counties of Lacombe and Stettler. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
LEDUC	Brusnyk, L., D. Westworth, K. Egan, A. McCann, L. Knapik and C. Schreiner. 1991. Environmentally sensitive areas study: County of Leduc. Prepared by Westworth and Associates for the Edmonton Metropolitan Regional Planning Commission, Edmonton.
LETHBRIDGE	Cottonwood Consultants Ltd. 1987. Environmentally significant areas in the Oldman River Region: County of Lethbridge. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
LLOYDMINSTER	Cottonwood Consultants Ltd. 1995. Environmentally significant areas of the Lloydminster Area, Alberta and Saskatchewan. Prepared by Cottonwood Consultants Ltd. for Nature Conservancy of Canada and Husky Oil Operations, Calgary.
LOWER RED DEER	Cottonwood Consultants Ltd. 1991. Environmentally significant areas of the Lower Red Deer River. Prepared by Cottonwood Consultants Ltd. for Alberta Forestry, Lands and Wildlife, Edmonton.
MODEL FOREST	Sweetgrass Consultants Ltd. 1994. Environmentally significant areas in the Foothills Model Forest. Prepared by Sweetgrass Consultants, Calgary, for Foothills Model Forest, Hinton.
MONTANE	Alberta Environmental Protection. 1995. Alberta's Montane Subregion, Special Places 2000 and the significance of the Whaleback Montane. Natural Resources Service, Alberta Environmental Protection, Edmonton.
NEWELL	Cottonwood Consultants Ltd. 1991. Environmentally significant areas of the County of Newell. Prepared by Cottonwood Consultants Ltd. for the Southeast Regional Planning Commission, Medicine Hat.
PAINTEARTH	Sweetgrass Consultants Ltd. 1989. Environmentally significant areas of the County of Paintearth. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
PARKLAND	Saxena, A., V. Chisholm and J. Bentz. 1996. Environmentally significant areas inventory, Grassland and Parkland Natural Regions, Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton.
PEACE RIVER	Johnston, S., R. Ellis and D. Westworth. 1996. Inventory of environmentally significant areas in the Boreal Dry Mixedwood Natural Subregion, Peace River Section: 1995-1996. Prepared by Westworth, Brusnyk and Associates, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton.
PINCHER CREEK	Cottonwood Consultants Ltd. 1987. Environmentally significant areas in the Oldman River Region: MD of Pincher Creek. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
POSTON	Poston B., D.M. Ealey, P.S. Taylor and G.B. Keating. 1990. Priority migratory bird habitats of Canada's prairie provinces. Canadian Wildlife Service, Environment Canada. Edmonton, Alberta.
RED DEER	Sweetgrass Consultants Ltd. 1990. Environmentally significant areas of the County of Red Deer. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
STARLAND	Cottonwood Consultants Ltd. 1991. Environmentally significant areas in the Palliser Region: MD of Starland. Prepared by Cottonwood Consultants Ltd. for the Palliser Regional Planning Commission, Hanna.
STETTLER	Sweetgrass Consultants Ltd. 1988. Environmentally significant areas of the Counties of Lacombe and Stettler. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
STRATHCONA	Westworth, D. and L. Knapik. 1987. Significant natural features and landscapes of Strathcona County. Prepared by Westworth and Associates for Recreation and Parks, Strathcona County. *and*
	Infotech. 1989. Environmentally sensitive areas: County of Strathcona and MD of Sturgeon. Prepared by Infotech Services Land Evaluation Consultants for the Edmonton Metropolitan Regional Planning Commission, Edmonton.
STURGEON	Infotech. 1989. Environmentally sensitive areas: County of Strathcona and MD of Sturgeon. Prepared by Infotech Services Land Evaluation Consultants for the Edmonton Metropolitan Regional Planning Commission, Edmonton.
TABER	Cottonwood Consultants Ltd. 1988. Environmentally significant areas in the Oldman River Region: MD of Taber. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
VULCAN	Cottonwood Consultants Ltd. 1988. Environmentally significant areas in the Oldman River Region: County of Vulcan. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
WARNER	Cottonwood Consultants Ltd. 1987. Environmentally significant areas in the Oldman River Region: County of Warner. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
WETLANDS	Wallis, C. 1990. Reconnaissance survey of saline wetlands and springs in the grassland-parkland region of eastern Alberta. Prepared by Cottonwood Consultants Ltd., Calgary for World Wildlife Fund, Edmonton.
WILLOW CREEK	Cottonwood Consultants Ltd. 1989. Environmentally significant areas in the Oldman River Region: MD of Willow Creek. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning

	Commission, Lethbridge.

These reports contain descriptions of each ESA of regional or greater significance. Checksheets outlining location, significance, description, management considerations and references were included in earlier ESA reports. Later studies incorporated this information into electronic databases.

These ESA reports also contain extensive sections on management approaches to ESAs that are relevant to the Natural Subregions in which they occur. Some of the later ESAs identified the types of Natural History Themes (Alberta Parks Services 1994) represented.

2.2 Workshop on ESAs

A workshop was held in the fall of 1996 to review inconsistencies with ESA significance ratings and to finalize the criteria that would be used for ranking sites. The workshop gathered together the four principal companies and personnel that have undertaken most of the ESAs conducted in Alberta to date:

- Cottonwood Consultants - Cliff Wallis
- D.A. Westworth and Associates - Bob Ellis
- Geowest Environmental Consultants - Jerry Bentz, Amit Saxena
- Sweetgrass Consultants - Cleve Wershler

The workshop focused on areas of discrepancy between rankings cited in various studies. Much of the discussion revolved around the work of Poston and on planned revisions to the Status of Alberta Wildlife report. Some of the key decisions regarding ESA criteria from the workshop included:

1. while the actual river course may be of provincial or greater significance, land use activities may reduce the significance of the river valley. Valley segments of rivers that are extensively modified by human activity will not be considered to be internationally, nationally or provincially significant. Portions of nationally significant river valleys that are subject to some modification may be reduced to provincial significance.
2. information in non-ESA reports (e.g. Poston, Montane, Canadian Shield) will be used to supplement the standard ESA reports. The significance of sites identified by Poston may be reduced if the areas have been modified by human activity. Notes about the dynamic nature and reduced significance of some of Poston's sites during drought should be added to the site descriptions.
3. Trumpeter Swan long-term active nesting sites (based on Canadian Wildlife Service data) will be considered to be of at least provincial significance. This species was Alberta red-listed at the time of the workshop -- it is now a blue-listed species in the current Status of Alberta Wildlife report released in 1997 (Wildlife Management Division 1996). Many of these sites are also significant for other waterfowl and marsh birds and may be considered significant for other reasons as well.
4. COSEWIC Endangered species, e.g. Piping Plover, long-term nest sites will be considered at least of national significance and, where populations and global endangerment (e.g. Whooping Crane) warrant, may be considered of international significance.
5. key Grizzly Bear ranges in the Foothills and Boreal Forest are considered to be of provincial significance.
6. only the most productive Caribou, Moose, Elk, and deer habitats will be considered of provincial significance.
7. trophy fish lakes and commercial fishing lakes will be considered of provincial significance.
8. extensive unfragmented mixed grasslands will be considered at least of provincial significance.
9. larger blocks of unfragmented fescue grasslands will be considered at least of national significance.

2.3 Literature Review and Aerial Photograph Interpretation

Surficial geology maps and biophysical reports (see References) were reviewed that were relevant to each provincially, nationally or internationally significant ESA. Dominant surficial themes based on the literature

and on maps (for Foothills and Boreal Forest) derived by Alberta Parks Services from the digital Soil Landscapes of Canada files were initially plotted within each ESA on 1:250,000 scale maps.

Aerial photographs for each provincially, nationally or internationally significant ESA were analyzed. Using the dominant surficial themes identified from the literature, aerial photographs and knowledge of the Natural Subregions and individual sites, surficial unit polygons were identified in each ESA. These surficial units were based on recurring patterns of landscape features. For each surficial unit polygon, the percentage occurrence of each Natural History Theme (Alberta Parks Services 1994) was determined from aerial photograph interpretation. These figures are estimates with an accuracy of 85-90%. For the purposes of this evaluation, all figures are discrete and no double-counting was done.

Further refinement to the ESA boundaries was undertaken based on the interpretation of the most recent aerial photographs. Additional clearing, cultivation and fragmentation necessitated the revision of several boundaries and, in some cases, the lowering of previously assigned significance rankings.

Except for Wood Buffalo National Park, most aerial photography used was flown between 1985 and 1995. Photography for Wood Buffalo National Park was flown circa 1950. Photography used included:

Map Sheet	Job Numbers (1949 = 1949-1951 photography)
72E	92-93; 91-191
72L	91-191; 92-159; 82-52(Suffield block)
72M	92-159; 93-173
73D	87-89; 92-147; 92-159; 93-176
73E	87-89; 93-157; 93-174; 95-143
73L	89-176
73M	83-143
74D	84-102
74E	95-113; 94-111; 84-102
74L	84-102
74M	82-58
82G	92-93; 93-130
82H	92-93; 91-191
82I	92-93; 91-191; 83-82
82J	92-93; 93-130; 83-82
82O	92-103; 93-176; 82-52; 79-64
82P	93-176; 91-191; 79-64
83A	93-176
83B	91-193; 93-176
83C	91-193; 93-131
83E	93-131
83F	93-131; 85-123
83G	95-144; 91-193; 90-116
83H	93-176; 87-89
83I	91-274
83J	91-274
83K	95-96
83L	95-96
83M	95-097A
83N	85-123
83O	83-143; 92-95
83P	83-143; 92-95
84A	93-135; 91-192; 84-102
84B	86-138; 84-102
84C	93-134; 88-209; 84-102
84D	92-158; 89-183; 84-102
84E	92-94; 85-122
84F	94-109; 85-122
84G	95-113; 94-109; 85-122
84H	95-113; 94-111; 85-122
84I	83-142

84J	94-100; 83-142
84K	83-142
Map Sheet	**Job Numbers (1949 = 1949-1951 photography)**
84L	86-139; 83-142
84M	94-100; 94-99; 1949
84N	94-100; 94-99; 1949
84O	94-100; 1949
84P	94-100; 1949

2.4 Digital Map Production

Following the workshop and analysis of the aerial photographs, the final boundaries of the ESAs were determined. Digital files provided by Alberta Environmental Protection were the source of the ESA boundaries for most sites. Where there were two sources for the same site, the most accurate files digitized at the largest scale were chosen. Boundaries were adjusted based on aerial photograph interpretation to exclude significant areas of human disturbance. Internal polygon boundaries (surficial units/Natural History Themes) were digitized in ARCINFO from 1:250,000 scale maps. The entire work was cleaned and paper copies checked for errors. The spatial files were linked to the Natural History Theme database files.

A mylar and paper copies of each 1:250,000 NTS Map Sheet showing ESA boundaries and internal (surficial units/Natural History Themes) polygons were produced.

3. OVERVIEW OF NATURAL REGIONS AND SUBREGIONS

3.1 Grassland Natural Region

The Grassland Natural Region occupies a broad area of southern Alberta and extends west to the Rocky Mountains and north to the southern edge of the Parkland Natural Region in central Alberta. The region is a flat to gently rolling plain with a few major hill systems. Most of the bedrock is covered with extensive, thick glacial till deposits. The diversity of the uplands is increased by numerous areas of fine-textured materials laid down in proglacial lakes and coarse-textured deposits in dune fields and outwash plains, both of which are associated with proglacial lake basins.

Rivers in the Grassland Natural Region are part of either the Saskatchewan River or Missouri River systems. Where valleys are carved deeply into bedrock, badlands have developed. Numerous coulees and ravines are associated with these river valley systems. Seven exposures of igneous rock, all within the Milk River drainage, are the only igneous exposures in the grasslands of western Canada. With the exception of these isolated igneous outcrops, bedrock exposures are all of sedimentary rocks and commonly occur along stream valleys.

The Grassland Natural Region contains four Subregions - Dry Mixedgrass, Mixedgrass, Northern Fescue, and Foothills Fescue. These Subregions are separated primarily on the basis of climatic, soils and vegetational factors. The Dry Mixedgrass Subregion is most extensive, occurring from the U.S. border, north and west to the Northern Fescue and Mixedgrass Subregions. The Mixedgrass Subregion occurs generally west of the Dry Mixedgrass Subregion. The Northern Fescue and Foothills Fescue Subregions occurs in narrow belts along the northern and western margins of the Dry Mixedgrass and Mixedgrass Subregions. Although it is not shown on the Natural Regions Map, there is a disjunct occurrence of Foothills Fescue in the Cypress Hills at higher elevations within the mapped Mixedgrass Subregion boundary. More research is needed to accurately delineate the boundary between the Mixedgrass and Foothills Fescue in this area.

ESAs done in the Grassland Natural Region include:

ACADIA	Cottonwood Consultants Ltd. 1991. Environmentally significant areas in the Palliser Region: MD of Acadia. Prepared by Cottonwood Consultants Ltd. for the Palliser Regional Planning Commission, Hanna.
CALGARY	Lamoureux, R. G. Chow and B. Reeves. 1983. Environmentally significant areas of the Calgary region. Prepared by Lamoureux and Associates, Calgary for Calgary Regional Planning Commission, Calgary.
CARDSTON	Cottonwood Consultants Ltd. 1987. Environmentally significant areas in the Oldman River Region: MD of Cardston. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
CYPRESS	Cottonwood Consultants Ltd. 1991. Environmentally significant areas of the MD of Cypress. Prepared by Cottonwood Consultants Ltd. for the Southeast Regional Planning Commission, Medicine Hat.
FORTY MILE	Cottonwood Consultants Ltd. 1991. Environmentally significant areas of the County of Forty Mile. Prepared by Cottonwood Consultants Ltd. for the Southeast Regional Planning Commission, Medicine Hat.
GRASSLAND	Saxena, A., V. Chisholm and J. Bentz. 1996. Environmentally significant areas inventory, Grassland and Parkland Natural Regions, Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton.
KNEEHILL	Cottonwood Consultants Ltd. 1991. Environmentally significant areas in the Palliser Region: MD of Kneehill. Prepared by Cottonwood Consultants Ltd. for the Palliser Regional Planning Commission, Hanna.
LETHBRIDGE	Cottonwood Consultants Ltd. 1987. Environmentally significant areas in the Oldman River Region: County of Lethbridge. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
LOWER RED DEER	Cottonwood Consultants Ltd. 1991. Environmentally significant areas of the Lower Red Deer River. Prepared by Cottonwood Consultants Ltd. for Alberta Forestry, Lands and Wildlife, Edmonton.
NEWELL	Cottonwood Consultants Ltd. 1991. Environmentally significant areas of the County of Newell. Prepared by Cottonwood Consultants Ltd. for the Southeast Regional Planning Commission, Medicine Hat.
PAINTEARTH	Sweetgrass Consultants Ltd. 1989. Environmentally significant areas of the County of Paintearth. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.

PARKLAND	Saxena, A., V. Chisholm and J. Bentz. 1996. Environmentally significant areas inventory, Grassland and Parkland Natural Regions, Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton.
PINCHER CREEK	Cottonwood Consultants Ltd. 1987. Environmentally significant areas in the Oldman River Region: MD of Pincher Creek. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
POSTON	Poston B., D.M. Ealey, P.S. Taylor and G.B. Keating. 1990. Priority migratory bird habitats of Canada's prairie provinces. Canadian Wildlife Service, Environment Canada. Edmonton, Alberta.
STARLAND	Cottonwood Consultants Ltd. 1991. Environmentally significant areas in the Palliser Region: MD of Starland. Prepared by Cottonwood Consultants Ltd. for the Palliser Regional Planning Commission, Hanna.
STETTLER	Sweetgrass Consultants Ltd. 1988. Environmentally significant areas of the Counties of Lacombe and Stettler. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
TABER	Cottonwood Consultants Ltd. 1988. Environmentally significant areas in the Oldman River Region: MD of Taber. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
VULCAN	Cottonwood Consultants Ltd. 1988. Environmentally significant areas in the Oldman River Region: County of Vulcan. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
WARNER	Cottonwood Consultants Ltd. 1987. Environmentally significant areas in the Oldman River Region: County of Warner. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
WETLANDS	Wallis, C. 1990. Reconnaissance survey of saline wetlands and springs in the grassland-parkland region of eastern Alberta. Prepared by Cottonwood Consultants Ltd., Calgary for World Wildlife Fund, Edmonton.
WILLOW CREEK	Cottonwood Consultants Ltd. 1989. Environmentally significant areas in the Oldman River Region: MD of Willow Creek. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.

3.1.1 Dry Mixedgrass Subregion

The topography of the Dry Mixedgrass Subregion is generally subdued with only a few minor uplands. The predominant landform is a low-relief ground moraine but there are significant areas of hummocky moraine, glaciofluvial outwash, glaciolacustrine sand plains, fine-textured glaciolacustrine lake deposits, and eroded plains. Elevations range from 600 m near Empress to more than 1300 m on the lower slopes of the Cypress Hills and the Sweetgrass Hills. Although permanent streams are relatively rare, the ones that do exist are well defined. The Subregion is drained by several major rivers that have carved deeply into the bedrock in some places. This has exposed Cretaceous shales and sandstones, creating extensive badlands in some areas. Drainage is to the Missouri River system via the Milk River and to the Saskatchewan River system via all of the other rivers in the Subregion.

Climatically, the Dry Mixedgrass Subregion is the warmest and driest in Alberta. It has a typical continental climate with cold winters, warm summers and low precipitation. Because of the warm summer temperatures and a high average wind speed, the rate of evaporation is high throughout the summer months. There is high daily and seasonal temperature variation. It is characterized by a mean annual temperature of $4^{o}C$ and a growing season (May-September) mean of about $16^{o}C$.

Total annual precipitation is typically around 260-280 mm and summer precipitation is the lowest of any Subregion in Alberta. Compared to other Subregions, the Dry Mixedgrass Subregion has a high year-to-year precipitation variability. Spring is the wettest season with about two-thirds of the annual precipitation falling as rain, the peak occurring in June. The amount of snow cover is relatively low as is the number of days of continuous snow cover. Chinooks are most common along the western border of the Subregion where 10-20 chinook days per year are normal.

The characteristic soils of the Dry Mixedgrass Subregion are Brown Chernozems. Brown Solonetz soils are common in the extreme southeast of the Subregion and in a large area north of Dinosaur Provincial Park.

The name 'Mixedgrass' comes from the predominance of both short and mid-height grasses. The most widespread are the mid-grasses, spear grass, western wheat grass and June grass and the short grass,

blue grama. Northern wheat grass and western porcupine grass are characteristic of moister sites within the Subregion.

The majority of Dry Mixedgrass vegetation is a spear grass-blue grama community with western wheat grass and northern wheat grass also important in hummocky moraine areas. Fine-textured soils in glacial lake basins are characterized by the northern wheat grass - June grass community. Solonetzic soils are typically occupied by the western wheat grass - blue grama community.

The Dry Mixedgrass Subregion contains the greatest number of animal species in the Grassland Natural Region. Many, especially those of sand dune areas and the extreme southeast, occur nowhere else in Alberta. A few are absent or local in the rest of Canada. Characteristic species of heavily-grazed uplands include horned lark, McCown's longspur, chestnut-collared longspur, and Richardson's ground squirrel. Species of lightly-grazed areas include Baird's sparrow, Sprague's pipit, sharp-tailed grouse, and upland sandpiper. Western meadowlark and white-tailed jack rabbit tolerate a broad spectrum of grazing conditions.

Sage grouse, lark bunting, Brewer's sparrow and pronghorn show an affinity for sagebrush flats in the uplands and valley bottoms.

Sand plain and dune areas contain a number of rare and local species that are restricted to these habitats including Ord's kangaroo rat and western hognose snake. Wider ranging species that also occur here include sharp-tailed grouse, grasshopper sparrow and mule deer.

Riparian shrublands and forests support a diverse animal community, including brown thrasher, gray catbird, yellow-breasted chat, mourning dove, northern flicker, house wren, northern oriole, deer mouse, Nuttall's cottontail, and white-tailed deer.

Rock outcrops and badlands are local but significant as nesting habitat to a number of birds including golden eagle, rock wren, ferruginous hawk, prairie falcon and mountain bluebird.

Marshes and wetlands are important breeding and migratory habitat for many birds, as well as key habitat for breeding amphibians including chorus frogs, leopard frogs, plains spadefoots and garter snakes.

3.1.2 Mixedgrass Subregion

The Mixedgrass Subregion is similar to the Dry Mixedgrass Subregion in many features. Those that differentiate it from the Dry Mixedgrass Subregion are emphasised here.

The topography of the Mixedgrass Subregion is generally subdued with only a few minor uplands. The predominant landforms are ground moraine and hummocky moraine but there are important areas of glaciolacustrine sand plains and fine-textured glaciolacustrine lake deposits.

The few permanent streams are well-defined. Drainage is either to the Missouri River system via the Milk River or to the Saskatchewan River system.

The climate of the Mixedgrass Subregion is slightly moister and cooler than that of the Dry Mixedgrass Subregion. The mean annual temperature is about 5 ^{o}C with a mean summer temperature of about 15^{o}C which is about 1-2^{o}C cooler than the Dry Mixedgrass Subregion. Winter temperatures in the Mixedgrass Subregion, are 1-2^{o}C warmer than the Dry Mixedgrass Subregion, with a greater frequency of chinook days (20-30 days) but with greater snow cover due to greater winter precipitation. Annual precipitation in the Mixedgrass Subregion is about 20% greater than for the Dry Mixedgrass Subregion.

The characteristic soils of the Mixedgrass Subregion are Dark Brown Chernozems as contrasted with the Brown Chernozems of the Dry Mixedgrass Subregion. A few Black Chernozems occur on moister sites along the northern and western boundaries of this Subregion.

The vegetation of the Mixedgrass Subregion is similar to the Dry Mixedgrass Subregion; however, it is characterized by increased biomass production and a greater abundance of species that favor cooler and moister sites. Species such as northern wheat grass and western porcupine grass are more dominant than in the Dry Mixedgrass Subregion.

The majority of Mixedgrass Subregion vegetation is dominated by spear grass, porcupine grass, western wheat grass and northern wheat grass. Fine-textured soils in glacial lake basins are characterized by the northern wheat grass - June grass community. On drier exposed sites blue grama is more common.

Extensive narrow-leaved cottonwood forests occur along the Oldman, Belly, Waterton, and St. Mary's rivers and nowhere else in Canada.

The wildlife of the Mixedgrass Subregion is generally similar to, but less diverse than, that of the Dry Mixedgrass Subregion. Sandy areas are less common in this Subregion and extensive agricultural development has left comparatively little in natural habitat. Wildlife in the forests and shrublands of the southwestern rivers is similar to that of the Milk River in the Dry Mixedgrass Subregion.

3.1.3 Northern Fescue Subregion

Topographically, the Northern Fescue Subregion is characterized by gently rolling terrain. The most common landforms are low-relief ground moraine and hummocky moraine. Areas of outwash and sand plains, dune fields, and fine-textured glaciolacustrine deposits occupy a smaller but significant amount of the landscape. Eroded plains are important in the Sullivan Lake area. The lowest elevations are in the eastern parts of the Subregion.

Stream drainage is part of the Saskatchewan River system except for a large area of internal drainage in the Sounding Creek basin. Few stream valleys dissect the Subregion but those with permanent flow are usually well-incised.

The climate of the Northern Fescue Subregion is transitional between the Mixedgrass and Central Parkland Subregions. The mean May-September temperature is 14^{o}C and the frost-free period is about 90 days. Mean annual precipitation is about 400 mm with mean May-September precipitation about 280 mm.

The predominant soils are Dark Brown and Black Chernozems, with Brown Solonetz soils extending through the centre of the Subregion in a broad band north of Hanna.

The grasslands are dominated by rough fescue, with june grass, western porcupine grass, northern wheatgrass and Hooker's oatgrass also important. Common forbs include prairie crocus, prairie sagewort, mouse-ear chickweed, wild blue flax and old man's whiskers.

Sand dunes contain a mixture of rough fescue grasslands with scattered shrubs of silverberry or thickets of rose and western snowberry.

No animal species is restricted to the Northern Fescue Subregion and the composition is similar to that of the Mixedgrass Subregion. Generally, species that favour lightly to moderately grazed Northern Fescue grassland also favour lightly grazed Mixedgrass areas. These include Baird's sparrow, Sprague's pipit, upland sandpiper and sharp-tailed grouse. With heavy grazing, species more typical of the Mixedgrass Subregion increase, including horned lark, chestnut-collared longspur and Richardson's ground squirrel. Species more characteristic of the Northern Fescue Subregion than the Mixedgrass Subregion include savannah sparrow and thirteen-lined ground squirrel.

3.1.4 Foothills Fescue Subregion

The Foothills Fescue Subregion occurs largely on morainal, glaciolacustrine and outwash deposits on the lower flanks of the Foothills Geologic Belt, the Porcupine Hills, and onto the adjacent plains area. It

occurs primarily as a narrow band between the Mixedgrass Subregion and the Foothills Parkland Subregion, although in some areas Foothills Grassland merges directly into the Montane Subregion. Although it is not shown on the Natural Regions Map, there are disjunct areas on unglaciated loess deposits on the plateau of the Cypress Hills and immediately adjacent plains. There is a large area of unglaciated terrain on the plateau of the Milk River Ridge.

Elevations are much higher than in the other three grassland Subregions, ranging up to 1400 m in the Cypress Hills.

A small portion of this subregion, in the Milk River Ridge and Cypress Hills areas, drains into the Milk River system. The rest is part of the Saskatchewan River system.

The climate of the Foothills Fescue Subregion differs from that of the Northern Fescue Subregion in having a greater frequency of chinooks and thus, a milder winter climate. There is also greater snowfall in late winter and early spring. The majority of precipitation falls during the growing season.

The mean annual precipitation ranges from 650 mm in the far south to about 500 mm in the north. The mean May - September precipitation is 290 mm. The mean May - September temperature is 11^{o}C to 13^{o}C . The mean annual temperature is 3^{o}C and the frost-free period averages 90 days.

The soils of this Subregion are predominantly Dark Brown and Black Chernozems. Solonetzic soils are not important in the Foothills Fescue Subregion.

The Foothills Fescue grasslands are dominated by rough fescue, Idaho fescue, Parry's oatgrass and intermediate oatgrass. In the Cypress Hills, Parry's oatgrass is rare and bearded wheatgrass is common. These grasslands have a greater variety and cover of forbs than does the Northern Fescue Subregion. Numerous species occur in the Foothills Fescue Subregion but not in the Northern Fescue Subregion.

Fewer animal species occur in the Foothills Fescue Subregion compared with other Subregions of the Grassland Natural Region. Along the western edge of the Foothills Fescue Subregion, some Rocky Mountain species occur.

3.2 Parkland Natural Region

The Parkland Natural Region, with the exception of the Peace River Parkland Subregion, forms a broad transition between the drier grasslands of the plains and the coniferous forests of the Boreal Forest and the Rocky Mountains. Except for small tongues extending a short distance into the northern U.S., this region is confined to the prairie provinces of Canada. It consists of three Subregions - Central, Foothills and Peace River - which are separated on the basis of geographic location and major floristic differences.

The Parkland Natural Region is the most densely populated region in Alberta, with the greatest density in the Central Parkland Subregion. Land use has changed much of the native vegetation; the most extensive alteration has been in the Peace River Parkland and the least in the Foothills Parkland. Many vegetation types were not adequately documented before they were eliminated or greatly reduced.

ESAs done in the Parkland Natural Region include:

CALGARY	Lamoureux, R. G. Chow and B. Reeves. 1983. Environmentally significant areas of the Calgary region. Prepared by Lamoureux and Associates, Calgary for Calgary Regional Planning Commission, Calgary.
CARDSTON	Cottonwood Consultants Ltd. 1987. Environmentally significant areas in the Oldman River Region: MD of Cardston. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
LACOMBE	Sweetgrass Consultants Ltd. 1988. Environmentally significant areas of the Counties of Lacombe and Stettler. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
LEDUC	Brusnyk, L., D. Westworth, K. Egan, A. McCann, L. Knapik and C. Schreiner. 1991. Environmentally sensitive areas study: County of Leduc. Prepared by Westworth and Associates for the Edmonton

	Metropolitan Regional Planning Commission, Edmonton.
LLOYDMINSTER	Cottonwood Consultants Ltd. 1995. Environmentally significant areas of the Lloydminster Area, Alberta and Saskatchewan. Prepared by Cottonwood Consultants Ltd. for Nature Conservancy of Canada and Husky Oil Operations, Calgary.
PAINTEARTH	Sweetgrass Consultants Ltd. 1989. Environmentally significant areas of the County of Paintearth. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
PARKLAND	Saxena, A., V. Chisholm and J. Bentz. 1996. Environmentally significant areas inventory, Grassland and Parkland Natural Regions, Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton.
PINCHER CREEK	Cottonwood Consultants Ltd. 1987. Environmentally significant areas in the Oldman River Region: MD of Pincher Creek. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
POSTON	Poston B., D.M. Ealey, P.S. Taylor and G.B. Keating. 1990. Priority migratory bird habitats of Canada's prairie provinces. Canadian Wildlife Service, Environment Canada. Edmonton, Alberta.
RED DEER	Sweetgrass Consultants Ltd. 1990. Environmentally significant areas of the County of Red Deer. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
STETTLER	Sweetgrass Consultants Ltd. 1988. Environmentally significant areas of the Counties of Lacombe and Stettler. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
STRATHCONA	Westworth, D. and L. Knapik. 1987. Significant natural features and landscapes of Strathcona County. Prepared by Westworth and Associates for Recreation and Parks, Strathcona County. *and*
	Infotech. 1989. Environmentally sensitive areas: County of Strathcona and MD of Sturgeon. Prepared by Infotech Services Land Evaluation Consultants for the Edmonton Metropolitan Regional Planning Commission, Edmonton.
STURGEON	Infotech. 1989. Environmentally sensitive areas: County of Strathcona and MD of Sturgeon. Prepared by Infotech Services Land Evaluation Consultants for the Edmonton Metropolitan Regional Planning Commission, Edmonton.
WETLANDS	Wallis, C. 1990. Reconnaissance survey of saline wetlands and springs in the grassland-parkland region of eastern Alberta. Prepared by Cottonwood Consultants Ltd., Calgary for World Wildlife Fund, Edmonton.

3.2.1 Central Parkland Subregion

The Central Parkland Subregion extends in a broad arc up to 200 km wide, north of the Grassland Natural Region and south of the Boreal Forest Natural Region. Surficial deposits include hummocky and ground moraines, glaciolacustrine deposits, coarse outwash, kame moraines, and dune fields. Moraines are most widespread, with kames locally extensive in eastern areas. The Neutral Hills are an excellent example of ice-thrust bedrock ridges. Elevations range from about 500 m where the Battle River enters Saskatchewan to around 1100 m in western portions. Numerous lakes and permanent wetlands occur throughout the Subregion. Many are slightly to strongly saline.

The mean annual temperature is 2^{o}C with an average frost-free period of 95 days. Mean annual precipitation is 350-450 mm.

Black and Dark Brown Chernozems predominate under grasslands while under aspen woodlands, Dark Gray Chernozems and Luvisolics are most common. A strip of Brown Solonetz soils runs through the centre of the Subregion from Vegreville, through Beaverhill Lake and into the Sullivan and Dowling lakes areas.

Within the Subregion, there is a continuum from south to north of grassland with groves of aspen, to aspen parkland, to closed aspen forest. True parkland vegetation with continuous aspen forest broken by grassland openings is now very rare due to large scale clearing. Elsewhere, native vegetation is scarce because of the high productivity of the soils for agriculture. Consequently, most of the remaining parkland sites are on rougher terrain or Solonetzic soils.

Two major forest types occur on morainal and glaciolacustrine materials - aspen forest and, in the northern part of the Subregion as well as on moister sites in depressions, balsam poplar forest. Both are characterized by a dense, lush, species-rich understory. The grassland vegetation of the 'parks' is essentially the same as that of the Northern Fescue Subregion. Rough fescue dominates most sites with western porcupine grass being important on south-facing slopes in the southern part of the Subregion and

on Solonetzic soils. Shrub communities are more extensive in the northern portion of the Subregion and often extend in belts outward from the forest communities. Major species are snowberry, rose, chokecherry, and saskatoon.

Animals of the Subregion are a mix of elements of the Northern Fescue Subregion and the boreal mixedwood Subregions. At the southern edge of the Subregion, grassland species such as upland sandpiper, Sprague's pipit and Baird's sparrow occur but become less common further north. Along the northern boundary, boreal forest species such as woodchuck, broad-winged hawk and rose-breasted grosbeak are more common. Franklin's ground squirrel and piping plover range primarily in this Subregion.

3.2.2 Foothills Parkland Subregion

The Foothills Parkland Subregion occupies a narrow band along the eastern edge of the foothills from Calgary south to the Porcupine Hills, and from Pincher Creek south to the U.S. border in the Waterton Lakes National Park area. The topography is rougher than that of the Central Parkland Subregion, and elevations are higher, ranging to over 1300 m near Paine Lake. Surficial deposits include extensive areas of hummocky and ground moraine as well as more restricted areas of outwash and glaciolacustrine deposits along valleys. Extensive river terraces occur in some areas.

Mean annual precipitation ranges from 650 mm in the far south to 500 mm in the northern part of the Subregion. The mean May-September temperature is 12-13^{o}C and the frost-free period averages 90 days.

Predominant soils in the forested areas are Black Chernozems with Dark Brown and Black Chernozems in the grasslands. Regosolics occur on active stream floodplains while Gleysolics occur in wetland sites.

Foothills Parkland generally forms a narrow, transitional band between the grasslands of the Foothills Fescue Subregion and the forests of the Montane Subregion. As in the Central Parkland Subregion, there is a continuum from grassland with groves, to forest with grassy parks, to closed deciduous forest. Because of rapid topographic and climatic change, the transition occurs over one to five kilometres. This compression results in small geographic areas being very diverse. The northern boundary has been placed near Calgary since this is the northern limit of a number of distinctive southwestern species.

The grassland is similar to the Foothills Fescue Subregion, a fescue-oatgrass community with a large diversity of forb and grass species. Aspen generally dominates upland forests with balsam poplar on moister sites. A distinctive characteristic of these woods in the southwestern part of the Subregion is large amounts of glacier lily which bloom in early to mid-May. Willow groveland, a distinctive community, occurs extensively in the northern part of the Subregion.

Many animal species that occur in the Central Parkland Subregion are absent here but other species give this Subregion a distinctive character. Rocky Mountain species in upland forests and shrublands include dusky flycatcher, MacGillivray's warbler, lazuli bunting and white-crowned sparrow. In the far south, black-headed grosbeaks and blue grouse are typical of aspen forests.

3.2.3 Peace River Parkland Subregion

The Peace River Parkland is characterized by broad, gently rolling plains with scattered uplands and deeply-incised, steep-sided river valleys. Mass wasting is common along stream valleys. The main portion is in the Grande Prairie and Peace River areas with smaller areas further north to Fort Vermilion. Most of the extensive grasslands of this Subregion have been cultivated and only small, scattered remnants are still in native cover. Although they are characteristic of this Subregion, the south-facing slopes of the Peace River valley and small disjunct northern areas are not displayed on the Natural Regions Map.

The mean annual precipitation is 350-440 mm. The mean May-September temperature is 13^{O}C and the frost-free period averages 95 days. The Subregion has shorter, cooler summers and longer, colder winters than the other parkland Subregions. It also has higher precipitation, less wind and lower evaporation.

The soils of the grasslands are mostly Solonetzic while those of the forested portion are mostly Luvisolics. The Solonetzic soils are an important factor in maintaining the grasslands here with fire and, possibly, climate playing a secondary role.

The upland forests of the Peace River Parkland occur mostly on till deposits and are virtually indistinguishable from those of the surrounding Dry Mixedwood Boreal Forest. They are dominated by aspen and white spruce with lesser amounts of balsam poplar especially on wetter sites. The grasslands, on Solonetzic soils, are dominated by sedges, intermediate oat grass, western porcupine grass, bearded wheatgrass, old man's whiskers, and low goldenrod. Grasslands on steep, south-facing slopes are dominated by porcupine grass, sedges, and pasture sage. More northerly grasslands are a wheatgrass-sedge type. These isolated grasslands are also notable for disjunct species occurrences and the presence of species which have a more southerly or westerly distribution.

Wildlife of the Peace River Parkland Subregion is similar to that of the adjacent boreal forest mixedwood Subregions. Few animals of Central Parkland grassland habitats are present. Lakes and ponds of the Peace River Parkland constitute a major nesting area for the rare trumpeter swan. Three species of fish barely range into Alberta along the upper Peace River: redside shiner, northern squawfish and longscale sucker.

3.3 Foothills Natural Region

The Foothills Natural Region is transitional between the Rocky Mountains Natural Region and the Boreal Forest Natural Region. It consists of two Subregions, the Lower Foothills and the Upper Foothills. It occurs from about Turner Valley in the south, north along the eastern edge of the Rocky Mountains in a gradually widening belt, and also includes several outlying hill masses such as Swan Hills, Pelican Mountain, and the Clear Hills.

ESAs done in the Foothills Natural Region include:

BRAZEAU	Patriquin, D. and R. Ellis. 1992. Environmentally significant areas study: Municipal District of Brazeau, White Zone. Prepared by Westworth and Associates, Edmonton for Yellowhead Regional Planning Commission.
CALGARY	Lamoureux, R. G. Chow and B. Reeves. 1983. Environmentally significant areas of the Calgary region. Prepared by Lamoureux and Associates, Calgary for Calgary Regional Planning Commission, Calgary.
CLEARWATER	Sweetgrass Consultants Ltd. 1991. Environmentally significant areas of the MD of Clearwater. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
DAVID THOMPSON	Sweetgrass Consultants Ltd. 1989. Environmentally significant areas of the David Thompson Corridor. Prepared by Sweetgrass Consultants, Calgary, for Alberta, Forestry, Lands and Wildlife, Edmonton.
FOOTHILLS	Bentz, J., A. Saxena and T. Normand. 1995. Environmentally significant areas inventory, Foothills Natural Region, Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Land Information Division, Alberta Environmental Protection, Edmonton.
MODEL FOREST	Sweetgrass Consultants Ltd. 1994. Environmentally significant areas in the Foothills Model Forest. Prepared by Sweetgrass Consultants, Calgary, for Foothills Model Forest, Hinton.
POSTON	Poston B., D.M. Ealey, P.S. Taylor and G.B. Keating. 1990. Priority migratory bird habitats of Canada's prairie provinces. Canadian Wildlife Service, Environment Canada. Edmonton, Alberta.

3.3.1 Lower Foothills Subregion

The Lower Foothills Subregion generally occurs on rolling topography created by the deformed bedrock along the edge of the Rocky Mountains. It also includes several flat-topped erosional remnants with flat-lying bedrock that are partially capped with Tertiary gravels, such as Swan Hills, Pelican Mountain, and Clear Hills. Surficial materials are commonly morainal and extensive organic deposits occur in valleys and wet depressions, especially in eastern portions. Along the mountains, bedrock outcrops of marine shales and non-marine sandstones occur often in valleys. Fluvial and glaciofluvial deposits occur along major stream valleys.

The climatic regime is continental. Mean annual precipitation ranges from 285-756 mm with an average of about 465 mm and increases from east to west and south to north. Although this Subregion is somewhat cooler in summer than the adjacent, lower elevation Boreal Forest Subregions, it is warmer in winter because it is often not influenced by cold Arctic air masses.

Soils of upland forests are predominantly Luvisolics and Brunisolics with Gleyed Luvisols and Gleysolics in more poorly drained sites. Organic soils are common in depressional sites, and Regosolics occur along stream valleys and on steeper slopes.

The forests reflect the transitional nature of this Subregion in which mixed forests of white spruce, black spruce, lodgepole pine, balsam fir, aspen, paper birch, and balsam poplar occur. Lodgepole pine communities are the best indication of the lower boundary with the Boreal Forest mixedwood forests. The upper boundary to the Upper Foothills Subregion is marked by the absence of aspen, balsam poplar and birch. Lodgepole pine forests occupy extensive portions of the upland, especially following fire. On mesic sites, white spruce and aspen are frequent. Black spruce forests occur on moist upland sites in the north but essentially do not occur south of the Red Deer River, although one small, disjunct stand is known near Bragg Creek. Black spruce also occurs on wet Organic soils (muskegs). Fens, both patterned and unpatterned, are common in much of this Subregion. These communities typically contain scattered trees of black spruce and tamarack.

Many of the animals that inhabit coniferous forests are wide-ranging species that are common to spruce and pine forests of the Boreal Forest, Foothills, and Rocky Mountain Natural Regions. However, for those species that have Rocky Mountain and Boreal Forest subspecies, the Boreal Forest subspecies is characteristic of the Lower Foothills. Species of coniferous forests include boreal chickadee, spruce grouse, ruby-crowned kinglet, white-winged crossbill, and red squirrel. Deciduous forests have diverse animal communities including ruffed grouse, warbling vireo, black-capped chickadee and Tennessee warbler. Along the boundary with the Central Mixedwood Subregion, species more typical of the boreal forest occur including moose, yellow-bellied sapsucker, rose-breasted grosbeak and purple finch.

3.3.2 Upper Foothills Subregion

The Upper Foothills Subregion occurs on strongly rolling topography along the eastern edge of the Rocky Mountains from about the Bow River north to the Grande Cache area, with disjunct occurrences in the Swan Hills and Clear Hills. The Subregion is generally between the Lower Foothills and Subalpine Subregions. Bedrock outcrops of marine shales and non-marine sandstones are frequent. Morainal deposits are common over bedrock throughout much of the area, although colluvium and residuum occur on steeper terrain.

This Subregion has the highest summer precipitation in Alberta at about 340 mm and has a mean annual precipitation of about 540 mm. The mean May-September temperature is about 10^{o} - 12^{o}C. The winters are colder than the Lower Foothills Subregion but the Upper Foothills Subregion generally is similarly little affected by cold Arctic air masses.

Soils of upland sites are typically Luvisolics and Brunisolics with Gleysolics and Organics in wet sites.

Upland forests of the Upper Foothills Subregion are nearly all coniferous and dominated by white spruce, black spruce, lodgepole pine, and subalpine fir. Lodgepole pine forests occupy extensive portions of the Subregion on upland sites. The understory of upland spruce forests is very similar to that of the lodgepole pine forests with older stands on mesic sites often having a well developed moss layer. Black spruce dominates on wet sites with Organic and Gleysolic soils.

Animals of the Upper Foothills Subregion are similar to those of coniferous forests of the Lower Foothills and Subalpine Subregions. These include pine siskin, yellow-rumped warbler, ruby-crowned kinglet, white-crowned sparrow and varied thrush. Elk and both black and grizzly bear are also characteristic. Species diversity is lower here, generally, than in the Lower Foothills Subregion because of a lower vegetational diversity, including few deciduous forest stands.

3.4 Rocky Mountain Natural Region

The Rocky Mountain Natural Region is part of a major uplift that trends along the western part of Alberta forming the Continental Divide. It is separated from the Foothills Natural Region primarily by structural geology, age and lithology. The Rocky Mountain Natural Region is underlain primarily by upthrust and folded carbonate and quartzitic bedrock whereas the Foothills Natural Region is mostly deformed sandstone and shale. Exceptions include areas of the Montane Subregion in the 'geological' Foothills of the Porcupine and Cypress Hills, and occurrences of the Subalpine and Alpine Subregions on folded bedrock of the 'geological' Foothills Belt in the Kakwa area.

This Region is the most rugged topographically in Alberta and ranges from about 10 km wide in the Waterton Lakes National Park area to more than 100 km wide in the central portion. Elevations rise from east to west, from major river valleys at 1000 to 1500 m to 3700 m along the Continental Divide.

The two major mountain ranges, the easterly Front Ranges and the westerly Main Ranges, are composed mostly of thrust-faulted sediments. Major valleys trend southeast-northwest through the mountains and are occupied by large rivers. Many of Alberta's largest rivers originate here with drainage into the Saskatchewan and Mackenzie River systems. The highest mountains occur in the central part of the Region with the lower mountains in the far north and far south.

Three Natural Subregions have been recognized, Montane, Subalpine and Alpine, which mainly reflect changes in environmental conditions due to changes in altitude.

ESAs done in the Rocky Mountain Natural Region include:

BOW CORRIDOR	Sweetgrass Consultants Ltd. 1991. Environmentally significant areas in the Bow River Corridor. Prepared by Sweetgrass Consultants, Calgary, for the MD of Bighorn, Exshaw.
CALGARY	Lamoureux, R. G. Chow and B. Reeves. 1983. Environmentally significant areas of the Calgary region. Prepared by Lamoureux and Associates, Calgary for Calgary Regional Planning Commission, Calgary.
CANMORE	Cottonwood Consultants Ltd. 1994. Environmentally significant areas in the Town of Canmore. Prepared by Cottonwood Consultants Ltd. for the Town of Canmore, Canmore.
CARDSTON	Cottonwood Consultants Ltd. 1987. Environmentally significant areas in the Oldman River Region: MD of Cardston. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
CROWSNEST PASS	Sweetgrass Consultants Ltd. 1988. Environmentally significant areas of the Municipality of Crowsnest Pass. Prepared by Sweetgrass Consultants, Calgary, for Alberta, Forestry, Lands and Wildlife, Edmonton.
CYPRESS	Cottonwood Consultants Ltd. 1991. Environmentally significant areas of the MD of Cypress. Prepared by Cottonwood Consultants Ltd. for the Southeast Regional Planning Commission, Medicine Hat.
DAVID THOMPSON	Sweetgrass Consultants Ltd. 1989. Environmentally significant areas of the David Thompson Corridor. Prepared by Sweetgrass Consultants, Calgary, for Alberta, Forestry, Lands and Wildlife, Edmonton.
MODEL FOREST	Sweetgrass Consultants Ltd. 1994. Environmentally significant areas in the Foothills Model Forest. Prepared by Sweetgrass Consultants, Calgary, for Foothills Model Forest, Hinton.
MONTANE	Alberta Environmental Protection. 1995. Alberta's Montane Subregion, Special Places 2000 and the significance of the Whaleback Montane. Natural Resources Service, Alberta Environmental Protection, Edmonton.

PINCHER CREEK	Cottonwood Consultants Ltd. 1987. Environmentally significant areas in the Oldman River Region: MD of Pincher Creek. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
WILLOW CREEK	Cottonwood Consultants Ltd. 1989. Environmentally significant areas in the Oldman River Region: MD of Willow Creek. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.

3.4.1 Montane Subregion

Much of the southerly portion of the Montane Subregion occurs on east-west trending ridges that extend out from the Foothills Belt from the U.S. border to the Porcupine Hills. To the north, the Montane Subregion occurs mostly along major river valleys - the Bow, North Saskatchewan and Athabasca rivers. Disjunct occurrences are at the Ya-Ha-Tinda along the Red Deer River and portions of the Cypress Hills. Sandstone outcrops are typical of the main, southerly portion. The Cypress Hills are capped by Tertiary gravels and were unglaciated during the last glaciation. The landforms of the major valleys are primarily fluvial and glaciofluvial terraces and fans with smaller areas of glaciolacustrine, aeolian and morainal deposits.

Chinooks are characteristic and the Subregion is intermittently snow-free in the winter. The mean temperature for May-September is about 12^{o}C. There are about 70 frost-free days per year. Average annual precipitation is about 600 mm with a range of 300-1280 mm. Precipitation is lower in the northerly portion of the Montane.

Soils vary greatly with the complex topographic and climatic conditions in this Subregion and a wide range of soils is typical. Soils under grasslands are mostly Chernozemics, Brunisolics and Regosolics. Forest soils include Brunisolics and Luvisolics.

The Montane landscape is characterized by a pattern of open forests and grasslands. Characteristic tree species include Douglas fir, limber pine and white spruce. Ridgetop, open forests dominated by Douglas fir and limber pine are among the driest forest communities and are species-rich due to the great habitat diversity. Limber pine forests are generally open and occur on the most exposed rock outcrops and eroding morainal or colluvial slopes. Grasslands are typically dominated by bluebunch wheatgrass, fescue grasses and oatgrasses with a large diversity of forbs. Lodgepole pine forests occur on upland sites and are similar to dry forests of the adjacent Subalpine Subregion. White spruce forests occur on more mesic sites especially along streams on fluvial terraces. Aspen forests occur characteristically on fluvial fans and terraces.

Douglas fir - limber pine habitats are typically inhabited by blue grouse, mountain chickadee, Clark's nutcracker, mule deer, elk and Columbian ground squirrel. These habitats are also important ungulate winter range. Denser Douglas fir and lodgepole pine forests also contain yellow-rumped warbler, dark-eyed junco, chipping sparrow, and red squirrel. Aspen forests typically contain MacGillivray's warbler, warbling vireo and lazuli bunting. Spotted frog and long-toed salamander are two species of wet areas that are restricted to the Rocky Mountain Natural Region in Alberta. Also, the Mearn's subspecies of the dark-eyed junco occurs in Canada only in the Cypress Hills.

3.4.2 Subalpine Subregion

The Subalpine Subregion occupies a band between the Montane and Alpine Subregions in the south and between the Upper Foothills and Alpine Subregions in the north. Morainal materials are common with colluvial and residual bedrock materials frequent at higher elevations. Fluvial and glaciofluvial deposits are common along stream valleys.

The mean annual temperature ranges from -1^{o}C to 3^{o}C. Below freezing temperatures occur in all months and the frost-free period is likely less than 30 days. Total annual precipitation ranges from 460 mm in the drier Front Ranges to more than 1400 mm in parts of the south. Winter precipitation is higher in this Subregion than any other in Alberta with often more than 200 cm of snowfall.

Soils vary widely reflecting the great diversity in parent materials and ecological conditions. Brunisolics and Luvisolics are most common and occur under a wide variety of conditions. Podzolics are largely confined to upper elevation, moist sites under spruce-fir forests. Cryosolics occur in Upper Subalpine sites in the Front Ranges from central Banff National Park to Willmore Wilderness Park. Gleysolics and Organics occur on wet sites.

The Subalpine is divided into a Lower Subalpine characterized by closed forests of lodgepole pine, Engelmann spruce and subalpine fir, and an Upper Subalpine with spruce-fir closed forests and open forests near treeline. At lower elevations, lodgepole pine forests cover extensive areas following fire. Engelmann spruce-subalpine fir forests typically occur on higher, moister sites which have not been as subject to fire. Older, mesic forests have a thick carpet of mosses and lichens. The understory of the forests of the Waterton Lakes National Park area contains a number of species that do not occur further north.

Open forests in the Upper Subalpine are transitional to the treeless Alpine Subregion above. Dominant trees include Engelmann spruce, subalpine fir, whitebark pine and, south of Bow Pass, subalpine larch. High elevation grasslands occur on steep, southerly and westerly aspects in the Front Ranges. Snow avalanches also create a diverse mix of shrubby and herbaceous communities.

The animals in the Subalpine generally overlap with the Subregions above and below. Some species are common to both the Montane and Subalpine Subregions; others occur in both the Subalpine and Alpine Subregions. Species of the coniferous forests are widespread throughout the Foothills and Boreal Forest Natural Regions including spruce grouse, gray jay, pine siskin, boreal chickadee, marten, snowshoe hare, black bear, deer mouse, and red squirrel. Several Subalpine forest birds are restricted to the Rocky Mountain Natural Regions including Steller's jay, varied thrush and Townsend's warbler. A few species are confined to the northern part of the Subregion, such as willow ptarmigan, mountain caribou and golden-crowned sparrow.

3.4.3 Alpine Subregion

The Alpine Subregion includes all areas above treeline including vegetated areas, rockland, snowfield and glaciers. Materials are generally residual bedrock and colluvium often on steep slopes. Extensive areas of unvegetated bedrock occur. Rock glaciers occur from Kananaskis Country north to Jasper National Park.

Climatic data for the Alpine Subregion are spotty both geographically and in time. However, this clearly is the coldest Subregion in Alberta with mean May-September temperatures of about $6^{o}C$ and essentially no frost-free period. Winter temperatures are colder than the Subalpine Subregion. Mean annual precipitation ranges from 420-850 mm and is likely higher for some areas.

Much of the Alpine Subregion has no soil, the amount of weathered material being too thin to qualify as a soil. Soils generally are weakly-developed Regosolics and Brunisolics.

Alpine vegetation typically forms a complex, fine-scale mosaic in which microclimatic variations are reflected by marked changes in dominant species. Significant environmental factors include aspect, wind exposure, time of snow melt, soil moisture and snow depth. Deep, late-melting snowbeds are occupied by black alpine sedge communities. Moderate snowbed communities typically contain dwarf shrub heath tundra which is dominated by heathers, mountain heathers, and grouseberry. Shallow snow areas on ridgetops and other exposed sites typically contain communities dominated by white mountain avens, snow willow and moss campion, or kobresia. Diverse, colourful herb meadows occur in moist sites below melting snow banks or along streams. Highest elevation communities are composed mainly of lichens on rocks and shallow soil.

Some floristic differences are apparent south of Crowsnest Pass. Mountain heathers are absent and heathers are more restricted than further north. Bear grass meadows occur in some low elevation Alpine areas and other vegetation communities are apparently confined to this part of the province.

Many animals range regularly in both the Subalpine and Alpine Subregions, including Columbian ground squirrel, pika, hoary marmot, grizzly bear, mountain goat, and bighorn sheep. White-tailed ptarmigan, gray-crowned rosy finch, horned lark and water pipit are restricted to the Alpine Subregion during the nesting season.

3.5 Boreal Forest Natural Region

The Boreal Forest Natural Region is the largest in Alberta. It consists of broad lowland plains and discontinuous but locally extensive hill systems. The bedrock is buried deeply beneath glacial deposits and outcrops occur only rarely along major stream valleys. Major surficial features are moraines in the uplands, and glaciofluvial and glaciolacustrine deposits in the lowlands. Fluvial deposits, including the Peace-Athabasca Delta, occur along major rivers. The land generally slopes to the north and east but the most prominent highlands are located in the northern part of the Region. The Region drains primarily into the Mackenzie River system although a substantial portion of the southern Subregions is part of the Saskatchewan River system.

The presence of extensive wetlands is a major characteristic of the Boreal Forest Natural Region. Large wetlands occupy vast areas of the lowlands. Bogs, fens, and swamps are abundant and marshes are locally prevalent.

The Boreal Forest Natural Region is very diverse topographically, climatically and biologically. Many of the changes are gradual and subtle which makes division into Subregions often difficult and seemingly arbitrary. Lack of adequate information about much of this vast area further compounds the problems. However, the Region has been divided into six Subregions (Dry Mixedwood, Central Mixedwood, Wetland Mixedwood, Boreal Highlands, Peace River Lowlands, Subarctic) based primarily on vegetational, geological and landform characteristics.

ESAs done in the Boreal Forest Natural Region include:

BARRHEAD	Wallis, C. and L. Knapik. 1990. Environmentally significant areas of the County of Barrhead. Prepared by Cottonwood Consultants Ltd. for the Agriculture Services Board, County of Barrhead, Barrhead.
BIRCH MOUNTAINS	Westworth and Associates Ltd. 1994. An inventory of significant natural features in the Birch Mountains -- Firebag River Integrated Resource Planning Area. Prepared by Westworth and Associates Ltd. for Resource Information Branch, Alberta Environmental Protection, Edmonton.
BOREAL	Geowest Environmental Consultants. 1997 (in prep.). Environmentally significant areas inventory of the Boreal Forest Natural Region of Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton
BRAZEAU	Patriquin, D. and R. Ellis. 1992. Environmentally significant areas study: Municipal District of Brazeau, White Zone. Prepared by Westworth and Associates, Edmonton for Yellowhead Regional Planning Commission.
CLEARWATER	Sweetgrass Consultants Ltd. 1991. Environmentally significant areas of the MD of Clearwater. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
DAVID THOMPSON	Sweetgrass Consultants Ltd. 1989. Environmentally significant areas of the David Thompson Corridor. Prepared by Sweetgrass Consultants, Calgary, for Alberta, Forestry, Lands and Wildlife, Edmonton.
DRY MIXEDWOOD	Bentz, J., V. Chisholm, and A. Saxena. 1996. Environmentally significant areas inventory of the Boreal Dry Mixedwood Subregion of Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton.
EASTERN BOREAL	Westworth and Associates Ltd.. 1990a. Significant natural features of the eastern Boreal Forest Region of Alberta. Prepared by Westworth and Associates for Alberta Forestry, Lands and Wildlife, Edmonton.
LACOMBE	Sweetgrass Consultants Ltd. 1988. Environmentally significant areas of the Counties of Lacombe and Stettler. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
LEDUC	Brusnyk, L., D. Westworth, K. Egan, A. McCann, L. Knapik and C. Schreiner. 1991. Environmentally sensitive areas study: County of Leduc. Prepared by Westworth and Associates for the Edmonton Metropolitan Regional Planning Commission, Edmonton.
LLOYDMINSTER	Cottonwood Consultants Ltd. 1995. Environmentally significant areas of the Lloydminster Area, Alberta and Saskatchewan. Prepared by Cottonwood Consultants Ltd. for Nature Conservancy of Canada and Husky Oil Operations, Calgary.
PEACE RIVER	Johnston, S., R. Ellis and D. Westworth. 1996. Inventory of environmentally significant areas in the Boreal

	Dry Mixedwood Natural Subregion, Peace River Section: 1995-1996. Prepared by Westworth, Brusnyk and Associates, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton.
POSTON	Poston B., D.M. Ealey, P.S. Taylor and G.B. Keating. 1990. Priority migratory bird habitats of Canada's prairie provinces. Canadian Wildlife Service, Environment Canada. Edmonton, Alberta.
RED DEER	Sweetgrass Consultants Ltd. 1990. Environmentally significant areas of the County of Red Deer. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
STRATHCONA	Westworth, D. and L. Knapik. 1987. Significant natural features and landscapes of Strathcona County. Prepared by Westworth and Associates for Recreation and Parks, Strathcona County. *and*
	Infotech. 1989. Environmentally sensitive areas: County of Strathcona and MD of Sturgeon. Prepared by Infotech Services Land Evaluation Consultants for the Edmonton Metropolitan Regional Planning Commission, Edmonton.
STURGEON	Infotech. 1989. Environmentally sensitive areas: County of Strathcona and MD of Sturgeon. Prepared by Infotech Services Land Evaluation Consultants for the Edmonton Metropolitan Regional Planning Commission, Edmonton.

3.5.1 Dry Mixedwood Subregion

The Dry Mixedwood Subregion is characterized by low relief and level to undulating terrain. Surficial materials are mostly ground moraine and hummocky moraine with some areas of dunes and sandy outwash plain. The Subregion includes the southern edge of the Boreal Forest Natural Region from Cold Lake west to about Barrhead and south along the western edge of the Central Parkland Subregion to about Gull Lake. The northern part of the Cooking Lake moraine east of Edmonton is a disjunct portion. Another large area of Dry Mixedwood occurs in northwestern Alberta in a broad band centered on the Peace River.

The climate is subhumid, continental with short, cool summers and long, cold winters. The mean May-September temperature is about 13^{o}C and the growing period is about 90 days. Annual precipitation averages about 350 mm. Overall, the climate is somewhat drier and warmer than the Central Mixedwood Subregion.

Soils are typically Gray Luvisols in well-drained, upland till sites and Eutric Brunisols in coarse-textured sandy uplands. Organics and Gleysolics occur on wet depressional sites.

The vegetation is transitional between the Central Parkland and Central Mixedwood Subregions and there are community types common to all three. The differences are largely in the proportion of various vegetation types and other landscape features. Aspen is an important species in all three Subregions, occurring in both pure and mixed stands. Balsam poplar frequently occurs with aspen especially on moister sites in depressions and along streams. Successionally, white spruce and balsam fir may replace aspen and balsam poplar. However, frequent fire seldom permits this and pure deciduous stands are common. Coniferous species are more common further north with mixed stands of aspen and white spruce being widespread.

Upland aspen forests contain a diverse understory. Both balsam poplar and paper birch may occur in these forests as well. Coniferous forests generally have a less diverse understory with greater moss cover. Mixedwood forests generally contain a mosaic of deciduous and coniferous patches with species typical of each occurring through the stand. Dry, sandy uplands are usually occupied by jack pine forests. These may be quite open and have a prominent ground cover of lichens. Peatlands are common and are extensive in some areas, e.g. south of Athabasca, but are not as prevalent as in other Boreal Forest Subregions. Peatland complexes typically contain both nutrient-poor, acidic bog portions, and more nutrient-rich fens.

Characteristic species of deciduous forests include least flycatcher, house wren, northern (Baltimore) oriole and rose-breasted grosbeak. Species of mixedwood forests include yellow-bellied sapsucker, Swainson's thrush, magnolia warbler, white-throated sparrow, pileated woodpecker and northern goshawk. Some species are restricted to the Cold Lake area and represent an eastern faunal element. These include yellow rail, sedge wren, great-crested flycatcher, chestnut-sided warbler and blackburnian warbler.

3.5.2 Central Mixedwood Subregion

Surficial materials are predominantly ground moraine and hummocky moraine landforms with some areas of dunes, sandy outwash plain, and glaciolacustrine plain. The terrain has low relief and a level to undulating surface. The Subregion includes much of the central and southeastern part of the Boreal Forest Natural Region and is the largest Subregion in Alberta, extending from central Alberta to the Northwest Territories border in Wood Buffalo National Park. Highland plateaus and hill masses within the Central Mixedwood Subregion are mostly placed in other Subregions such as the Boreal Highlands.

The climate is subhumid, continental with short, cool summers and long, cold winters. The mean May-September temperature is about 12^{O}C and the frost-free period is about 85 days. Annual precipitation averages about 380 mm. Winters are relatively dry. Overall, the climate is somewhat moister and cooler than the Dry Mixedwood Subregion with somewhat lower moisture deficits.

Soils are similar to those of the Dry Mixedwood Subregion with Gray Luvisols in well-drained, upland till sites and Eutric Brunisols in coarse-textured sandy uplands. Organics and Gleysolics occur on wet depressional sites.

The vegetation of the Central Mixedwood Subregion is similar to that of the Dry Mixedwood Subregion. Differences are in the proportion of various vegetation types and other landscape features. Aspen is characteristic occurring in both pure and mixed stands. Balsam poplar frequently occurs with aspen especially on moister sites in depressions and along streams. Paper birch also occurs commonly with aspen and forms nearly pure stands infrequently, e.g. in the Christina Highland. Successionally, white spruce and balsam fir will replace aspen and balsam poplar as stand dominants. However, frequent fire seldom permits this and pure deciduous stands are common. Further north, coniferous species are more common with mixed stands of aspen and white spruce being widespread. Upland aspen forests contain a diverse understory. Both balsam poplar and paper birch may occur in these forests. Coniferous forests are not common but generally have greater moss cover. Mixedwood forests, containing a mosaic of deciduous and coniferous patches with species typical of each are widespread on upland sites. Dry, sandy upland sites are typically occupied by jack pine forests. Fluvial deposits along major stream valleys have white spruce or white spruce-balsam poplar forests that often contain large trees that have benefitted from the favourable nutrient and moisture regimes of these sites. Peatlands are common and extensive. Peatland complexes typically contain both nutrient-poor, acidic bog portions and more nutrient-rich fens.

The wildlife of this Subregion is the most diverse of the Boreal Forest Natural Region. The species of coniferous forests are wide-ranging and include gray jay, red-breasted nuthatch, pine siskin, red and white-winged crossbills, dark-eyed junco, boreal chickadee, and red squirrel. Three warblers, bay-breasted, Cape May and Blackburnian, are confined largely to mature conifer dominated mixedwood stands in the central and eastern portions of the Subregion. Balsam fir stands have a particularly diverse assemblage of coniferous forest birds.

Characteristic species of deciduous forests are similar to those in the Dry Mixedwood Subregion. The most species-rich habitats are mixedwoods and shrublands associated with swamps, ponds, streams and lakes. Some species are mostly restricted to these sites. Typical, widespread mammals include beaver, moose, varying hare, black bear, wolf, lynx, least chipmunk, moose and ermine. Others, such as fisher, wolverine, river otter, and woodland caribou, are less common and locally distributed.

3.5.3 Wetland Mixedwood Subregion

The topography of the Wetland Mixedwood Subregion is generally subdued and nearly level to gently rolling. Surficial materials are predominantly glaciolacustrine overlain by extensive organic and till deposits. Limited areas of glaciofluvial and aeolian sandy deposits also occur.

The climate is characterized by cool, moist summers and long, cold winters. It is generally colder than the Central Mixedwood Subregion but probably more moderate than the Subarctic or Boreal Highlands

Subregions. The mean May-September temperature is about 11^{o}C and the frost-free period is about 85 days. Average annual precipitation is 400-450 mm. Snow cover lasts an average of 185 days per year, one of the longest in Alberta.

Organic and Gleysolic soils are widespread in the wet depressional sites that are prevalent in this Subregion. Discontinuous permafrost occurs in many peatlands. Upland sites typically have Gray Luvisols or Eutric Brunisols.

The vegetation is quite similar to that of the Central Mixedwood Subregion, although little is known about much of it. Generally, the landscape contains a greater proportion of wetlands, both peatlands and willow-sedge complexes on mineral soil, and more upland black spruce forest. This perhaps reflects the cooler climate with a lower moisture deficit. Drier tills and glaciofluvial deposits typically have pine forests. Mesic till sites are limited but contain typical aspen-white spruce mixedwood forest. Moist upland sites on tills and glaciolacustrine deposits generally have black spruce or mixed black and white spruce closed forests with a well-developed moss layer. Mature white spruce-balsam poplar forests, similar to those along the lower Peace and Athabasca rivers, occur along the lower Hay River.

Peatlands are common and extensive, and typically contain both nutrient-poor, acidic bog portions and more nutrient-rich fens. Permafrost frequently occurs in these peatlands.

The wildlife of the Wetland Mixedwood Subregion is relatively depauperate both in species and numbers compared with the Central Mixedwood Subregion. The scarcity of deciduous and mixedwood communities is largely responsible for this. The extensive wetlands that characterize this Subregion provide important habitat for nesting and migrating waterfowl including sandhill crane and the rare whooping crane.

3.5.4 Boreal Highlands Subregion

The Boreal Highlands Subregion occurs on the sides and tops of plateaus and hill masses within the Central Mixedwood and Wetland Mixedwood Subregions. It includes portions of the Cameron Hills, Caribou Mountains, Buffalohead Hills, Birch Mountains, Thickwood Hills, and the highlands around Graham and Peerless lakes, and south of Ft. McMurray. The topography varies from rolling uplands to steep slopes on the flanks of hill masses and plateaus. Most common is ground moraine and hummocky moraine.

Climatic data are scarce but conditions appear cooler and moister than the Central Mixedwood Subregion. May-September temperatures average 12^{o}C but the winter temperatures are likely colder than the Central Mixedwood. May-September precipitation is about 265 mm which is slightly greater than the Central Mixedwood.

Soils are similar to those of the Central Mixedwood Subregion with Gray Luvisols in well-drained, upland till sites. Organics and Gleysolics occur on wet depressional sites.

The vegetation is similar to that of the Central Mixedwood Subregion. Mixedwood forests of aspen and white spruce are characteristic but, with the somewhat moister conditions, greater amounts of balsam poplar and white spruce are expected. Black spruce may also occur more frequently in upland sites and coniferous forests occupy a large proportion of the landscape. Upland white spruce-aspen mixedwood and aspen forests contain a diverse understory. Balsam poplar and paper birch may occur in these forests also. Coniferous forests generally have a less diverse understory with greater moss cover..

Peatlands are common and extensive, and typically contain both nutrient-poor, acidic bog portions and more nutrient-rich portions. Patterned peatlands occur in some areas and permafrost is frequent.

The animals of the Boreal Highlands Subregion are similar to those of the Central Mixedwood Subregion, although the species diversity is somewhat reduced although not as much as in the Subarctic Subregion.

The occurrence of woodland caribou in the Birch and Caribou mountains is noteworthy although this species also uses adjacent Subregions as well.

3.5.5 Peace River Lowlands Subregion

The Peace River Lowlands Subregion consists primarily of fluvial landforms along the lower Peace, Birch and Athabasca rivers including the Peace-Athabasca Delta, one of the largest freshwater deltas in the world. Although the bedrock is seldom exposed, it influences the character of till deposits and groundwater discharge. The bedrock includes Cretaceous marine shales and silty shales, Devonian marine limestones and dolomites, evaporite gypsum and anhydrite, and marine shales and siltstones.

The climate is characterized by a cool summers and long, cold winters. The mean annual temperature is -3.5^{o}C. Total annual precipitation is divided about equally between snow and rain. Total May-September precipitation averages 250 mm (range 150-300 mm).

Soils on well drained upland sites are mostly Eutric Brunisols and Gray Luvisols. However, the majority of the Subregion is occupied by Cumulic Regosols and Gleysolics on active fluvial landforms or by Organics in wet depressional areas.

White spruce forests containing large trees (16-23 m tall) occur on fluvial terraces along major rivers. These forests have been heavily logged and little remains currently. On drier upland sites, jack pine forests occur. Mixedwood forests of aspen, balsam poplar, and white spruce occur on mesic sites. Non-forested, wet fluvial communities form a very complex mosaic of aquatic, shoreline, meadow, shrub and marsh vegetation. Much of this complexity is driven by periodic flooding and deposition of fresh fluvial sediments, especially in the Peace-Athabasca Delta area.

The overall diversity of wildlife is lower here than in the Central Mixedwood Subregion although many of the same species occur in both Subregions. However, the Peace-Athabasca Delta supports a rich wildlife population and is a major nesting and moulting ground for ducks, and a key staging and migration area for waterfowl such as tundra swan. Bison use the large wet sedge meadows. Muskrats are also important in this area.

White pelicans nest along the Slave River and the most northerly populations and hibernacula of common (red-sided) garter snakes also occur here.

A very diverse fish assemblage occurs in this Subregion. Lake whitefish, northern pike, goldeneye, emerald shiner, longnose sucker, trout-perch, walleye, ninespine stickleback, flathead chub, burbot, spottail shiner, spoonhead sculpin and longnose dace are common in the rivers and streams. Round whitefish and short-jawed cisco are local and uncommon, and occur nowhere else in Alberta.

3.5.6 Subarctic Subregion

The Subarctic Subregion occurs on the tops of the Birch Mountains, the Caribou Mountains, and the Cameron Hills. These flat-topped hill systems are erosional remnants that rise above the surrounding plain. Surficial deposits are primarily till or organic peat. The latter predominates and contains discontinuous permafrost. Palsas and peat plateaus in these peatlands are characteristic of the Subarctic. Morainal and organic deposits occur on the plateaus.

The climate is continental, cold-temperate with moist, short, cool summers and long, cold winters. The mean May-September temperature is about 10-12^{o}C. While summer temperatures are cooler here than in adjacent low elevation areas, winter temperatures are likely more moderate, especially when cold Arctic air masses affect lower areas and temperatures increase with altitude. Total annual precipitation is likely 400-450 mm with most falling in the summer. The frost-free period is less than 45 days.

Soils are predominantly Organics and Cryosolics on poorly drained sites. Luvisolics occur on well drained sites while Gleysolics are typical of poorly drained mineral soils.

The most widespread vegetation is an open forest of black spruce/Labrador tea/lichen on peat. Widespread fires in this type have resulted in large areas of heath shrub/lichen with scattered, young black spruce. Black spruce/feathermoss forests occur on mineral soils. A similar forest on warmer sites has less cover of feathermosses and greater amounts of lichens. Less common on warm, well-drained sites are mixed forests of white spruce-aspen or white spruce-paper birch. Black spruce-lodgepole pine (jack pine in the Birch Mountains) also occur in limited areas of warmer, drier sites. Fens, both patterned and unpatterned, occur often as part of peatland complexes that contain a variety of peatlands. Organic landforms include palsas and peat plateaus that are related to the occurrence of discontinuous permafrost.

The Subarctic Subregion is lower in wildlife diversity than other Boreal Forest Subregions because of the harsh environment and limited vegetational diversity, especially the scarcity of deciduous communities. Some Boreal Forest species are either local or absent, while other species more typical of Subarctic habitats further north are present. These latter include red-throated loon, arctic loon, surf scoter, tree sparrow and northern phalarope.

Common species of black spruce forests include gray jay, common raven, dark-eyed junco, chipping sparrow, red squirrel, snowshoe hare and black bear. Woodland caribou occur in the Birch and Caribou mountains. Wetland species include lesser yellowlegs, rusty blackbird, and moose. The largest concentration of nesting bald eagles in Alberta is around Bistcho Lake in the Cameron Hills and there are nesting colonies of white pelicans in the Birch Mountains.

3.6 Canadian Shield Natural Region

The Canadian Shield extends only peripherally into the far northeast corner of Alberta. The Natural Region contains two quite different Subregions. The Kazan Upland Subregion includes most of the exposed Canadian Shield in Alberta north of Lake Athabasca and is characterized by exposed, glaciated bedrock. The Athabasca Plain Subregion includes part of the north shore of Lake Athabasca and the Canadian Shield south of the Lake Athabasca, and is characteristically shallow glacial outwash deposits over Canadian Shield bedrock.

The only ESA study done in the Canadian Shield is:

CANADIAN SHIELD	Alberta Parks Services. 1995. Natural history overview and theme evaluation, Canadian Shield (Athabasca Plain and Kazan Upland). Parks Services, Alberta Environmental Protection, Edmonton.

3.6.1 Athabasca Plain Subregion

The Athabasca Plain Subregion is characterized by generally low relief. Fluvial and aeolian deposits predominate in the eastern part, till and glaciofluvial deposits in the west. Most deposits are sandy and derived from the Athabasca sandstone. Extensive stretches of sandy beach occur along Lake Athabasca, including a sand spit that juts three km into the lake at Sand Point. Distinctive landscape features include large areas of kame and kettle, and active dunes. The kames, at over 60 m high, are among the largest in the world. The active dune system is the largest in Alberta. The paleodunes are unique in Alberta; they are aligned opposite to other dunes in the province. Also, linear ridges of similar size are not known from any other place in Alberta. Numerous lakes dot the landscape and rivers are small and uncommon.

Climatic data are scarce however, the climate has warm, moderately dry summer and long, cold winters. The mean May-September temperature is about 13^{o}C and precipitation for this period averages 300 mm.

Soils of upland sites are predominantly Brunisolics developed in the sandy, coarse-textured parent materials. Podzolics develop in some moister sites. Organics predominate in wet depressional areas with Cryic Fibrisols perhaps most characteristic. Regosolics occur in areas of current aeolian activity.

Extensive forests dominated by jack pine occur on upland sites with sandy deposits. White spruce is codominant with jack pine on some sites. Peatlands range from relatively dry bogs dominated by jack pine, black spruce, Labrador tea, and reindeer lichens to wetter peatlands with black spruce, tamarack, Labrador tea, and peatmosses. Riparian habitats are not extensive but contain mixed forests of aspen, balsam poplar and white spruce that are similar to those of the Central Mixedwood Subregion.

The environment in the immediate vicinity of Lake Athabasca is different than the main upland portion of the Subregion and there are significant differences between the north and south shores. "Park-like" open white spruce forests occur along the shore of Lake Athabasca. A number of significant (rare, endemic, disjunct) plant species occur in the Subregion.

Little is known of the animals of the Athabasca Plain Subregion, however there are similarities to both the Kazan Upland Subregion and, in jack pine forest and peatland habitats, to the adjacent Central Mixedwood Subregion. Sandhill cranes are notable breeding species here. As well, arctic and Caspian terns are subarctic species that have nested in the Subregion.

3.6.2 Kazan Upland Subregion

The distinctive feature of the Kazan Upland Subregion is the extensive outcropping of granitoid Precambrian bedrock. The bedrock plays a direct role in the vegetation pattern because of the extent of the outcrops and its acidic nature. It is dominated by a complex of crystalline rocks. The predominant rocks are distributed in three major north-south trending belts - the western granitoids, the eastern granitoids, and the central granitic gneisses. The topography is rolling and local relief can be as great as 90 m. The bedrock is covered with patches of outwash or morainal deposits, and there are also eskers and roche moutonée knobs. Glacial erosion produced highly-polished, striated and grooved rock surfaces. Rock-basin lakes are common throughout the Subregion. Rivers are small and uncommon. Most are of the slow-moving 'muskeg' type.

Few climatic data are available but the climate generally is cool and subhumid with warm, dry summers and cold winters. The mean May-September temperature is about 12^{O}C. Annual precipitation averages 320 mm.

Much of the Kazan Upland Subregion has no soil, being either exposed bedrock or where the amount of weathered material is too thin over bedrock to qualify as a soil. Where soils have developed in upland sites, Podzolics and Regosolics are most common. Organics and Cryosolics occur in the peatlands.

The vegetation of the uplands is a mosaic of rock barrens, jack pine open forest on sand plains and rocky hills, and black spruce in wet depressional peatlands. Jack pine forests are most widespread, especially in the northeast, and often contain aspen. The understory of these forests is quite simple and lichens are often as important as vascular plants. The forests of rocky sites typically contain jack pine, black spruce, and paper birch. On sites with deeper Podzolic soils, forests of jack pine, paper birch and black spruce have a better developed understory. Peatlands are mainly acidic, nutrient-poor bogs dominated by black spruce, tamarack, Labrador tea, reindeer lichens and peatmosses. Discontinuous permafrost is widespread in the peatlands.

Characteristic animals of upland jack pine forests include common nighthawk, gray jay, common raven, boreal chickadee, American robin, hermit thrush, dark-eyed junco, red squirrel, varying hare, lynx and black bear. Wetland and open water species include common loon, lesser scaup, bufflehead, Bonaparte's gull, spotted sandpiper, alder flycatcher, rusty blackbird, red-winged blackbird, moose, beaver and mink. Bald eagle and osprey are widely distributed, nesting near the numerous lakes. Golden eagle, which does not nest in the Boreal Forest, nests locally on cliffs. Rare peregrine falcons have also nested

on cliffs in the area. The arctic loon is a subarctic species that has bred in the Subregion. Winter visitors from further north include willow ptarmigan and, occasionally, barren ground caribou and arctic fox.

4. NATURAL HISTORY THEME ANALYSIS

Special Places incorporates a land classification scheme for planning a protected areas system for Alberta. Alberta's system has been developed and refined over the past two decades and has been upheld by the Canadian Council on Ecological Areas (1992) as a national model for the protected area representation analysis.

The classification currently in use by the Alberta government has recently been revised by Alberta Parks Services (1994). Natural Regions are recognized on the basis of broad differences in landscape patterns, especially the broad vegetational, soil and physiographic features, for example grassland vs. parkland vs. forest, Chernozemic soils vs. Luvisolic soils, or mountains vs. foothills vs. plains. These features also reflect broad patterns of climate and geology. To a lesser extent, wildlife features are used, although wildlife occurrence patterns are usually not as distinctive or useful as soil, physiographic and vegetation patterns.

This land classification scheme results in fairly broad delineations of Natural Regions which are further divided into Subregions. Each Subregion is then further subdivided into Natural History Themes that can be both representative (typical or widely distributed) and special (unique or atypical features). The two-tiered theme system, in combination with the Natural Regions and Subregions classification, forms a five level hierarchy for protected areas planning (Table 1).

Table 1. Natural Diversity Classification Hierarchy for Protected Areas Planning in Alberta.

Classification Hierarchy	Example 1	Example 2
NATURAL REGION (broad geographic region)	**GRASSLAND**	**BOREAL FOREST**
⇩	⇩	⇩
SUBREGION (narrowly defined geographic region within a Natural Region)	**MIXED GRASSLAND**	**SUBARCTIC**
⇩	⇩	⇩
LEVEL 1 THEME (broad landscape type within a Subregion)	**SANDY UPLAND-DUNE FIELD**	**ORGANIC WETLAND**
⇩	⇩	⇩
LEVEL 2 THEME (broad habitat/vegetation type within a Level 1 Theme)	**ACTIVE SAND DUNE**	**BLACK SPRUCE FOREST**
⇩	⇩	⇩
Level 3 Theme (specific geologic feature, plant community or species within a Level 2 Theme)	**Parabolic Dune**	**Black Spruce-Cloudberry Community Type**

In Alberta, six Natural Regions are currently recognized (Alberta Parks Services 1994): Grassland, Parkland, Foothills, Rocky Mountain, Boreal Forest, and Canadian Shield. The distinguishing and typical features of each are described briefly in section 3. The six Natural Regions are divided into 20 Subregions (Table 2) based on recurring landscape patterns relative to other parts of the Natural Region.

Table 2. Natural Regions and Subregions of Alberta.

Grassland Natural Region
- Dry Mixedgrass Subregion
- Mixedgrass Subregion
- Northern Fescue Subregion
- Foothills Fescue Subregion

Parkland Natural Region
- Central Parkland Subregion
- Foothills Parkland Subregion
- Peace River Parkland Subregion

Foothills Natural Region
- Lower Foothills Subregion
- Upper Foothills Subregion

Rocky Mountain Natural Region
- Montane Subregion
- Subalpine Subregion
- Alpine Subregion

Boreal Forest Natural Region
- Dry Mixedwood Subregion
- Central Mixedwood Subregion
- Wetland Mixedwood Subregion
- Boreal Highlands Subregion
- Peace River Lowlands Subregion
- Subarctic Subregion

Canadian Shield Natural Region
- Athabasca Plain Subregion
- Kazan Upland Subregion

The features and landscape patterns used to recognize Subregions are of a finer degree and spatial scale than those used to recognize Regions. For example, the Grassland Natural Region is divided into four Subregions (Dry Mixedgrass, Mixedgrass, Northern Fescue, and Foothills Fescue) on the basis of various differences in the vegetation communities, soils and climate (Table 3).

Table 3. Differences among the Subregions of the Grassland Natural Region.

Subregion	Vegetation	Soils	Climate
Dry Mixedgrass	spear grass western wheatgrass blue grama	Brown Chernozems, Solonetzics	warmest & driest few chinooks
Mixedgrass	spear grass porcupine grass western wheatgrass	Dark Brown Chernozems	intermediate between Foothills Fescue & Dry Mixedgrass
Northern Fescue	rough fescue june grass porcupine grass	Dark Brown & Black Chernozems, Solonetzics	coldest & wettest few chinooks
Foothills Fescue	rough fescue Idaho fescue oatgrasses	Dark Brown & Black Chernozems few Solonetzics	frequent chinooks mildest winters

The specific criteria used to make the divisions into Subregions vary among Regions because different patterns of features are important in the natural character of each Region. All, however, reflect significant differences in landscape or ecosystem type.

Achuff and Wallis (1992) have defined Level 1 Natural History Themes as "broad, significant, easily recognizable landscape types within a Subregion that contain a complex of physical and biological feature that are apparent even to untrained observers." Level 1 and Level 2 themes are generally the working scales through which diversity representation is incorporated into the Special Places 2000 program. Level 3 themes, which are usually species-specific, are also relevant for the conservation of either small, sedentary populations, or local endemic populations.

4.1 Protected Area Targets

Protected Areas are places that are explicitly legislated and managed to protect important natural features. They play an important role in conserving biological diversity, i.e. the structural and functional variety of life forms at genetic, species, community and ecosystem levels. While there is an emphasis in this classification-evaluation system on biological diversity, often referred to as biodiversity, there are also non-biological landscape features of interest to the protected area system. These landscape features combined with the biodiversity constitute Alberta's overall natural diversity. The targets developed for Alberta apply to both natural and biodiversity.

As with any numerical system, great care should be used in applying it to natural systems. This is to be used as a dynamic tool for sorting and priorizing and should not be used as an absolute and inviolable reference point. The targets are based on the assumption that lands specified for meeting those targets will have a prime function in ecosystem protection and will not be subject to significant recreation and tourism use. It has been suggested that these targets reflect one-quarter to one-tenth the lands required for meeting a multiplicity of objectives related to landscape protection. The requirements of large carnivores and migratory birds and mammals are not adequately addressed by these targets. Large wilderness areas in the order of 4000 sq. km and larger are recommended for complete biodiversity and wilderness protection (Canadian Environmental Advisory Council 1991). Increasingly, it is becoming necessary to influence external management to ensure ecosystem integrity within protected areas. It should be pointed out that even a large area like Wood Buffalo National Park is not immune from external modification such as has occurred in the Peace-Athabasca delta following construction of the Bennett Dam hundreds of kilometres upstream in British Columbia.

Level 1 Natural History Theme targets (Table 4 and following sections) indicate a desired area of protection that will be adequate to represent a considerable portion of Alberta's natural diversity -- additional lands and management approaches are needed to adequately protect the full range of Alberta's natural diversity. They are a "best guess" based on a review of literature on conservation biology (see Achuff et al. 1988 for summary to that date; also Wilson and Peter 1988 and Office of Technology Assessment 1987) and an understanding of Alberta's ecosystems. The size of the targets for Level 1 Natural History Themes indicate the importance of various Natural History Themes to natural diversity representation as well as the areal extent of those Natural History Themes in the landscape of each Subregion. While they reflect areal extent, the targets are not in exact proportion to the areal distribution of other Natural History Themes in a Subregion. Some Natural History Themes are more diverse and important biologically, e.g. springs in the Mixed Grassland Subregion.

Unless a protected area is large relative to the size of the Subregion, more than one area will be required to achieve adequate representation. These replicates serve to cover off some of the geographic variation within Subregions.

A detailed analysis of the Natural History Theme Representation within each ESA can be found in Appendix 1.

Targets and existing protection (Alberta Parks Services, personal communication, 1997) are shown for each Subregion in the following sections.

4.2 Targets - Level 1 Natural History Themes - Dry Mixed Grassland Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
NON-SANDY UPLAND - GLACIAL LAKE BED	250	0
NON-SANDY UPLAND - GROUND MORAINE	250	29.5
NON-SANDY UPLAND - HUMMOCKY MORAINE	250	102
SANDY UPLAND - SANDY PLAIN	250	128
SANDY UPLAND - DUNE FIELD	250	278
VALLEY/RIDGE - EXPOSED SLOPE	100	100
VALLEY/RIDGE - PROTECTED SLOPE	25	125
VALLEY/RIDGE - FLOOR/STREAM	100	60.7
VALLEY/RIDGE - SPRINGS	2.5	1.1
WETLAND - WET MEADOW	10	4.4
WETLAND - SHALLOW MARSH	2.5	3.35
WETLAND - DEEP MARSH	2.5	.05
WETLAND - ALKALI WETLAND	10	5

4.3 Targets - Level 1 Natural History Themes - Mixed Grassland Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
NON-SANDY UPLAND - GLACIAL LAKE BED	25	4.32
NON-SANDY UPLAND - GROUND MORAINE	100	8.65
NON-SANDY UPLAND - HUMMOCKY MORAINE	100	5.35
SANDY UPLAND - SANDY PLAIN	25	2.006
SANDY UPLAND - DUNE FIELD	25	2.003
VALLEY/RIDGE - EXPOSED SLOPE	10	1.44
VALLEY/RIDGE - PROTECTED SLOPE	10	48.727
VALLEY/RIDGE - FLOOR/STREAM	25	48.614
VALLEY/RIDGE - SPRINGS	2.5	.0206
WETLAND - WET MEADOW	2.5	3.0112
WETLAND - SHALLOW MARSH	2.5	3.0006
WETLAND - DEEP MARSH	2.5	0
WETLAND - ALKALI WETLAND	2.5	0

4.4 Targets - Level 1 Natural History Themes - Northern Fescue Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
NON-SANDY UPLAND - GLACIAL LAKE BED	100	.5
NON-SANDY UPLAND - GROUND MORAINE	100	10.8
NON-SANDY UPLAND - HUMMOCKY MORAINE	100	131.3
SANDY UPLAND - SANDY PLAIN	25	4
SANDY UPLAND - DUNE FIELD	25	4
VALLEY/RIDGE - EXPOSED SLOPE	25	3.5
VALLEY/RIDGE - PROTECTED SLOPE	10	4.9
VALLEY/RIDGE - FLOOR/STREAM	25	2.6
VALLEY/RIDGE - SPRINGS	2.5	.15
WETLAND - WET MEADOW	10	12.15
WETLAND - SHALLOW MARSH	10	25.5
WETLAND - DEEP MARSH	2.5	15.5
WETLAND - ALKALI WETLAND	2.5	4
WETLAND - LAKE	10	0

4.5 Targets - Level 1 Natural History Themes - Foothills Fescue Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
NON-SANDY UPLAND - GLACIAL LAKE BED	10	187
NON-SANDY UPLAND - GROUND MORAINE	100	192.2
NON-SANDY UPLAND - HUMMOCKY MORAINE	25	40.2
SANDY UPLAND - SANDY PLAIN	10	26
VALLEY/RIDGE - EXPOSED SLOPE	10	8.1
VALLEY/RIDGE - PROTECTED SLOPE	10	43.4
VALLEY/RIDGE - FLOOR/STREAM	10	40.6
VALLEY/RIDGE - RIDGE/VALLEY WALL	25	11.3
VALLEY/RIDGE - SPRINGS	1	7.12
WETLAND - WET MEADOW	10	.27
WETLAND - SHALLOW MARSH	10	.25
WETLAND - DEEP MARSH	2.5	.1

4.6 Targets - Level 1 Natural History Themes - Central Parkland Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
NON-SANDY UPLAND - GLACIAL LAKE BED	250	0
NON-SANDY UPLAND - GROUND MORAINE	250	158.6
NON-SANDY UPLAND - HUMMOCKY MORAINE	250	184.6
SANDY UPLAND - SANDY PLAIN	250	14.9
SANDY UPLAND - DUNE FIELD	100	30.5
SANDY UPLAND - KAME MORAINE	100	21.9
VALLEY/RIDGE - EXPOSED SLOPE	25	11.6
VALLEY/RIDGE - PROTECTED SLOPE	25	11.2
VALLEY/RIDGE - FLOOR/STREAM	25	10.2
VALLEY/RIDGE - SPRINGS	2.5	3.25
WETLAND - WET MEADOW	10	12.5
WETLAND - SHALLOW MARSH	10	21.95
WETLAND - DEEP MARSH	10	33.45
WETLAND - ALKALI WETLAND	10	21.25
WETLAND - LAKE	100	0

4.7 Targets - Level 1 Natural History Themes - Foothills Parkland Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
NON-SANDY UPLAND - GLACIAL LAKE BED	25	33
NON-SANDY UPLAND - GROUND MORAINE	100	53.05
VALLEY/RIDGE - EXPOSED SLOPE	10	2.25
VALLEY/RIDGE - PROTECTED SLOPE	10	9.65
VALLEY/RIDGE - FLOOR/STREAM	25	15.7
VALLEY/RIDGE - RIDGE/VALLEY WALL	25	12.3
VALLEY/RIDGE - SPRINGS	2.5	5.35
WETLAND - WET MEADOW	10	2.9
WETLAND - SHALLOW MARSH	10	2.55
WETLAND - DEEP MARSH	10	2.2

4.8 Targets - Level 1 Natural History Themes - Peace River Parkland Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
NON-SANDY UPLAND - GLACIAL LAKE BED	100	4.65
VALLEY/RIDGE - EXPOSED SLOPE	25	3
VALLEY/RIDGE - PROTECTED SLOPE	10	6
VALLEY/RIDGE - FLOOR/STREAM	10	3.7
WETLAND - WET MEADOW	10	0
WETLAND - SHALLOW MARSH	10	0
WETLAND - DEEP MARSH	10	0
WETLAND - LAKE	10	0

4.9 Targets - Level 1 Natural History Themes - Lower Foothills Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
VALLEY/RIDGE - FLOOR/STREAM	100	100.9
VALLEY/RIDGE - RIDGE/VALLEY WALL	500	136.9
WETLAND - MINERAL	250	26.9
WETLAND - ORGANIC	250	41.3
WETLAND - LAKE	25	20.15

4.10 Targets - Level 1 Natural History Themes - Upper Foothills Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
VALLEY/RIDGE - FLOOR/STREAM	100	10.2
VALLEY/RIDGE - RIDGE/VALLEY WALL	500	38.5
WETLAND - MINERAL	50	4.6
WETLAND - ORGANIC	50	12.1
WETLAND - LAKE	10	10.7

4.11 Targets - Level 1 Natural History Themes - Montane Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
VALLEY/RIDGE - FLOOR/STREAM	100	100.15
VALLEY/RIDGE - RIDGE/VALLEY WALL	500	600
WETLAND - MINERAL	10	10
WETLAND - LAKE	10	10

4.12 Targets - Level 1 Natural History Themes - Subalpine Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
VALLEY/RIDGE - FLOOR/STREAM	100	100
VALLEY/RIDGE - RIDGE/VALLEY WALL	500	600
WETLAND - MINERAL	25	25
WETLAND - ORGANIC	10	35
WETLAND - LAKE	10	20

4.13 Targets - Level 1 Natural History Themes - Alpine Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
VALLEY/RIDGE - FLOOR/STREAM	100	100
VALLEY/RIDGE - RIDGE/VALLEY WALL	500	600
WETLAND - MINERAL	25	25
WETLAND - LAKE	10	10
GLACIER/SNOWFIELD	10	20

4.14 Targets - Level 1 Natural History Themes - Dry Mixedwood Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
NON-SANDY UPLAND - GLACIAL LAKE BED	250	2.5
NON-SANDY UPLAND - GROUND MORAINE	250	79.1
NON-SANDY UPLAND - HUMMOCKY MORAINE	250	310.2
SANDY UPLAND - DUNE FIELD	250	62.2
SANDY UPLAND - SANDY PLAIN	250	90.2
VALLEY/RIDGE - EXPOSED SLOPE	100	0
VALLEY/RIDGE - PROTECTED SLOPE	100	39.25
VALLEY/RIDGE - FLOOR/STREAM	250	69.3
WETLAND - MINERAL	100	57.6
WETLAND - ORGANIC	100	94.45
WETLAND - LAKE	250	66.85

4.15 Targets - Level 1 Natural History Themes - Central Mixedwood Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
NON-SANDY UPLAND - GLACIAL LAKE BED	250	250
NON-SANDY UPLAND - GROUND MORAINE	500	650
NON-SANDY UPLAND - HUMMOCKY MORAINE	500	548.75
SANDY UPLAND - DUNE FIELD	500	400
SANDY UPLAND - SANDY PLAIN	500	454.2
VALLEY/RIDGE - PROTECTED SLOPE	100	.8
VALLEY/RIDGE - EXPOSED SLOPE	100	14.3
VALLEY/RIDGE - FLOOR/STREAM	250	144.5
WETLAND - MINERAL	500	400
WETLAND - ORGANIC	500	800
WETLAND - LAKE	500	541.25

4.16 Targets - Level 1 Natural History Themes - Wetland Mixedwood Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
NON-SANDY UPLAND - GROUND MORAINE	250	250
NON-SANDY UPLAND - HUMMOCKY MORAINE	250	450
SANDY UPLAND - SANDY PLAIN	250	0
VALLEY/RIDGE - FLOOR/STREAM	100	100
WETLAND - MINERAL	250	250
WETLAND - ORGANIC	250	500
WETLAND - LAKE	250	500

4.17 Targets - Level 1 Natural History Themes - Boreal Highlands Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
NON-SANDY UPLAND - GROUND MORAINE	250	250
NON-SANDY UPLAND - HUMMOCKY MORAINE	250	350
VALLEY/RIDGE - PROTECTED SLOPE	100	75
VALLEY/RIDGE - FLOOR/STREAM	150	150
WETLAND - MINERAL	100	75
WETLAND - ORGANIC	250	225
WETLAND - LAKE	25	155

4.18 Targets - Level 1 Natural History Themes - Peace River Lowlands Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
NON-SANDY UPLAND - GLACIAL LAKE BED	250	100
VALLEY/RIDGE - FLOOR/STREAM	250	100
WETLAND - MINERAL	250	100
WETLAND - ORGANIC	250	200

4.19 Targets - Level 1 Natural History Themes - Subarctic Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
NON-SANDY UPLAND - GROUND MORAINE	250	250
VALLEY/RIDGE - PROTECTED SLOPE	250	100
WETLAND - MINERAL	250	150
WETLAND - ORGANIC	250	400
WETLAND - LAKE	25	260

4.20 Targets - Level 1 Natural History Themes - Athabasca Plain Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
SANDY UPLAND - SANDY PLAIN	100	10
SANDY UPLAND - DUNE FIELD	100	21
SANDY UPLAND - KAME COMPLEX	100	22
VALLEY/RIDGE - FLOOR/STREAM	10	1
WETLAND - ORGANIC	25	1
WETLAND - MINERAL	25	5
WETLAND - LAKE	25	5

4.21 Targets - Level 1 Natural History Themes - Kazan Upland Subregion

	TARGET AREA (SQ. KM)	EXISTING REPRESENTATION (SQ. KM)
NON-SANDY UPLAND - BEDROCK	100	0
SANDY UPLAND - SANDY PLAIN	100	0
VALLEY/RIDGE - FLOOR/STREAM	10	0
WETLAND - ORGANIC	25	0
WETLAND - MINERAL	25	0
WETLAND - LAKE	100	0

5. OVERVIEW OF ENVIRONMENTALLY SIGNIFICANT AREAS

The following tables provide listings of the various ESAs by natural region and subregion (with area and significance in sections 5.1 to 5.6) and by size (section 5.7).

5.1 Grassland Natural Region Sites

5.1.1 Dry Mixedgrass Subregion

Site Name	Significance	Area (hectares)
Alkali Creek Moraine	Provincial	41097
Antelope Lake	Provincial	1064
Bow River - Bow City/Scandia	Provincial	6650
Bow River - Hays	Provincial	9692
Bow River - Majorville	Provincial	15037
Chappice-Sam Lakes	International	14385
Coleman Lake	Provincial	1753
Deer Creek	Provincial	18983
Dinosaur	International	22886
Dune Point Springs	Provincial	1182
Eagle Butte	Provincial	288
Empress Creek	Provincial	876
Esther/Douglas Lake Native Prairie	Provincial	3300
Etzikom Coulee	Provincial	22131
Fincastle Lake	Provincial	750
Forty Mile Coulee Reservoir	National	1014
Grassy Island Native Prairie	National	2267
Grassy Lake Wetlands	Provincial	1283
Hays Reservoir	Provincial	989
Jenner Moraine	Provincial	164295
Jenner Springs	Provincial	962
Kininvie	Provincial	7928
Kirkpatrick Native Prairie	International	11520
Lafine White-tailed Deer Habitat	Provincial	18065
Lake Newell	National	30382
Lathom-San Francisco Lakes	Provincial	11889
Little Bow Reservoir	Provincial	238
Little Rolling Hills	Provincial	23627
Louisiana Lakes	Provincial	51195
Lower Bow Dunes	National	8094
Majorville	Provincial	3722
Many Island Lake	National	19339
Manyberries Creek Badlands	National	9016
McAlpine Creek	Provincial	285
Middle Sand Hills	Provincial	12794
Milk River - Breed Creek	National	16412
Milk River - Pakowki/Pinhorn	National	35749
Milk River Canyon	National	47794
Milk River Section	International	137
Muddy Buttes	Provincial	148
Murray Lake	Provincial	2224

Native Prairie (Brostem Reservoir)	National	15939
Native Prairie (Major Lake)	Provincial	67596
Oldman River - Lethbridge East	Provincial	3657
Pakowki Lake	National	37607
Plover Lake	National	1161
Purple Springs Dunes	Provincial	8423
Red Deer River - Alkali Creek/Dune Point	Provincial	5634
Red Deer River - Bindloss/Empress Terraces	National	9895
Red Deer River - Finnegan/Steveville Terraces	Provincial	19518
Red Deer River - Jenner	Provincial	8641
Red Rock Coulee	Provincial	1610
Remount	National	27776
Ross Creek	National	22086
Sage Creek	National	136533
Sounding Creek Native Prairie	Provincial	35651
South Saskatchewan Canyon	National	21081
South Saskatchewan River - Medicine Hat North	National	14982
South Saskatchewan River - Medicine Hat West	Provincial	27651
Suffield	National	173021
Taber Lake	Provincial	561
Travers Reservoir	National	141
Turin Dunes	National	251
Tyrell-Rush Lakes	Provincial	647
Verdigris Coulee	International	7923
Wolf Island Dunes	Provincial	1686
Writing-on-Stone	International	7189
Youngstown Aspen Groveland	Provincial	21324
		1319626

Dry Mixedgrass Subregion	Provincial	National	International
Total (ha)	625046	630540	64040

5.1.2 Mixedgrass Subregion

Site Name	Significance	Area (hectares)
Black Butte	National	106
Bluestem	Provincial	3882
Bow River - Calgary to Siksika Reserve	International	8572
Bow River - Majorville	Provincial	326
Cypress Hills	National	17229
Deer Creek	Provincial	2048
Eagle Butte	Provincial	39868
Keho Lake	Provincial	2016
Kipp Section	International	107
Lenzie Section	International	91
Little Bow Reservoir	Provincial	2661
Lower Belly River	National	4273
Lower St. Mary River	Provincial	3081
Lower Sweetgrass Hills	National	2207
Majorville	Provincial	37269
Manyberries Creek Badlands	National	17559

McAlpine Creek	Provincial	5988
McGregor Lake	National	8861
Milk River - Breed Creek	National	737
Milk River - Pakowki/Pinhorn	National	8659
Milk River Canyon	National	2253
Milk River Ridge - North East	Provincial	12552
Milk River Ridge - Northeast Slope	Provincial	3970
Milk River Ridge - Unglaciated	National	536
Milk River Ridge Reservoir	Provincial	2022
Namaka-Stobart Lakes	National	1076
Oldman River - Brocket	National	487
Oldman River - Lethbridge East	Provincial	9595
Oldman River - Macleod	National	5320
Oldman Section	International	56
Porcupine Hills	Provincial	954
Red Rock Coulee	Provincial	2181
Ross Creek	National	10508
Sage Creek	National	3693
Scabby Butte	International	151
St. Mary Type Section	International	107
Stirling Lake	Provincial	1266
Travers Reservoir	National	13868
Turin Dunes	National	263
Twin River Ash	Provincial	25
Twin River Valley	Provincial	27050
Tyrell-Rush Lakes	Provincial	1447
Wintering Hills	Provincial	1587
Writing-on-Stone	International	2071
		268578

Mixedgrass Subregion	Provincial	National	International
Total (ha)	159788	97635	11155

5.1.3 Northern Fescue Subregion

Site Name	Significance	Area (hectares)
Battle River - Bigknife	National	3181
Battle River - Brownfield	Provincial	4721
Bodo	International	34855
Brent Lake	Provincial	134
Chain-Farrell Lakes	International	7625
Dowling Lake	International	4584
Ensleigh Lakes	Provincial	266
Esther/Douglas Lake Native Prairie	Provincial	15388
Gooseberry Lake	Provincial	686
Gough Lake	Provincial	10507
Grassy Island Lake	National	5874
Grassy Island Native Prairie	National	35399
Handhills	Provincial	7984
Handhills Fescue	International	7711
Handhills Lake	International	2981

Kirkpatrick Lake	National	3821
Kirkpatrick Native Prairie	International	24051
Lanes Lake	Provincial	1208
Little Fish Lake	International	1849
Marion-Shooting Lake Wetlands	Provincial	7486
Middle Lakes	National	6779
Muddy Buttes	Provincial	11360
Muddy Buttes Badlands	Provincial	625
Mudspring Lake	Provincial	2046
Neutral Hills	Provincial	9315
Paintearth	Provincial	3174
Ribstone Creek - Nose Hill	Provincial	4119
Rumsey North	Provincial	89
Rumsey South	International	21199
Silver Heights	National	604
Sounding Dunes	National	542
Sounding Lake	National	23
Sullivan Lake	National	28035
Tolman Badlands	Provincial	14368
Willow Creek	Provincial	8878
Wintering Hills	Provincial	9407
Youngstown Aspen Groveland	Provincial	608
		301482

Northern Fescue Subregion	Provincial	National	International
Total (ha)	112369	84258	104855

5.1.4 Foothills Fescue Subregion

Site Name	Significance	Area (hectares)
Bluestem	Provincial	3386
Bow River - Calgary to Siksika Reserve	International	6565
Canon Coulee	Provincial	2364
Carway Iris	National	101
Coulee Ridges	Provincial	8364
Crowsnest River	International	198
Frank Lake	Provincial	1591
Glenwoodville Erratic	Provincial	54
Irricana Reservoir	National	237
Janet Sloughs	Provincial	363
Lower Belly River	National	295
Lower St. Mary River	Provincial	1832
Lynch Lakes	Provincial	404
Milk River Ridge - North East	Provincial	16974
Milk River Ridge - North West	National	42972
Milk River Ridge - Northeast Slope	Provincial	3609
Milk River Ridge - Unglaciated	National	3348
Milk River Ridge Reservoir	Provincial	211
North Fork Milk River - A	Provincial	12776
Oldman River - Brocket	National	1518
Oldman River - Porcupine Hills	Provincial	2956

Paine - Beaverdam	National	295
Pine Ridge	Provincial	228
Porcupine Hills	Provincial	27543
Ross Lake Unglaciated	National	1115
St. Mary Reservoir	National	4579
Todd Creek Ridge	Provincial	78
Upper St. Mary River	Provincial	4181
Whaleback	National	886
		149023

Foothills Fescue Subregion	Provincial	National	International
Total (ha)	86914	55346	6763

5.2 Parkland Natural Region Sites

5.2.1 Central Parkland Subregion

Site Name	Significance	Area (hectares)
Albert Lake	Provincial	167
Battle River - Bigknife	National	16274
Battle River - Brownfield	Provincial	8566
Battle River - Camp Wainwright	National	2188
Battle River - Driedmeat Lake	Provincial	4789
Battle River - Marsden	National	3821
Battle River - Wainwright	National	8278
Baxter Lake	National	1589
Bearhills Lake	Provincial	1952
Beaverdam Creek	Provincial	481
Beaverhill Lake	International	19540
Bellshill Lake	National	1116
Big Hay Lake	National	1975
Big Lake	Provincial	2140
Bittern Lake	National	3821
Bodo	International	15
Buffalo Lake	International	17440
Cipher Lake	National	151
Clarke Lake	Provincial	418
Cluster of Unnamed Lakes	National	491
Coal Lake	Provincial	2147
Delburne Wetlands	Provincial	922
Earlie Lake	Provincial	167
Edberg Slough	Provincial	594
Edgerton Dunes	Provincial	10914
Erskine Lake	National	336
Ewing Lake	National	1373
Gillespie Lake	Provincial	1380
Greenlee Lake	National	110
Gull Lake	Provincial	9612
Horseshoe Lake	National	471
Kenilworth Lake	National	1218

Killarney/Dillberry/Leane Lake Complex	International	3455
Lousana Canyon	Provincial	7205
Lowden Wetlands	National	3554
Manawan (Egg) Lake	National	1760
Marion-Shooting Lake Wetlands	Provincial	2040
Metiskow Lake	National	305
Mikwan-Goosequill-Hummock Lakes	National	3510
Ministik Lake	Provincial	244
Mudspring Lake	Provincial	304
North Saskatchewan River - Edmonton	Provincial	7342
North Saskatchewan River - Elk Point	Provincial	2829
Paintearth	Provincial	4592
Peter's Pond	Provincial	341
Pine Lake	Provincial	1300
Plain Lake	Provincial	842
Pointe-Aux-Pins Soapholes	Provincial	89
Red Deer Lake	Provincial	2956
Reflex Lake	International	569
Ribstone Creek - Camp Wainwright	Provincial	5397
Ribstone Creek - Edgerton	Provincial	1775
Ribstone Lake	Provincial	726
Rumsey North	Provincial	11392
Rumsey South	International	4653
Samson Lake	Provincial	2355
Silver Heights	National	11374
Sounding Dunes	National	56929
Sounding Lake	National	5310
Sunken Lake	Provincial	417
Tolman Badlands	Provincial	15504
Unnamed Lake S of Sunken L	National	187
Vermilion Lake - Vermilion Provincial Park	Provincial	822
Wagner Natural Area	Provincial	752
Wainwright Base	National	53394
Wainwright Dunes Ecological Reserve	Provincial	3178
Watt Lake	Provincial	2660
Wavy Lake	National	1910
Whitford-Rush Lakes	National	1745
Willow Lake	Provincial	2830
Wood Lake	Provincial	280
		351283

Central Parkland Subregion	Provincial	National	International
Total (ha)	122421	183190	45672

5.2.2 Foothills Parkland Subregion

Site Name	Significance	Area (hectares)
Beaverdam Creek	Provincial	699
Big Hill Creek	Provincial	2250
Cloudy Ridge	Provincial	428
Dungarvan Wetlands	Provincial	383

Highwood-Pekisko Upland	Provincial	11011
Horseshoe Lake	Provincial	75
Lee Creek Ponds	Provincial	98
Margaret Lake	Provincial	893
Meinsinger Lake	Provincial	22
Okotoks Erratic	International	9
Paine - Beaverdam	National	2613
Pekisko Creek	Provincial	6060
Pine Ridge	Provincial	4950
Police Outpost	National	527
Sarcee (Tsuu Tsina Reserve)	Provincial	6646
Sheep River	Provincial	1416
		38080

Foothills Parkland Subregion	Provincial	National	International
Total (ha)	34931	3140	9

5.2.3 Peace River Parkland Subregion

Site Name	Significance	Area (hectares)
Bear Lake	National	4200
Buffalo Lake Complex	National	975
Flyingshot Lake	National	269
Kleskun Hill	National	2420
Peace River	National	1527
Peace River - Dunvegan	National	2097
Peace River - Parkland	National	6671
Clairmount Lake	Provincial	1202
Ferguson Lake	Provincial	443
Kakut Lake	Provincial	544
Kleskun Lake	Provincial	1601
Representative Area (#89)	Provincial	312
Smoky River	Provincial	80
Wood Lake	Provincial	150
		22491

Peace River Parkland Subregion	Provincial	National	International
Total (ha)	4332	18159	0

5.3 Foothills Natural Region Sites

5.3.1 Lower Foothills Subregion

Site Name	Significance	Area (hectares)
Athabasca River - Foothills	National	32249
Athabasca River - Whitecourt-Vega	National	4
Athabasca River - Whitecourt-Vega	Provincial	29
Buck Lake	Provincial	3789
Burnstick Lake	Provincial	1358

Chinchaga Diversity Area	Provincial	748470
Chinchaga River	Provincial	570
Clearwater River	Provincial	4986
Cow Lake	Provincial	1750
Crimson-Louis Lake Wetlands	Provincial	7600
Crooked Lake	Provincial	1720
Cutbank River	Provincial	19384
Freeman River	Provincial	3648
Goose-Wallace Mountain	Provincial	667
Kakwa River	Provincial	16476
Lesser Slave Lake	Provincial	17
Little Smoky Caribou Range	Provincial	11512
Little Smoky River	Provincial	8787
Lower Pinto Creek	Provincial	43
Lower Wildhay River	Provincial	6786
Marten Mountain	Provincial	16337
Middle Berland River	Provincial	6807
Narraway River	Provincial	9836
North Saskatchewan River - Drayton Valley	National	23702
North Saskatchewan River - Genessee-Drayton Valley	Provincial	22
Nose Creek	Provincial	5993
Parallel Creek Peatland	Provincial	66
Pembina River	Provincial	22404
Pouce Coupe River	Provincial	8611
Ram River	Provincial	1872
Raven River	Provincial	2
Sheep River	Provincial	5435
Simonette River	Provincial	21657
South Notikewin - Deadwood Diversity Area	Provincial	41944
Tony Creek	Provincial	12991
Upper North Saskatchewan River	National	4612
Upper Red Deer River	Provincial	86
Wapiti River	Provincial	11
Whitemud River Diversity Area	Provincial	41562
		1093795

Lower Foothills Subregion	Provincial	National	International
Total (ha)	1033228	60567	0

5.3.2 Upper Foothills Subregion

Site Name	Significance	Area (hectares)
Athabasca River - Foothills	National	698
Berland River-Donald Flats	Provincial	3716
Berland River-Hendrickson Creek	Provincial	4313
Blackstone River	Provincial	5859
Chinchaga Diversity Area	Provincial	41106
Clearwater River	Provincial	28864
Coal Valley Highland	Provincial	15478
Cutbank River	Provincial	7589
Donald Creek Drainage	Provincial	33003

Freeman River	Provincial	4810
Goose-Wallace Mountain	Provincial	23855
Jarvis Creek	Provincial	4505
Kakwa River	Provincial	34248
Little Smoky Caribou Range	Provincial	136346
Little Smoky River	Provincial	119
Lower Pinto Creek	Provincial	13504
Lower Wildhay River	Provincial	16524
Marshybank Ecological Reserve	Provincial	1048
Middle Berland River	Provincial	4852
Muskeg-Little Smoky Rivers	Provincial	35222
Narraway River	Provincial	14053
North Ram River	Provincial	10593
Nose Creek	Provincial	3040
Pembina River	Provincial	2331
Ram River	Provincial	7470
Shunda Creek	Provincial	9952
Simonette River	Provincial	14750
Solomon-Ice Water-Paradise Creek	Provincial	8782
Swan Hills Plateau Remnant	Provincial	5550
Tony Creek	Provincial	289
Upper North Saskatchewan River	National	9211
Upper Pinto Creek	Provincial	9809
Upper Red Deer River	Provincial	4608
Wapiabi Creek	Provincial	7449
		523546

Upper Foothills Subregion	Provincial	National	International
Total (ha)	513637	9909	0

5.4 Rocky Mountain Natural Region Sites

5.4.1 Montane Subregion

Site Name	Significance	Area (hectares)
Beauvais Lake Provincial Park	Provincial	732
Birdseye Butte Pond	Provincial	76
Bow Valley Provincial Park	Provincial	1441
Brule Lake	Provincial	3604
Chapel Butte	Provincial	3086
Cloudy Ridge	Provincial	7
Connelly Creek Ridges	Provincial	5358
Crowsnest River	International	2231
Crowsnest Spring	Provincial	64
Crowsnest Volcanics	Provincial	230
Cypress Hills	National	44585
Eagle Butte	Provincial	5524
Exshaw/Grotto Mountain	Provincial	1128
Frank Slide	International	391
Grassi Lakes	Provincial	37

Kootenay Plains	Provincial	13111
Kylo Hill-Mount Backus	Provincial	345
Livingstone Range	Provincial	84
Lynch Lakes	Provincial	3030
Margaret Lake	Provincial	326
Mokowan Butte	National	986
Paine - Beaverdam	National	1357
Porcupine Hills	Provincial	17045
Rock-Cow Creek Wetlands	Provincial	3103
Todd Creek Ridge	Provincial	6719
West Bow Flats	Provincial	1576
Whaleback	National	27144
White Goat Lakes	Provincial	203
Wind Valley	International	441
Ya-Ha-Tinda	Provincial	2477
Yamnuska	Provincial	877
		147318

Montane Subregion	Provincial	National	International
Total (ha)	70183	74072	3063

5.4.2 Subalpine Subregion

Site Name	Significance	Area (hectares)
		39700
Berland River-Hendrickson Creek	Provincial	5547
Bow Valley Provincial Park	Provincial	276
Cardinal River Headwaters	National	9352
Crowsnest Volcanics	Provincial	74
Dry Canyon	Provincial	73
Exshaw/Grotto Mountain	Provincial	248
Frank Slide	International	175
Kootenay Plains	Provincial	473
Livingstone Range	Provincial	177
McLeod River Headwaters	National	5682
North Ram River	Provincial	20
Red Cap	National	10909
Rock-Cow Creek Wetlands	Provincial	423
Shunda Creek	Provincial	1032
Solomon-Ice Water-Paradise Creek	Provincial	343
Wapiabi Creek	Provincial	740
West Bow Flats	Provincial	86
Whitehorse Creek	National	3453
Wind Valley	International	423
Yamnuska	Provincial	194
		79400

Subalpine Subregion	Provincial	National	International
Total (ha)	9706	29396	598

5.4.3 Alpine Subregion

Site Name	Significance	Area (hectares)
Cardinal River Headwaters	National	7532
Exshaw/Grotto Mountain	Provincial	30
McLeod River Headwaters	National	3202
Red Cap	National	3888
Whitehorse Creek	National	5452
Yamnuska	Provincial	2
		20106

Alpine Subregion	Provincial	National	International
Total (ha)	32	20074	0

5.5 Boreal Forest Natural Region Sites

5.5.1 Dry Mixedwood Subregion

Site Name	Significance	Area (hectares)
Amisk Lake	Provincial	1085
Amisk Valley	Provincial	4508
Arthur Lake	Provincial	71
Athabasca River - Pembina Reach	National	24125
Battle Lake	Provincial	1258
Bear River Sandhills	Provincial	7742
Beaver Lake	Provincial	2103
Bisbing Lake	Provincial	55
Blackfoot Grazing Reserve	Provincial	10001
Bleak Lake Wetlands	Provincial	6793
Buck Lake	Provincial	172
Buffalo Bay/Horse Lakes	Provincial	13053
Bunder Lake	Provincial	1352
Bush (Wilkin) Lake	Provincial	814
Cache Creek - Wolverine Sand Hills	Provincial	71632
Cache Lake	National	1576
Cardinal Lake	National	6820
Caribou Mountains Escarpment	Provincial	42
Charlotte Lake	Provincial	1730
Child Lake	Provincial	657
Chip Lake	Provincial	8954
Clear River Moose Range	Provincial	35272
Clearwater River	Provincial	4165
Cooking Lake	Provincial	3961
Coyote Lake Natural Area	Provincial	1035
Dick Lake	Provincial	166
Duck Lake	National	659
Edward Lake	National	344
Elk Island National Park	National	19391
Flat Lake	National	4105
Flood Lake	Provincial	465

Flyingshot Lake (SW)	Provincial	116
Forsyth Lake	National	448
Fort Vermilion Sand Hills	National	71549
Frank Lake	Provincial	180
Frog Lake	Provincial	7623
Genessee Natural Area	International	296
George Lake	Provincial	203
Gerry Lake	Provincial	640
Glory Hills	Provincial	2648
Goodfare Lake	Provincial	189
Gull Lake	Provincial	668
Harold Lake	Provincial	607
Hastings Lake	Provincial	928
High Level Salt Meadows	Provincial	1637
Horse Lake (East)	Provincial	60
Jean D'Or Meadows	Provincial	1689
Jessie Lake	National	954
Kerr Lake	Provincial	517
Kimiwan Lake	National	7374
La Crete Sand Hills	National	6794
La Glace Lake	National	1514
Lac Brosseau	National	395
Lac Canard	Provincial	188
Lac La Biche	National	28583
Lac La Biche Peatlands	Provincial	10917
Lac Magloire	National	1250
Lac Sante	Provincial	958
Lac St. Anne	National	8170
Lesser Slave Lake	Provincial	136952
Little Smoky River	Provincial	36745
Long Lake	Provincial	1780
Maloney Lake	National	657
Manatokan Lake	National	843
McCullough Lake	National	159
McNaught Lake	Provincial	248
Ministik Lake	Provincial	10632
Miquelon Lake	National	3591
Muriel Lake	Provincial	7949
North Saskatchewan River - Edmonton	Provincial	4629
North Saskatchewan River - Elk Point	Provincial	14228
North Saskatchewan River - Genessee-Drayton Valley	Provincial	9433
North Saskatchewan River - Genessee-Drayton Valley	Provincial	5172
North Shore Moose Area	Provincial	16
Peace River	National	177225
Peace River - Dunvegan	National	100149
Peace River - Parkland	National	45
Peace River - Smoky Junction	National	14844
Pembina River	Provincial	8886
Pigeon Lake	Provincial	11633
Pipestone Creek	National	303
Pluvius Lake	Provincial	377

Pouce Coupe River	Provincial	12651
Puskwaskau River	Provincial	3990
Rat Lake	Provincial	355
Raven River	Provincial	4492
Reed Lake	National	1567
Reita Lake	Provincial	1939
Representative Area (#84)	Provincial	22564
Representative Area (#89)	Provincial	16544
Saskatoon Lake	Provincial	1583
Simonette River	Provincial	10536
Sinclair (Brainard) Lake	National	588
Smoky Lake	National	2486
Smoky River	Provincial	53770
South Notikewin - Deadwood Diversity Area	Provincial	33591
Stebbing Lake	Provincial	447
Valhalla Lake	National	438
Vermilion Lakes	National	3770
Wabamun Lake	Provincial	11394
Wabasca Bison Range	National	12257
Wabasca River	Provincial	3927
Wakomao Lake	Provincial	808
White Earth Natural Area	Provincial	2338
Winagami Lake/South Heart River	Provincial	16789
Wolfe Lake	Provincial	212
		1156733

Dry Mixedwood Subregion	Provincial	National	International
Total (ha)	653464	502973	296

5.5.2 Central Mixedwood Subregion

Site Name	Significance	Area (hectares)
Albright Lake	Provincial	467
Athabasca River - Foothills	National	20
Athabasca River - Pembina Reach	National	86706
Athabasca River - Rapids Reach	National	103522
Athabasca River - Tar Sands Reach	National	63573
Athabasca River - Whitecourt-Vega	National	13810
Athabasca River - Whitecourt-Vega	Provincial	33483
Athabasca Sand Dune-Peatland Complex	Provincial	9152
Beaver Lake	Provincial	4013
Beavertail Creek-Lower Reach	Provincial	410
Beavertail Creek-Upper Reach	Provincial	114
Birch Lake	Provincial	3558
Birch Mountains Diversity Area	Provincial	4442
Boivin Creek Peatland	Provincial	21469
Brine Creek Salt Plain	National	13727
Buffalo Bay/Horse Lakes	Provincial	15
Cadotte Lake	Provincial	1810
Calling Lake	Provincial	20100
Caribou Mountains Escarpment	Provincial	226

Cattail Lake	Provincial	119
Chain Lakes	Provincial	88
Clearwater River	National	62056
Cold Lake	National	34345
Crag and Tail	Provincial	66707
Crow Lake Diversity Area	Provincial	11201
Cutbank River	Provincial	2538
Dickson Lake Complex	Provincial	512
Egg Lake-Algar Lake Diversity Area	Provincial	381656
Ells River	Provincial	17154
Erickson Lake	Provincial	158
Eymundson Sinkholes (002)	Provincial	841
Fawcett Lake	Provincial	4991
Firebag River	Provincial	26059
Fowell Lake Complex	Provincial	2563
Freeman River	Provincial	5013
Frenchman Lake	Provincial	1438
Ft. Assiniboine Horizontal Fen	Provincial	3141
Garden River Bison Range	National	370038
Gipsy Lake	Provincial	6040
Godin Lake	Provincial	2301
Gods Lake	Provincial	1769
Gordon Lake	Provincial	19199
Graham Creek	Provincial	192
Grassy Lake	Provincial	424
Grist Lake	Provincial	3118
Haig Lake	Provincial	2764
Harper Springs Natural Area	Provincial	5822
Heart Lake	Provincial	6379
High Hill River	Provincial	12588
Holmes Crossing Sand Hills	National	5983
Hume-Steeprock Creeks	Provincial	378
Iosegun River	Provincial	8386
Ironwood Lake	Provincial	979
Jackfish Lake	Provincial	429
Kamisak Lake	Provincial	236
Keeping Lake Complex	Provincial	138
La Saline Springs Natural Area	Provincial	733
Lake Claire	National	3663
Lakeland Diversity Area	Provincial	22559
Lakeland Provincial Recreation Area	Provincial	27130
Lattice Creek	Provincial	171
Lesser Slave Lake	Provincial	156
Lesser Slave Lake Horizontal Fen	Provincial	14953
Lesser Slave River	Provincial	5241
Little Smoky River	Provincial	11862
Little Smoky-Iosegun Natural Area	Provincial	1618
Lower Christina River	Provincial	25496
Lubicon Lake	Provincial	4284
Marguerite River Dissected Kame	Provincial	1668
Maybelle River Sand Hills	National	33824

McClelland Lake	Provincial	6405
McClelland Lake Fen	Provincial	3071
McClelland Lake Sinkholes	Provincial	2052
Moose Lake	Provincial	530
Needle Lake Bison Range	National	2608
Nipisi Lake	Provincial	2588
North Shore Moose Area	Provincial	19044
North Wabasca Lake	Provincial	16056
Orloff Lake	Provincial	2443
Parallel Creek Peatland	Provincial	355986
Paxton-Larocque Lakes	National	657
Peace River	National	47567
Peace-Athabasca Rivers Delta	International	2766
Pelican Lake	Provincial	5307
Pembina River	Provincial	2088
Pine Lake Bison Range	National	318104
Pinto Creek Elk Range	Provincial	3975
Preston Lake	Provincial	490
Primrose Lake South Basin	National	2622
Puskwaskau Lake	Provincial	881
Puskwaskau River	Provincial	1433
Raspberry Lake	Provincial	600
Raup Lake Salt Plains	National	4535
Ray Lake	Provincial	246
Redwillow River	Provincial	675
Redwillow River Grizzly Range	Provincial	18653
Rich Lake	National	1084
Richardson River Active Dunes	National	687
Richardson River Sand Hills	National	68825
Ronald Lake	Provincial	326
Salt River	Provincial	48
Salt River Salt Plains	National	171
Sand River	Provincial	20503
Schultz's Bog Diversity Area	Provincial	80247
Seibert Lake	Provincial	3558
Side Lake	Provincial	497
Simonette River	Provincial	12862
Slave River	National	121
Smoky River	Provincial	200
Snipe Lake	Provincial	4935
South Wabasca Lake	Provincial	9704
Spencer Lake	Provincial	2239
Square Lake	National	3414
Steele Lake	Provincial	2834
Stony Creek Moose and Grizzly Range	Provincial	16753
Sturgeon Lake	National	6766
Sweetgrass Bison Range	National	55822
Touchwood Lake	Provincial	5374
Trout River Delta	Provincial	24879
Tufa-Unusual Wetland Feature	Provincial	258
Twin Lakes	Provincial	229

Two Lakes	Provincial	83
Unnamed Lake (T67 R01 S10 W6) - BF Site #510	Provincial	59
Unnamed Lake (T67 R26 S03 W5) - BF Site #416	Provincial	290
Unnamed Lake Complex (T71 R12 S07 W6) - BF Site #608	Provincial	348
Unnamed Lake Complex (T71 R12 S29 W6) - BF Site #609	Provincial	158
Unnamed Lake Complex (T72 R13 S33 W6) - BF Site #614	Provincial	146
Unnamed Lakes (T68 R11 S27 W6) - BF Site #506	Provincial	277
Unnamed Lakes (T71 R24 S32 W5) - BF Site #705	Provincial	289
Upper Wabasca River	Provincial	31295
Utikuma Lake	National	33000
Utikumasis Lake	National	1747
Wabasca Bison Range	National	2990
Wabasca River	Provincial	67765
Wabasca River (Canyon)	Provincial	29773
Wabasca River - Wabasca Lake	Provincial	3584
Wapiti River	Provincial	9422
Weaver Lake	Provincial	1566
Whooping Crane Nesting Habitat	International	5083
Winagami Lake/South Heart River	Provincial	649
Windsor Creek	Provincial	509
Winefred Lake	Provincial	12339
Winefred/Grist Watershed	Provincial	77191
Wolf Lake	Provincial	4696
Yoke Lake	Provincial	215
		3028910

Central Mixedwood Subregion	Provincial	National	International
Total (ha)	1679074	1341987	7849

5.5.3 Wetland Mixedwood Subregion

Site Name	Significance	Area (hectares)
Caribou Mountains Escarpment	Provincial	62
Chinchaga Diversity Area	Provincial	284
Chinchaga River	Provincial	71975
Garden River Bison Range	National	6430
Haig River	Provincial	6243
Hay River	Provincial	91765
Hay-Zama Lakes Complex	International	55434
Kilome Lake Complex	Provincial	51864
Lessard Creek Peat Plateau Bog	Provincial	3783
Merryweather Lake	Provincial	1971
Needle Lake Bison Range	National	165965
Unnamed Lake (T106 R05 S05 W6) - BF Site #2102	Provincial	126
Unnamed Lake (T121 R19 S32 W4) - BF Site #2503	Provincial	1910
Whooping Crane Nesting Habitat	International	9269
Zama Lake Ribbed Fen	Provincial	9407
		476488

Wetland Mixedwood Subregion	Provincial	National	International
Total (ha)	239390	172395	64703

5.5.4 Boreal Highlands Subregion

Site Name	Significance	Area (hectares)
Birch Mountains Diversity Area	Provincial	229054
Cameron Hills Glacial Flutings	Provincial	9959
Caribou Mountains Escarpment	Provincial	190469
Egg Lake-Algar Lake Diversity Area	Provincial	113576
Ells River	Provincial	1204
Gods Lake	Provincial	51
Haig Lake	Provincial	74
Peerless/Graham Lake Watershed	Provincial	95576
Russell Lake	Provincial	3466
Sawn Lake	Provincial	1804
Trout River Delta	Provincial	5141
Wabasca River	Provincial	3109
Wadlin Lake	Provincial	2453
		655936

Boreal Highlands Subregion	Provincial	National	International
Total (ha)	655936	0	0

5.5.5 Peace River Lowlands Subregion

Site Name	Significance	Area (hectares)
Athabasca River - Tar Sands Reach	National	10416
Brine Creek Salt Plain	National	4854
Garden River Bison Range	National	12292
La Butte Creek	Provincial	765
Lake Claire	National	168012
Maybelle River Sand Hills	National	3746
Peace River	National	197522
Peace-Athabasca Rivers Delta	International	280320
Pine Lake Bison Range	National	58904
Raup Lake Salt Plains	National	4177
Richardson River Sand Hills	National	9327
Salt River	Provincial	11046
Salt River Salt Plains	National	7192
Slave River	National	61981
Slave River Rapids	National	24190
Stony Islands	Provincial	613
Sweetgrass Bison Range	National	3202
		858559

Peace River Lowlands Subregion	Provincial	National	International
Total (ha)	12424	565815	280320

5.5.6 Subarctic Subregion

Site Name	Significance	Area (hectares)
Birch Mountains Diversity Area	Provincial	91829
Bistcho Lake	Provincial	46927
Bistcho Lake Peat Plateau Bog	Provincial	257361
Cameron Hills Glacial Flutings	Provincial	20856
Caribou Mountains Escarpment	Provincial	34164
Caribou Mountains Northern Ribbed Fens	Provincial	3847
Caribou Mountains Peat Plateau Bog	Provincial	3277
Margaret Lake	Provincial	9106
		467367

Subarctic Subregion	Provincial	National	International
Total (ha)	467367	0	0

5.6 Canadian Shield Natural Region Sites

5.6.1 Athabasca Plain Subregion

Site Name	Significance	Area (hectares)
Archibald Lake Dunes	National	7425
Crag and Tail	Provincial	4012
Egg Island Ecological Reserve	Provincial	171
Glacial Lake Berg	Provincial	183
Lake Athabasca - North Shore - Fidler - Greywillow	Provincial	5216
Lake Athabasca - Shelter - Sand Points	Provincial	19007
Lake Athabasca - South Shore	Provincial	3663
Maybelle River Sand Hills	National	14285
Old Fort Bay Dunes	Provincial	38273
Paxton-Larocque Lakes	National	37030
Richardson River Sand Hills	National	3985
Richardson Tower Lakes	Provincial	6159
Wylie Lake	Provincial	174
		139583

Athabasca Plain Subregion	Provincial	National	International
Total (ha)	76858	62725	0

5.6.2 Kazan Upland Subregion

Site Name	Significance	Area (hectares)
Caspian Tern	Provincial	2325
Charles-Cornwall Lakes	Provincial	62413
Colin Lake	Provincial	20694
Glacial Lake Berg	Provincial	4303
La Butte Creek	Provincial	5645
Lake Athabasca - North Shore - Fidler - Greywillow	Provincial	1752
Lake Athabasca - Shelter - Sand Points	Provincial	470
Leland-Tulip Lakes	Provincial	31421

Waugh Lake	Provincial	3844
Woodman - Alexander Lakes	Provincial	13834
Wylie Lake	Provincial	38133
		184834

Kazan Upland Subregion	Provincial	National	International
Total (ha)	184834	0	0

5.7 ESAs Sorted by Size

5.7.1 Sites Larger Than 10 Sq. Km.

Name	Area (ha)
Chinchaga Diversity Area	838663
Egg Lake-Algar Lake Diversity Area	495231
Peace River	470740
Garden River Bison Range	388748
Pine Lake Bison Range	377008
Parallel Creek Peatland	356052
Birch Mountains Diversity Area	325325
Peace-Athabasca Rivers Delta	283079
Bistcho Lake Peat Plateau Bog	257532
Caribou Mountains Escarpment	224978
Suffield	173021
Lake Claire	171692
Needle Lake Bison Range	168573
Jenner Moraine	164297
Little Smoky Caribou Range	147859
Sage Creek	140220
Lesser Slave Lake	137126
Athabasca River-Pembina Reach	110834
Athabasca River-Rapids Reach	103521
Peerless/Graham Lake Watershed	95576
Hay River	91764
Richardson River Sand Hills	82139
Schultz's Bog Diversity Area	80247
Winefred/Grist Watershed	77192
Hand Hills Fescue	77091
South Notikewin/Deadwood Caribou Range	75536
Wabasca River	74805
Athabasca River-Tar Sands Reach	74005
Cache Creek - Wolverine Sand Hills	71630
Fort Vermilion Sand Hills	71549
Crag and Tail	70716
Native Prairie (Major Lake)	67600
Charles-Cornwall Lakes	62412
Slave River	62097
Clearwater River	62055
Cypress Hills	61817
Simonette River	59799

Sweetgrass Bison Range	59019
Little Smoky River	57511
Sounding Dunes	57474
Peace River - Dunvegan	55864
Hay-Zama Lakes Complex	55436
Smoky River	54049
Wainwright Base	53406
Kilome Lake Complex	51862
Maybelle River Sand Hills	51855
Louisiana Lakes	51201
Kakwa River	50728
Milk River Canyon	50061
Athabasca River - Whitecourt-Vega	47325
Bistcho Lake	46927
Eagle Butte	45686
Porcupine Hills	45543
Milk River Ridge-Northwest	42973
Whitemud River Diversity Area	41562
Alkali Creek Moraine	41097
Majorville	40989
Wylie Lake	38307
Old Fort Bay Dunes	38285
Clearwater River	38036
Paxton-Larocque Lakes	37694
Grassy Island Native Prairie	37677
Pakowki Lake	37606
Pembina River	35709
Sounding Creek Native Prairie	35651
Kirkpatrick Native Prairie	35572
Clear River Moose Range	35275
Muskeg-Little Smoky Rivers	35201
Bodo	34855
Cold Lake	34349
Utikuma Lake	33002
Donald Creek Drainage	32999
Athabasca River - Foothills	32969
Ross Creek	32578
Leland-Tulip Lakes	31421
Upper Wabasca River	31295
Cameron Hills Glacial Flutings	30818
Lake Newell	30387
Trout River Delta	30019
Tolman Badlands	29879
Wabasca River (Canyon)	29774
Milk River Ridge-Northeast	29523
Cutbank River	29510
Lac La Biche	28583
Sullivan Lake	28035
Whaleback	28030
Remount	27776
South Saskatchewan River-Medicine Hat West	27650

Lakeland Provincial Recreation Area	27101
Twin River Valley	27052
Manyberries Creek Badlands	26581
Firebag River	26059
Rumsey South	25852
Lower Christina River	25496
Goose-Wallace Mountain	24527
Slave River Rapids	24188
Narraway River	23890
North Saskatchewan River - Drayton Valley	23700
Little Rolling Hills	23630
Chinchaga River	23470
Lower Wildhay River	23314
Dinosaur	22886
Lakeland Diversity Area	22565
Representative Area #84	22563
Etzikom Coulee	22131
Youngstown Aspen Groveland	21935
Boivin Creek Peatland	21469
Pouce Coupe River	21330
Deer Creek	21032
Colin Lake	20694
Sand River	20501
Calling Lake	20100
Beaverhill Lake	19547
Red Deer River-Finnegan/Steveville Terraces	19516
Battle River - Bigknife	19454
Lake Athabasca - Shelter-Sand Points	19439
Elk Island National Park	19391
Many Island Lake	19316
Gordon Lake	19199
North Shore Moose Area	19068
Esther/Douglas Lake Native Prairie	18673
Redwillow River Grizzly Range	18656
Brine Creek Salt Plain	18582
Ells River	18359
Ells River	18359
Lac Canard	18340
Lafine White-Tailed Deer Habitat	18068
Buffalo Lake	17440
Winagami Lake/South Heart River	17437
Milk River-Breed Creek	17153
North Saskatchewan River - Elk Point	17057
Cardinal River Headwaters	16884
Representative Area #89	16857
Stony Creek Moose and Grizzly Range	16753
Marten Mountain	16337
North Wabasca Lake	16056
Native Prairie (Brostem Reservoir)	15940
Coal Valley Highland	15478
Bow River -Majorville	15370

Wabasca Bison Range	15248
Bow River - Calgary to Siksika Reserve	15137
South Saskatchewan River-Medicine Hat North	14987
Lesser Slave Lake Horizontal Fen	14953
Red Cap	14792
Peace River - Smoky Junction	14769
North Saskatchewan River - Genessee-Drayton Valley	14629
Chappice-Sam Lakes	14384
Whooping Crane Nesting Habitat	14365
South Saskatchewan Canyon	14037
Travers Reservoir	14000
Woodman-Alexander Lakes	13838
Upper North Saskatchewan River	13828
Kootenay Plains	13587
Lower Pinto Creek	13554
Freeman River	13476
Battle River - Brownfield	13284
Tony Creek	13283
Oldman River-Lethbridge East	13252
Buffalo Bay/Horse Lakes	13069
Middle Sand Hills	12827
North Fork Milk River A	12767
Lakeland Provincial Park	12671
High Hill River	12588
Winefred Lake	12338
Silver Heights (wetlands only)	11986
North Saskatchewan River - Edmonton	11970
Lathom-San Francisco Lakes	11889
Middle Berland River	11650
Pigeon Lake	11633
Muddy Buttes	11503
Rumsey North	11481
Wabamun Lake	11394
Crow Lake Diversity Area	11201
Salt River	11098
Highwood-Pekisko Upland	11010
Wintering Hills	10993
Shunda Creek	10978
Edgerton Dunes	10930
Lac La Biche Peatlands	10917
Ministik Lake	10876
North Ram River	10608
North Ram River	10608
Gough Lake	10517
Gull Lake	10282
Gull Lake	10282
Blackfoot Grazing Reserve	10001
Red Deer River-Bindloss/Empress Terraces	9881
Berland River-Hendrickson Creek	9860
Upper Pinto Creek	9802
South Wabasca Lake	9704

Bow River - Hays	9692
Marion-Shooting Lakes	9525
Wapiti River	9435
Zama Lake Ribbed Fen	9404
Ram River	9334
Neutral Hills	9316
Writing-on-Stone	9255
Athabasca Sand Dune-Peatland Complex	9153
Solomon-Ice Water-Paradise Creeks	9123
Margaret Lake	9108
Nose Creek	9030
Chip Lake	8956
Whitehorse Creek	8910
Willow Creek	8887
McLeod River Headwaters	8885
McGregor Lake	8860
Raup Lake Salt Plains	8711
Red Deer River-Jenner	8641
Purple Springs Dunes	8423
Iosegun River	8389
Coulee Ridges	8364
Battle River - Wainwright	8281
Wapiabi Creek	8184
Lac St. Anne	8170
Lower Bow Dunes	8104
Hand Hills	7984
Muriel Lake	7949
Kininvie	7930
Verdigris Coulee	7925
Paintearth	7767
Bear River Sand Hills	7742
Chain - Farrell Lakes	7625
Frog Lake	7623
Crimson-Louis Lake Wetlands	7600
Milk River Ridge-Northeast Slope	7585
Archibald Lake Dunes	7425
Kimiwan Lake	7374
Salt River Salt Plains	7364
Bluestem	7272
Lousana Canyon	7205
Lake Athabasca-North Shore/Fidler-Gray Willow Points	6969
Sheep River	6849
Cardinal Lake	6820
Todd Creek Ridge	6796
La Crete Sand Hills	6794
Bleak Lake Wetlands	6793
Peace River - Parkland	6789
Middle Lakes	6782
Sturgeon Lake	6765
Bow River - Bow City/Scandia	6650
Sarcee (Tsuu Tina) Reserve	6647

McClelland Lake	6405
La Butte Creek	6403
Heart Lake	6379
McAlpine Creek	6266
Haig River	6244
Richardson Tower Lakes (also called Archer-Bowen-Brander Lakes)	6159
Beaver Lake	6114
Pekisko Creek	6064
Gipsy Lake	6040
Holmes Crossing Sand Hills	5989
Grassy Island Lake	5871
Blackstone River	5857
Harper Springs Natural Area	5823
Red Deer River-Alkali Creek/Dune Point	5634
Swan Hills Plateau Remnant	5550
Puskwaskau River	5411
Ribstone Creek-Camp Wainwright	5397
Touchwood Lake	5374
Connelly Creek Ridges	5358
Sounding Lake	5333
Oldman River-Macleod	5323
Pelican Lake	5307
Lesser Slave River	5246
Pine Ridge	5183
Fawcett Lake	4994
Snipe Lake	4935
Lower St. Mary River	4915
Battle River - Driedmeat Lake	4789
Upper Red Deer River	4700
Wolf Lake	4697
Dowling Lake	4584
St. Mary Reservoir	4578
Lower Belly River	4565
Amisk Valley	4532
Jarvis Creek	4505
Raven River	4497
Glacial Lake Berg	4485
Lubicon Lake	4285
Paine-Beaverdam	4262
Bear Lake	4200
Upper St. Mary River	4181
Ribstone Creek-Nose Hill	4120
Flat Lake	4105
Pinto Creek Elk Range	3975
Cooking Lake	3961
Buck Lake	3961
Lac Brosseau	3946
Milk River Ridge-Unglaciated	3886
Caribou Mountains Northern Ribbed Fens	3848
Waugh Lake	3844
Bittern Lake	3821

Kirkpatrick Lake	3821
Battle River - Marsden	3814
Red Rock Coulee	3791
Lessard Creek Peat Plateau Bog	3784
Vermilion Lakes	3770
Berland River - Donald Flats	3720
Lake Athabasca - South Shore	3665
Brûlé Lake	3604
Miquelon Lake	3591
Wabasca River - Wabasca Lake	3584
Birch Lake	3558
Seibert Lake	3558
Lowden Wetlands	3554
Rock-Cow Creek Wetlands	3535
Mikwan-Goosequill-Hummock Lakes	3510
Russell Lake	3465
Killarney/Dillberry/Leane Lake Complex	3447
Lynch Lakes	3423
Square Lake	3415
Caribou Mountains Peat Plateau Bog	3276
Grist Lake	3218
Wainwright Dunes Ecological Reserve	3178
Fort Assiniboine Horizontal Fen	3142
Chapel Butte	3085
McClelland Lake Fen	3071
Hand Hills Lake	2981
Red Deer Lake	2956
Oldman River-Porcupine Hills	2956
Little Bow Reservoir	2910
Haig Lake	2844
Steele Lake	2834
Willow Lake	2830
Watt Lake	2660
Glory Hills	2648
Primrose Lake South Basin	2627
Nipisi Lake	2588
Fowell Lake Complex	2564
Smoky Lake	2487
Ya-Ha-Tinda	2477
Wadlin Lake	2454
Orloff Lake	2444
Crowsnest River	2428
Kleskun Hill	2420
Canon Coulee	2364
Samson Lake	2355
Mudspring Lake	2344
White Earth Natural Area	2338
Caspian Tern	2324
Godin Lake	2301
Bighill Creek	2250
Spencer Lake	2239

Milk River Ridge Reservoir	2233
Murray Lake	2224
Lower Sweetgrass Hills	2197
Coal Lake	2147
Big Lake	2140
Battle River - Camp Wainwright	2108
Tyrell-Rush Lakes	2098
Tyrell-Rush Lakes	2098
McClelland Lake Sinkholes	2052
Keho Lake	2016
Oldman River-Brocket	2008
Big Hay Lake	1975
Merryweather Lake	1971
Bearhills Lake	1953
Reita Lake	1939
Unnamed Lake (T121 R19 S32 W4)	1910
Wavy Lake	1910
Little Fish Lake	1849
Gods Lake	1820
Cadotte Lake	1810
Sawn Lake	1806
Long Lake	1780
Ribstone Creek-Edgerton	1776
Manawan (Egg) Lake	1760
Coleman Lake	1753
Cow Lake	1750
Utikumasis Lake	1748
Whitford-Rush Lakes	1745
Charlotte Lake	1730
Crooked Lake	1720
Bow Valley Provincial Park	1716
Bow Valley Provincial Park	1716
Jean D'Or Meadows	1689
Wolf Island Dunes	1686
Marguerite River Dissected Kame	1668
West Bow Flats	1658
High Level Salt Meadows	1637
Little Smoky-Iosegun Natural Area	1618
Kleskun Lake	1601
Frank Lake	1591
Baxter Lake	1589
Saskatoon Lake	1583
Cache Lake	1576
Reed Lake	1567
Weaver Lake	1566
La Glace Lake	1514
Frenchman Lake	1439
Exshaw/Grotto Mountain	1406
Gillespie Lake	1381
Ewing Lake	1373
Burnstick Lake	1357

Bunder Lake	1352
Pine Lake	1300
Grassy Lake Wetlands	1283
Stirling Lake	1266
Battle Lake	1258
Lac Magloire	1250
Kenilworth Lake	1218
Margaret Lake	1216
Lanes Lake	1208
Clairmount Lake	1202
Beaverdam Creek	1182
Dune Point Springs	1182
Beaverdam Creek	1182
Plover Lake	1161
Ross Lake Unglaciated	1119
Bellshill Lake	1116
Amisk Lake	1085
Rich Lake	1084
Namaka-Stobart Lakes	1076
Yamnuska	1073
Yamnuska	1073
Antelope Lake	1064
Marshybank Ecological Reserve	1048
Coyote Lake Natural Area	1035
Forty Mile Coulee Reservoir	1014

5.7.2 Sites Less Than 10 Sq. Km.

Name	Area (ha)
Hays Reservoir	989
Mokowan Butte	986
Ironwood Lake	979
Buffalo Lake Complex	975
Jenner Springs	962
Lac Sante	958
Jessie Lake	954
Hastings Lake	928
Delburne Wetlands	922
Redwillow River	920
Puskwaskau Lake	882
Empress Creek	874
Wind Valley	863
Manatokan Lake	843
Plain Lake	842
Eymundson Sinkholes	841
Vermilion Lake - Vermilion Provincial Park	824
Bush (Wilkin) Lake	814
Wakomao Lake	809
Wagner Natural Area	752
Fincastle Lake	750
La Saline Springs Natural Area	733

Beauvais Lake Provincial Park	732
Ribstone Lake	726
Gooseberry Lake	686
Richardson River Active Sand Dunes	685
Duck Lake	658
Child Lake (Child Lake Salt Meadows Natural Area)	657
Maloney Lake	657
Gerry Lake	640
Muddy Buttes Badlands	625
Stony Islands	613
Harold Lake	607
Raspberry Lake	601
Edberg Slough	594
Sinclair (Brainard) Lake	588
Frank Slide	567
Reflex Lake	566
Taber Lake	561
Kakut Lake	544
Police Outpost	532
Moose Lake	531
Kerr Lake	517
Turin Dunes	514
Dickson Lake Complex	513
Windsor Creek	509
Side Lake	499
Preston Lake	491
Cluster of Unnamed Lakes (Hughenden)	491
Horseshoe Lake	470
Albright Lake	468
Flood Lake	465
Stebbing Lake	450
Forsyth Lake	448
Ferguson Lake	443
Valhalla Lake	438
Cloudy Ridge	437
Jackfish Lake	431
Grassy Lake	424
Clarke Lake	418
Sunken Lake	415
Beavertail Creek-Lower Reach	413
Dungarvan Wetlands	383
Hume-Steeprock Creeks	379
Pluvius Lake	377
Janet Sloughs	365
Rat Lake	355
Unnamed Lake Complex (T71 R12 S07 W6)	349
Kylo Hill-Mount Backus	345
Peter's Pond	341
Erskine Lake	336
Ronald Lake	326
Metiskow Lake	305

Pipestone Creek	303
Crowsnest Volcanics	301
Genessee Natural Area	296
Unnamed Lake (T67 R26 S03 W5)	291
Unnamed Lakes (T71 R24 S32 W5)	289
Wood Lake	280
Unnamed Lakes (T68 R11 S27 W6)	277
Flyingshot Lake	269
Ensleigh Lakes	267
Tufa-Unusual Wetland Feature	258
Livingstone Range	257
McNaught Lake	248
Ray Lake	246
Irricana Reservoir	237
Kamisak Lake	236
Twin Lakes	229
Yoke Lake	216
Wolfe Lake	212
George Lake	203
White Goat Lakes	203
Graham Creek	190
Goodfare Lake	189
Unnamed Lake (South of Sunken Lake)	188
Frank Lake	180
Egg Island Ecological Reserve	171
Lattice Creek	171
Albert Lake	167
Earlie Lake	167
Dick Lake	166
Unnamed Lake Complex (T71 R12 S29 W6)	160
McCullough Lake	159
Erickson Lake	158
Cipher Lake	151
Scabby Butte	151
Wood Lake	148
Unnamed Lake Complex (T72 R13 S33 W6)	147
Keeping Lake Complex	139
Milk River Section	135
Brent Lake	134
Unnamed Lake (T106 R05 S05 W6)	128
Cattail Lake	119
Beavertail Creek-Upper Reach	115
Flyingshot Lake (SW)	113
Edward Lake	112
Greenlee Lake	110
Kipp Section	107
St. Mary Type Section	107
Black Butte	106
Carway Iris	101
Lee Creek Ponds	98
Lenzie Section	91

Pointe-Aux-Pins Soapholes	89
Chain Lakes	88
Two Lakes	84
Birdseye Butte Pond	76
Dry Canyon	76
Horseshoe Lake	75
Arthur Lake	71
Crowsnest Spring	64
Unnamed Lake (T67 R01 S10 W6)	60
Horse Lake (East)	60
Oldman Section	56
Bisbing Lake	55
Glenwoodville Erratic	54
Grassi Lakes	36
Twin River Ash	25
Meinsinger Lake	23
Okotoks Erratic	9

6. DATA GAPS AND RESEARCH NEEDS

With the completion of the Boreal Forest Natural Region ESA work in 1996-97, most non-mountainous regions have been surveyed for ESAs. The most conspicuous omissions include the Rocky Mountain Natural Region as well as Indian Reserves, Metis settlements and municipalities in southern Alberta. Small portions of the Rocky Mountain Natural Region have been inventoried but there has been no comprehensive survey of this region.

The first ESA study was conducted in 1983, almost 15 years ago. The concepts of ESAs have evolved since that time and there have been significant fluctuations in climate and changes in land use practices. A periodic resurvey should be undertaken to evaluate the effects of climatic fluctuations and land use changes on ESA boundaries and significance. In addition, the analysis that Alberta Environmental Protection is undertaking with respect to Special Places 2000 may highlight Natural History Themes that are poorly represented in known ESAs (e.g. Glacial Lake Bed in Dry Mixedgrass). Subregion boundaries and concepts of Natural History Themes representation have changed since some of the earlier ESAs. With the new soils and geological information now available, it would allow more precise identification of small land parcels that contain poorly represented Natural History Themes . An outstanding remaining issue is how to differentiate (on a Natural History Theme representation basis) Non-sandy Upland-Glacial Lake Bed from other Central Mixedwood Boreal Forest Natural History Themes. Glacial Lake Bed was originally not recognized as distinct in earlier Natural History Theme reports. For the purpose of this report, all Glacial Lake Bed in the Central Mixedwood Boreal Forest is presumed to be allocated under Wetland or Ground Moraine Natural History Themes.

In undertaking this provincial assessment of ESAs, it became clear that a few key areas may have been missed by the original ESA work, e.g. fescue grasslands south and east of Little Fish Lake; Frog Lake area dry mixedwood stands and Halverson Ridge foothills forest. The focus of many ESA studies, particularly in the Boreal Forest, has been on diverse wetlands, sand dunes and river valleys. Although some areas have been identified, representative areas of upland mixedwood do not appear to have been well documented in most ESA work. Areas that should be looked for include clusters of old growth sites that may occur within more extensive areas of younger growth and unfragmented diverse forested uplands. In the grasslands, the full extent of remnant fescue grasslands needs to be more carefully examined in areas adjacent to known ESAs (e.g. Little Fish Lake) and within heavily fragmented regionally significant ESAs (e.g. Contracosta Native Prairie). Comments from regional fish and wildlife biologists, naturalists and other experts may highlight these and other significant areas that should be added to the ESA database.

Only sketchy information is available on the site specific distribution of rare plants and animals. While the critical habitats for some species such as birds of prey are reasonably well- documented, limited research has been undertaken on smaller mammals, songbirds, reptiles, amphibians, non-sport fish, invertebrates, and plants.

We are, however, confident that all rare species known for Alberta are represented in habitats which have been incorporated into ESAs for other reasons. While many specific areas of rare plant and animal habitats may still not be defined, the most significant concentrations of rare plants and animals should be accounted for by these ESAs. Although areas of potential habitat could be extracted from existing data, further field studies are required to accurately define the specific distribution of rare plants and animals. Considerably more work is needed to assess the significance of sites for non-vascular plants and invertebrate animals.

More detailed studies would be helpful in refining management strategies for each ESA. Priority for this kind of management research should be given to areas with the highest significance level (national or international) or where developments are planned.

REFERENCES

Achuff, P. and G.H. La Roi. 1977. *Picea-Abies* forests in the highlands of northern Alberta. Vegetatio 33: . 127-146.

Achuff, P. J. Godfrey and C. Wallis. 1988. A systems planning natural history framework and evaluation system for Alberta Recreation and Parks. Edmonton.

Achuff, P.L. and C. Wallis. 1992. Natural regions and subregions of Alberta, a revised classification for protected areas management. Alberta Tourism, Parks and Recreation and Alberta Forestry, Lands and Wildlife. Edmonton.

Agriculture Canada. 1988. Soil landscapes of Canada: Alberta. Pub. # 5237/B. Agriculture Canada, Land Resource Research Centre, Ottawa.

Alberta Culture. 1984. Palaeontological resource sensitivity zones - map. Prepared by Historical Resources Division, Alberta Culture, Edmonton.

Alberta Ecological Survey. 1977. Cardinal River Divide ecological reserve - a nomination. Prepared for the Government of Alberta.

Alberta Energy and Natural Resources, Fish and Wildlife Division. 1986. Bats of Alberta, "the real story...". Produced in cooperation with Alberta Agriculture. AGDEX 684-8, Edmonton.

Alberta Environment. 1982. Slave River hydro feasibility study. Alberta Environment, Edmonton.

Alberta Environmental Protection. 1995. Alberta's Montane Subregion, Special Places 2000 and the significance of the Whaleback Montane. Natural Resources Service, Alberta Environmental Protection, Edmonton.

Alberta Environmental Protection. n.d. Berland Subregional Integrated Resource Plan (Draft Plan). Publication I/46R, Alberta Environmental Protection, Edmonton.

Alberta Fish and Wildlife. 1989. Draft, wildlife input to the Bow Corridor IRP background paper. Alberta Forestry, Lands and Wildlife, Edmonton.

Alberta Fish and Wildlife. 1994. Operating guidelines for industrial activity in caribou ranges in northwest Alberta and 1:500,000 scale map of key moose and caribou ranges. Unpublished report, Alberta Environmental Protection, Fish and Wildlife Services, Peace River Region. Peace River.

Alberta Forestry, Lands and Wildlife. 1990. Coal Branch Subregional Integrated Resource Plan. Edmonton.

Alberta Forestry, Lands and Wildlife. 1992. Bow Corridor local integrated resource plan. Publication I/301, Alberta Forestry, Lands and Wildlife, Edmonton.

Alberta Government. 1984. A policy for resource management of the Eastern Slopes -- revised 1984. Government of Alberta. Edmonton. 20 pp.

Alberta Natural and Protected Areas. 1986. A summary of Alberta's natural areas: reserved and established. Prepared by Natural and Protected Areas, Public Lands Division, Alberta Forestry, Lands and Wildlife, Edmonton.

Alberta Parks Services. 1994. Natural regions, subregions and natural history themes of Alberta, a classification for protected areas management. Report originally prepared by P. Achuff, 1992, revised and updated July 1994, Parks Services, Alberta Environmental Protection, Edmonton.

Alberta Parks Services. 1995. Natural history overview and theme evaluation, Canadian Shield (Athabasca Plain and Kazan Upland). Parks Services, Alberta Environmental Protection, Edmonton.

Alberta Recreation and Parks. 1980. An outdoor recreation plan for the northeast Alberta region. Alberta Recreation and Parks, Edmonton.

Alberta Wilderness Association. 1976. The western Swan Hills-Alberta's forgotten wilderness. Alberta Wilderness Association and National and Provincial Parks Association of Canada, Edmonton chapter. 43 pp. + maps.

Alberta Wilderness Association. 1985. Wilderness in Alberta: the need is now. Alberta Wilderness Association, Calgary.

Alberta Wilderness Association. 1990. Protected Areas Map.

Alden, W. 1932. Physiography and glacial geology of eastern Montana and adjacent areas. United States Geological Survey Professional Paper 174.

Allan, J. and J. Sanderson. 1945. Geology of Red Deer and Rosebud sheets, Alberta. Alberta Research Council Report 13.
Allen, D.C. 1992. Biological diversity-is variety the spice of life? Pages 60-64 in: Blouin, G. and R. Comeau (eds). Forestry on the Hill: Biodiversity and Monocultures. Special Issue #3. Canadian Forestry Association. Ottawa, Ontario.
Allen, J. 1987. Nesting surveys on selected Great Blue Heron colonies -- central region. Alberta Fish and Wildlife, Red Deer.
Allen, L. 1982a. Natural Areas (Provincial Site of Interest) inspection report - Battle River #8. Alberta Natural Areas Program, Edmonton.
Allen, L. 1982b. Natural Areas (Provincial Site of Interest) inspection report - Battle River #9. Alberta Natural Areas Program, Edmonton.
Allen, L. and P. McIsaac. 1980a. Natural Areas inspection report - Oxville. Alberta Natural Areas Program, Edmonton.
Andersen, P. 1981. Waterfowl surveys and habitat evaluation for waterfowl on Buffalo Lake. Alberta Fish and Wildlife, Red Deer.
Andriashek. L. 1980. Surficial geology of Wapiti Map Sheet 83L. Alberta Research Council Open File 1983-023.
Andriashek. L. 1983. Preliminary report of the surficial geology and Quaternary stratigraphy of Edmonton. Alberta Research Council Open File 1983-020. 17 pages.
Argus, G. and K. Pryer. 1990. Rare vascular plants in Canada, our natural heritage. Botany Division, Canadian Museum of Nature, Ottawa.
Ashton, S., B. Benn, O. Bornemisza, L. Ciarniello, A. Ehrlich, M. Eyre, G. Greenaway, D. Hallett, G. Hegman, S. Herrero, A. McCrae, K. Oldershaw, E. Stafford and R. Wolfe. 1994. The Wind Valley: a proposal for an Ecological Reserve. Environmental Science Program, Faculty of Environmental Design, University of Calgary, Calgary.
Austin, M.P. and C.R. Margules. 1986. Assessing representativeness. Pages 45-67 in: Usher, M.B. (ed.) Wildlife Conservation Evalution. Chapman and Hall Ltd. London.
Barendregt, R. 1983. Correlation of Quaternary chronologies. In "Proceedings of a symposium on correlation of Quaternary chronologies, Toronto, May, 1983. Geo Books, Norwich, England.
Barendregt, R., no date (a). The physical setting of the southern Alberta landscape. Unpublished manuscript, University of Lethbridge, Lethbridge.
Barendregt, R., no date (b). The McNeil Erratics Train. Unpublished manuscript.
Barnes, R.G. 1977. Hydrogeology of the Mount Robson-Wapiti Area, Alberta. Report 76-5. Alberta Research Council. Edmonton.
Barnes, R.G. 1978. Hydrogeology of the Brazeau-Canoe River Area, Alberta. Report 77-5. Alberta Research Council. Edmonton.
Battle River Regional Planning Commission. 1966. Pigeon Lake: planning a recreational resource. Battle River Regional Planning Commission, Wetaskiwin.
Battle River Regional Planning Commission. 1984. Pigeon Lake Management Plan: discussion draft. Battle River Regional Planning Commission, Wetaskiwin.
Battle River Regional Planning Commission. 1985. Pigeon Lake Management Plan. Battle River Regional Planning Commission, Wetaskiwin.
Bayrock, L. 1958a. Glacial geology, Alliance-Brownfield district, Alberta. Alberta Research Council Earth Sciences Report 57-2.
Bayrock, L. 1958b. Glacial geology, Galahad-Hardisty district, Alberta. Alberta Research Council Earth Sciences Report 57-3.
Bayrock, L. 1967. Surficial geology of the Wainwright area (east half), Alberta. Alberta Research Council Earth Sciences Report 67- 4.
Bayrock, L. 1971. Surficial geology of the Bitumount area, Alberta. Alberta Research Council Surficial Geology Maps.
Bayrock, L. 1972a. Surficial geology of the Edmonton mapsheet (83H). Alberta Research Council, Edmonton.
Bayrock, L. 1972b. Surficial geology of the Fort Chipewyan area, Alberta. Alberta Research Council Surficial Geology Maps.

Bayrock, L. 1972c. Surficial Geology of the Lake Claire map-area, Alberta. Alberta Research Council Surficial Geology Maps.
Bayrock, L. 1972d. Surficial geology of the Peace Point and Fitzgerald map-areas, Alberta. Alberta Research Council Surficial Geology Maps.
Bayrock, L. 1973. Surficial geology of the Edmonton map-area Alberta. Alberta Research Council Earth Sciences Report 73-2.
Bayrock, L. 1974. Surficial geology, Waterways, Alberta. Alberta Research Council Surficial Geology Maps.
Bayrock, L. and G. Hughes. 1962. Surficial geology of the Edmonton district, Alberta. Alberta Research Council Earth Sciences Report 62-6.
Bayrock, L. and J. Jones. 1963. Surficial geology of the Vauxhall district, Alberta. Alberta Research Council Earth Sciences Report 63-2.
Bayrock, L. and J. Root. 1972. Geology of the Peace-Athabasca River Delta region, Alberta. Alberta Research Council Contribution Series 761, in hydrologic investigations, technical appendices 1, 1973, Section N, 60 pages.
Bayrock, L. and T. Reimchen. 1980. Surficial geology of the Alberta Foothills and Rocky Mountains. Alberta Research Council Surficial Geology Maps.
Beak Associates Consulting Ltd. 1986. Lac des Arcs fish and waterfowl study. Improvement District #8, Alberta Municipal Affairs, Canmore.
Beaty, C. 1975. The landscapes of southern Alberta. University of Lethbridge, Lethbridge.
Beechey, T.J. 1989. Guidelines for the selection of protected ecological areas. Occasional Paper No. 5 Canadian Council on Ecological Areas. Ottawa. 14 pp.
Belicek, J. 1976. Coccinellidae of western Canada and Alaska. M.Sc. thesis. University of Alberta, Edmonton. 408 pp.
Bentz, J. and A. Saxena. 1993. Significant ecological features inventory of the Lesser Slave Lake integrated resource planning area. Prepared for Resource Information Division, Alberta Environmental Protection by Geowest Environmental Consultants Ltd. 138 pp.
Bentz, J. and A. Saxena. 1994. Significant ecological features inventory of the Whitecourt-Swan Hills Integrated Resource Planning Area. Prepared by Geowest Environmental Consultants Ltd. for Resource Information Division, Alberta Environmental Protection, Edmonton.
Bentz, J. and E. Karpuk. 1990. Biophysical inventory and land use evaluations of the Upper Red Deer River corridor. Alberta Forestry, Lands and Wildlife, Land Information Services Division. 50 pp.
Bentz, J., A. Saxena and T. Normand. 1995. Environmentally significant areas inventory, Foothills Natural Region, Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Land Information Division, Alberta Environmental Protection, Edmonton.
Bentz, J., A.Saxena and R. Schultz. 1994. Biophysical Inventory of Shoreland Areas - Burnstick Lake, Alberta. Prepared for Alberta Environmental Protection by Geowest Environmental Consultants Ltd.
Bentz, J., D. Brierley, W. Hay, S. Nelson et al. 1988. Integrated resource inventory of the Coal Branch Study Area: Physical Land Classification. Alberta Energy and Natural Resources, Edmonton.
Bentz, J., D. Brierley, W. Hay, S. Nelson, S. Robertson, and R. Wehrhahn. 1986. Integrated resource inventory of the Coal Branch study area. Vol. 1-Ecological Land Classification and Vol. 2-Physical Land Classification. Alberta Forestry, Lands and Wildlife, Resource Evaluation and Planning Division. Edmonton.
Bentz, J., O'Leary and A. Saxena. 1993. Ecological land classification of the Whitecourt-Swan Hills integrated resource planning area. Prepared for Resource Information Division, Alberta Environmental Protection by Geowest Environmental Protection by Geowest Environmental Consultants Ltd. 138 pp.
Bentz, J., V. Chisholm, and A. Saxena. 1996. Environmentally significant areas inventory of the Boreal Dry Mixedwood Subregion of Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton.
Berg, T. and R. McPherson. 1972. Surficial geology of the Medicine Hat area, Alberta. Alberta Research Council Surficial Geology Maps.
Biggs, W., S. Leigh-Spencer and D. Smith. 1973. An ecological survey Crimson Lake Provincial Park. Alberta Parks Planning, Edmonton.

Bishoff, K. and R. Fyfe. 1975. Surveys of rare, potentially endangered and sensitive birds in the oil sands and adjacent areas of northwestern Alberta. Alberta Oil Sands Environmental Research Program, Edmonton.

Boag, T.D. 1993. A general fish and riverine habitat inventory, Peace and Slave Rivers, April to June 1992. Northern River Basins Study, Northern River Basins Study Project Report No. 9. Edmonton.

Borneuf, D. 1976. Hydrogeology of the Foremost Area, Alberta. Report 74-4, Alberta Research Council, Edmonton.

Borneuf, D. 1983. Springs of Alberta. Earth Sciences Report 82-3, Alberta Research Council, Edmonton.

Boyacioglu, E. 1974. Wolf Lake biophysical analysis and evaluation of capability. Alberta Forestry, Lands and Wildlife, Edmonton.

Boyacioglu, E. 1975. Fort Assiniboine biophysical analysis and evaluation of capability. Alberta Forestry, Lands and Wildlife, Edmonton.

Boyacioglu, E. 1977. Sturgeon Lake biophysical analysis and evaluation of capability. Alberta Forestry, Lands and Wildlife, Edmonton.

Boyd, M. 1977. Analysis of fur production records by individual fur-bearing species for registered trapping areas in Alberta, 1970-1975. Alberta Recreation, Parks, and Wildlife, Fish and Wildlife Division. 72 pp.

Boydell, A., L. Bayrock and T. Reimchen. 1974. Surficial geology of the Rocky Mountain House area, Alberta. Alberta Research Council Surficial Geology Maps.

Bradley, C. 1978. Precambrian Shield study. Part I: Information survey and bibliography. Resource Assessment and Management Section, Alberta Parks Division, Edmonton.

Bradley, C. 1988. Modifications by dams of river regimes in North America. Paper presented to Joint Conference on Water Management, November 21-23, 1988, Lethbridge. Canadian Water Resources Association and Alberta Irrigation Projects Association.

Bradley, C. and D. Smith. 1986. Plains cottonwood recruitment and survival on a prairie meandering river floodplain, Milk River, southern Alberta and northern Montana. Canadian Journal of Botany 64: 1433-1442.

Bradley, C. and M. Fairbarns. 1984. Vegetation, flora and special features of the candidate Goose Mountain ecological reserve. Prepared for the Natural Areas Program, Public Lands Division, Alberta Energy and Natural Resources, Edmonton.

Bradley, L. and C. Bradley. 1977. Aspen groveland resource assessment: Neutral Hills area. Alberta Recreation, Parks and Wildlife; Resource Assessment and Management Section. Edmonton. 63 pp.

Braidwood, B.R. 1987. A proposed Classification, evaluation, and priorization framework for the conservation of special natural features of interest in Alberta, Canada. M.Sc. Thesis. University of Alberta. Edmonton.

Brechtel, S. 1981. The White Pelican, Double-crested Cormorant and Great Blue Heron in Alberta, 1980. Alberta Fish and Wildlife Report 80-005, Edmonton.

Breitung, A. 1954. A botanical survey of the Cypress Hills. Canadian Field- Naturalist 68: 55-91.

Brown, W. 1988. North Saskatchewan River basin wetland and riparian habitat overview. Prepared by Terrestrial and Aquatic Environmental Managers Ltd. for Alberta Environment, Planning Division, Edmonton.

Brundtland, G.M. (ed.) 1987. Our Common Future. World Commission on Environment and Development. Oxford University Press. Toronto, Ontario. 116 pp.

Brunton, D. 1979. Taxonomy, distribution and ecology of the cliff-brake ferns (*Pellaea*: Polypodiaceae) in Alberta. Canadian Field-Naturalist 93(3): 288-295.

Brusnyk, L., D. Westworth, K. Egan, A. McCann, L. Knapik and C. Schreiner. 1991. Environmentally sensitive areas study: County of Leduc. Prepared by Westworth and Associates for the Edmonton Metropolitan Regional Planning Commission, Edmonton.

Butler, J. 1983. Challenges and changing perspectives in the management of fish and wildlife resources. Agriculture and Forestry Bulletin 6 (3): 10-13.

Cairns, J. 1983. Are single species toxicity tests alone adequate for estimating environmental hazard? Hydrobiologa 100: 47-57.

Cameron, T. 1974. Biophysical analysis and evaluation of capability -- Suffield Block. Land Use Assignment Committee, Alberta Lands and Forests, Edmonton.
Campbell, T. 1981. Writing-on-Stone Provincial Park biophysical resource overview and analysis. Alberta Recreation and Parks, Edmonton.
Canadian Council on Ecological Areas. 1992. Framework for developing a nation-wide system of ecological areas, Part 1 - a strategy. Canadian Council on Ecological Areas, Ottawa. 10 pp.
Canadian Environmental Advisory Council. 1992. A protected areas vision for Canada. Canadian Environmental Advisory Council, Ottawa. 87 pp.
Canadian Wildlife Service. 1972. Kangaroo rats and rattlesnakes. Canadian Wildlife Service, Ottawa.
Champion Forest Products Ltd. (n.d.). Integrated forestry-wildlife-fish resource management approach for the Champion Forest Products (Alberta) Ltd. Forest Management Area, Hinton.
Christiansen, E. 1977. Glacial spillways in the prairies. Parks Canada Contract 77-2. Indian and Northern Affairs, Ottawa.
Clark, J. 1982. An update of management strategies of colonial nesters in the southern region (White Pelican, Double-crested Cormorant and Great Blue Heron). Alberta Fish and Wildlife, Lethbridge.
Clark, J. 1984. Sharp-tailed Grouse dancing ground investigations (southern region, 1984). Alberta Fish and Wildlife, Lethbridge.
Clayton, T. and G. Ash. 1980. A fisheries overview study of the Milk River basin. Prepared for Alberta Environment by R.L. and L. Environmental Services, Edmonton.
Clifford, H. and G. Bergstrom. 1976. The blind aquatic isopod *Salmasellus* from a cave spring in the Rocky Mountains' eastern slopes with comments on a Wisconsin refugium. Canadian Journal of Zoology 54: 2028-2032.
Colinvaux, P. 1986. Ecology. John Wiley and Sons. New York, NY.
Collins, G. and A. Swan. 1955. Glacial geology, St. Ann area, Alberta. Alberta Research Council Report 67.
COSEWIC. 1996. 1996 Canadian endangered species and other wildlife at risk. Committee on the Status of Endangered Wildlife in Canada, Ottawa.
Coté, R. 1989. Introductory remarks. Proceedings of a workshop on valuing special places and species. Dalhousie University, Halifax.
Cottonwood Consultants. 1978. Coal Valley wildlife monitoring program-1978 study. Luscar Ltd., Edmonton.
Cottonwood Consultants. 1983. A biophysical systems overview for ecological reserves planning in Alberta. Alberta Recreation and Parks, Edmonton.
Cottonwood Consultants. 1986a. An overview of reptiles and amphibians in Alberta's Grassland and Parkland Natural Regions. World Wildlife Fund Canada, Toronto.
Cottonwood Consultants. 1986b. The proposed Rumsey ecological reserve -- a biophysical overview. Alberta Recreation and Parks, Edmonton.
Cottonwood Consultants. 1987a. The proposed Middle Sand Hills ecological reserve -- a biophysical overview. Alberta Recreation and Parks, Edmonton.
Cottonwood Consultants. 1987b. Alberta snake hibernacula survey. World Wildlife Fund Canada, Toronto.
Cottonwood Consultants. 1987b. Environmentally significant areas in the Oldman River Region: MD of Cardston. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
Cottonwood Consultants. 1987c. Environmentally significant areas in the Oldman River Region: County of Lethbridge. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
Cottonwood Consultants. 1987d. Environmentally significant areas in the Oldman River Region: MD of Pincher Creek. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
Cottonwood Consultants. 1987e. Environmentally significant areas in the Oldman River Region: County of Warner. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.

Cottonwood Consultants. 1988a. Environmentally significant areas in the Oldman River Region: MD of Taber. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
Cottonwood Consultants. 1988b. Environmentally significant areas in the Oldman River Region: County of Vulcan. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
Cottonwood Consultants. 1989. Environmentally significant areas in the Oldman River Region: MD of Willow Creek. Prepared by Cottonwood Consultants Ltd. for the Oldman River Regional Planning Commission, Lethbridge.
Cottonwood Consultants. 1990. Bow/Canmore corridor environmental issues analysis. Alberta Tourism, Edmonton.
Cottonwood Consultants. 1991a. Environmentally significant areas in the Palliser Region: MD of Acadia. Prepared by Cottonwood Consultants Ltd. for the Palliser Regional Planning Commission, Hanna.
Cottonwood Consultants. 1991b. Environmentally significant areas of the MD of Cypress. Prepared by Cottonwood Consultants Ltd. for the Southeast Regional Planning Commission, Medicine Hat.
Cottonwood Consultants. 1991c. Environmentally significant areas of the County of Forty Mile. Prepared by Cottonwood Consultants Ltd. for the Southeast Regional Planning Commission, Medicine Hat.
Cottonwood Consultants. 1991d. Environmentally significant areas in the Palliser Region: MD of Kneehill. Prepared by Cottonwood Consultants Ltd. for the Palliser Regional Planning Commission, Hanna.
Cottonwood Consultants. 1991e. Environmentally significant areas of the Lower Red Deer River. Prepared by Cottonwood Consultants Ltd. for Alberta Forestry, Lands and Wildlife, Edmonton.
Cottonwood Consultants. 1991f. Environmentally significant areas of the County of Newell. Prepared by Cottonwood Consultants Ltd. for the Southeast Regional Planning Commission, Medicine Hat.
Cottonwood Consultants. 1991g. Environmentally significant areas in the Palliser Region: MD of Starland. Prepared by Cottonwood Consultants Ltd. for the Palliser Regional Planning Commission, Hanna.
Cottonwood Consultants. 1994. Environmentally significant areas in the Town of Canmore. Prepared by Cottonwood Consultants Ltd. for the Town of Canmore, Canmore.
Cottonwood Consultants Ltd. 1995. Environmentally significant areas of the Lloydminster Area, Alberta and Saskatchewan. Prepared by Cottonwood Consultants Ltd. for Nature Conservancy of Canada and Husky Oil Operations, Calgary.
Coupland, R. 1973. A theme study of natural grassland in western Canada. National and Historic Parks Branch Contracts 72-5 and 72- 91. Indian and Northern Affairs, Ottawa.
Crack, S. and B. Danielson. 1974a. An ecological survey of Beauvais Lake Provincial Park. Alberta Parks Planning, Edmonton.
Crack, S. and B. Danielson. 1974b. An ecological survey of Police Outpost Provincial Park. Alberta Parks Planning, Edmonton.
Daborn, G. 1976. Occurrence of an arctic fairly shrimp *Polyartemiella hazeni* (Murdoch) 1884 (Crustacea: Anostraca) in Alberta and Yukon Territory. Canadian Journal of Zoology 54: 2026-2028.
David, P. 1977. Sand dune occurrences of Canada. Indian Affairs, National Parks Branch Report #74-230, Ottawa.
Dawson, G. and R. McConnell. 1895. Glacial deposits of southwestern Alberta in the vicinity of the Rocky Mountains. Bulletin of the Geological Society of America 7: 31-66.
de Vries, B. 1966. *Iris missouriensis* in southwestern Alberta and in central and northern British Columbia. Canadian Field Naturalist 80: 158-160.
Doberstein, A. 1978. An evaluation of migratory bird resources in the Battle River Basin, Canadian Wildlife Service, Edmonton.
Douglas, R. 1950. Callum Creek, Langford Creek, and Gap map areas, Alberta. Geological Survey of Canada Memoir 402.
Downing, D., D. O'Leary and R. Schultz. 1987. Integrated resource inventory - Smoky-Peace Point, 2 volumes. Alberta Forestry, Lands and Wildlife, Edmonton.

Dumais, M. 1976. Vascular plant investigations in the region of Rocky Mountain House and Crimson Lake Provincial Park. Edmonton Naturalist 4(7): 165-173.
Eagles, P. 1980. Criteria for the designation of environmentally sensitive areas. In: Protection of Natural Areas in Ontario. University of Toronto Press. Toronto, Ontario.
Eagles, P. 1984. The planning and management of environmentally sensitive areas. Longman, London and New York.
Ebel, R., D. Poll and B. Finkelman. 1973. An ecological survey of Big Knife Provincial Park. Alberta Parks, Edmonton.
Edgar, L, G. Michalchuk, D. O'Leary and R. Schultz. 1987. Ecological inventory and evaluation: Haig Lake study. Alberta Energy and Natural Resources, Edmonton.
Edmonds, E.J. and K.G. Smith. 1991. Mountain caribou calf production and survival, and calving and summer habitat use in west-central Alberta. Wildlife Research Series No. 4. Alberta Forestry, Lands and Wildlife; Fish and Wildlife Division. Edmonton. 17 pp.
Edmonton Regional Planning Commission. 1974. Regional lake perspective. Edmonton Regional Planning Commission, Edmonton.
Envirocon. n.d. Dinosaur Provincial Park Resource Atlas. Alberta Lands and Forests, Edmonton.
Environmentally Significant Areas Subcommittee. 1993. Preliminary inventory, Town of Canmore environmentally sensitive areas. Environmental Advisory Review Committee, Town of Canmore.
Fairbarns, M. 1979a. Northeastern Alberta: a park resource assessment study, Part 1: Regional Overview. Alberta Recreation and Parks. Edmonton.
Fairbarns, M. 1979b. Northeastern Alberta: a park resource assessment study, Part 2: Recreational and Preservation Recommendations. Alberta Recreation and Parks. Edmonton.
Fairbarns, M. 1990. The salt meadows of northwestern Alberta: a reconnaissance biophysical inventory. Alberta Forestry, Lands and Wildlife. Edmonton.
Fehr, A. 1982. The candidate Rumsey ecological reserve, a biophysical inventory. Alberta Energy and Natural Resources, Public Lands Division, Edmonton.
Fenton, M. and L. Andriashek. 1983. Surficial geology Sand River, Alberta. Alberta Research Council Map.
Fenton, M., L. Andriashek and J. Root. 1979. Surficial geology, Wabamun Lake, Alberta. Alberta Research Council Surficial Geology Map.
Ferguson, N. 1980. Berland current regional plan study area physical land classification. Alberta Forestry, Lands and Wildlife, Edmonton.
Fish and Wildlife Division. 1989. Wildlife management plan - Ministik Lake game bird sanctuary. Prepared by Alberta Fish and Wildlife Division, St. Paul.
Fox, R. 1980. *Picopsis pattersoni* n. gen. and sp., an unusual therian from the Upper Cretaceous of Alberta, and the classification of primitive tribosphenic mammals. Canadian Journal of Earth Sciences 17: 1489-1498.
Fox, R. 1984. A primitive, "obtuse-angled" symmetrodont (Mammalia) from the Upper Cretaceous of Alberta, Canada. Canadian Journal of Earth Sciences 21: 1204-1207.
Geist, V. 1992. Commentary on the Three Sisters development and the Wind/Pigeon Valleys complex. Presentation to the Natural Resources Conservation Board Hearing on Three Sisters Resort Development.
Geowest Environmental Consultants. 1997 (in prep.). Environmentally significant areas inventory of the Boreal Forest Natural Region of Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton
Godfrey, J. 1958. Aerial photographic interpretation of Precambrian structures north of Lake Athabasca, Alberta. Bulletin #1, Alberta Research Council, Edmonton.
Godfrey, J. 1961. Geology of the Andrew Lake, north district, Alberta. Alberta Research Council Earth Sciences Report 58-3.
Godfrey, J. 1963. Geology of the Andrew Lake, south district, Alberta. Alberta Research Council Earth Sciences Report 61-2.
Godfrey, J. 1966. Geology of the Bayonet, Ashton, Potts and Charles Lake districts, Alberta. Alberta Research Council Earth Sciences Report 65-6.

Godfrey, J. 1970. Geology of the Marguerite River district, Alberta. Alberta Research Council General Geology Maps.
Godfrey, J. 1979. Geology of the Alexander-Wylie Lakes district, Alberta. Alberta Research Council Earth Sciences Report 78-1.
Godfrey, J. 1980. Geology of the Fort Chipewyan district, Alberta. Alberta Research Council Report 78-3.
Godfrey, J. 1984. Geology of the Ryan-Fletcher Lakes district, Alberta. Alberta Research Council Earth Sciences Report 84-2. Alberta Research Council, Edmonton.
Godfrey, J. 1986. Geology of the Precambrian Shield in northeastern Alberta. Map EM180, Alberta Research Council, Edmonton.
Godfrey, J. 1987. Geology of the Bocquene-Turtle Lakes district, Alberta. Alberta Research Council Earth Sciences Report 84-5. Alberta Research Council, Edmonton.
Godfrey, J. and C. Langenberg. 1986. Geology of the Fitzgerald-Tulip Lake-Mercredi-Charles Lake district, Alberta. Alberta Research Council Earth Sciences Report 84-7. Alberta Research Council, Edmonton.
Godfrey, J. and C. Langenberg. 1987. Geology of the Myers-Daly Lakes district, Alberta. Alberta Research Council Earth Sciences Report 84-6. Alberta Research Council, Edmonton.
Godfrey, J. and E. Peikert. 1963. Geology of the St. Agnes Lake district, Alberta. Alberta Research Council Earth Sciences Report 62-1.
Godfrey, J. and E. Peikert. 1964. Geology of the Colin Lake district, Alberta. Alberta Research Council Earth Sciences Report 62-2.
Goossen, J.P. 1996 (in prep.). Atlas of Piping Plover Lakes in Alberta. Canadian Wildlife Service, Edmonton
Graham, L.L., K.R. Bodden and D.K. Berry. 1995. 1994 Alberta resident angling survey. Alberta Environmental Protection, Fisheries Management Division. Edmonton.
Gravenor, C. 1956. Glacial geology of Castor district, Alberta. Alberta Research Council Earth Sciences Report 56-2.
Gravenor, C. and L. Bayrock. 1955. Glacial geology of Coronation district. Research Council of Alberta Earth Sciences Report 55-1.
Gravenor, C. and R. Ellwood. 1957. Glacial geology of Sedgewick district. Alberta Research Council Earth Sciences Report 57-1.
Griffiths, D. 1982. Slave River hydroelectric project, environmental implications. Unpublished manuscript, Slave River Coalition, Fort Smith, NWT.
Griffiths, D. 1987. A survey of wetland wildlife resources, Strathcona County, Alberta. Prepared for County of Strathcona, Sherwood Park.
Griffiths, D. and G. Griffiths. 1987. Biophysical survey of the Coyote Lake district, Leduc County, Alberta. Alberta Forestry, Lands and Wildlife, Edmonton.
Griffiths, D. and G. Griffiths. 1988. Greater Coyote Lake management area, significant features assessment. Alberta Forestry, Lands and Wildlife, Edmonton.
Hage, C. 1945. Geology - Cowley. Geological Survey of Canada Map 816A.
Harris, L.D. and R.F. Noss. 1985. Problems in categorizing the status of species: endangerment with the best intentions. In: Proceedings of the 16th Annual IUCN Technical Meeting. International Union for the Conservation of Nature and Natural Resources. Gland, Switzerland.
Harrison, J. 1976. Evolution of a landscape: the Quaternary period in Waterton Lakes National Park. Geological Survey of Canada Miscellaneous Report 26.
Hay, W. and D. O'Leary. 1988. Integrated resource inventory of the Wandering River study area. Alberta Forestry, Lands and Wildlife, Edmonton.
Helliwell, D.R. 1975. The concept of waste and the conservation of nature. Environmental Conservation 2:271-273.
Henderson, E. 1959. Surficial geology of Sturgeon Lake map-area, Alberta. Geological Survey of Canada Memoir 303.
Herrero, S. 1992. The Wind Valley region: its importance to large mammalian carnivores and the predicted impacts of development. Prepared by BIOS Environmental Research and Planning Associates Ltd., Calgary for Canadian Parks and Wilderness Society, Alpine Club of Canada and

Sierra Club of Alberta, Calgary. Presentation to the Natural Resources Conservation Board Hearing on Three Sisters Resort Development.
Herrmann, K. 1993. Significant vegetation of Footner Lake Forest. Alberta Forestry, Lands and Wildlife. Edmonton.
Hills, G.A. 1976. An integrated iterative holistic approach to ecosystem classification. In J. Thie and G. Ironsides (eds.), Ecological (biophysical) land classification in Canada, Proceedings of the 1st Meeting of the Canada Committee on Ecological (Biophysical) Land Classification, pp. 73-98.
Hofman, D.E. 1991. The 1991 Piping Plover census in Alberta. Alberta Fish and Wildlife. Red Deer
Höhn, E. 1972. Arctic Loon breeding in Alberta. Canadian Field-Naturalist 86: 372.
Höhn, O. & P. Marklevitz. 1974. Noteworthy summer observations of birds in the Caribou Mountains, Alberta. Canadian Field-Naturalist 88: 77-78.
Höhn, O. & R. Burns. 1975. A reconnaissance of the birds & mammals of the Caribou Mountains, Alberta. Blue Jay 33: 73-83.
Höhn, O. & R. Burns. 1976. Further notes on birds & mammals of the Caribou Mountains, Alberta. Blue Jay 34: 56-58.
Höhn, O. & R. Burns. 1976. Additional bird & mammal observations in the Caribou Mountains, Alberta. Blue Jay 34: 176-177.
Höhn, O. & D. Weseloh. 1978. 1977 bird observations in the Caribou Mountains, Alberta. Blue Jay 36: 115.
Horberg, L. 1952. Pleistocene drift sheets in the Lethbridge region, Alberta, Canada. Journal of Geology 60 (4): 303-330.
Horberg, L. 1954. Rocky Mountain and continental Pleistocene deposits in the Waterton region, Alberta, Canada. Bulletin of the Geological Society of America 65: 1093-1150.
Hummel, M. (ed.) 1989. Endangered Spaces: The Future of Canada's Wilderness. Key Porter Books. Toronto, Ontario.
Infotech. 1989. Environmentally sensitive areas: County of Strathcona and MD of Sturgeon. Prepared by Infotech Services Land Evaluation Consultants for the Edmonton Metropolitan Regional Planning Commission, Edmonton.
Irish, E. 1967a. Geology - Foremost. Geological Survey of Canada Map 22-1967.
Irish, E. 1967b. Geology - Gleichen. Geological Survey of Canada Map 19-1967.
Irish, E. 1967c. Geology - Medicine Hat. Geological Survey of Canada Map 21-1967.
Irish, E. 1967d. Geology - Drumheller. Geological Survey of Canada Map 5-1967.
Irish, E. 1967e. Geology - Lethbridge. Geological Survey of Canada Map 20-1967.
Irish, E. 1967f. Geology - Oyen. Geological Survey of Canada Map 21-1966.
Jaques, D. 1979. Biophysical classification, effects of grazing and biomass estimation using LANDSAT imagery on native fescue grasslands of southwestern Alberta. Kananaskis Center for Environmental Research, Calgary.
Jennings, M.D. and J.P. Reganold. 1991. Hierarchy and subsidy-stress as a theoretical basis for managing environmentally sensitive areas. Landscape and Urban Planning 21: 31-45.
Johnston, A. 1977. The Suffield Grazing Reserve. Agriculture Canada, Lethbridge.
Johnston, S., R. Ellis and D. Westworth. 1996. Inventory of environmentally significant areas in the Boreal Dry Mixedwood Natural Subregion, Peace River Section: 1995-1996. Prepared by Westworth, Brusnyk and Associates, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton.
Jones, J. 1966. Geology and groundwater resources of the Peace River district, northwestern Alberta. Alberta Research Council Bulletin 16. 143 pages.
Jones, M.V. and Associates. 1973. Environmental inventory of Entrance Provincial Park, Alberta. Prepared for Alberta Forestry. Edmonton.
Jones, P. and R. Workum. 1978. Geological guide to the central Foothills and Rocky Mountains of Alberta. Canadian Society of Petroleum Geologists' International Conference, June, 1978. Canadian Society of Petroleum Geologists, Calgary.
Karlstrom, E. 1985. Pre-Wisconsin paleosols on Mokowan Butte. In "CANQUA symposium on the paleoenvironmental reconstruction of the late Wisconsin deglaciation and the Holocene", August, 1985, Lethbridge. Canadian Quaternary Association, Lethbridge.

Karr, J.R. and D.R. Dudley. 1981. Ecological perspective on water quality goals. Environmental Management 5: 55-68.
Kathol, C. and R. McPherson. 1975. Surficial geology of the Edmonton Area, Alberta. Alberta Research Council Bulletin 32.
Kemp, G. 1983. Walsh Flats pronghorn winter range, options for protection and management. Fish and Wildlife Division, Lethbridge.
Kemper, J. 1976. Evaluation of fish and wildlife resources -- the Cooking Lake study area: implications for waterfowl and migratory birds. In: Cooking Lake area study Vol. 4, Ecology. Alberta Environment, Planning Division, Edmonton.
Kerr, D.S., E. Gasser and D.A. Young. 1988. Whitecourt newsprint mill environmental impact assessment-biophysical studies. Prepared by Environmental Management Associates for Alberta Newsprint Company.
Kindle, E.M. 1928. The occurrence and correlation of a Devonian fauna from Peace River, Alberta. Geological Survey, Bulletin No. 49. Ottawa, Ontario.
Kocaoglu, S. 1980. Brazeau-Pembina study area physical land classification. Alberta Forestry, Lands and Wildlife, Edmonton.
Kocaoglu, S. 1983. Rocky-North Saskatchewan study area physical land classification. Alberta Forestry, Lands and Wildlife, Edmonton.
Kocaoglu, S. and J. Bennett. 1983. Integrated resource inventory special Lakeland area. Alberta Forestry, Lands and Wildlife, Edmonton.
Komex International Ltd. 1992. Cardinal River headwaters special features inventory and impact assessment. Prepared for Land Information Services Division, Alberta Forestry, Lands and Wildlife.
Kondla, N. and H. Crawford. 1971. An ecological survey of Dinosaur Provincial Park. Alberta Parks, Edmonton.
Kondla, N. and W. Smith. 1972. An ecological survey of Dry Island Buffalo Jump Provincial Park. Alberta Parks Planning, Edmonton.
Kristensen, J. 1981. Great blue heron (*Ardea herodias*) colony in the Peace-Athabasca Delta, Alberta. Canadian Field-Naturalist 95: 95-96.
Kuijt, J. 1982. Flora of Waterton Lakes National Park. University of Alberta Press, Edmonton.
Kuijt, J. and G. Michener. 1985. First record of the bitterroot, Lewisia rediviva in Alberta. Canadian Field-Naturalist 99 (2): 264-266.
Kuijt, J. and J. Trofymow. 1975. Range extensions of two rare Alberta shrubs. Blue Jay 33 (2): 96-98.
Kumar, P. 1975. Snipe Lake biophysical analysis and evaluation of capability. Alberta Forestry, Lands and Wildlife, Edmonton.
Kupsch, W. O. 1962. Ice-thrust ridges in Western Canada. Journal of Geology 70(5): 582-594.
Lacy, C. 1971. General summary of Ducks Unlimited records on waterfowl and wetlands of the Cooking Lake Moraine. Appendix E in An economic analysis of the Cooking-Hastings Lake. Prepared by EPEC Consulting Ltd. for Alberta Environment, Edmonton.
Laframboise, M. 1986. Raptor population and nesting site survey for Dinosaur Provincial Park. Alberta Recreation and Parks.
Lamoureux, R. G. Chow and B. Reeves. 1983. Environmentally significant areas of the Calgary region. Prepared by Lamoureux and Associates, Calgary for Calgary Regional Planning Commission, Calgary.
Land Information Services Division. 1991. Integrated resource inventory and evaluation of Berland Study Area. Edmonton.
Landals, M. 1978. Lake Athabasca sand dunes. Unpublished manuscript.
Landres, P.B., J. Verner, and J.W. Thomas. 1988. escological uses of vertebrate indicator species: a critique. Conservation Biology 2: 316-328.
Langenberg, C. and J. Godfrey. 1977. A computer based structural study of the Tulip Lake dome in the Precambrian Shield of northeastern Alberta; Program Abstracts, Geological Association of Canada Annual Meeting, Vancouver.
Langston, W. 1975. The ceratopsian dinosaurs and associated lower vertebrates from the St. Mary River Formation at Scabby Butte, southern Alberta. Canadian Journal of Earth Sciences 12: 1576- 1608.

Levinson, A. and E. Karpuk. 1980. Livingstone-Porcupine study area physical land classification. Alberta Forestry, Lands and Wildlife, Edmonton.
Loewen, V. and J. Gould. 1979b. IBP Checksheet - Battle River (148). Alberta Natural Areas Program, Edmonton.
Longmore, L. and C. Stenton. 1981. The fish and fisheries of the South Saskatchewan River basin. Planning Division, Alberta Environment, Edmonton.
Longmore, L.A., K. Brickley, and C.E. Stenton. 1982. The sport fishery in Alberta: Facts and figures for 1975-1980. Fisheries Management Report No. 28. Alberta Energy and Natural Resources. Fish and Wildlife Division. Edmonton.
Luck, S. 1982. Vermilion Provincial Park resource inventory and assessment. Resource Planning Section, Alberta Parks, Edmonton.
Lynch-Stewart, P. 1983. Land use change on wetlands in southern Canada: review and bibliography. Working Paper No. 26, Lands Directorate, Environment Canada, Ottawa.
MacDonald, C. 1987. Kimiwan Lake bird survey. Edmonton.
MacDonald, D. 1982. Marl resources of Alberta. Earth Sciences Report 82-1, Alberta Research Council, Edmonton.
MacGregor, C. 1984. Kananaskis Country ecological land classification and evaluation. Alberta Forestry, Lands and Wildlife, Edmonton.
Mackey, B.G., H.A. Nix, M.F. Hutchinson, J.P. MacMahon, and P.M. Fleming. 1988. Assessing representativeness of places for conservation reservation and heritage listing. Environmental Management 12(4): 501-514.
MacPherson, R. 1972. Surficial geology - Medicine Hat. Map, Alberta Research Council, Edmonton.
McAllister, D. 1970. Rare or endangered Canadian fishes. Canadian Field-Naturalist 84: 5-8.
McCulley, K. 1983a. A review of petroleum development in critical wildlife habitat near Manyberries, Alberta. Fish and Wildlife Division, Alberta Energy and Natural Resources, Lethbridge.
McCulley, K. 1983b. An inventory of islands in the Oldman River from Fort Macleod to the Grand Forks. Alberta Fish and Wildlife, Lethbridge.
McPherson, H. 1968. Historical development of the lower Red Deer Valley, Alberta. Canadian Geographer 12: 227-240.
Mitchell, P. and E. Prepas (eds.). 1990. Atlas of Alberta. University of Alberta Press. Edmonton.
Mondor, C. 1990. The concept of representativeness in the design of protected area systems. Canadian Council on Ecological Areas Occasional Paper #10: 21-46. Canadian Council on Ecological Areas. Ottawa.
Morrison, R.I.G., R.W. Butler, G.W. Beyersbergen, H.L. Dickson, A. Bourget, P.W. Hicklin, and J.P. Goossen, R.K. Ross, and C.L. Gratto-Trevor. 1995. Potential Western Hemisphere Shorebird Reserve Network sites for migrant shorebirds in Canada, Second Edition, 1995. Tech. Rep. Ser. No. 227. Canadian Wildlife Service. Ottawa, ON. 98 pp.
Mortimer, Patricia R. 1978. The alpine vascular flora and vegetation of Prospect Mountain, Front Range, Rocky Mountains, Alberta. M.Sc. thesis, University of Alberta, Edmonton.
Moss, E. 1983. Flora of Alberta, second edition, revised by J. Packer. University of Toronto Press, Toronto.
Mowat, C. and R. Maerz. 1988. Raptor survey of Dinosaur Provincial Park, Alberta. Unpublished report, Alberta Recreation and Parks, Edmonton.
Mulira, J. 1986. Eolian landforms of Alberta. Alberta Forestry, Lands and Wildlife Publication T/129, Edmonton.
Munro, J. 1929. Glimpses of little-known western lakes and their bird life. Canadian Field-Naturalist 43: 181-187.
Nagy, J.A., A.W.L. Hawley, M.W. Barrett. and J. Nolan. 1989. Population characteristics of Grizzly and Black Bears in west central Alberta. Publication AECV88-R1, Wildlife Biology Group, Alberta Environmental Centre, Vegreville. 35 pp.
National Wetlands Policy Forum. 1988. Protecting America's wetlands: an action agenda. The Conservation Foundation. Washington, DC. 69 pp.

Natural and Protected Areas, unpublished. File information for the Natural and Protected Areas program, Alberta Parks Service (formerly Public Lands Division, Alberta Forestry, Lands and Wildlife), Edmonton.
Natural Areas Program. 1983. Flora of the Cardinal Divide proposed ecological reserve. Edmonton.
Natural Resources Conservation Board. 1992. Decision report - Application #9103 - Three Sisters Golf Resorts Inc. Application to construct a recreational and tourism project in the Town of Canmore, Alberta. Natural Resources Conservation Board, Calgary.
Nelson, J.S. and M.J. Paetz. 1992. The Fishes of Alberta, 2nd ed. The University of Alberta Press and The University of Alberta Press. Edmonton.
Nelson, S. 1983. Ecological land classification and evaluation: Sturgeon Lake-Puskwaskau. Alberta Forestry Lands and Wildlife, Edmonton.
Nelson, S., D. Downing, and B. Braidwood. 1989. Site selection criteria and evaluation for natural areas. Alberta Forestry, Lands and Wildlife. Land Information Services Division. Resource Information Branch. Edmonton. 46 pp.
Nelson, S. and G. Michalchuk. 1988. Ecological land classification and evaluation: Yellowhead North. Alberta Forestry Lands and Wildlife, Edmonton.
Nelson, S., D. O'Leary and D. Downing. 1989. Holmes Crossing proposed Natural Area, biophysical inventory. Resource Information Branch, Alberta Forestry, Lands and Wildlife, Edmonton.
Nicholson, B. 1991. A selection of 54 peatlands chosen as a first approach to the preservation of important wetlands and peatlands in the province of Alberta. Prepared for Natural Areas Program, Alberta Energy and Natural Resources, Edmonton.
Nietfeld, M., J. Wilk, K. Woolnough, and B. Hoskin. 1985. Wildlife habitat requirement summaries for selected wildlife species in Alberta. Fish and Wildlife Division, Alberta Energy and Natural Resources.
Nordstrom, W. 1987. Significant feature evaluation. Alberta Recreation and Parks. Edmonton.
Nystrom, Lee, Kobayashi and Associates. 1988. Environmental impact assessment of the proposed Whitecourt newsprint Mill. Prepared for Alberta Newsprint Company Ltd.
Office of Technology Assessment. 1987. Technologies to maintain biological diversity. Office of Technology Assessment, U.S. Congress, Washington, D.C. 334 pp.
O'Leary, D. 1988. Biophysical inventory of the Marshybank Ecological Reserve, Alberta. Alberta Forestry, Lands and Wildlife; Land Information Services Division. Edmonton. 38 pp.
O'Leary, D. and D. Downing. 1986. Integrated resource inventory - Grande Prairie County west, 2 volumes. Alberta Forestry, Lands and Wildlife, Edmonton.
O'Leary, D., D. Downing, D. Schindler and L. Boyd. 1986. Integrated resource inventory - Kimiwan-Winagami, 2 volumes. Alberta Forestry Lands and Wildlife, Edmonton.
O'Leary, D.. 1984. Ecological land classification and evaluation, Cadotte-Little Buffalo Lake. Alberta Forestry Lands and Wildlife, Edmonton.
Ojamaa, P. 1975. Pollhaven biophysical analysis and evaluation of capability. Alberta Forestry, Lands and Wildlife, Edmonton.
Ojamaa, P. 1976. Little Smoky biophysical analysis and evaluation of capability. Alberta Forestry, Lands and Wildlife, Edmonton.
Ojamaa, P. 1978. Cold Lake biophysical analysis and evaluation of capability. Alberta Forestry, Lands and Wildlife, Edmonton.
Ojamaa, P. and Associates. 1986. Ram-Clearwater study area physical land classification. Alberta Forestry, Lands and Wildlife, Edmonton.
Ollerenshaw, N. and L. Hills (eds.). 1978. Field guide to rock formations of southern Alberta (stratigraphic sections guidebook). Canadian Society of Petroleum Geologists, Calgary.
Owens, R. and T. Myres. 1972. Effects of agriculture upon populations of native passerine birds of an Alberta fescue grassland. Canadian Journal of Zoology 51: 697-713.
Packer, J.G. and C.E. Bradley. 1984. A checklist of the rare vascular plants in Alberta. Provincial Museum of Alberta, Natural History Occasional Paper No. 54.
Packer, John G. and Dale H. Vitt. 1974. Mountain Park: a plant refugium in the Canadian Rocky Mountains. Canadian Journal of Botany 52: 1391-1409.
Paetz, M. and J. Nelson. 1970. The fishes of Alberta. Queen's Printer, Edmonton.

Park, J. and K. Bennett. 1983. Integrated resource inventory - Wapiti Sand Dunes Study Area. Alberta Forestry Lands and Wildlife, Edmonton.
Patriquin, D. and R. Ellis. 1992. Environmentally significant areas study: Municipal District of Brazeau, White Zone. Prepared by Westworth and Associates, Edmonton for Yellowhead Regional Planning Commission.
Patriquin, D.L. 1993. An overview of priority vertebrate species and habitats in relation to NAWMP program delivery in Alberta. North American Waterfowl Management Plan. Edmonton.
Pedocan Land Evaluation Ltd. 1992. Biophysical Inventory and land use evaluations of the Obed Lakes shoreland area. Prepared for Alberta Forestry, Lands and Wildlife, Land Information Services Division, Resource Information Branch.
Penner, D.F. and P.S. Jalkotzy. 1982. Ecological studies of the Pinto Creek Mountain Goat population: interim report on phase 1 research, 1981. Prepared by McCourt Management Ltd for Environmental Planning, Production Dept., Gulf Canada Resources Inc.
Peterson, E.B. and N.M. Peterson. 1991. A first approximation of principles and criteria to make Canada's protected area systems representative of the nation's ecological diversity. Canadian Environmental Advisory Council. Ottawa.
Pigeon Lake Study Group. 1975. The Pigeon Lake study. Edmonton Metropolitan Regional Planning Commission, Edmonton.
Pike, E. 1978. Origin of tundra butterflies in Alberta, Canada and their significance in the study of refugia of Wisconsin age. M.Sc. thesis, University of Alberta, 137 pp.
Pinel, H. and N. Kondla. 1985. Skippers and butterflies of the Police Coulee area, Alberta. Blue Jay 43 (4): 213-223.
Poston B., D.M. Ealey, P.S. Taylor and G.B. Keating. 1990. Priority migratory bird habitats of Canada's prairie provinces. Canadian Wildlife Service, Environment Canada. Edmonton.
Power, T. 1985. Economic valuation of the natural environment: profaning the sacred? Pages 37-44 in "Economy and ecology - the economics of environmental protection", a symposium sponsored by the Canadian Society of Professional Biologists, February, 1985, Edmonton. Canadian Society of Professional Biologists, Edmonton.
Price, R. 1970. Geology, Canmore (two sheets, west and east halves). Geological Survey of Canada Maps 1265A and 1266A.
Probst, J.R. and T.R. Crow. 1991. Integrating biological diversity and forest management. Journal of Forestry (Feb): 12-17.
Quinn, M.S. 1989. The importance of conserving biological diversity through a system of protected areas in northern Alberta. World Wildlife Fund. Edmonton.
Raup, H. and G. Argus. 1982. The Lake Athabasca sand dunes of northern Saskatchewan and Alberta, Canada. 1. The land and vegetation. National Museums of Canada, National Museum of Natural Sciences Publications in Botany No. 12, Ottawa.
Rayner, M. 1984. Ecological land classification and evaluation, Ram-Clearwater. Alberta Forestry Lands and Wildlife, Edmonton.
Rayner, M. and K. Dutchak. 1984. Ecological land classification and evaluation, Chungo-Cline-Nordegg. Alberta Forestry Lands and Wildlife, Edmonton.
Reeder, S.W. and W. Odynsky. 1965. Reconnaissance soil survey of the Cherry Point and Hines Creek area. Research Council of Alberta, Report No. 85. Edmonton.
Reid, W.V. and K.R. Miller. 1989. Keeping options alive: the scientific basis for conserving biodiversity. World Resources Institute. Gland, Switzerland. 128 pp.
Renewable Resources Consulting Services. no date. Northeast Alberta Regional Plan Project, Fishery Resources, Volume 1, Regional Assessment and Volume 2, Technical Appendices. Prepared for Ekistic Design Consultants Ltd., Edmonton.
Rhude, L. 1977. Characteristics of some Canadian Shield Lakes in Alberta. Fisheries Survey Report No. 22, Alberta Fish and Wildlife Edmonton.
Roed, M. 1970. Surficial geology, Edson, Alberta. Alberta Research Council Surficial Geology Maps.
Russell, A.P. and A.M. Bauer. 1993. The Amphibians and Reptiles of Alberta. University of Alberta Press. Edmonton. 264 pp.

Russell, L. and R. Landes. 1940. Geology of the southern Alberta Plains. Geological Survey of Canada Memoir 221.
Rutter, N. 1972. Geomorphology and multiple glaciation in the area of Banff, Alberta. Geological Survey of Canada, Bulletin 206.
Rutter, N. and E. Christiansen. 1972. Quaternary geology and geomorphology between Winnipeg and the Rocky Mountains. Excursion C-22, XXIV International Geologic Congress, Montreal.
Salt, J.R. 1985a. Checklist of the mammals of the Cardinal Divide Region. Alberta Naturalist Vol. 15 (3).
Salt, J.R. 1985b. Checklist of the birds of the Cardinal Divide Region. Alberta Naturalist Vol. 15 (4).
Salt, J.R. and Associates, Consultants. 1990. Report on wapiti/ungulate survey - Wind Valley/Canmore Flats region. Unpublished report for Sweetgrass Consultants, Calgary.
Salwasser, H. 1990. Conserving biological diversity: a perspective on scope and approaches. Forest Ecology and Management. 35: 79-90.Sauchyn, D. 1979. Cold Lake study area physical land classification. Alberta Forestry, Lands and Wildlife, Edmonton.
Saxena, A., V. Chisholm and J. Bentz. 1996. Environmentally significant areas inventory, Grassland and Parkland Natural Regions, Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton.
Saxena, A., V. Chisholm and J. Bentz. 1996. Environmentally significant areas inventory, Grassland and Parkland Natural Regions, Alberta. Prepared by Geowest Environmental Consultants, Edmonton for Resource Data Division, Alberta Environmental Protection, Edmonton.
Scheelar, M. & W. Odynsky. 1968. Soil survey of Grimshaw & Notikewin area. Alberta Soil Survey Report 25.
Schmutz, J.K. 1994. A census of breeding burrowing owls in southern Alberta, 1994. Prepared for Alberta Environmental Protection, Natural Resources Service. Edmonton. 15 pp.
Schultz, R. and J. Bentz. 1993. Integrated resource inventory - Lesser Slave Lake Study Area. Alberta Environmental Protection, Edmonton.
Scott-Brown, M., S. Herrero, and C. Mamo. 1986. Monitoring of released Swift Foxes in Alberta and Saskatchewan. Contract OSG83-00213, Canadian Wildlife Service, Ottawa.
Semenchuk, G.P., ed. 1992. The atlas of breeding birds in Alberta. Federation of Alberta Naturalists. Edmonton.
Shaffer, M. 1985. Assessment of application of species viability theories. Office of Technical Assessment, U.S. Congress, Washington, D.C..
Shawa, M. 1975. Guidebook to selected sedimentary environments in southwestern Alberta, Canada. Canadian Society of Professional Geologists Field Conference, 1975. Canadian Society of Professional Geologists, Calgary.
Shetsen, I. 1980. Sand and gravel resources of the Lethbridge area. Earth Sciences Report 81-4. Alberta Research Council, Edmonton.
Shetsen, I. 1987. Quaternary geology, southern Alberta. Alberta Research Council, Edmonton.
Shetsen, I. 1990. Quaternary geology, central Alberta. Alberta Research Council, Edmonton.
Simons, H.A. Ltd. 1986. Environmental impact assessment of the proposed Whitecourt pulp mill. Prepared for Millar Western Pulp Ltd.
Smith, A. and L. Dickson. 1989. Prairie shorebird survey 1987. Canadian Wildlife Service, Edmonton.
Smith, B. and C. Bradley. 1990a. Status report on smooth goosefoot (*Chenopodium subglabrum*), a threatened species in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa.
Smith, B. and C. Bradley. 1990b. Status report on sand verbena (*Abronia micrantha*), a threatened species in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa.
Smith, B. and C. Bradley. 1990c. Status report on western spiderwort (*Tradescantia occidentalis*), an endangered species in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa.
Smith, H.C. 1993. Alberta Mammals: An Atlas and Guide. Provincial Museum of Alberta. Edmonton. 238 pp.
Smith, R. and L. Flake. 1981. The effects of grazing on forest regeneration along a prairie river. Prairie Naturalist 1981: 41-44.
Smith, W. and C. Wallis. 1976. Preliminary investigation of the birds of Pakowki Lake, Alberta. Blue Jay 34: 168-171.

St.-Onge, D. 1967. Surficial geology, Iosegun Lake (east half). Geological Survey of Canada Map 15-1966.
St.-Onge, D. 1974. The geomorphology of the Swan Hills area, Alberta. Geological Survey of Canada Paper 74-26.
St.-Onge, D. and S. Richard. 1975. Surficial geology of Whitecourt, Alberta. Geological Survey of Canada Map 1367A.
Stalker, A. 1956. Surficial geology, Beiseker. Geological Survey of Canada Map 55-7.
Stalker, A. 1957. Some features of the surficial geology of the Fort Macleod region of Alberta. Pages 52-71 in "Guide book, seventh annual field conference". Alberta Society of Petroleum Geologists, Calgary.
Stalker, A. 1957. Surficial geology, High River. Geological Survey of Canada Map 14-1957.
Stalker, A. 1958. Surficial geology - Fort Macleod. Geological Survey of Canada Map 21-1958.
Stalker, A. 1960. Surficial geology of the Red Deer-Stettler map-area, Alberta. Geological Survey of Canada Memoir 306.
Stalker, A. 1961. Surficial geology - Lethbridge. Geological Survey of Canada Map 41-1962.
Stalker, A. 1962. Surficial geology of the Fernie area. Geological Survey of Canada Map 31-1961.
Stalker, A. 1963a. Quaternary stratigraphy in Alberta. Geological Survey of Canada Paper 62-34.
Stalker, A. 1963b. Surficial geology of the Lethbridge area. Geological Survey of Canada Map 41-1962.
Stalker, A. 1965. Surficial geology - Bassano. Geological Survey of Canada Map 5-1965.
Stalker, A. 1973. Surficial geology of the Drumheller area, Alberta. Geological Survey of Canada Memoir 370.
Stalker, A., no date. The big rock. Page 9-11 in collection of papers for Geography 3710, University of Lethbridge.
Stelfox, H. 1981. Ecological land classification and evaluation, Red Deer-James. Alberta Forestry, Lands and Wildlife, Edmonton.
Stelfox, J.G. and G.R. Kerr. 1962. The status of Rocky Mountain Goats in the forested regions of the Wildhay River and Pinto Creek areas in Zone 14 East of the Sixth Meridian; and Their Prospects For Future Survival.
Strong, W. 1978. Biophysical and evaluation of capability - Lakeland Area. Alberta Forestry, Lands and Wildlife, Edmonton.
Strong, W. 1979. Livingstone-Porcupine ecological land classification and evaluation. Alberta Forestry, Lands and Wildlife, Edmonton.
Strong, W. 1981. Jean D'Or Prairie ecological land classification and evaluation. Alberta Forestry, Lands and Wildlife, Edmonton.
Sweetgrass Consultants Ltd. 1988a. Environmentally significant areas of the Municipality of Crowsnest Pass. Prepared by Sweetgrass Consultants, Calgary, for Alberta, Forestry, Lands and Wildlife, Edmonton.
Sweetgrass Consultants Ltd. 1988b. Environmentally significant areas of the Counties of Lacombe and Stettler. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
Sweetgrass Consultants Ltd. 1989a. Environmentally significant areas of the David Thompson Corridor. Prepared by Sweetgrass Consultants, Calgary, for Alberta, Forestry, Lands and Wildlife, Edmonton.
Sweetgrass Consultants Ltd. 1989b. Environmentally significant areas of the County of Paintearth. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
Sweetgrass Consultants Ltd. 1990. Environmentally significant areas of the County of Red Deer. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.
Sweetgrass Consultants Ltd. 1991a. Environmentally significant areas in the Bow River Corridor. Prepared by Sweetgrass Consultants, Calgary, for the MD of Bighorn, Exshaw.
Sweetgrass Consultants Ltd. 1991b. Environmentally significant areas of the MD of Clearwater. Prepared by Sweetgrass Consultants, Calgary, for the Red Deer Regional Planning Commission, Red Deer.

Sweetgrass Consultants Ltd. 1994. Environmentally significant areas in the Foothills Model Forest. Prepared by Sweetgrass Consultants, Calgary, for Foothills Model Forest, Hinton.
Tedder, W. 1979. Iosegun Lake study area physical land classification. Alberta Forestry, Lands and Wildlife, Edmonton.
Tedder, W. 1981. Peace River slopes study area physical land classification. Alberta Forestry, Lands and Wildlife, Edmonton.
Tokarsky, O. 1977. Hydrogeology of the Whitecourt area, Alberta. Alberta Research Council Report 76-3, Edmonton.
Toth, J. 1966. Mapping and interpretation of field phenomena for groundwater reconnaissance in a prairie environment, Alberta, Canada. International Association of Scientific Hydrology XI Annee, No. 2: 1-49.
Turner, W. 1966. Wylie Lake report. Parks Division, Alberta Recreation and Parks, Edmonton.
United Nations Environment Programme. 1992. Convention on biological diversity. Adopted in June, 1992 at the Earth Summit in Rio de Janeiro, Brazil. United Nations Environment Programme, Nairobi, Kenya.
Van Waas, C. 1974. Biophysical analysis and evaluation of capability: Namur Lake Area. Land Use Assignment Section, Alberta Lands and Forests.
Vermeer. K. 1969. Great Blue Heron colonies in Alberta. Canadian Field-Naturalist 83: 237-242.
Vitt, D. 1992. The peatlands of Alberta: a 1:1,000,000 summary map, edited by B. Nicholson and L. Halsey. Alberta Forestry, Lands and Wildlife, Edmonton.
Wallace, R.R. and P.J. McCart. 1984. The fish and fisheries of the Athabasca River Basin: their status and environmental requirements. Alberta Environment. 269 pp + appendix.
Wallis, C. 1976. Milk River Canyon resource evaluation. Alberta Parks, Edmonton.
Wallis, C. 1977. Red Deer River resource evaluation. Alberta Recreation and Parks Division, Edmonton.
Wallis, C. 1980. Montane, Foothills Parkland and Southwest Rivers, natural landscapes survey, 1978-79. Alberta Recreation and Parks, Edmonton.
Wallis, C. 1985. The extravagance of wilderness - whose values, whose dollars and sense? Pages 45-51 in "Economy and ecology - the economics of environmental protection", a symposium sponsored by the Canadian Society of Professional Biologists, February, 1985, Edmonton. Canadian Society of Professional Biologists, Edmonton.
Wallis, C. 1987. Critical, threatened and endangered habitat. In "Proceedings of workshops on endangered species and habitats in the Prairie Provinces", January, 1986, Edmonton (in press).
Wallis, C. 1989. Flora and special features survey of the Milk River Natural Area. Publication T/213, Alberta Forestry Lands and Wildlife, Edmonton.
Wallis, C. 1990a. Chappice Lake, biophysical overview. Prepared by Cottonwood Consultants for the Nature Conservancy of Canada, Calgary.
Wallis, C. 1990b. Preliminary biophysical survey of the Bodo-Altario area. Prepared by Cottonwood Consultants Ltd. for Alberta Forestry, Lands and Wildlife; Natural and Protected Areas Program. Edmonton. 32 pp.
Wallis, C. 1990c. Reconnaissance survey of saline wetlands and springs in the grassland-parkland region of eastern Alberta. Prepared by Cottonwood Consultants Ltd., Calgary for World Wildlife Fund, Edmonton.
Wallis, C. and C. Wershler. 1981. Kootenay Plains flora and grassland vegetation assessment. Natural Areas Program, Edmonton.
Wallis, C. and C. Wershler. 1984. Kazan Upland Resource Assessment for ecological reserves planning in Alberta. Alberta Energy and Natural Resources Report T/54, Natural Areas Technical Report No. 12. Public Lands Division, Edmonton.
Wallis, C. and C. Wershler. 1985. Little Fish Lake resource assessment for Ecological Reserves planning in Alberta. Prepared by Cottonwood Consultants Ltd. for Alberta Energy and Natural Resources, Public Lands Division. Edmonton.
Wallis, C. and C. Wershler. 1988. Rare wildlife and plant conservation studies in sandhill and sand plain habitats of southern Alberta. Alberta Forestry, Lands and Wildlife, Edmonton.
Wallis, C. and L. Knapik. 1990. Environmentally significant areas of the County of Barrhead. Prepared by Cottonwood Consultants Ltd. for the Agriculture Services Board, County of Barrhead, Barrhead.

Wallis, C., W. Smith and C. Wershler. 1994. An overview of wetland, old-growth and riparian avian resources in Lakeland Provincial Park and Provincial Recreation Area. Alberta Parks, Lac La Biche.
Wayland, M. and T. Arnold. 1993. A survey of birds -- Wapiti, Peace and Athabasca Rivers, June and July 1992. Project 2362-B1, Northern River Basins Study, Edmonton.
Wells, R. and J. Bentz. 1990. Integrated resource inventory - Red Deer River Corridor Study Area. Alberta Forestry, Lands and Wildlife, Edmonton.
Wershler, C. 1976. South Writing-on-Stone natural history inventory. Alberta Recreation and Parks, Edmonton.
Wershler, C. 1989. 1988 Census and habitat evaluation for migrating shorebirds in Alberta. Prepared by Sweetgrass Consultants, Calgary for World Wildlife Fund Canada, Canadian Wildlife Service, and Alberta Forestry, Lands and Wildlife, Edmonton.
Wershler, C. and C. Wallis. 1987. Status of the Piping Plover in Alberta. Prepared by Sweetgrass Consultants, Calgary for World Wildlife Fund Canada, , Canadian Wildlife Service, and Alberta Forestry, Lands and Wildlife, Edmonton.
Wershler, C. and C. Wallis. 1989. Survey and evaluation of Northern Fescue Grassland in Alberta. Prepared by Sweetgrass Consultants, Calgary, for Alberta Forestry, Lands and Wildlife, Edmonton.
Weseloh, D. and L. Cocks. 1979. Recent nesting of the Caspian Tern at Egg Island, Lake Athabasca, Alberta. Blue Jay 37: 212-215.
Westgate, J. 1968. Surficial geology of the Foremost-Cypress Hills area, Alberta. Research Council of Alberta Bulletin 22.
Westworth and Associates. 1990. Significant natural features of the eastern boreal forest region of Alberta. Prepared by Westworth and Associates for Alberta Forestry, Lands and Wildlife, Edmonton.
Westworth and Associates. 1992. An overview of potential forest harvesting impacts on fish and fish habitats in the northern boreal forests of Canada's Prairie Provinces. Prepared for Department of Fisheries and Oceans, Ottawa.
Westworth and Associates. 1994. An inventory of significant natural features in the Birch Mountains -- Firebag River Integrated Resource Planning Area. Prepared by Westworth and Associates Ltd. for Resource Information Branch, Alberta Environmental Protection, Edmonton.
Westworth, D. 1990. An assessment of the significant features of the Amisk Valley. Prepared by Westworth and Associates Ltd. for Alberta Forestry, Lands and Wildlife, Resource Information Branch. Edmonton. 71 pp.
Westworth, D. and L. Knapik. 1987. Significant natural features and landscapes of Strathcona County. Prepared by D. Westworth and Associates for County of Strathcona, Recreation and Parks.
Wildlife Management Division. 1996. The status of Alberta Wildlife. Alberta Environmental Protection, Edmonton.
Wilson, E.O. and F.M. Peter. 1988. Biodiversity. National Academy Press, Washington, D.C. 521 pp.
World Resources Institute. 1992. Global biodiversity strategy. World Resources Institute, Washington, D.C. 244 pp.
World Wide Fund for Nature. 1988. The importance of biological diversity. World Wide Fund for Nature, Gland, Switzerland.
Yamnuska Natural Area Study Committee. 1974. Yamnuska - introductory study of a natural area with proposals for its protection and use. Joint report of Calgary Field Naturalists' Society and the Bow River Naturalists.
Zelt, K. and W. Glasgow. 1976. Fish and wildlife. In: Cooking Lake area study, Volume IV. Prepared by Alberta Fish and Wildlife for Planning Division, Alberta Environment, Edmonton.

GLOSSARY OF LEVEL 1 NATURAL HISTORY THEME TERMS

Grassland, Parkland, Boreal Forest and Canadian Shield Terms

Bedrock - applies only to upland Precambrian bedrock outcrops in the Canadian Shield, Kazan Upland Subregion. All other bedrock types occur under Valley/Ridge Natural History Themes.

Dune Field - sandy deposits arranged by wind into dune formations. Although there are minor dunes within the mountains, this Natural History Theme is not represented at Level 1 in foothill and mountain environments.

Exposed Slope - valley slopes with exposed bedrock at the surface; a Natural History Theme confined largely to southern Alberta and Mixedwood Subregions..

Floor/Stream - applies to stream-influenced valley bottoms including the stream channel and related riparian woodland and shrubbery.

Glacial Lake Bed - predominantly fine-grained glacial lake deposits in plains areas. It may also include ground moraines with a thin veneer of fine glacial lake deposits. This term does not apply in Foothills, Mountain and Canadian Shield environments.

Ground Moraine - flat to undulating moraine of low relief, including draped and stagnation moraine. While this term is generally consistent across all regions, some areas of hummocky moraine are lumped with into Ground Moraine in the Foothills Parkland since it is a minor component of this Subregion. Predominantly sandy phases are included under Sandy Plain. This term does not apply in Foothills, Mountain and Canadian Shield environments.

Hummocky Moraine - moderately to strongly undulating knob and kettle topography, including stagnation, ridged-end and ice-thrust moraine. This term does not apply in Foothills, Mountain and Canadian Shield environments.

Kame Moraine - hummocky sandy terrain that has been deposited in mounds by meltwater in contact with glacier ice; a group of interconnecting kames. This is a significant landscape in only the Central Parkland and Athabasca Plain Subregions.

Lake - any sizable body of water, whether fresh or alkaline.

Non-Sandy Upland - a variety of plains landscapes that are morainal or glaciolacustrine in nature. Note that there are sandy ground moraines and sandy glaciolacustrine deposits that are included under the Sandy Upland-Sandy Plain Natural History Theme.

Protected Slope - vegetated valley slopes; a Natural History Theme confined largely to southern Alberta and Mixedwood Subregions.

Sandy Plain - fairly level and sandy terrain derived from ice-contact fluvial or lacustrine deposits and, in rare circumstances, on sandy morainal materials. This Natural History Theme is not represented in foothill and mountain environments.

Sandy Upland - a variety of plains landscapes that are characterized by thick deposits of coarse sand. This includes some areas of sandy moraine, lake deposits as well as the more typical dune fields, kames and outwash plains. This Natural History Theme is not represented in foothill and mountain environments.

Springs - while not strictly a valley feature, most springs occur in valleys and are included under the Valley/Ridge Natural History Themes. There are some springs on upland sites adjacent to lakes and other wetlands.

Valley/Ridge - valleys in the plains area encompassing a variety of valley slopes, river terraces and springs Natural History Themes.

Wetland - in southern Alberta plains, refers largely to non-woody meadow and marsh vegetation. In northern Alberta, it refers mainly to mineral and organic wetlands, many of which have woody cover. It also includes the Lake Natural History Theme which is widely distributed.

Foothills and Mountains Terms

Floor/Stream - applies to stream-influenced valley bottoms including the stream channel and related riparian woodland and shrubbery.

Glacier-Snowfield - occurs only in the Alpine Subregion

Lake - any sizable body of water.
Mineral - wetlands with minimal peat accumulation. Includes marsh and swamp vegetation in areas outside the Parkland and Grassland Natural Regions.
Organic - wetlands with significant peat accumulation. Includes bog and fen vegetation.
Ridge/Valley Wall - a strictly non-plains term that applies largely to Foothills and Mountain Natural Regions but also to "foothills" portions of the Foothills Fescue and Foothills Parkland Subregions.
Valley/Ridge - includes most of the uplands in the Foothills and Rocky Mountain Subregions.
Wetland - refers mainly to mineral and organic wetlands, many of which have woody cover. It also includes the Lake Natural History Theme which is widely distributed.