Wildlife Habitat Reclamation Manual

Jeffrey E. Green
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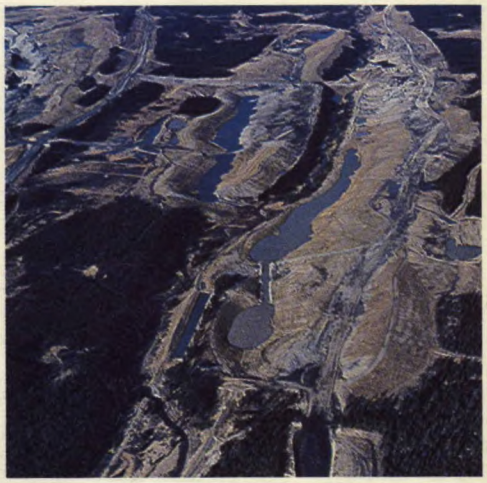

Methods for Reclamation of Wildlife Habitat in the Canadian Prairie Provinces

Environment Canada

Alberta Recreation, Parks and Wildlife Foundation

Wildlife Habitat Canada

METHODS FOR RECLAMATION OF WILDLIFE HABITAT IN THE CANADIAN PRAIRIE PROVINCES

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Prepared
for

Environment Canada, Western Region,
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PREFACE

This manual is based on a two volume technical report entitled:

Reclamation of Wildlife Habitat in the Canadian Prairie Provinces. Volume I: Techniques for the Creation and Enhancement of Wildlife Habitat. *Prepared by Jeffrey E. Green, Richard E. Salter and Courtland E. Fooks of The Delta Environmental Management Group Ltd., Calgary, Alberta for the Recreation, Parks and Wildlife Foundation and Environment Canada. 141 pp.*

and

Reclamation of Wildlife Habitat in the Canadian Prairie Provinces. Volume II: Habitat Requirements of Key Species. *Prepared by Jeffrey E. Green and Richard E. Salter of The Delta Environmental Management Group Ltd., Calgary, Alberta for the Recreation, Parks and Wildlife Foundation and Environment Canada. 106 pp.*

Limited numbers of these reports are available from Environment Canada, Edmonton, Alberta.

PHOTOGRAPH AND ILLUSTRATION CREDITS

The following agencies and individuals contributed photographs and illustrations on the pages listed below. Where more than one photograph or illustration is used, the number is shown in parentheses.

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We would like to specially acknowledge the Coal Association of Canada, Alberta Forestry, Lands and Wildlife, and the Alberta Reclamation Research Technical Advisory Committee for their cooperation in permitting use of information from the Mountain/ Foothills Reclamation Research Program.

A large number of industry and government personnel have contributed information and provided helpful suggestions during the development of this manual. We would particularly like to thank Barry Munson, Garry Trottier and Keith Yonge for their support and input.

We are especially grateful to Blackbird Naturgraphics Inc., Calgary, Alberta for the illustration and graphic design of the manual; and to Barry Edwards for providing use of the wildlife silhouettes.

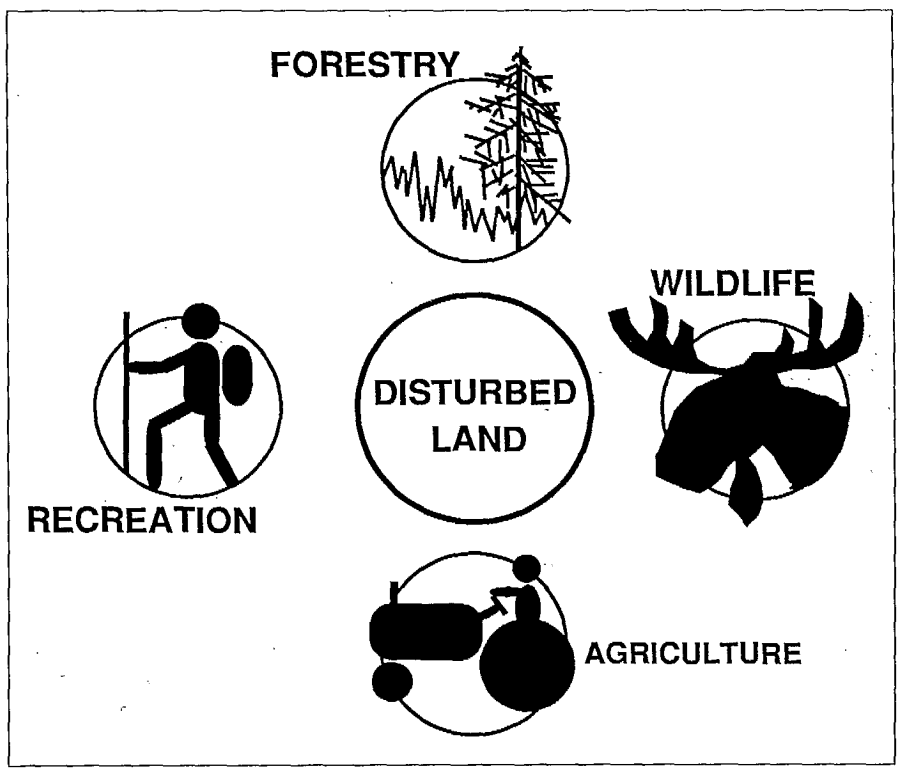
TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

During the exploration for and development of renewable and nonrenewable resources, natural forest cover and groundcover must often be removed, and in some cases the topsoil and underlying mineral soils are disturbed. These disturbed lands are often able to support only a limited variety of plants and animals, and natural processes may be incapable of or slow to repair the damage. The need for reclamation is obvious, and soil reclamation and revegetation are now recognized as essential components of most resource development projects.

Four major land uses are recognized for reclaimed sites within the prairie provinces: forestry, agriculture, wildlife and recreation. Until the mid-1970s, forestry was the only use that was commonly considered for reclamation in the Mountains, Foothills and Boreal Forest regions, whereas agriculture was the predominant use in the Prairie Grassland and Aspen Parkland. However, with improved reclamation methods and an increased awareness of the importance of natural areas, greater emphasis has been placed on reclamation and enhancement of wildlife habitat.



Wildlife habitat reclamation is adaptable to a wide range of reclamation situations, and is often the most appropriate use for problem reclamation areas such as steep slopes and highwalls, areas with unproductive soil or extreme microclimates, and rock outcrops or end pits. It is this adaptability and flexibility that makes a wildlife end use one of the most viable and economical objectives for reclamation in the prairie provinces, particularly in areas where conventional reclamation methods for agriculture and forestry are not desirable, or cannot be applied at reasonable cost. Even if forestry, agriculture or recreation are the principal end uses for a reclamation plan, the creation or enhancement of wildlife habitat can always be included as a secondary objective, or incorporated into small "difficult " areas within a site.

Although development of wildlife habitat can sometimes involve large-scale reclamation programs, it also can be successfully achieved through only minor changes to standard planting procedures, site contouring and planning. As an added benefit, reclamation costs can be reduced by retaining some site development features such as highwalls, terraces or ponds, and through resultant lower costs for equipment, labour and materials handling.

About the Manual

This manual provides information on the planning and application of techniques for reclamation of wildlife habitat. Individuals and groups who may find this manual of use include:

- **Onsite reclamation staff, operators and reclamation planners,** who will find ideas on how to deal with existing problem areas in ongoing developments, and on how to plan for expansion into new development areas.

- **Engineers,** who will become more aware of the types of pre- and post-development site features that will be most useful to wildlife, and can then incorporate design changes that help to meet these ends.

- **Biologists and wildlife-oriented groups,** who will find ideas on how to capitalize on the many opportunities for habitat reclamation and to improve wildlife habitats in disturbed areas.

- **Government agencies,** which may more commonly recommend wildlife habitat reclamation as an acceptable end use or integrated end use in development and reclamation plans.

Most of the techniques in this manual are best suited for medium to large-sized sites that are five or more hectares in size. Small disturbed areas (less than 5 ha) also provide opportunities for habitat reclamation, but the types of uses may be limited by the available space relative to the spatial needs of the larger wildlife species. Nevertheless, habitat reclamation in small areas can benefit a number of wildlife species such as songbirds, upland game birds and furbearers. Some of the same techniques can be used to improve wildlife habitat along abandoned right-of-ways or portions of active right-of-ways.

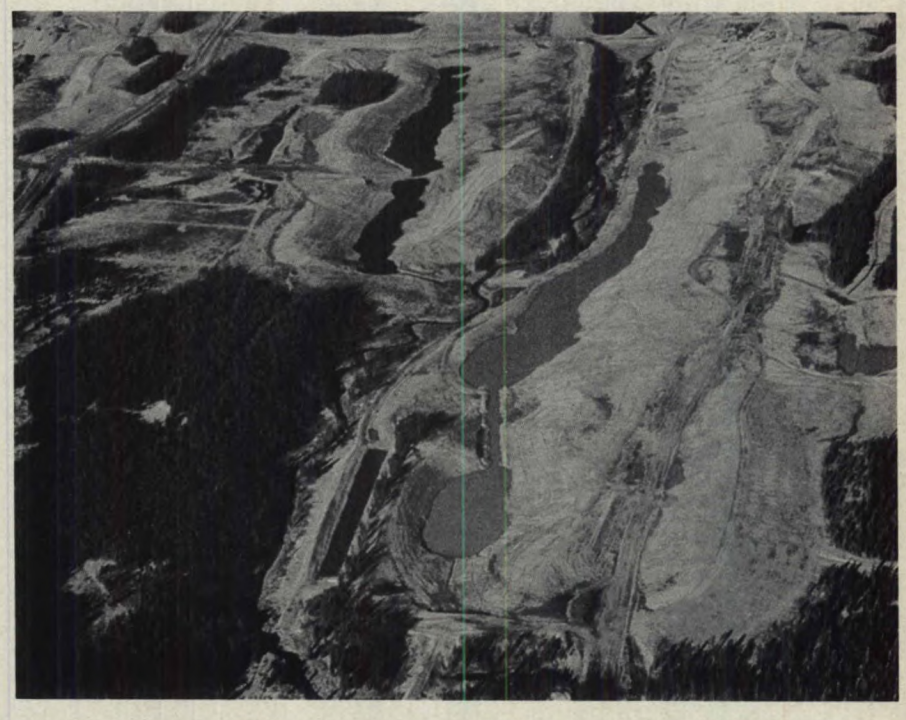
Using the Manual

Readers not familiar with habitat reclamation and approaches for developing and implementing a habitat reclamation plan should first refer to Chapters 1, 2 and 3. These chapters briefly describe the basic habitat needs of wildlife and means of simplifying the planning and reclamation process.

Chapters 4 through 6 describe reclamation methods for improving and creating landforms and water forms, and for revegetating these for wildlife. Chapter 7 describes special habitat features that can be developed to encourage wildlife use of reclamation areas.

Chapter 8 summarizes information on the important wildlife species, habitats and reclamation opportunities in the Mountains, Foothills, Boreal Forest, Aspen Parkland and Prairie Grassland regions. Methods for choosing key wildlife species and reclaimable habitats are discussed. Tabular summaries of the habitat requirements and reclamation methods for key wildlife species are provided in Chapter 9.

Chapter 10 describes some of the more common wildlife problems that may be encountered on active or abandoned reclamation areas, such as girdling damage to trees and shrubs, and human-wildlife interactions. Methods of dealing with these problems are recommended.



CONCEPTS IN WILDLIFE HABITAT RECLAMATION

Planning for Reclamation

Importance of Planning

Before developing a site or preparing a reclamation plan, all available information on current wildlife use of habitats on and around the proposed site should be examined. This information is often obtained during the environmental impact assessment for the development, and provides a framework for subsequent reclamation planning. For example, knowledge of which species are abundant can be used to select key wildlife species on which to focus reclamation efforts. Information on plant communities can be used in selecting plant species for reclamation, and for roughing out a landscape plan. Planning will result in a cost-effective reclamation program, and will ensure that site-specific or innovative options for reclamation are not overlooked.

New Developments

The need to inventory wildlife and plant communities prior to development, and to plan the major components of the reclamation program, cannot be overemphasized. Development of the reclamation plan in cooperation with provincial fish and wildlife management personnel or other wildlife authorities will help to identify important habitat and travel corridors that can be maintained on the site, as well as future opportunities to create landforms and water forms that are attractive to wildlife. For instance, by selectively clearing forest cover and locating industrial areas to minimize loss of important habitat, impacts to wildlife can be reduced. Such considerations also can promote later use of reclaimed areas.

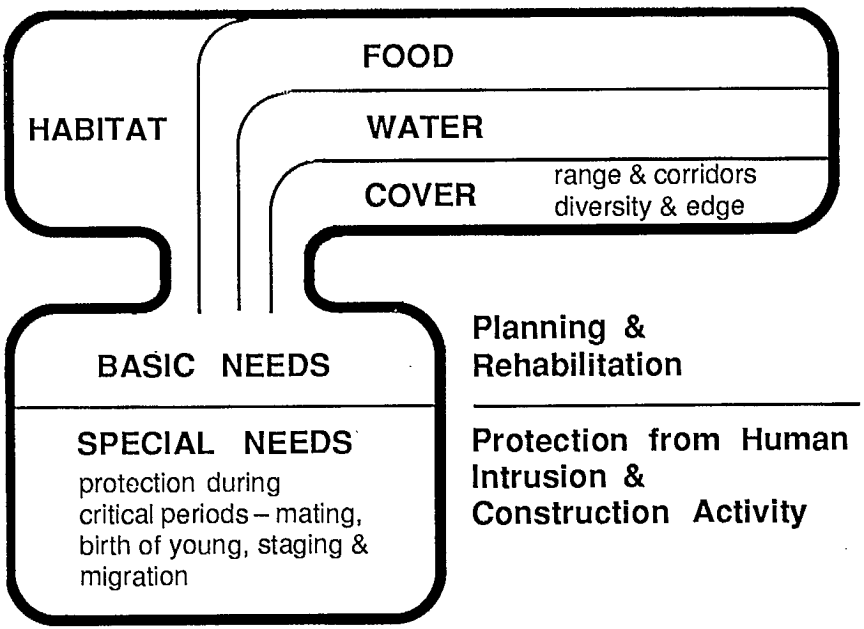
Mine pits, haul roads, overburden dumps, ponds and drainage systems can be designed to create sites that are suitable for the development of wildlife habitat. By incorporating site modifications for wildlife in the planning stage, costs for habitat reclamation can be minimized. Modifications to major site features, such as the shape and location of overburden piles and the location of drainage channels and ponds, can only be practicably accomplished during the planning phase.

Ongoing or Abandoned Sites

The potential for wildlife habitat enhancement is by no means exclusive to new developments. Many of the techniques discussed in this manual can be modified or used directly to enhance existing reclaimed areas for wildlife, while also being economic and compatible with ongoing activities on a site. Free-dumping of overburden, planting of treed clumps in open grassland areas, development of nesting islands and creation of meander channels are just a few of the methods available to improve habitat values on currently active or abandoned sites.

Basic Needs of Wildlife

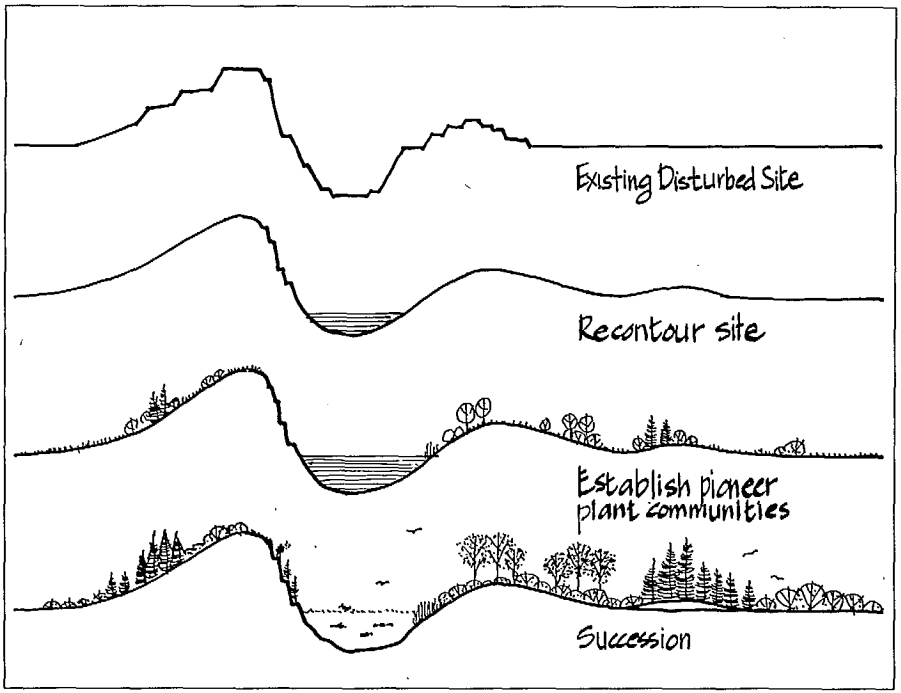
Successfully reclaimed areas will provide the basic needs of wildlife for food, water, cover and space on either a seasonal or a year-round basis. Seasonal changes in these needs also should be considered. Factors such as local landforms, water drainage, water availability, the location and kinds of plant communities and, in some cases, protection from human disturbance must also be considered. With some wildlife species, special seasonal needs for mating, raising of young and feeding must be met.



Primary Elements of Reclamation

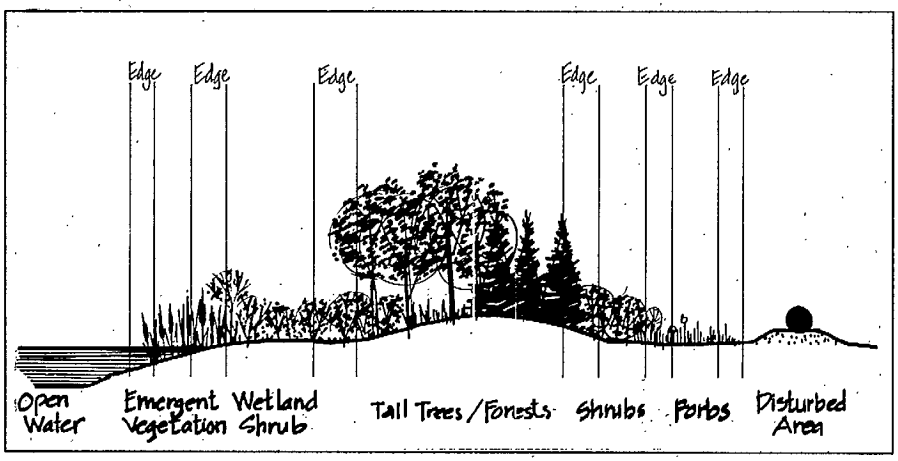
Wildlife habitat can be defined as a particular combination of landforms, plant communities and/or water forms that together provide basic life requisites (food, cover and water), either year-round or on a seasonal basis. Reclamation for wildlife should aim to provide these primary elements of habitat and then let natural processes add to and fine-tune the habitat structure to the specific conditions of the site. For example, a reclamation program might include clump plantings of the dominant species of trees, shrubs and groundcovers associated with a particular type of habitat. Each clump planting would be located in a specific area of the site that met its needs for slope, aspect, exposure to sun and wind, moisture and soil; subsequent natural invasion of local plants and spreading of plants from the clumps would then slowly complete the habitat development process.

To simplify the establishment of vegetation, pioneer plant species typical of those that naturally invade burned areas, avalanche slopes and other disturbed areas should be established first. Pioneer plants invade quickly and grow well on disturbed areas, and are commonly preferred sources of food and cover for a wide variety of wildlife species. They also are important in providing suitable conditions for the invasion of other, slower-growing species such as spruce and fir. In some cases, pioneering agronomic species also can provide these basic requirements.



Diversity and Edge

Edge or border areas between different plant communities are important to wildlife because of the variety of cover, food and water sources found in these areas. Habitat diversity is thus one of the keys to successful reclamation for wildlife. Reclamation for wildlife should maximize the diversity of landforms, water forms and vegetation within the physical limitations of the site.



Key Wildlife Species and Reclamation

To design a reclamation plan for more than a few wildlife species would be complex, inefficient and costly, and would result in questionable success. By designing the reclamation plan for a few key wildlife species, rather than for all of the species present, the tasks of integrating wildlife uses with other site uses, and of developing a workable reclamation plan, are simplified. The resulting habitats for key wildlife species also will be attractive to many other kinds of wildlife. For example, a reclamation plan for a site in the Aspen Parkland might focus on providing deciduous forest and water areas suitable for use by beavers, thereby also providing habitat for many other species requiring deciduous forest or standing water habitat.

Once basic habitats for key wildlife species have been established, habitat development can be fine-tuned by adding features that will benefit other species. Continuing with the above example, once the major elements of beaver habitat have been provided, nest boxes could be erected to encourage nesting by a variety of birds.

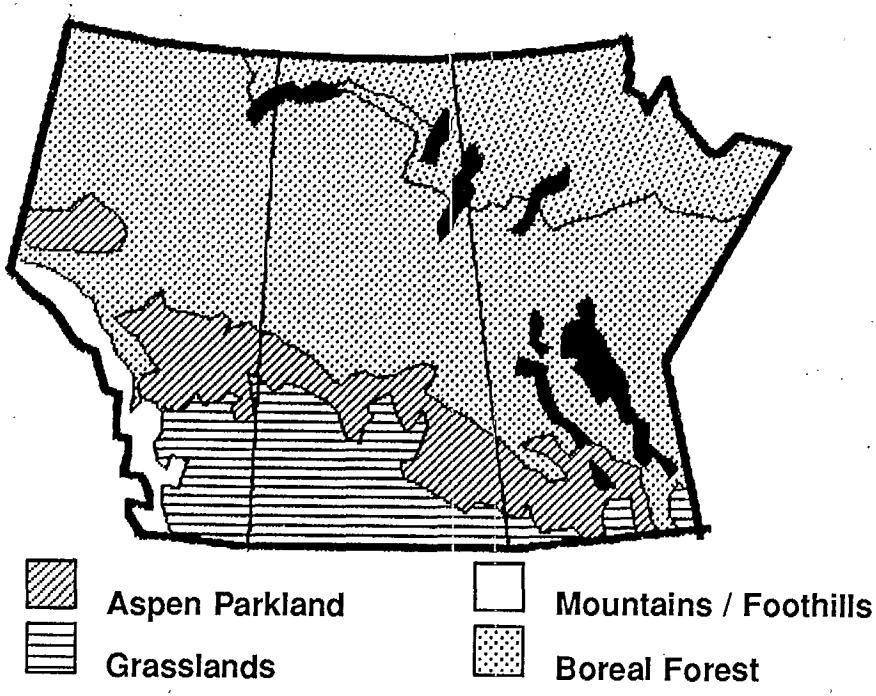
Selecting Key Wildlife Species

Because of the central role of key wildlife species in the design of a reclamation plan, they must be carefully selected to reflect the general habitat needs of wildlife on and around the development site. Key wildlife species should be common in the region, able to use pioneer plant communities and/or represent the needs of a number of other wildlife species that occur in the local area. Key wildlife species for a site might include one or more of the big game or high profile species in the area, but might also include one or more small or less noticeable species. Such mixes of key wildlife species will help to ensure a balanced approach to habitat development.

The provincial agency responsible for fish and wildlife management should be contacted to assist in the selection of key wildlife species for a site. This is particularly important if it is desirable to have the reclamation program complement existing or proposed wildlife management programs in the region.

Habitat Regions

Regional differences in wildlife distributions and in climate, landforms, soil types and vegetation need to be considered in the planning and selection of methods for reclamation of wildlife habitat. In order to facilitate the incorporation of regional considerations into reclamation planning, we have divided the prairie provinces into four broad regions (the Mountains/Foothills, Boreal Forest, Aspen Parkland and Prairie Grassland) based on topography and predominant vegetation cover. The major habitat types, types of industrial disturbances and appropriate key wildlife species are described for each of these regions in Chapter 8. Specific reclamation methods are described for each key wildlife species in Chapter 9.



CHAPTER 2

INVENTORY OF EXISTING HABITATS AND WILDLIFE POPULATIONS

Regardless of whether a development is operating or still in the planning stage, existing wildlife habitats and wildlife numbers on and around the development site should be identified before starting a habitat reclamation program. Much of this information can be obtained from documents prepared for the environmental impact assessment for the development. If some reclamation has already occurred, additional surveys may be necessary to update the existing information. By taking stock of the existing and potential site features – landforms, water forms and vegetation as well as wildlife numbers and distributions – the reclamation plan can be designed to combine surrounding land uses with the post-development landscape. Such integration will maximize the benefits to wildlife and help to reduce reclamation costs.

Landforms

In the context of this manual, landforms are distinct units of land characterized by particular physical features such as slope, aspect and drainage. Examples of landforms are cliffs, ravines, swales, north-facing slopes, knob and kettle terrain, poorly drained sites, hilltops, flatlands and drainage channels.

- Identify existing landforms in terms of slope, aspect, soil (and rock) types and slope stability.

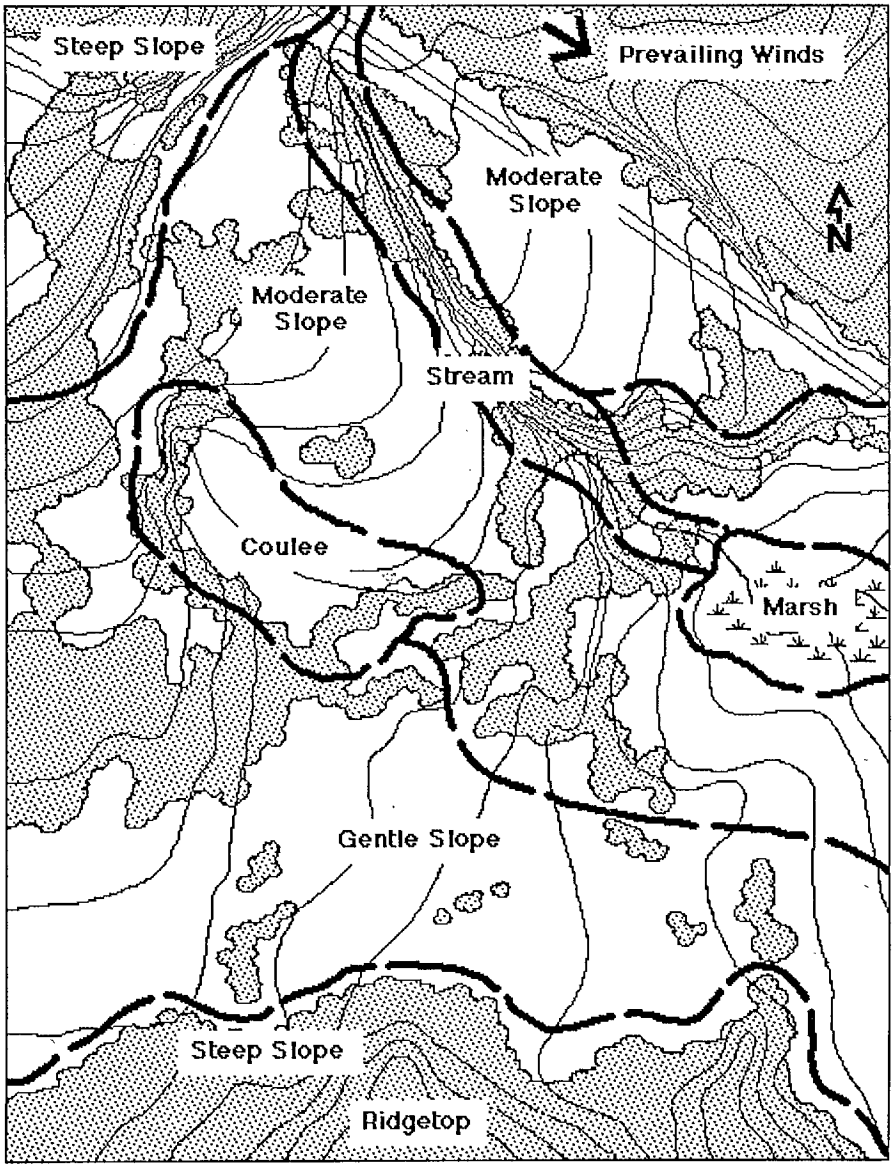
- If the site is still active or undeveloped, identify the expected final landforms for the site.

- Prepare maps of the existing and expected landforms on the site.

- Note current uses of landforms by wildlife in terms of the type and season of use. (For example, raptor nesting on cliffs during the spring, moose feeding in lowland or poorly drained sites during early spring, or bighorn sheep grazing on steep, south to west-facing slopes during winter.)

- If the project is in the initial planning stages, determine if any of the existing landforms that are important for wildlife can be maintained in whole or in part. Also decide if enhancement of these sites is possible (see Chapter 4).

Landforms Map



Water Forms

Water forms are distinct aquatic units characterized by shape, water flow, depth, and seasonal hydrology. Examples of water forms include lakes, ponds, wetlands, watercourses, and riparian areas.

- Identify existing watercourses, lakes, ponds, seeps, marshes, and poorly drained areas on the site. Prepare an overlay using the landform map as a base.

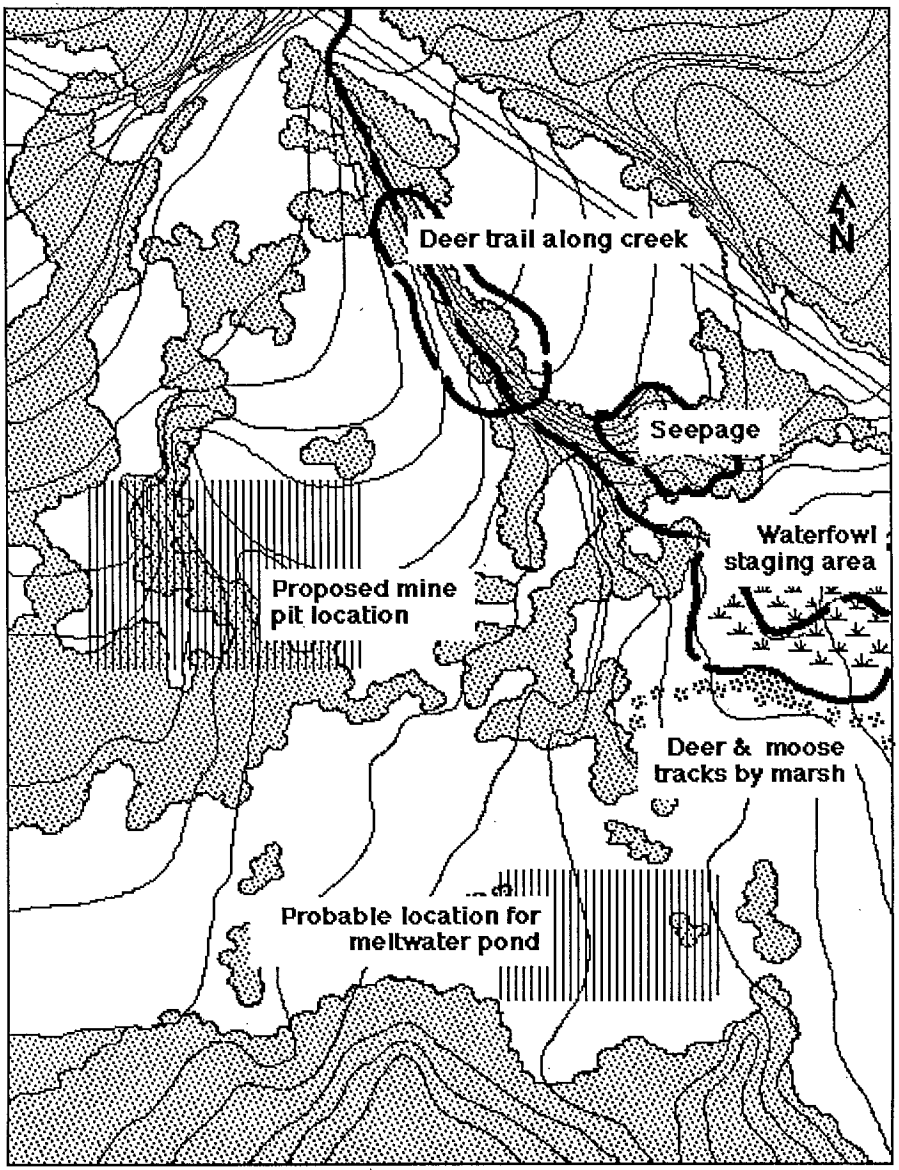
- Identify existing uses of these water forms by wildlife, and the season of use.

- On existing disturbed areas, use the landform map to help determine if potential water forms can be economically developed on the site.

- On undeveloped sites, determine if any of the existing water forms can be maintained. If they can be maintained, determine if enhancement is possible (see Chapter 5).

- Using the post-development landform map, identify where waterbodies and drainage courses will develop naturally. Decide if modifications to the site plan can be made to improve the water forms for wildlife, or to better complement watercourses or waterbodies on surrounding areas.

Water Forms Map



Plant Communities

Plant communities can be defined as distinct assemblages of plant species with a characteristic canopy height and structure. In some communities several layers – for example, trees, tall shrubs, low shrubs and groundcovers – may be present.

■ Identify the major plant communities – for example, spruce forest, aspen forest, willow shrublands and open grasslands – that occur on and around the site. Prepare an overlay of these communities using the landform map as a base.

■ Take note of the landforms and water forms that are naturally associated with these communities.

■ For each plant community, identify the types and season of use by wildlife.

■ Specifically note the areas used for food and cover.

■ Identify the species of trees, shrubs and groundcovers most commonly used by wildlife, and in particular the plants used by the key wildlife species for the site.

■ Select areas of native plant cover that can be maintained during site development and operation. Determine if enhancement of these communities is possible (see Chapter 6).

Plant Communities Map

Aspen Forest

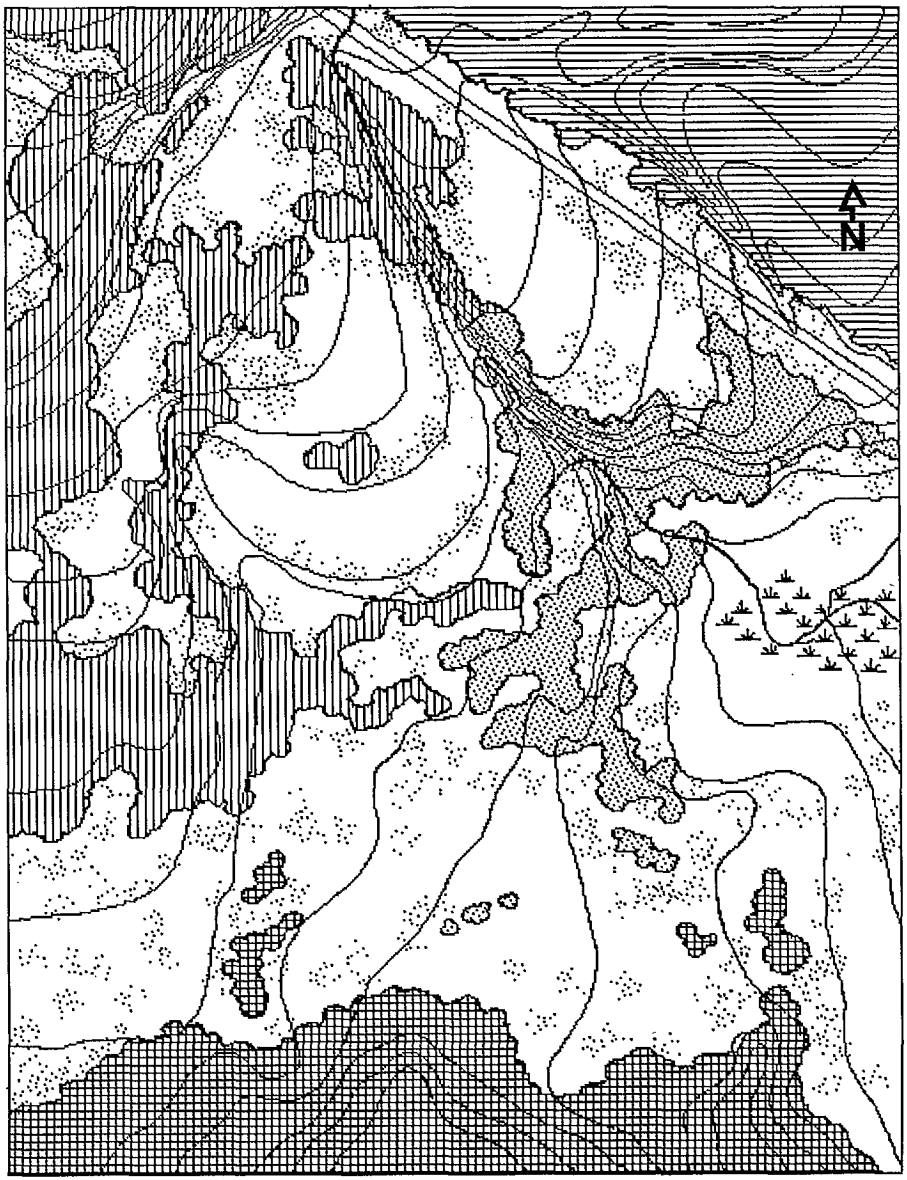
Mixed Conifer/Deciduous Forest

White Spruce Forest

Tall Shrub

Grasses & Forbs

Marsh/Wetland



Wildlife Numbers and Distribution

- Conduct surveys to determine the kinds and numbers of wildlife present on and around the site.

- For the key wildlife species, note the types and season(s) of use for each major plant community, water form, and landform (as identified above).

- Identify any areas that are important as feeding, escape or reproductive habitat (such as calving grounds and den sites) or are used frequently as travel corridors. If possible, maintain all or portions of these areas during site development and operation.

- In cases where important habitat or travel corridors must be disturbed, plan habitat enhancement in surrounding areas to reduce the effects on wildlife.

Integration of Baseline Information

Once the inventory has been completed, information on wildlife, plants, water forms and landforms can be used to:

- designate areas of natural habitat to be left intact during site development, and

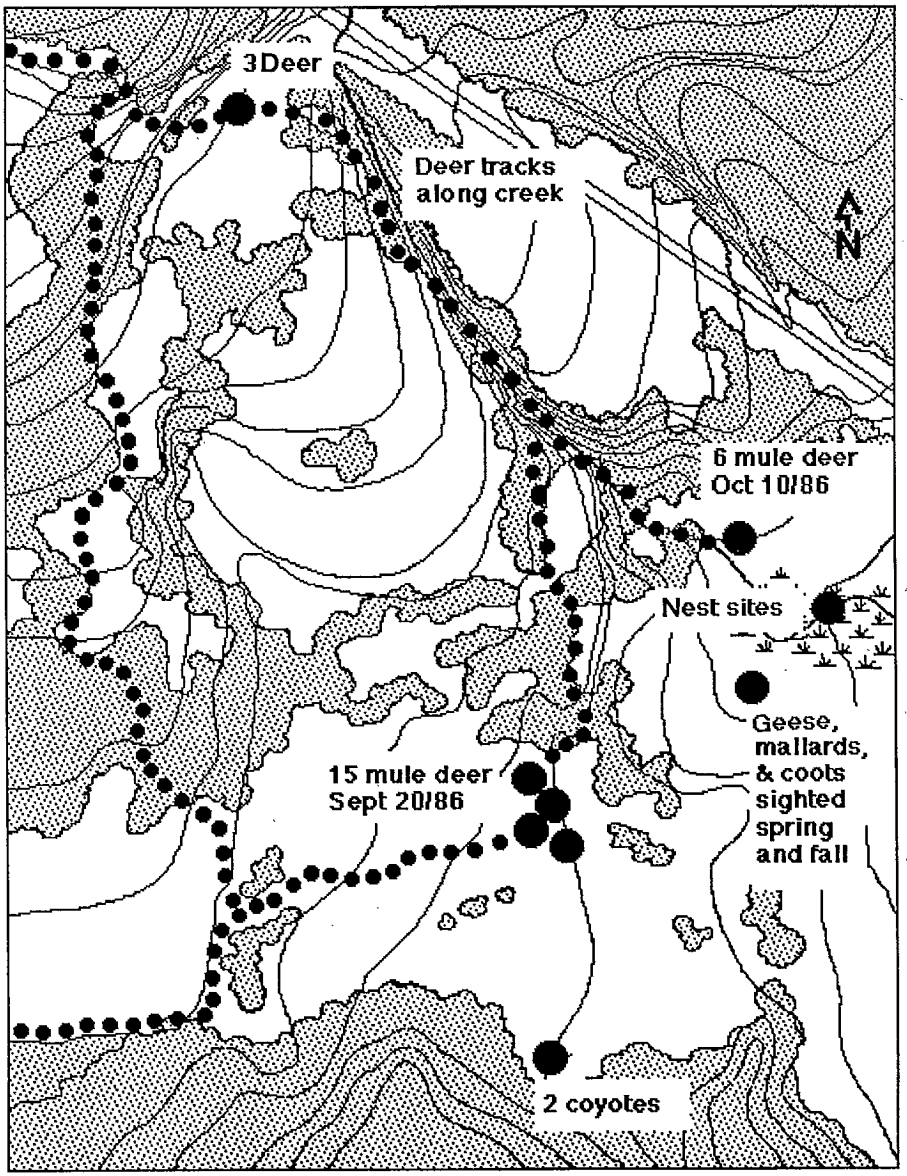
- develop reclamation plans for specific land units on the site.

Information on wildlife numbers and distributions also can be used to finalize the selection of appropriate key wildlife species. The landform map and overlays of water forms, plant communities and wildlife uses also will help to highlight the habitat features that are most attractive to the key wildlife species.

Wildlife Distribution Map

Wildlife Sightings

Wildlife Movement Corridors



CHAPTER 3

PREPARING A RECLAMATION PLAN

Preparation of a detailed development and reclamation plan is an important step towards successful reclamation of wildlife habitat. The earlier in a development program that an inventory of site resources and a detailed reclamation plan are completed, the more opportunities there are likely to be for developing high quality wildlife habitat. Early completion of these stages can often mean that some of the existing site features can be maintained. More importantly, new site features can be developed, as materials handling and reclamation costs will be reduced by forward planning.

Once the site inventory has been completed, there are a number of steps involved in developing a reclamation plan and putting it into action.

Regulatory Approval

- Contact appropriate regulatory agencies (e.g., government departments responsible for the environment, mining, energy, fish and wildlife, and reclamation) for approval of the wildlife end use.

- On approval, obtain input from appropriate agencies on selection of key wildlife species and on existing regional habitat management plans.

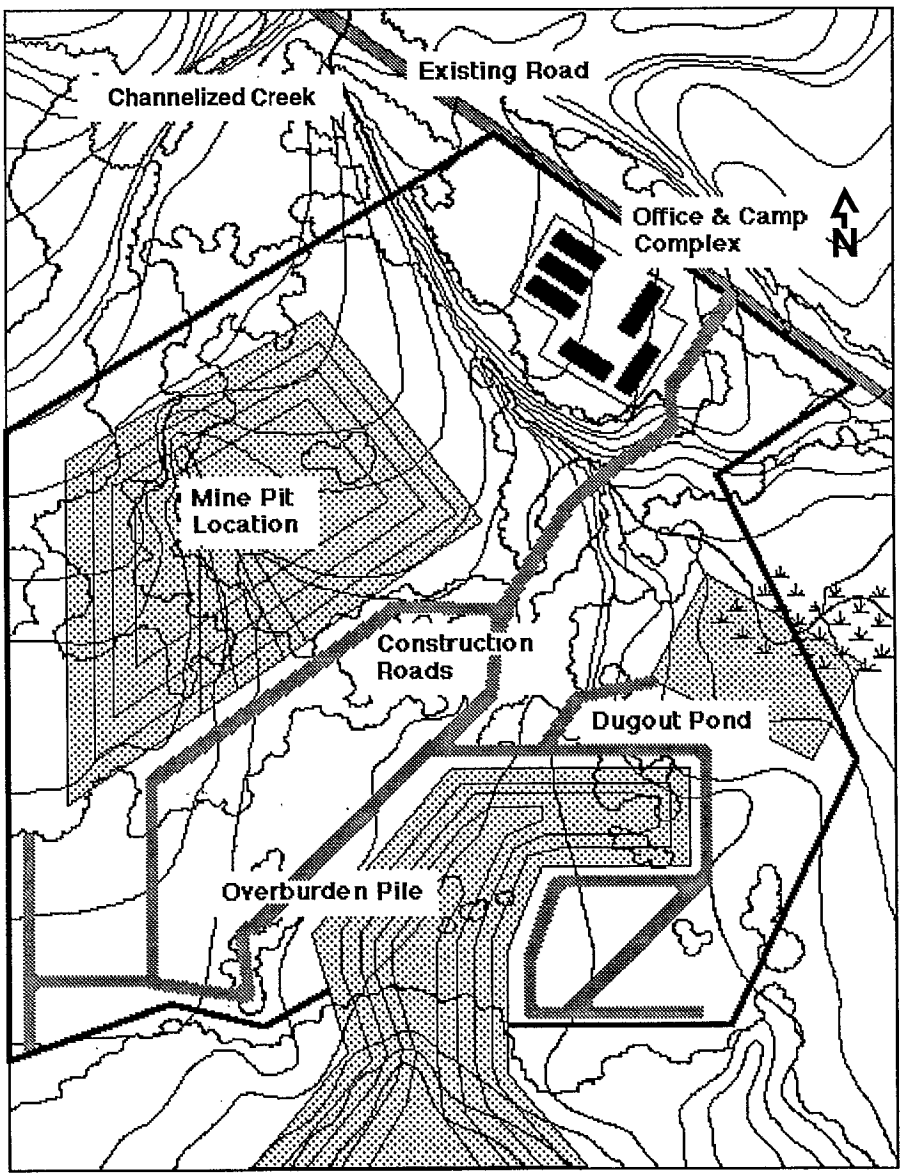
- In cooperation with regulatory agencies, establish realistic goals for reclamation, and determine safety requirements for features such as highwalls, pits, waterbodies and watercourses.

Selection of Key Wildlife Species

- Select key wildlife species for each landform type that will be present on the reclaimed site. One or more key wildlife species can be selected for a site. For example, moose might be chosen to represent valley bottom habitats, whereas white-tailed ptarmigan might be chosen for windswept hilltops and upper slope locations.

■ Once a key wildlife species has been selected for the landform type, an appropriate habitat area for that species should be selected for development. Using the above example, a valley bottom area for moose might be developed as a bottomland shrub community.

Planned Development



Maintaining Natural Habitats

Using the inventory maps of the site, determine which areas of natural habitat can be practicably maintained during site operations and reclamation. Development of long-term reclamation plans in cooperation with the site engineers and operators can help identify these sites at an early stage. Watercourses, wetlands, waterbodies, wildlife travel corridors and areas of dense evergreen or mixed forest cover are particularly important habitats to maintain within disturbed sites.

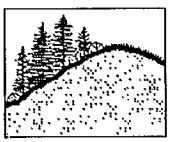
When areas of undisturbed habitat are maintained, complementary new habitats should be provided on adjacent disturbed areas. For example, if a stand of dense white spruce is left standing and moose are the key wildlife species, a willow shrub community could be developed on suitable landforms around the spruce stand. The spruce would provide immediate cover, whereas the shrubland would eventually provide both browse and cover.

Planning Priorities

Landform features should be developed first. Water forms should then be selected to conform with expected drainage patterns on the site. Plant communities and special site features that are compatible with the expected conditions on the site can then be chosen.

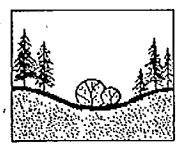
Landform Types

Highwalls/Cliffs



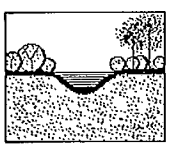
Steep Slopes/
Ridgetops

Moderate to
Gentle Slopes

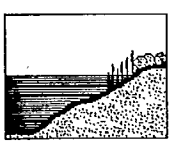


Bottomlands

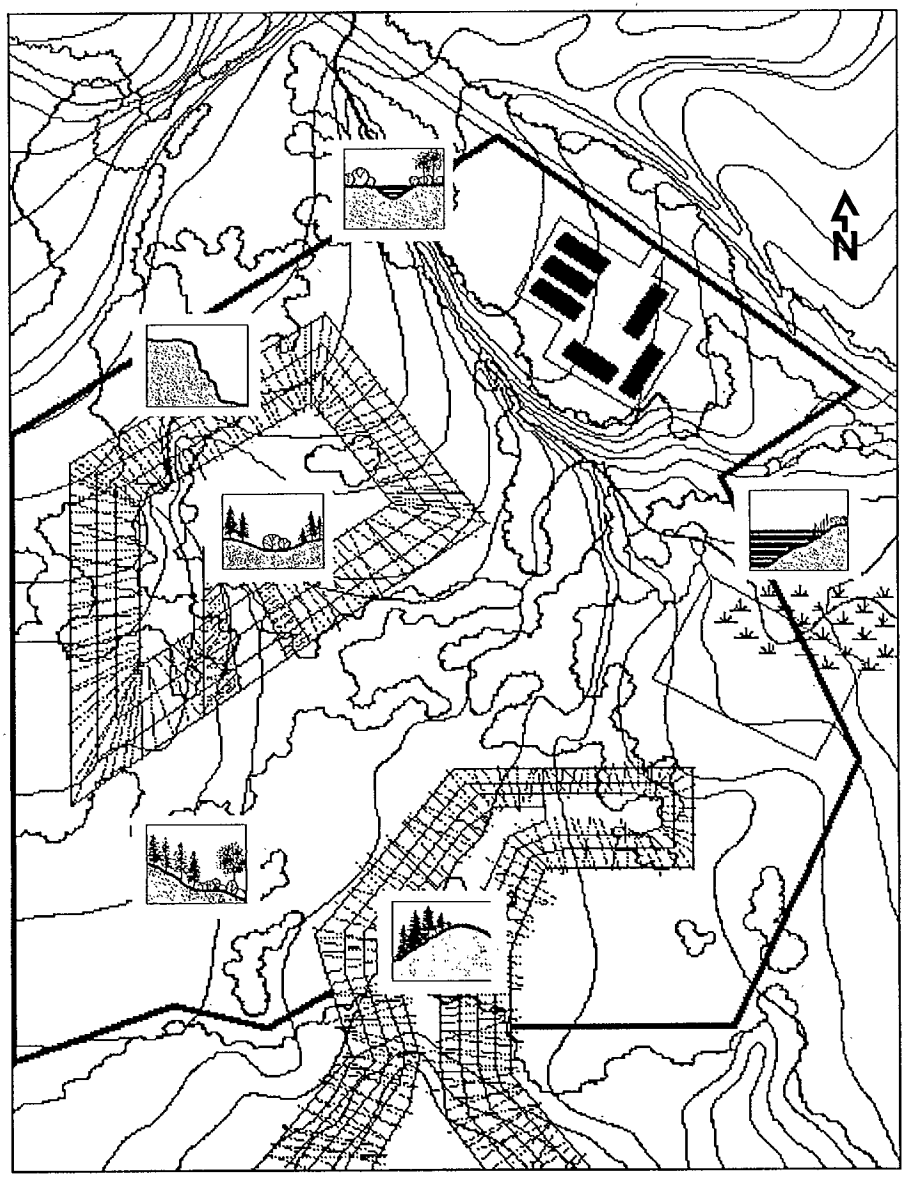
Water Form Types



Watercourses



Ponds/Lakes



Landforms

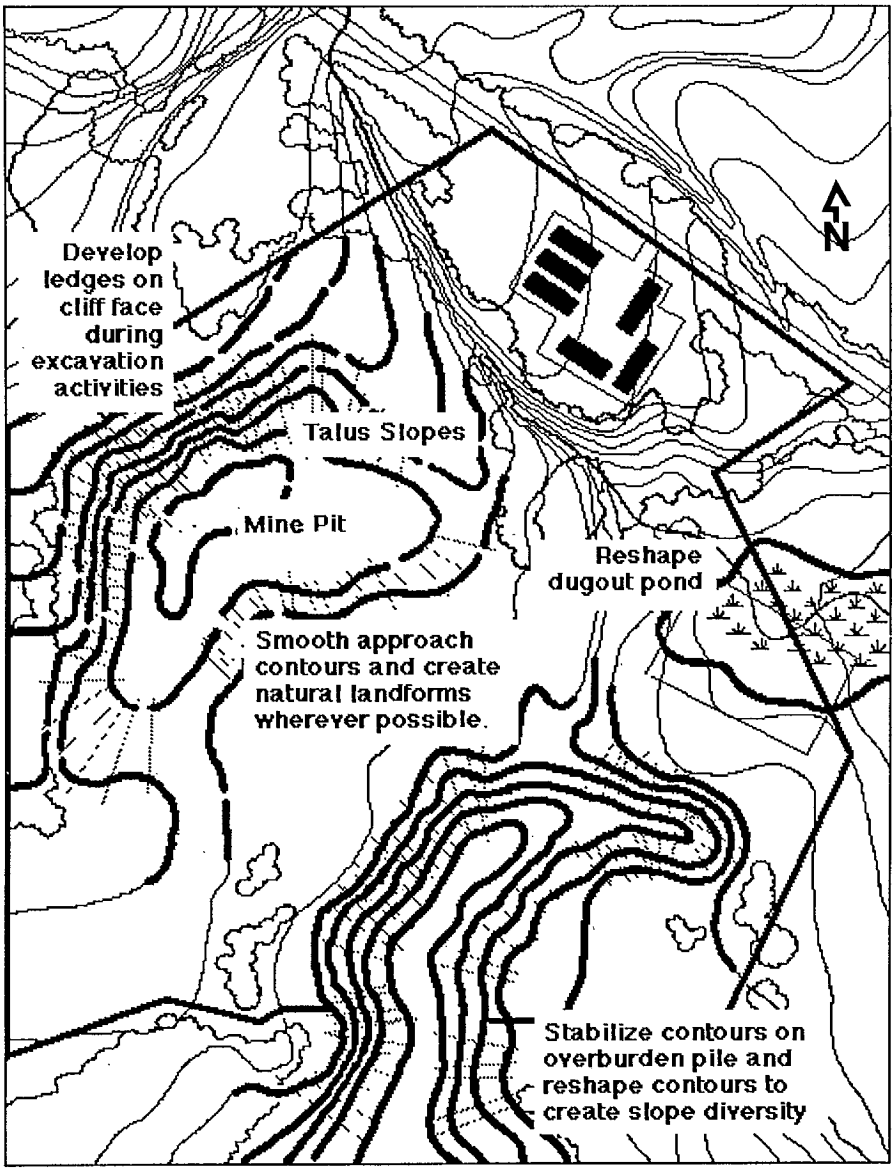
- Based on the operational plan for the site – for example, where pits will be developed and not backfilled, where overburden waste piles and drainage ponds will be located – determine which landforms will best benefit the key wildlife species.

- Identify landforms that will be created during normal site development and operation, and that offer habitat reclamation potential when left intact. For example, a highwall might be left to create a cliff habitat or an end pit might be used to create a pond. Ensure that these areas are identified in the development plan.

- Identify landforms that will be created specifically for wildlife either during site operation or reclamation. For example, an overburden pile could be shaped and oriented to provide sheltered areas for wildlife, or a tailings pond could be shaped to provide good shoreline areas for waterfowl.

- Select areas for temporary storage of topsoil removed from the development site. Whenever possible, minimize the storage time between removal and reapplication to take maximum advantage of native seed and rootstock in the soil.

Landform Modification & Enhancement



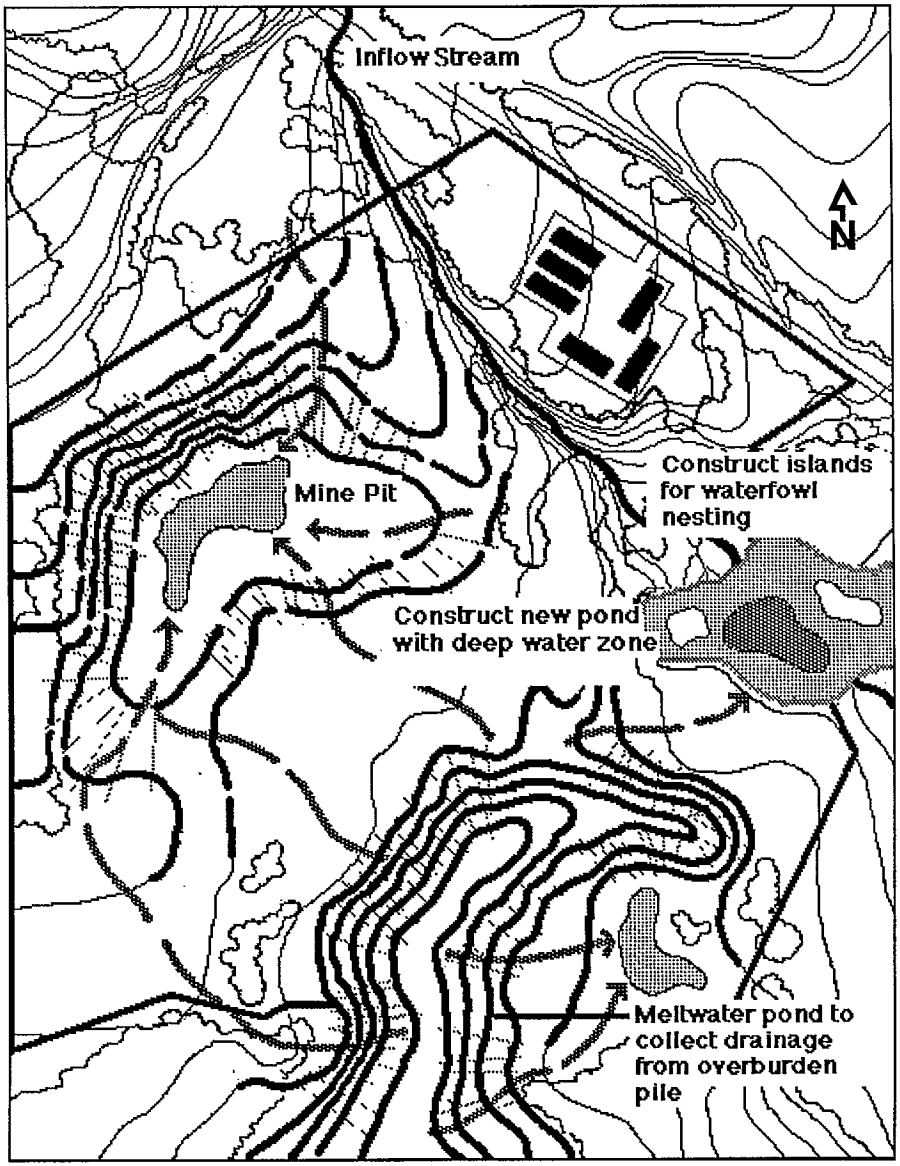
Drainage and Water Forms

- Determine which watercourses and waterbodies can be left intact on the site.

- Identify water forms that will be created during normal site development and operation. Examples include drainage ditches and settling ponds. Describe major enhancements to be made to these areas.

- Develop designs for water forms to be created specifically for wildlife. These designs could include creating watercourses, constructing dams, or contouring swales on hillsides to retain water.

Water Form Enhancement & Modification



Plant Communities

- Based on the selection of key wildlife species and habitats for reclamation, determine if the existing plant communities are still appropriate for the planned landforms and water forms.

- For each community, select plant species that are suitable for the key wildlife species. Select at least two or three plant species for each of the major habitat strata – trees, tall shrubs, low shrubs and groundcovers. The number of strata will depend on the habitat type required.

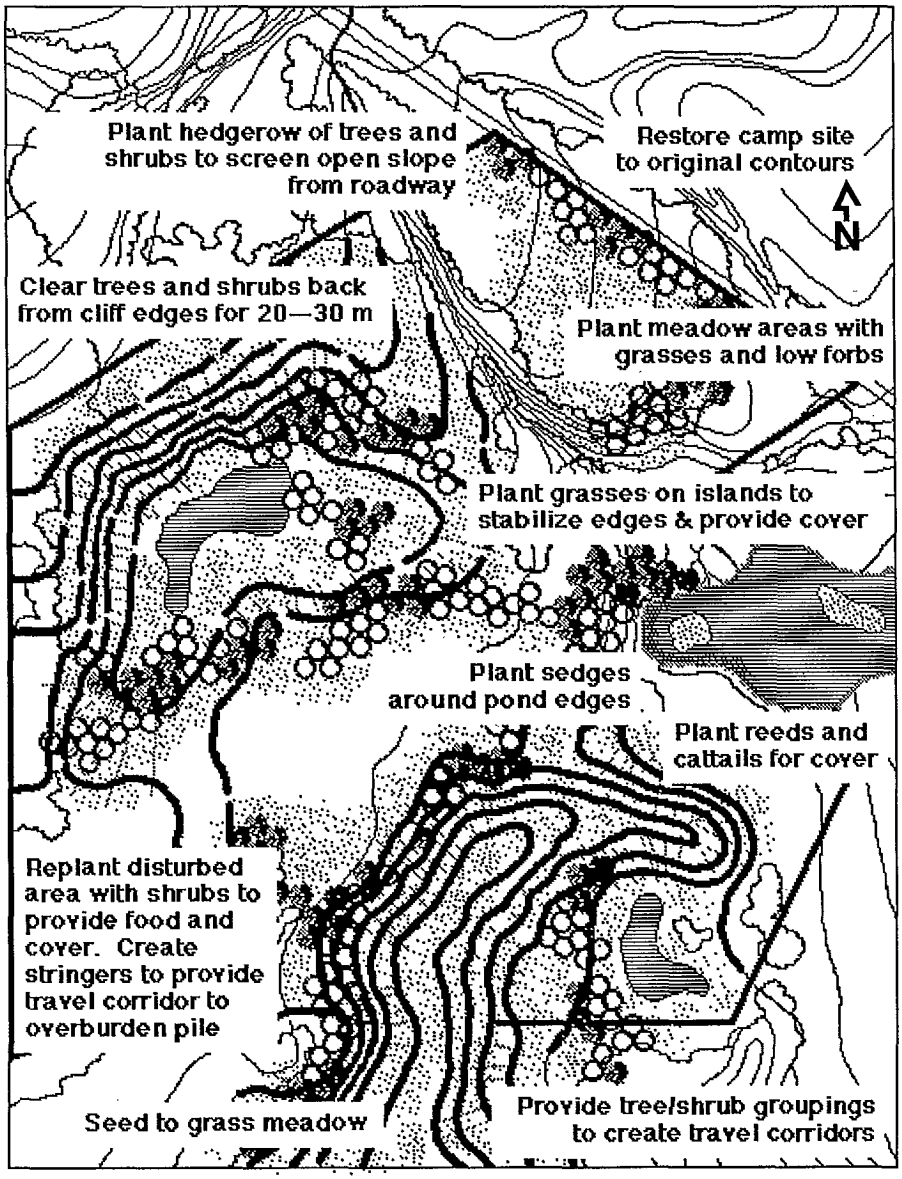
- For water forms, select appropriate plant species for open water and shoreline areas.

- For each plant community, identify the size of the planting area, the pattern or arrangement of plants within the planting area, and the spacing between plants.

- Identify any special maintenance needs. For example, watering of trees and shrubs may be necessary under some site conditions to ensure adequate survival of seedlings.

- Determine if native plants can be transplanted individually or as clumps to reclamation areas. Expansion areas for a development can sometimes provide tree and shrub stock for transplanting.

Landscaping & Site Restoration



Special Habitat Features

■ Some special features can be constructed from on-site material such as deadfall, rock rubble and brush, and potential locations for such material should be identified. Transfer of this material to either a permanent site or storage area should be scheduled in the development and operation plan.

■ Other special features such as artificial nesting sites can be added to a reclamation plan as needed.

Updating a Reclamation Plan

As development and operation proceed, reclamation planners should maintain frequent contact with the operations personnel to ensure that any new opportunities for wildlife habitat reclamation are considered. Annual development and reclamation reports to government agencies provide a good means of updating the reclamation plan. The operations personnel should also be made familiar with major aspects of the reclamation plan, particularly with regard to landforms and water forms, as they may be able to develop unforeseen features for wildlife at little extra cost.

CHAPTER 4

MODIFYING AND ENHANCING LANDFORMS

Natural landforms are an important element of wildlife habitat. Landform features such as slope pitch, orientation, shape, stability and soil texture all affect the establishment of plants which, in turn, affects habitat area, the amount of habitat edge, and habitat diversity. Landforms also influence the development of water forms within a site.

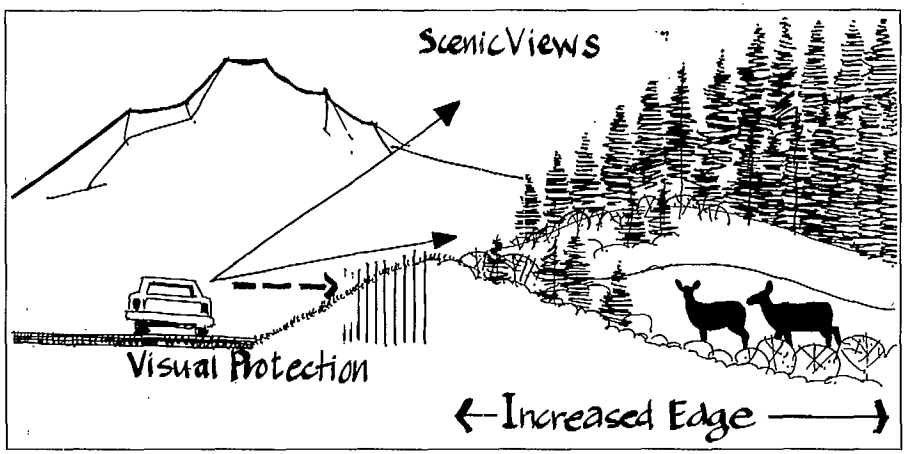
In addition, landforms provide special habitat features such as escape terrain for bighorn sheep, nesting sites for raptors, and burrowing sites for small mammals. Diverse terrain provides protective cover from climatic extremes as well as visual or hiding cover from predators and human disturbance.

Reclamation often results in a loss of landform diversity. Smooth contouring of slopes, destruction of highwalls and backfilling of end pits are often a regulatory requirement of reclamation plans. Recontouring disturbed landforms is usually a significant cost in reclamation and, in addition, may destroy areas of potential value to wildlife. In contrast, maintenance of disturbed landforms for use by wildlife will usually involve only minor terrain changes.

In this chapter we examine methods of improving post-development landforms for wildlife. Methods also are discussed for creating diverse landforms by modifying standard operational techniques.

Rolling Terrain

Rolling landforms suitable for use by wildlife can often be created through changes in the handling of materials, or by recontouring existing surface features. Rolling terrain provides a variety of exposures, increases snow accumulation, and helps retain rainfall and runoff, thus preventing surface erosion. It also provides a variety of sites for plants to establish, thus increasing the amount of edge and the potential for plant diversity. Rolling landforms also provide wildlife with visual protection from humans and predators. This will be particularly important during the first 5 - 10 years after reclamation when plant cover is still developing.



Above-Grade Features

Although large above-grade features (at least 20 m wide x 50 m long x 5 m high) are preferable, emphasis should be placed on providing a variety of different sized and shaped features. Two methods can be used to provide rolling terrain using above-grade features.

- Free-dumping of Overburden

Dump overburden in an irregular fashion on flatland areas or along existing slopes to create irregularly shaped waste piles. Ensure that any follow-up machine work will minimize the loss of surface irregularities on these areas.

- Recontouring

Regrade existing site features, such as spoil piles or overburden waste piles, to create gradually sloped ridges or rises that run across the fall line of the hill at right angles or very shallow angles (less than 22%). Excavated material can then be used to diversify the shape of the pile. Depressions between the ridges may be suitable for development of small ponds, marshland areas, and poorly drained shrublands.

Below-Grade Features

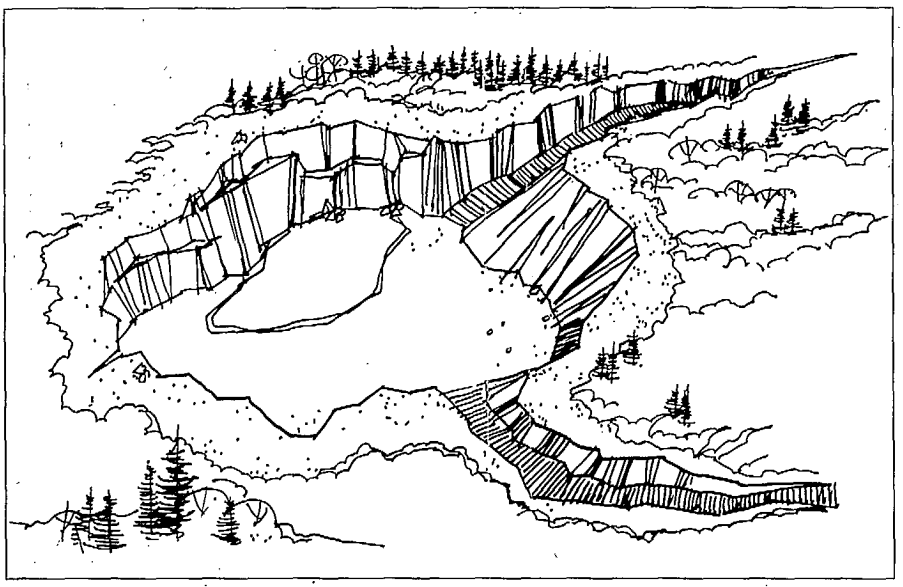
Below-grade features can be developed for wildlife through modification of existing site features or the excavation of new depressions or swales. With below-grade features it should be ensured that wildlife have sufficient access to and escape routes from the depression. Where possible, access should be provided at existing wildlife travel corridors. Below-grade features often provide excellent locations for the development of waterbodies (see Chapter 5).

• Modifying Site Features

Although some below-grade features can be developed for wildlife following the completion of activities on a site, it is preferable to develop these features as part of the operation plan. Features can then be easily modified, they can be larger or more extensive, and costs can be minimized.

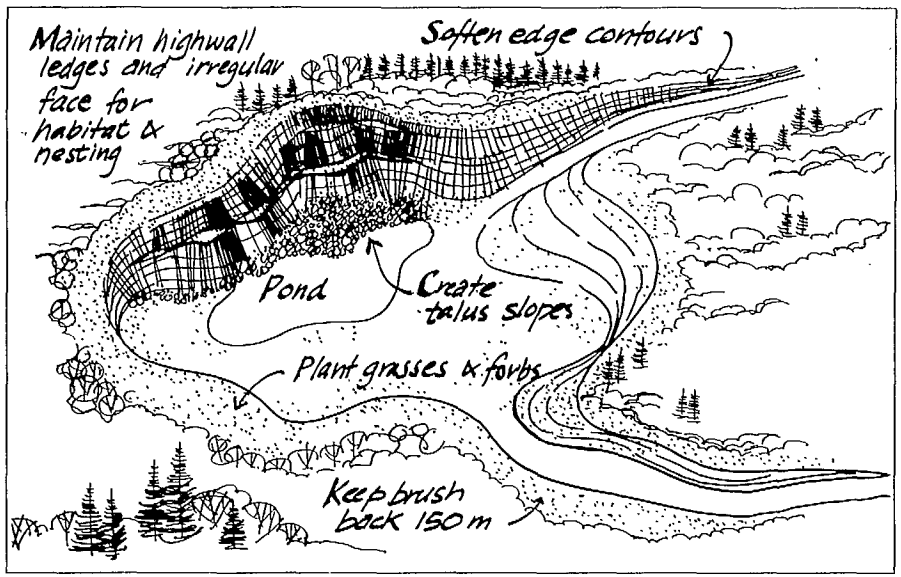
■ Regrade borrow pits and mine pits to provide gradual slopes (less than 44%) into the pit bottom. Keep the slopes, contours and elevations irregular.

■ Recontour or design below-grade haul roads as watercourses or to provide coulee-like approaches to pits.



- Excavation of Shallow Depressions

On flat areas or shallow slopes, depressions can be excavated to create shallow swales. This is particularly useful in dry areas where collection of rainfall and snowmelt promotes growth of trees and shrubs. Depressions should be 5 - 15 m wide, 10 - 20 m long and at least 1 - 2 m deep with gently sloped (less than 56%) approaches to the depression.



Shaping of Overburden and Spoil Piles

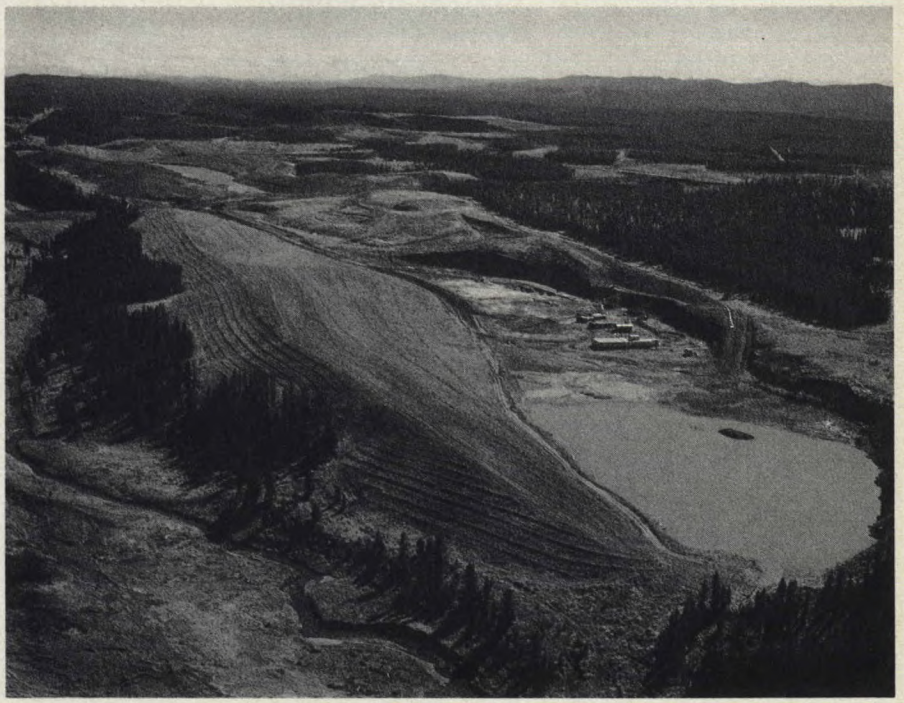
Spoil and overburden piles can be located to provide wildlife with a screen from heavy industrial activity, or can be irregularly contoured to provide a variety of landforms and aspects. However, to be economical, these features should be planned and started during the early stages of the development.

- Berms for screening should be a minimum of 2 - 3 m in height.

- Large overburden or waste piles should provide some shelter from the prevailing winds, as well as slopes exposed to these winds. A variety of slope angles, aspects and irregular local contours should be provided to increase habitat edge and growing sites for plants.

Special Landforms

Features such as highwalls, rock rubble, overhangs and caves are often created during site operations and provide important landforms for some wildlife species. Incorporation of these landforms into the reclamation plan is one means of increasing local landform diversity, with potentially significant cost savings to the development. Because opportunities for constructing these landforms are most common during the operational stage of a development, it is important that needs for special features are considered during the planning phase. Enhancement of these features is discussed in Chapter 7.



DEVELOPING AND ENHANCING WATER FORMS

Water is an essential habitat element for most wildlife. Establishment of permanent, self-sustaining water forms on or adjacent to a reclamation area is thus an important factor in providing good wildlife habitat, particularly on larger sites (greater than 3 - 5 ha) where some parts of the reclamation site may be far removed from an accessible water supply. (A major exception to this is ungulate wintering range, where water may encourage animals to remain throughout the summer, thus resulting in overuse of the site. See Chapter 10.)

Water forms also provide opportunities to create a variety of habitat edges associated with shorelines or streambanks. For example, willow shrublands thrive on saturated soils around waterbodies and along creeks, and provide forage for ungulates, cover for small mammals and birds, and shade for fish.

Development of water features for wildlife can be combined with and improve water protection measures on a site. The enhancement or creation of water features for wildlife can reduce downstream soil erosion, increase sediment retention, improve water chemistry, maintain groundwater supplies on the development site, and improve water quality in areas receiving run-off from the site.

Watercourses

Drainage structures are a common feature of most industrial sites. They can be designed to provide wildlife with a ready source of water and with travel corridors, and provide a good planting site for some trees and shrubs. Watercourse construction or enhancement for wildlife should involve three components:

- watercourse location and design
- channel and streambank stabilization
- streambank enhancement

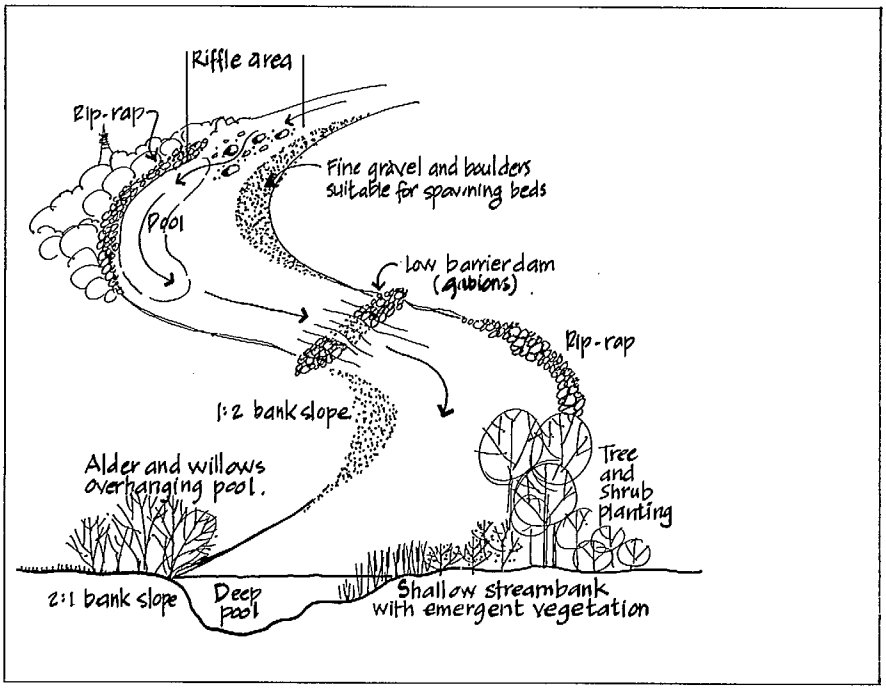
Locating and Designing Watercourses

The location of watercourses within a site will be determined primarily by landforms, but local routing can be modified by changing the gradient and channel shape. For maximum use by wildlife, a watercourse should have a shallow gradient (less than 11%) and a sinuous channel to slow water velocities. Sinuous channels eventually provide a variety of bank heights and shapes through natural erosion processes. Pools can be constructed at bends to provide deep water areas for fish and aquatic mammals. In flatland areas, bends in the watercourse can be extended to create oxbow lakes and wetlands.

- Watercourse width and depth must be sufficient to handle a maximum discharge equivalent to two consecutive 1:10 year flood events.

- Bends in the watercourse should be separated by distances 5 - 7 times the stream width.

- Pools on bends should be 0.5 - 1.0 m deeper than the channel bottom, and should be excavated when the channel is dry or during low water.



Instream Devices

■ **Checkdams** – low barriers to stream flow – can be placed in straight runs of a watercourse to create shallow upstream pools and downstream scour pools.

Checkdams should preferably extend 0.25 m above the streambed and should only be installed in low velocity streams (less than 3 cu metres/s). Checkdams are best constructed of rock, concrete, gabions or logs, with bracing extending at least 2 m into the streambank.

■ **Rock or concrete ledges** provide similar benefits to checkdams, but do not impound water upstream.

Rock or concrete slabs should be imbedded in the streambed. Rip-rap the scour pool and upstream edges to reduce erosion potential.

■ **Large boulders** in streams create pools and reduce current velocities.

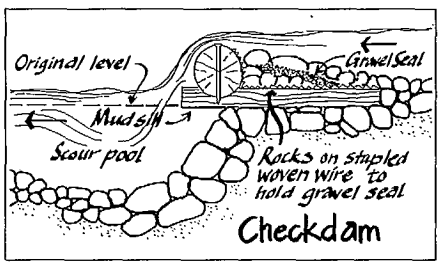
Preferred boulder sizes are 1 cu metre or larger. Large boulders should be located on firm substrates to minimize bottom scour. Boulders should not be placed in areas where water currents will be deflected onto soft streambank material.

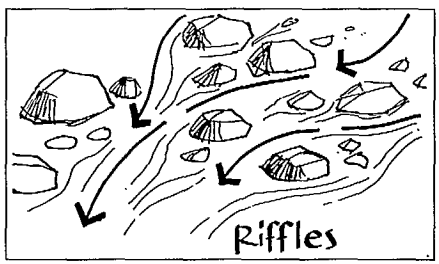
■ **Artificial meanders** can be used to reduce stream velocities and to increase habitat diversity in the stream channel.

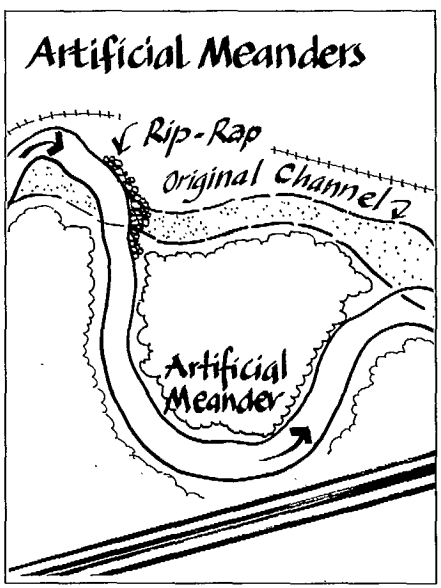
Meanders are best located in flatland areas. Rip-rap containing large boulders (up to 1 cu metre) should be used to stabilize the streambed and prevent streambank migration in meanders. The stream cross-section should be uniform within the meander.

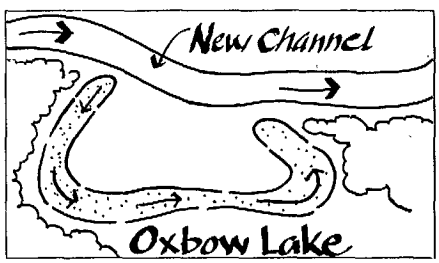
■ **Artificial oxbow lakes** can be constructed in conjunction with natural or artificial meanders, or by extending streambank channels on the outside edge of bends.

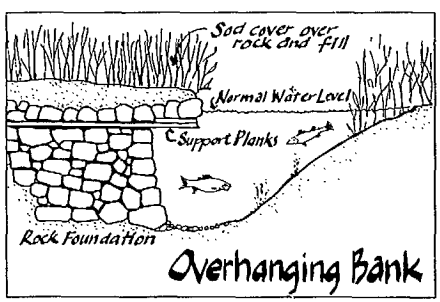
Oxbows are best constructed in flatland areas and on watercourses with low water velocities. Shallow sills should be constructed at both the inlet and outlet channels. Deeper areas can be dredged in the central area of the oxbow.











Streambank Stabilization

Newly constructed streambanks are prone to erosion and should be stabilized through revegetation and mechanical means.

Revegetation

Vegetation along streambanks binds the soil, provides food and cover for wildlife and, through shading, moderates water temperatures in the stream.

- Intermittent, gently sloping waterways can be reseeded with sedges or grasses (such as reed canarygrass, timothy or red fescue) to reduce water velocity and erosion.

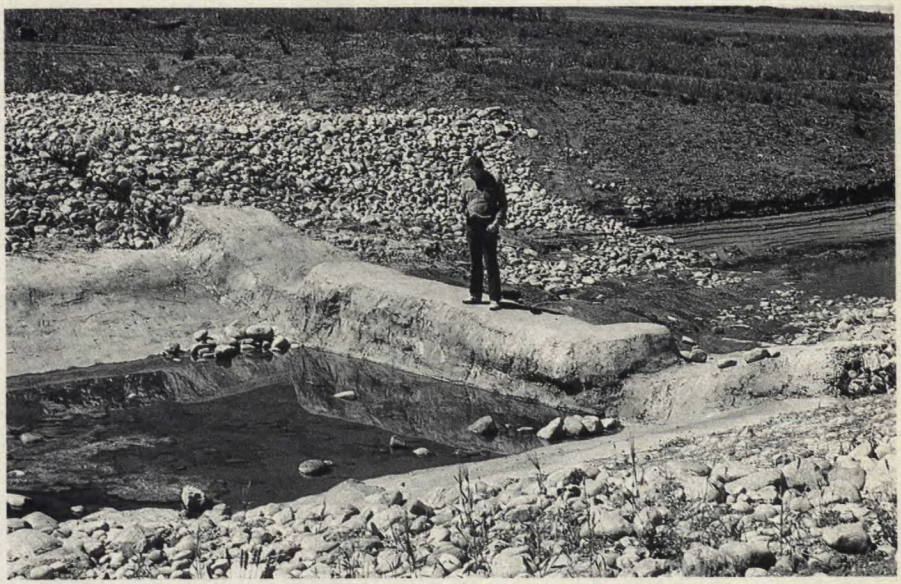
- In seasonal or permanent waterways, bank cover can be provided through seeding of grasses and sedges, clump planting of aquatic plants, and transplants of trees and shrubs.

- Plant good turf-forming groundcovers along streambanks; the species selected should be able to withstand a wide range of moisture conditions and short-term flooding.

- Clumps of aquatic plants such as bulrushes, cattails and sedges (with root clumps at least 0.25 cu metre in size) can be transplanted along streambanks in slow-moving areas of the watercourse. Clumps should be anchored securely with rocks or metal staples until roots are established.

- Shrubs can be planted using fresh cuttings of willows and alders (treat stems with rooting hormone) or transplants of established plants. Use shrubs to stabilize cutbanks and to establish plant cover in depositional areas of the stream.

- Plant trees 2 - 5 m back from the streambank to prevent excessive shading of the watercourse.



Mechanical Stabilization

Rip-rap, gabion matting, wood cribbing, and erosion control fabrics can be used to stabilize streambanks until bank vegetation is well established.

- Rip-rap must be of sufficient size, shape and weight to withstand expected water flows. Spaces between stones should be large enough to not become clogged with silt. Rip-rap must extend at least 40 cm below the low water line.

- Gabions should contain moderate to large-sized rock material (10 - 30 cm diameter) with wire mesh openings small enough to retain rock material. Lids of gabions should close in a downstream direction to avoid snagging. Debris should be removed periodically.

- Wood cribbing can rot quickly when exposed to air and should be maintained periodically.

- Erosion fabrics are useful for entrapping sediments and promoting plant growth, but must be securely anchored with staples or rock.

As mechanical methods are best used in combination with revegetation, a soil cap should be provided on these structures.

Overhanging Banks

Overhanging banks provide cover for fish and aquatic mammals such as beaver, muskrat, mink and otter. Artificial overhanging banks can be constructed on the outside bends of stream channels using log or plank platforms to support overhanging ledges of topsoil. Grass and sedge groundcovers and shrubs such as willows or alders should be planted on the platform for stabilization.

Creation of Lakes and Ponds

Lakes and ponds are defined as waterbodies with average water depths over 3 m, large open water areas (80% or more of the waterbody), and small areas of emergent plant growth. Sedimentation ponds, end pits, and tailings ponds provide potential sites for lake and pond development; however, water quality in some of these sites may restrict final uses if toxic leachates or residues are present. Spoil ridges or overburden can be used to create islands within lakes and ponds.

Location

Lakes and ponds should be located in areas where runoff from the reclaimed watershed will provide sufficient water to replenish annual water losses from the reservoir. One or more inlet streams and one outlet channel should be present.

Substrate

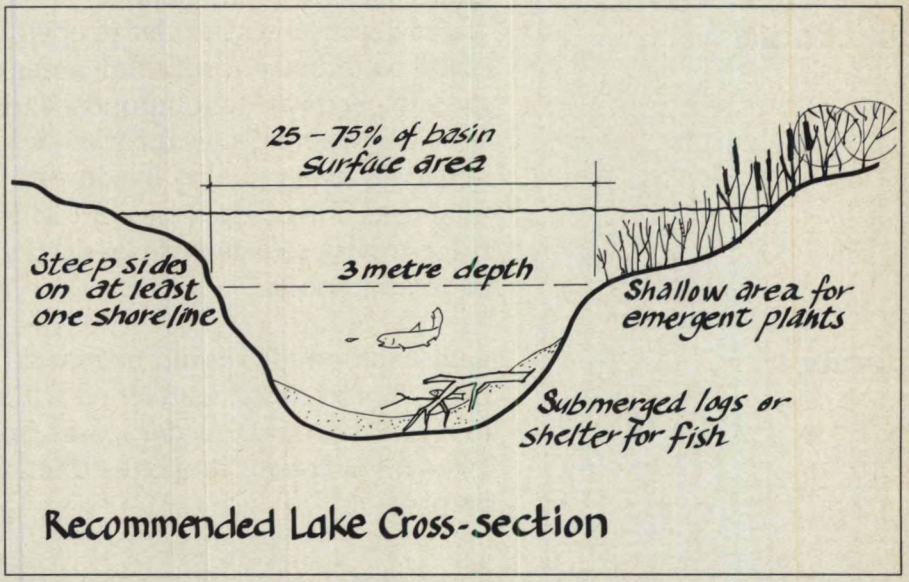
Substrates must retain water well enough to prevent saturation of the shoreline and sloughing of the outslopes from the lake. At least 20% of the substrate mix should be fine clays or other non-porous material. Compacting of substrates may be necessary. Topsoil and hay mulches should be applied to the bottom (to provide a growing substrate for plants) whenever operating water depths will be less than 3 m. Substrate materials should have a pH range of 5.5 - 7.5.

Depth

At least 25% and preferably 75% of the basin should be more than 3 m in depth.

Bottom Contours

Bottom contours should be irregular (with variations of 1 - 2 m) to provide a variety of bottom types. Narrow to wide shoreline shelves with gradual slopes (11 - 22%) and average depths of 0.5 - 1.5 m encourage growth of aquatic plants. In deep water areas and along some parts of the shoreline, steeper slopes (44 - 67%) should be used to provide access to deep water and to limit plant growth.



Recommended Lake Cross-section

Shoreline Configuration

Irregular shoreline shapes are preferable to smooth shapes, as irregular shorelines provide more wildlife habitat and help to reduce shoreline erosion. Peninsulas and bays should be constructed with a variety of water depths provided along the shoreline. The shelf width of shallow water areas along the shoreline also should be varied.

Creation of Wetlands

Wetlands are defined as small waterbodies with depths less than 1.5 m throughout most (80%) of the waterbody. Shallow basins within a site drainage system, borrow pits, sedimentation ponds, and sewage treatment lagoons all offer potential sites for wetland development. Wetlands provide a readily available water source for wildlife, improve soil moisture and groundwater supplies in surrounding areas, increase habitat edge, and provide opportunities for development of riparian communities. Wetland vegetation also offers a potential treatment for some water pollutants and for sedimentation.

Location

Because wetlands are shallow and aquatic plants are dependent on relatively stable water conditions, wetlands should be located in areas where flash floods are minimized (but where annual recharging of the wetland is still possible). Partial drainage of the wetland should be undertaken once every 3 - 10 years to allow reseeding of aquatic plants, and to promote decay of built - up organic debris. A controllable weir or stop-log weir should therefore be installed at the wetland outlet.

Substrate

Like substrates for lakes and ponds, wetland substrates should be relatively impervious. Bottom materials should be capped with a layer of topsoil (20 cm or more) and a thin layer (2 cm) of hay mulch to provide a growth medium for plants, and to establish a natural detrital cycle. Bottom substrates from wetlands or ponds that will be destroyed in other parts of the development site should be salavaged for use in the new wetlands.

Size

Wetland sizes can be adapted to the mine plan, but should be a minimum of 0.2 ha and preferably 0.4 - 2.0 ha. Larger wetlands can be developed, but should include small islands and complex shorelines to promote maximum use by wildlife.

Depth

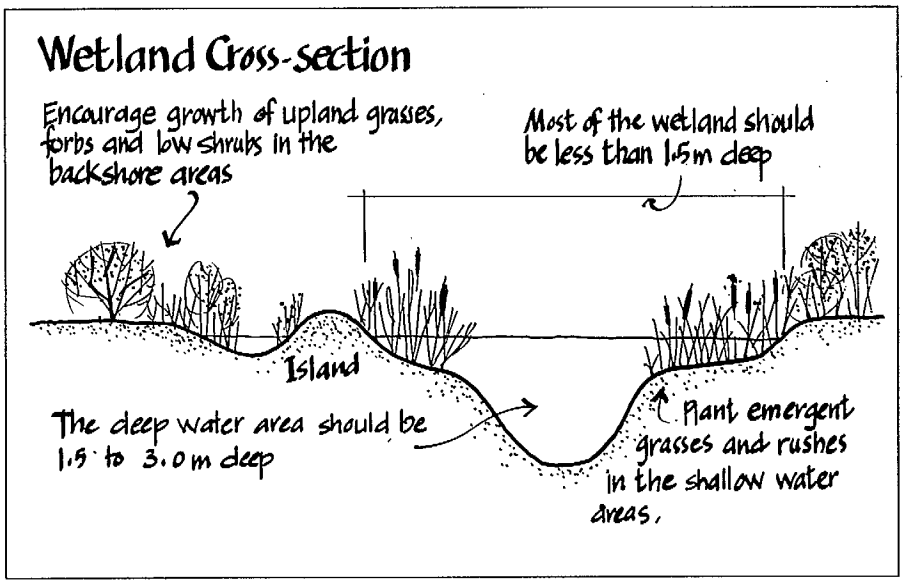
Wetland water depths should generally be 0.5 - 1.5 m. Because a 50:50 mix of open water and wetland vegetation is most productive for wildlife, depths should be variable throughout the wetland. Water depths should exceed 1.5 m in only 20% of the basin.

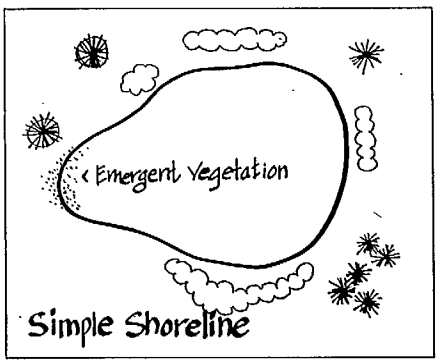
Bottom Contours

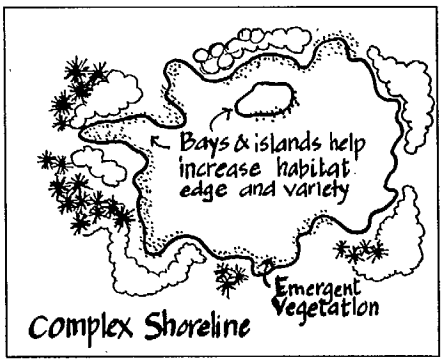
Overall bottom contours in a wetland should approximate the shape of a shallow saucer, with bottom slopes and outslopes of 11 - 22%. Bottom contours should include local irregularities to increase the interspersion of shoreline and shallow and open water areas. Slopes in deep pools should be 44 - 67%. Deep water areas can be created by excavating pools and constructing shoals or islands with the excavated material.

Shoreline Shape

Irregular shorelines are preferable for wetlands. Bays, peninsulas, shoals and islands increase habitat edge and provide a variety of habitats for wildlife.



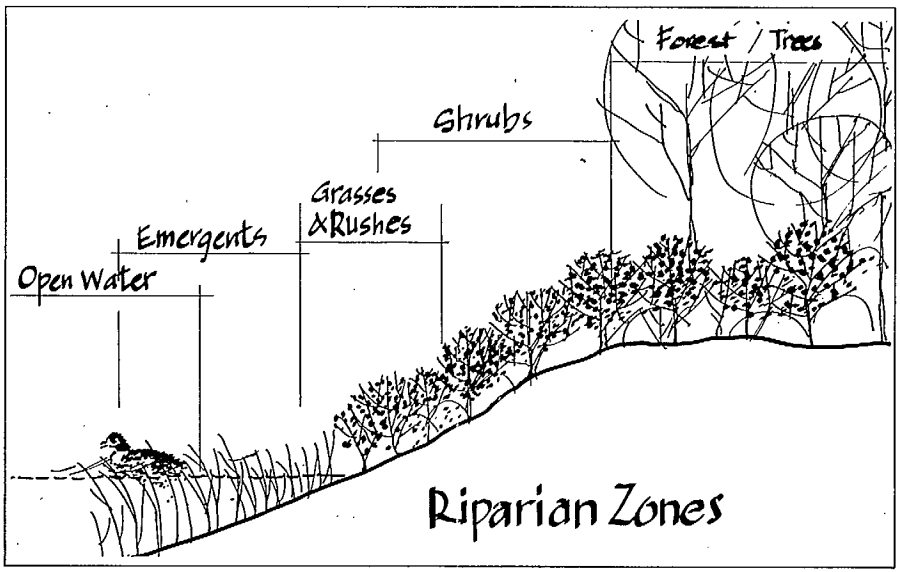




Riparian Zones

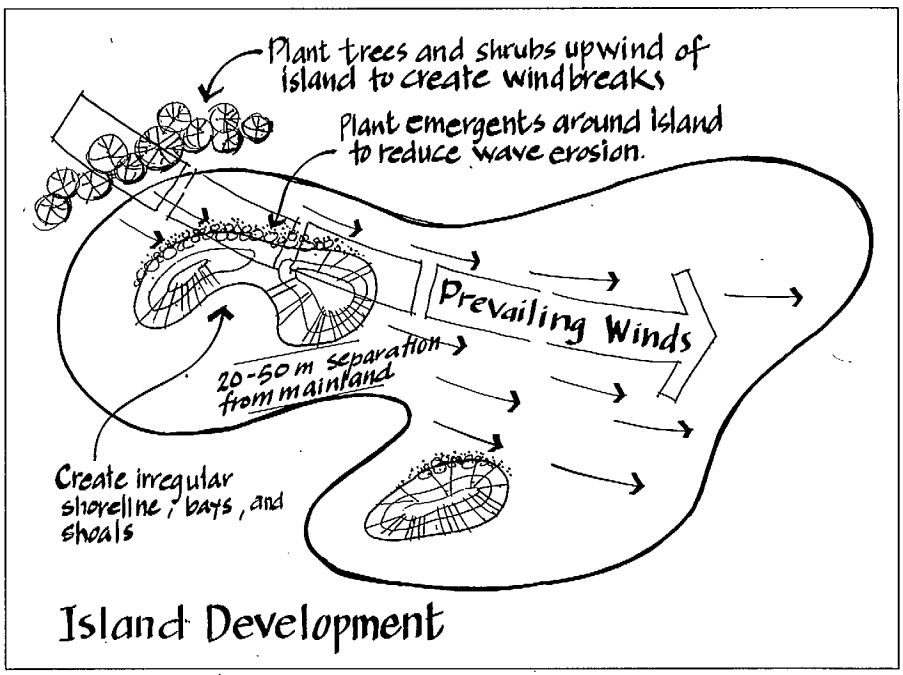
Riparian vegetation communities occur in moist or saturated soils adjacent to watercourses, waterbodies and seeps. They usually consist of dense shrubs such as willows or alders, with some grass and forb cover. Riparian communities intercept overland drainage, reduce soil erosion, stabilize streambanks, help trap sediments and nutrients, and provide productive sources of food and cover for many wildlife species. Because water is readily available, some trees and shrubs can be established more easily in riparian areas than in well-drained sites.

Shrub seedlings and/or stem cuttings of willow, alder and dwarf birch (treated with root hormone) can be used to establish shrub cover in riparian areas. Balsam poplar also can be planted in low densities (i.e., 10 - 20 m spacings). Sod-forming grasses such as red fescue or flood tolerant grasses such as reed canarygrass can be planted immediately adjacent to the water's edge to stabilize the streambank or shoreline. Interplanting of shrubs and grasses should be avoided as moist, grass dominated areas will attract small mammals, which may girdle and eventually kill tree and shrub plantings.

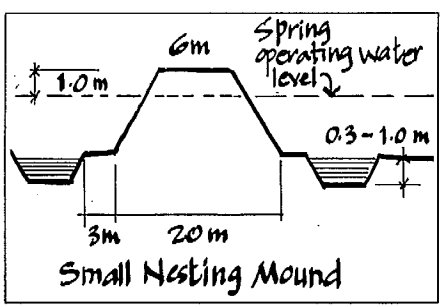


Island Development

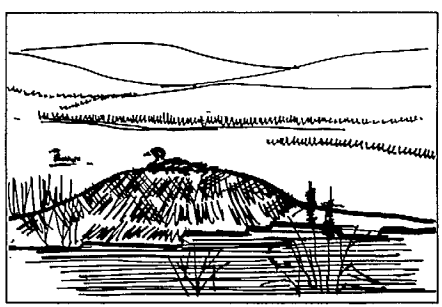
Small islands in lakes, ponds and wetlands, and even in slower- moving areas of streams, provide habitat edge, as well as seclusion for nesting and loafing waterfowl. They also add to the aesthetic appeal of the waterbody. Islands can be created by excavating and mounding of earth prior to flooding, by severing a peninsula from the mainland, by dumping rock or earth fill, or through modification of spoil piles in end pit lakes.



Island Development



Small Nesting Mound



Location

Islands should be separated from the mainland by water at least 20 - 50 m wide and 0.3 - 1.0 m deep. Islands should be spaced a minimum of 100 m apart, and located on the upwind side of the waterbody or in other areas protected from prevailing winds. Plantings of emergent vegetation around the island or clump plantings of trees and shrubs on the mainland upwind of the island help to reduce wave erosion. Long, narrow islands should be oriented parallel to the prevailing winds.

Size

Size does not appear to be a critical factor in wildlife use of islands. In large waterbodies (> 20 ha), several well-spaced small islands are preferable to one large island. Islands 100 sq metres or more in size are adequate for use by most waterfowl.

Substrate

Islands can be constructed of almost any stable fill material, but should be capped with 20 - 40 cm of topsoil to provide a suitable site for plant growth. Rock rip-rap or other physical erosion controls can be used in combination with plantings of emergent aquatic plants, grasses, and forbs to reduce erosion. Trees and tall-growing shrubs should generally not be planted on islands intended for use by waterfowl, as they provide perching sites for avian predators. However, on islands with exposed surface areas greater than 25 sq metres, a few widely spaced, low shrubs (rose, spiraea, snowberry, shrubby cinquefoil) will provide protection for waterfowl nests.

Shape

Shoreline complexity should increase with island size. Islands more than 1000 sq metres in size should include irregular shorelines, small bays, peninsulas and shoals. The tops of islands should be flat and on average 1 m above spring water levels. Side slopes should not exceed 44%.

RE-ESTABLISHMENT OF PLANT COMMUNITIES

Establishment of vegetation on reclaimed landforms and in and around water forms is the last essential element of wildlife habitat reclamation. Revegetation for wildlife must take account of several factors, including seasonal habitat needs of the key wildlife species, the size of the reclamation area, the placement and spacing of plants within communities, and the arrangement of the plant communities on the site.

The two most important considerations in revegetation for wildlife are:

1. that the plant communities are compatible with the physical elements of the site; and

2. that the combination of these plant communities and the physical elements of the site will fulfill the needs of the key wildlife species.

For example, plantings of white spruce trees would not be appropriate for a steep, south-facing, rocky slope, but would be suitable for a north to east-facing slope. Or, from a wildlife perspective, steep, south-facing, rocky slopes would be suitable for development as habitat for bighorn sheep only if the slope could provide some escape terrain and if adjacent areas could be reclaimed as forage-producing grassland communities.

Needs of Key Wildlife Species

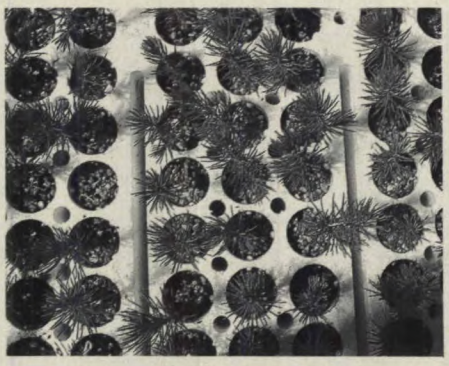
Selection of trees, shrubs, forbs and grasses must satisfy the needs of wildlife for food and cover. Information on wildlife use of plants on and around the site prior to development can be helpful in selecting appropriate plant species. Commonly preferred plants of each of the key wildlife species are discussed later in the manual (see Chapter 9).

Native vs. Agronomic Plant Species

Although it is often suggested that native plant species are superior to agronomic species for use in reclamation, there is little evidence to suggest that one group is superior to the other in terms of wildlife preference, nutritional value or growth. However, it does appear that once native species are established, little or no maintenance is required. As a general rule-of-thumb, if locally adapted, native plant stock is available and economic, it should be used in preference to agronomic species.

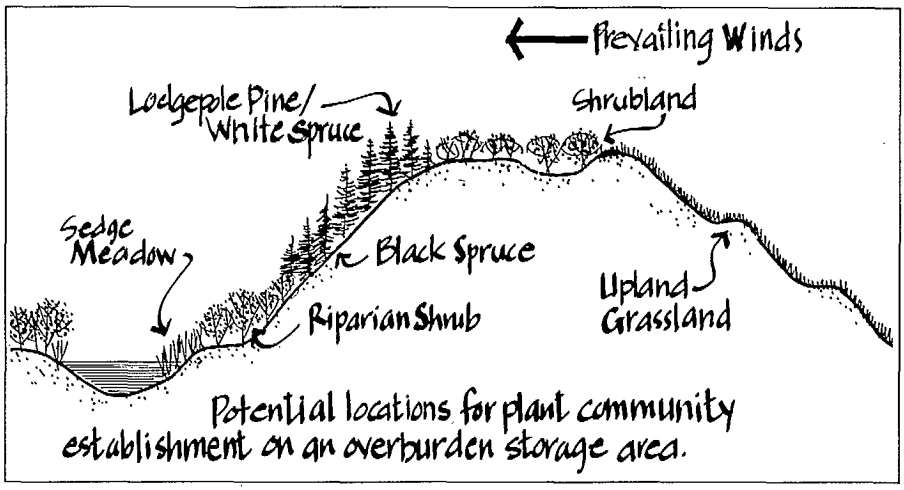
Palatability

The varying palatability of plants to wildlife can be a valuable tool in managing reclaimed habitat. Plants that are not commonly eaten can be chosen for discouraging use in areas sensitive to erosion or to overuse by wildlife. Conversely, palatable plant species can be used to encourage use. Use of fertilizer may increase the palatability of some plants, particularly to ungulates.

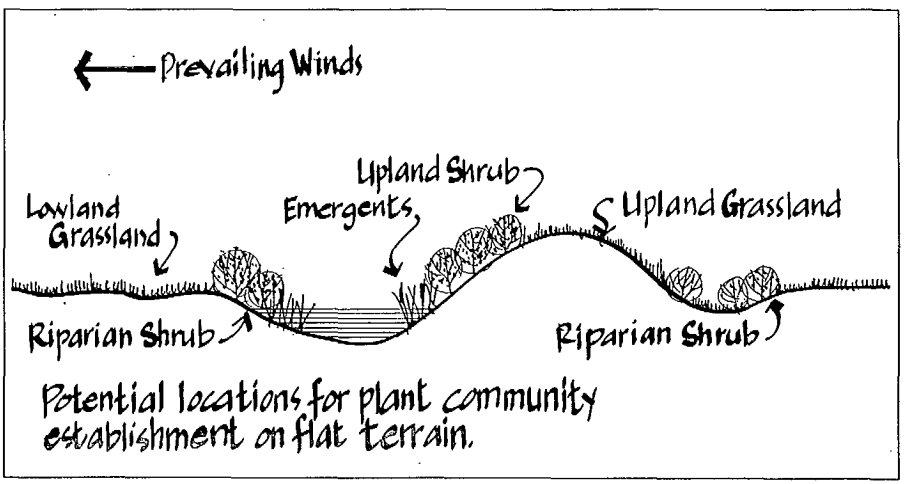


Locating Plant Communities

Plant communities should be established on sites that meet the tolerances of component species for slope, aspect, soil moisture, soil type and exposure to climatic extremes. The major types of plant communities and their potential locations within reclaimed sites are summarized in Table 1. The following planting suggestions are intended as general guidelines only. Examples of those communities on the site prior to development, or in adjacent areas, should be examined to help in the selection of trees, shrubs and groundcovers suitable for local conditions.



Potential locations for plant community establishment on an overburden storage area.



Potential locations for plant community establishment on flat terrain.

Grasslands

Grassland communities include alpine or tundra grasslands, upland grasslands, lowland grasslands and riparian meadows.

Alpine grasslands should generally be established in reclamation areas above 2000 m, although they also may be developed in dry, south-facing, subalpine areas with elevations as low as 1500 m. Because of the difficult growing conditions at these elevations, only a few grass species -- such as alpine bluegrass, bearded (alpine) wheatgrass and sheep (alpine) fescue -- can be practicably seeded. Sod transplants also may be of use.

Upland grasslands are best located on exposed ridgetops and on dry, exposed slopes at elevations of less than 2000 m. They can be planted with mixtures of crested wheatgrass, hairy wild rye, sheep (hard) fescue, green needle grass and june grass.

Lowland grasslands should be located on flat to gently sloping areas with good moisture conditions. Crested wheatgrass, redtop, hair grass, smooth brome, reed canarygrass, Canada bluegrass, green needle grass and red fescue all are suitable species.

Riparian meadows should be established on water-saturated soils around waterbodies and watercourses. Sedges, forbs, and some grasses (such as reed canarygrass and marsh reedgrass) are the best groundcovers.

Aquatic Plant Communities

Aquatic plant communities should be included in the development of all seasonal or permanent waterbodies. Possible species include emergent plants such as bulrushes, cattails, reed grasses, whitetop, sedges and arrowhead, and submergent or floating vegetation such as duckweed, yellow pond-lily or pondweed. Establishment of some emergent and submergent plants can be accelerated by transplanting root clumps (minimum of 0.25 cu metres), by transplanting mature plants, or by transferring bottom soil from adjacent wetlands. Most areas with water depths of 1.5 m or less can support emergent aquatic vegetation.

Table 1.
Plant Communities Appropriate to Regional and Site Conditions.

	Region/Community Type			
Prereclamation Landforms on the Site	**Mountains/ Foothills**	**Boreal Forest**	**Aspen Parkland**	**Prairie Grassland**
Steep slopes and ridgetops	Alpine grasslands Upland grasslands Coniferous forest Upland shrublands	Upland grasslands Deciduous forest Mixed forest Coniferous forest	Upland grasslands Coniferous forest	Upland grasslands Upland shrublands
Moderate to gentle slopes	Alpine grasslands Upland grasslands Upland shrublands Deciduous forest Mixed forest Coniferous forest	Upland grasslands Upland shrublands Deciduous forest Mixed forest Coniferous forest	Upland grasslands Upland shrublands Deciduous forest Mixed forest Coniferous forest	Upland grasslands Upland shrublands
Bottomlands (including existing or potential wetlands)	Lowland grasslands Riparian grasslands Aquatics Shrub meadows Riparian shrublands Coniferous forest	Lowland grasslands Riparian grasslands Aquatics Shrub meadows Riparian shrublands Deciduous forest Mixed forest Coniferous forest	Lowland grasslands Riparian grasslands Aquatics Shrub meadows Riparian shrublands Deciduous forest	Lowland grasslands Riparian grasslands Aquatics Riparian shrublands Deciduous forest

Shrub Meadows

Shrub meadows should be established in association with lowland grasslands or riparian meadows, and should generally be planted with shrubs such as willow, alder and dwarf birch. Well-dispersed shrubs and/or small clumps of shrubs (around 10 sq metres in size) can provide adequate cover. At maturity, shrubs should not occupy more than 25% of the community. Shrub meadows are a good community to develop in damp to water-saturated soils around waterbodies, along watercourses and in depressions.

Shrublands

Two types of shrubland can be developed: upland and riparian shrublands. In both cases, dense shrub growth should cover most of the area (more than 25%, and preferably 50 - 75%).

Upland shrublands should be established in association with upland grasslands, primarily on cool slopes and in flat, well-drained areas. Willow, alder, red osier dogwood, saskatoon, chokecherry and rose are the most suitable species for the Mountains/Foothills and Boreal Forest regions; snowberry, choke cherry, saskatoon, and buckbrush should predominate in the Aspen Parkland and Prairie Grassland regions.

Riparian shrublands are best suited to moist to wet soils found along watercourses and waterbodies, and in moist depressional sites and valley bottoms. Tall willow, dwarf birch, red osier dogwood and alder should dominate the shrub mix.

Deciduous Forest

Deciduous forest communities dominated by trembling aspen should be located on areas with moist to dry soil conditions. Aspen trees should eventually provide a moderately dense tree canopy (50 - 75% cover), with a shrub understory of saskatoon, rose, red osier dogwood, alder and/or buffaloberry. Common juniper and bearberry should be planted as groundcover on dry sites.

Mixed Forest

Mixedwood forests are best suited to mid- and lower slope locations with east, west or south aspects. Depending on the region within the prairie provinces, mixed forests should be made up of several tree species such as aspen, white spruce, Engelmann spruce, paper birch, lodgepole pine, jack pine and Douglas fir. Shrub understories should include red osier dogwood, rose, saskatoon, high and low-bush cranberry, alder and willow.

Coniferous Forest

Several different types of coniferous forest can be developed depending on the slope/aspect and soil moisture. Subalpine fir/white spruce forests should be established at mid- to high elevations (up to 2000 m) on north-facing slopes with dry to moist soils. Lodgepole pine or jack pine/white spruce forests are suited to flat or gently sloping north to northeastern aspects with drier soils. Alder and saskatoon are suitable understory shrubs. Lodgepole pine or jack pine/black spruce communities are best established on mid- to lower slopes on northern, eastern or western aspects, or in flat areas with moist to damp soils. Labrador tea, dwarf birch and bog cranberry are suitable shrubs for this community. Black spruce/tamarack forests are most suitable for establishment on damp to wet soils, on northern and eastern aspects or in flat areas. Dominant shrubs in this community should be Labrador tea, dwarf birch, willow and bog cranberry.

Designing and Arranging Plant Communities

Once appropriate plant communities have been matched to the physical conditions of the site and the desired end use, the reclamation plan should include plans for the design (i.e., size, and shape) of each individual plant community and for the spatial arrangement of the communities to best benefit the selected key wildlife species. Planting patterns within communities are discussed later in this chapter.

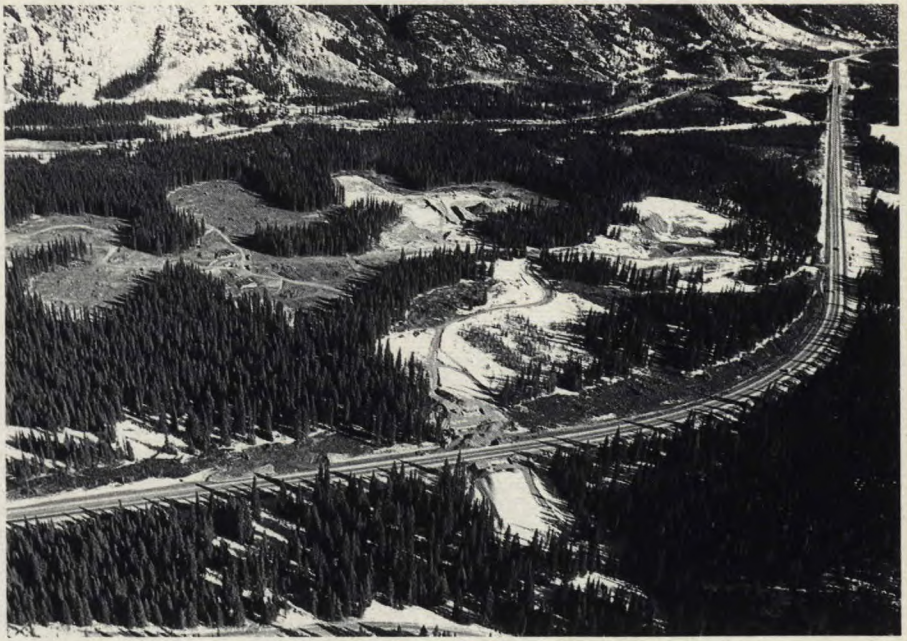
Because of time and cost restrictions in reclamation programs, it may not be possible to establish all the components of a plant community at one time. For example, in establishing woody plant communities, parts of the area can be planted with the appropriate tree and shrub species, and the interstitial areas planted with a low density of grasses and/or shrubs. Additional trees and shrubs can later be established in the interstitial areas as time, funds and materials permit. Natural invasion of trees and shrubs will also occur from surrounding undisturbed habitat, and eventually from the planted areas.

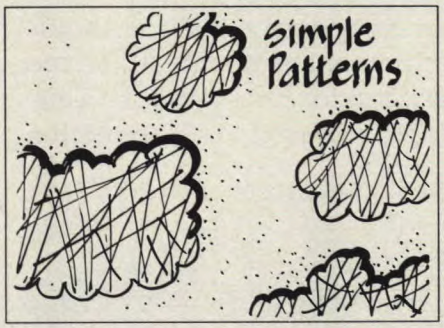
Size and Spacing of Plant Communities

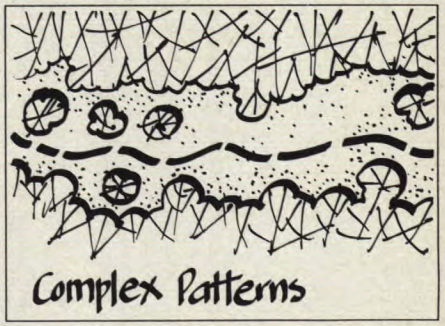
Both the optimal size and spacing of useable plant communities vary among wildlife species, and can be influenced by both landforms and plant communities in adjacent areas. It is therefore not possible to provide universal recommendations for community size and spacing. However, species-specific guidelines are provided in the key wildlife species summaries in Chapter 9.

Shaping Plant Communities

The shape of a plant community influences its use by wildlife. In general, units with an irregular shape provide the most habitat edge and hiding cover for wildlife.




Simple
Patterns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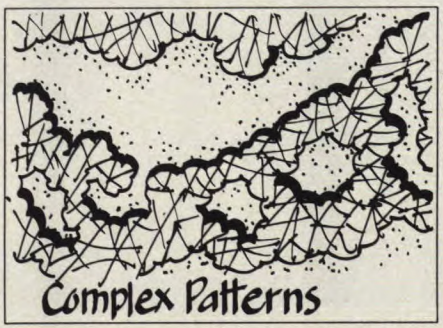
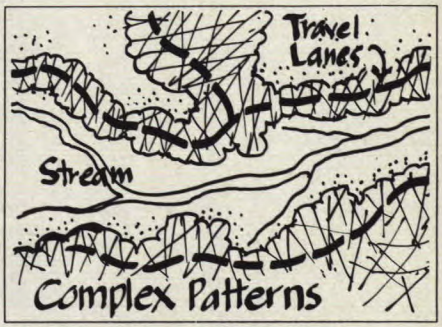

Complex Patterns


Travel
Lanes
Stream
Complex Patterns

Establishing Plant Communities

A number of techniques can be used to establish the basic elements of plant communities, particularly woody plant communities, for wildlife.

Shrub clusters can be used to provide core areas for shrubland reclamation. Shrub seedlings, bare root cuttings and seeds should be concentrated in discrete units at least 0.5 ha in size. Avoid planting grasses and legumes within the clump. In exposed areas, some physical protection such as snow fences, rock or soil berms, brush piles or deadfall may be necessary to protect the plantings from wind.

Topsoil islands can be used in areas with limited supplies of topsoil to provide localized growing sites with a thick, high quality growth medium for woody vegetation. Topsoil islands should be 0.5 ha or larger in size with a 35 - 40 cm layer of topsoil. Seedlings, transplants, bare rootstock and/or seed should be used to establish tree and shrub cover on topsoil islands. Areas between the islands should be planted with grasses, legumes and/or other forbs.

Wherever possible, topsoil should be transferred from new development areas directly to reclamation sites rather than stockpiled for long periods. This will provide a locally adapted and free source of native plant material for

immediate use. Direct transfer also reduces materials handling costs. Transfer of topsoil is best undertaken during the late fall to early spring period to ensure optimum plant survival.

Hedgerows can be used to reduce wind exposure as well as to provide visual cover and travel corridors for wildlife. Wide, multirow shelterbelts with 10 - 15 rows of trees and shrubs are better for wildlife than are single row plantings. Tall-growing coniferous and deciduous trees should be planted in the central portion of the hedgerow, with sequential rows of small trees, tall shrubs, low shrubs and tall groundcovers on either side of the central core. Rows within the hedgerow should be irregular and preferably contain a random mix of more than one species. In areas with strong prevailing winds, L, U or E-shaped designs provide increased protection for wildlife.

Transplanting clumps of native trees and shrubs from adjacent areas with tree spades or front end loaders can provide immediate cover on a site, as well as new localized sources of seed material for invasion of native vegetation. This technique is best used in protected locations with moist to damp soils. Care must be taken to ensure that the soil

around the root ball is well packed and that clump edges are sealed to prevent drying. Small rodents also may damage root pads by tunnelling and severing roots. Trees and shrubs less than 2 m in height are most likely to survive transplanting.

Preservation of natural vegetation islands on the development site ensures immediate cover and food for wildlife while providing a source of seed and plant stock for invasion into the reclaimed area. Fingers of natural cover also can be left along the edge of the development site. If islands of native vegetation can be preserved during site development and operation, they should be at least 0.5 ha in size and preferably be located along travel corridors, around important use sites or adjacent to watercourses and waterbodies.

Planting Within Units

Both planting patterns and plant spacing within individual communities strongly affect the degree of wildlife use, and ultimate reclamation success.

Planting Patterns

In tree-dominated communities, the trees and shrubs with the tallest mature heights should form the core, with progressively shorter trees and shrubs arranged in irregular bands around the core. The use of straight rows or uniformly shaped bands should be avoided as an irregular pattern will greatly increase habitat diversity. Planting densities of trees and shrubs within a band should vary so that small openings in the tree and shrub canopy will be formed as the plants mature.

In shrub-dominated habitats, the shrubs with the tallest mature heights should be planted in a central irregularly-shaped core with shorter shrubs and groundcovers blending gradually into the surrounding area.

Planting Densities

Stocking rates and plant spacings vary according to the desired type of habitat and the species of trees and/or shrubs involved. For example, in open parkland habitats, trees may be as much as 10 - 20 m apart. In dense, closed-canopy habitats, tree spacings may be as little as 3 - 5 m and shrub spacing as little as 2 - 4 m. Specific guidelines for plant spacings are provided for key wildlife species in Chapter 9.

SPECIAL HABITAT FEATURES

Special habitat features (e.g., talus piles, salt licks, nest structures) can be developed in conjunction with reclaimed landforms, water forms and vegetation to further improve habitat conditions for key species. In addition, special features provide a straightforward means of fine-tuning broad habitat development plans to incorporate the needs of other species (for example, cliff-nesting raptors) that might occur in association with specific sites.

Highwalls

Although many of the abrupt landform features on a site, such as cliffs, gullies, badlands and rough breaks may be lost during development, other landform features such as highwalls and steep slopes are created during site operations. These features can be enhanced for wildlife and also can provide aesthetic and scenic benefits, with only minimal modifications.

Highwalls should preferably consist of competent igneous, metamorphic or sedimentary rocks, as softer rocks may erode and slump more easily. Although the cliff face should be stable for safety reasons, small-scale failures (for example, within small areas along a single bench) can provide local variation in the cliff profile. Highwalls should be located perpendicular to the slope, and in upslope areas as opposed to valley bottoms.

The optimum length and height of highwalls varies depending on the key wildlife species. However, small segments (less than 400 m) generally are preferred over long continuous segments. The height of the cliff face should be varied. Cliff faces with a variety of outward and inward projections provide the best habitat. Adjacent and opposing slopes should be partially recontoured to provide open areas next to the cliff face. Only low groundcovers and shrubs should be planted within 150 m of the cliff face and cliff top, in order to minimize hiding cover for predators.

Access corridors should be provided every 100 - 400 m along a highwall to allow wildlife to ascend or descend without travelling around the site. Access can be created by dumping overburden or rock rubble up to the top of the highwall, or by conversion of access roads or corridors. Talus slopes (see below) also can provide access.

If bighorn sheep or mountain goats are likely to use a highwall, ledges should be provided along the steeper portions of the cliff face to serve as escape routes. Ledges should be 0.5 - 2.0 m in width and lead to existing ledges or access routes. Spacing of ledges up the cliff face should be variable, although it is preferable to have at least one ledge per 10 m rise of the cliff face.

Isolated ledges and holes on the cliff face can provide a variety of nesting sites for raptors and other birds. Ledges are preferred nesting sites for most raptors (for example, golden eagles, gyrfalcons, peregrine falcons), and should be 0.5 - 2.0 m wide and up to 10 m long. Holes are more commonly used by birds such as ravens, crows and Canada geese, and should be 0.5 - 2.0 m in diameter and 0.5 - 2.0 m deep. To avoid competition between nesting birds, only 2 - 3 suitable holes and ledges should be provided for each 400 m of cliff face.

Wherever possible, a water source should be provided

within 300 m of the cliff face. This will provide drinking water for a variety of species as well as hunting areas for raptors. Small waterbodies can often be developed in the end pit at the base of a highwall. However, these waterbodies should abut talus rather than the highwall to prevent undercutting of the cliff face.

Talus

Talus provides habitat for a number of small mammals and birds, and is a particularly useful habitat feature when provided in association with highwall enhancement.

Talus should be composed of metamorphic or igneous rocks or competent sedimentary rocks (such as sandstone) as softer rock will erode easily and fill the interstitial spaces. Individual rock pieces should be at least 0.5 - 1.5 cu metres in size. Talus piles should be a minimum of 2 - 3 m thick but should include a variety of depths to provide diverse habitat.

Rock Piles

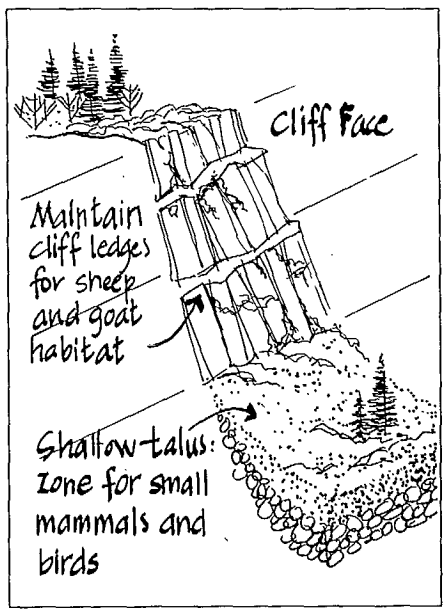
Rock piles can be used to provide cover for some small mammals and birds as well as landform diversity on a local scale. In some cases, rock piles can provide wind breaks for shrubs.

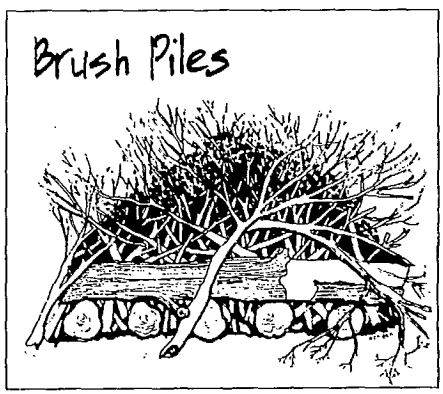
Rock piles should be 1 - 4 m high and occupy an area of around 10 sq metres. Lengths can be variable. The core of the rock pile should be constructed of three or more large boulders, 1 - 4 m in diameter, surrounded by smaller rocks. Rock piles for use by small mammals are best located in valley bottoms, draws and on protected hillsides, whereas rock piles for use by raptors are best located near hilltops.

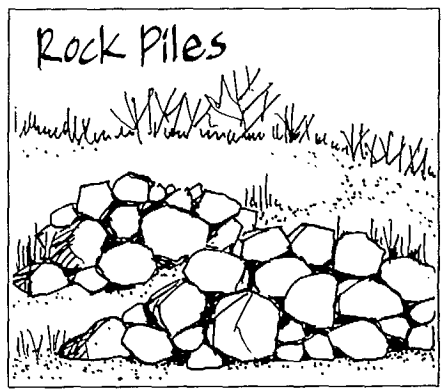
Brush Piles

Brush piles, like rock piles, can provide immediate (although temporary) cover for wildlife. However, because brush piles can become fire hazards, they should be located away from potential ignition sources.

Brush piles can be shaped as mounds or hedgerows and can be used in combination with rock piles. Brush piles should be created over a bowl-shaped depression centred on a piece of log or rock to provide clearance within the pile. Large branches (diameter of 5 cm or more and lengths greater than 1.2 m) should form the central core of the pile, and should be anchored in the soil or secured with wire or rocks. Small branches can be used to fill gaps in the central core and the outer parts of the brush pile.







Downfall, Stumps and Snags

Downfall, stumps and snags provide immediate landform diversity as well as cover for small mammals and birds.

Downed logs and stumps should be oriented at right angles across the slope of the land. Large diameter logs (more than 50 cm) provide the best cover. Logs of varying states of decay should be used.

Snags or standing dead trees should be 5 - 10 m in height and at least 20 - 30 cm diameter at breast height. The base should be anchored firmly in rock or concrete. Snags intended for use by raptors are best placed near hilltops or on mid-slopes.

Artificial Salt Licks

Artificial salt licks can be used to attract a variety of ungulates to a site, and hence to encourage use of adjacent vegetation communities. Conversely, salt can be used to draw animals away from overgrazed or heavily trampled areas.

Salt licks should be located on dry, flat sites or accessible ridgetops, never on slopes or other sites subject to water erosion. Licks should be located at least 400 m from drinking water sources.

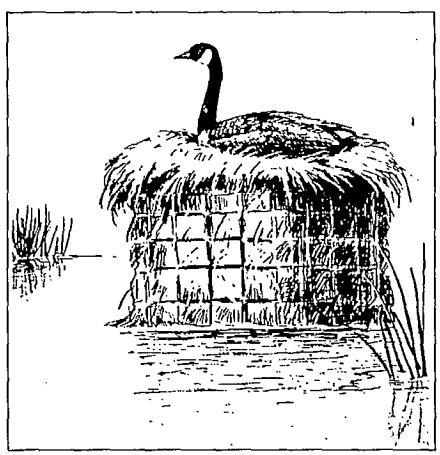
Iodized salt blocks (available from livestock feed stores) can be placed on the ground or in wooden troughs. Loose mineral salt (also available from feed stores) also can be used, but should be mixed with uncontaminated soil to prevent excessive intake. Only the latter method should be used on bighorn sheep range, as this species is susceptible to a communicable disease associated with communal use of salt blocks.

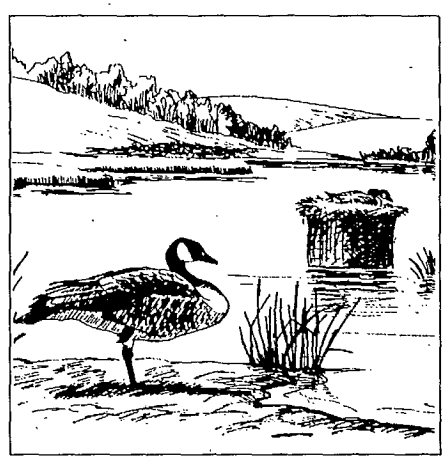
Licks should be relocated periodically if signs of overgrazing or overbrowsing appear in adjacent areas. All remaining salt/soil mixture should be removed from old sites, and the site covered with rock rubble to discourage further use.

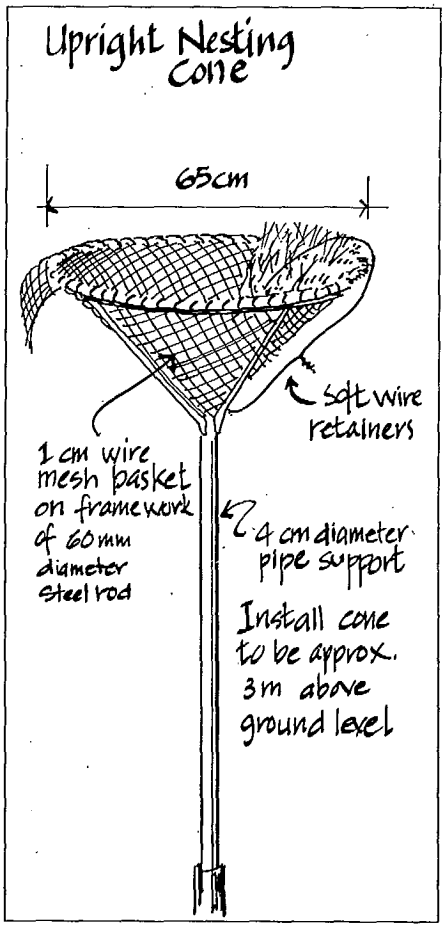
Artificial Nest Structures

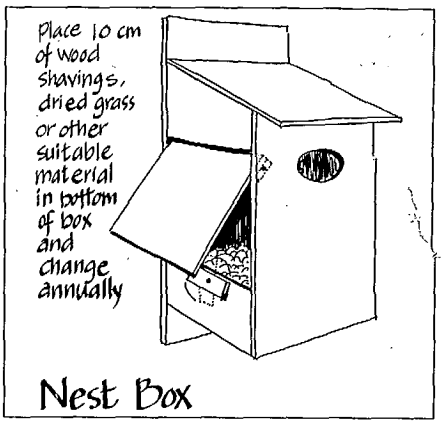
Artificial nest structures can be used to replace bird nesting sites that are normally provided by cavities in mature or dead trees. Nest boxes, nesting cones and platforms can be mounted on wood or steel poles to provide nesting sites for waterfowl. Because different types of birds require specific nest box sizes and designs, structures should be built specifically for a species or group of species. Specifications for some nesting structures are provided in Table 2.

Temporary nesting structures also can be installed to provide nesting sites for waterfowl. Round flax bales (1.5 m diameter) provide good nesting sites for Canada geese. Bales should be tightly wrapped with hog wire or paige wire, and located 20 - 50 m offshore in water no more than 1 m in depth. Minimum water depths during the open water season should exceed 15 cm. Bales should be spaced at least 90 m apart, and be separated by bands of emergent vegetation or shoreline projections whenever possible. A minimum of 1 ha of wetland is required for each nesting bale.






Upright Nesting Cone
65cm
soft wire retainers
1 cm wire mesh basket on framework of 60 mm diameter steel rod
4 cm diameter pipe support
Install cone to be approx. 3 m above ground level


Place 10 cm of wood shavings, dried grass or other suitable material in bottom of box and change annually
Nest Box

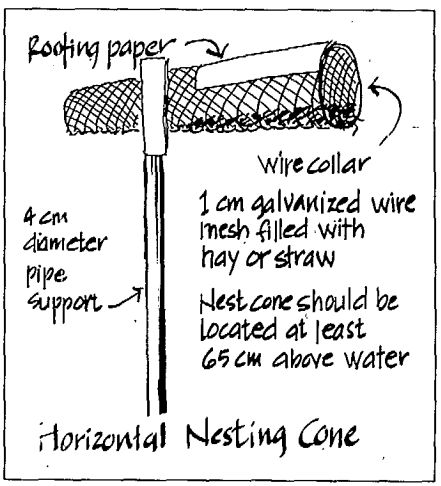

Roofing paper
wire collar
1 cm galvanized wire mesh filled with hay or straw
4 cm diameter pipe support
Nest cone should be located at least 65 cm above water
Horizontal Nesting Cone

Table 2.
Nest Box Dimensions and Placement Heights.

Species	Floor Dimensions (cm)	Wall Height (cm)	Entrance above Floor (cm)	Diameter of Entrance (cm)	Height above Ground (m)
Canada goose	150 x 150	0	(1)	(1)	2.0
Bluebirds	13 x 13	20	15	4.0	1.5 - 3
Robin	15 x 20	20	(1)	(1)	1.8 - 4.5
Chickadees	10 x 10	20 - 25	15 - 20	3.0	1.8 - 4.5
Nuthatches	10 x 10	20 - 25	15 - 20	3.0	3.6 - 6.0
House wren	10 x 10	15 - 20	3 - 15	2.5 - 3.0	1.8 - 3.0
Swallows	15 x 15	15	3 - 13	4.0	2.4 - 4.5
Phoebes	15 x 15	15	(1)	(1)	2.4 - 3.7
Flycatchers	15 x 15	20 - 25	15 - 20	6.5	1.8 - 6.0
Flickers	18 x 18	41 - 46	36 - 41	6.5	1.8 - 6.0
Downy woodpecker	10 x 10	23 - 30	15 - 20	3.0	1.8 - 6.0
Hairy woodpecker	15 x 15	30 - 38	23 - 30	4.0	3.7 - 6.0
Screech owl	20 x 20	30 - 38	23 - 30	7.5	3.0 - 8.0
Saw-whet owl	15 x 15	25 - 30	20 - 25	6.5	3.7 - 6.0
Barn owl	25 x 46	38 - 46	10	15.0	3.7 - 5.5
Sparrow hawk	20 x 20	30 - 38	23 - 30	7.5	3.0 - 9.0

[1]One or more sides open.

CHAPTER 8

RECLAIMING FOR KEY WILDLIFE SPECIES

Identifying the Options

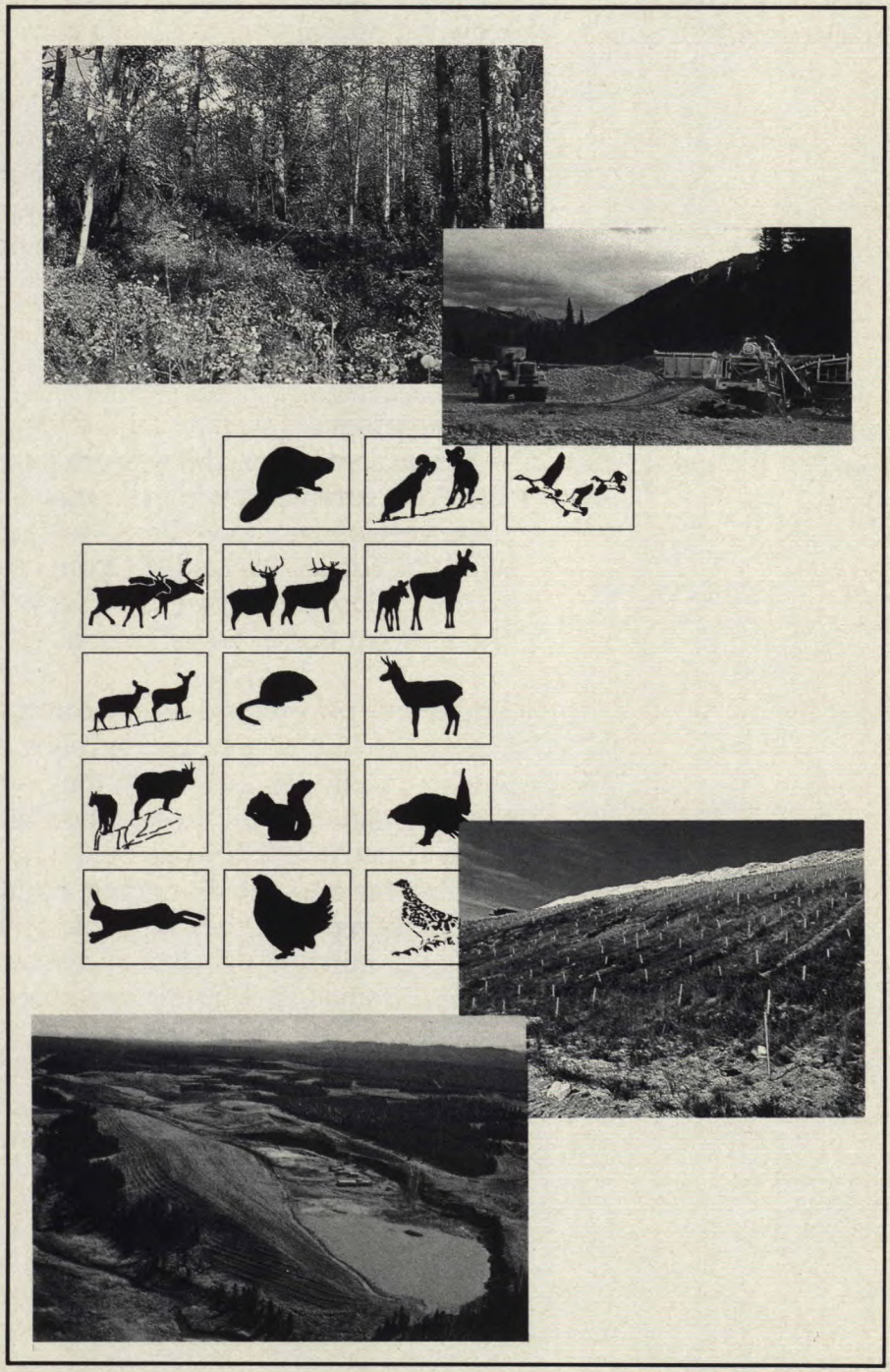
Previous chapters have provided a conceptual framework for wildlife habitat reclamation (Chapters 1 - 3) and have reviewed reclamation methodology (Chapters 4 - 7). Given the many factors that need to be considered, and the many methods available for reclamation, a clear pathway needs to be mapped out for reaching the desired end point of reclaimed, useable wildlife habitat. The aim of this chapter is to outline a process for streamlining the decisions necessary for the reclamation of habitat for one or more wildlife species. The basic steps involved are:

- Identification of the natural region within which the reclamation project is located (for users of this manual this will be either the Mountains/Foothills region, the Boreal Forest region, the Aspen Parkland region, or the Prairie Grasslands region). This will narrow the choice of habitats that can be reclaimed, based on climatic and other ecological considerations and on the wildlife species for which reclamation will be appropriate.

- Identification of the major landforms that will need to be enhanced or modified. This will further narrow the choice of appropriate key wildlife species.

- Selection of one or more key wildlife species on which to focus reclamation efforts. This also will help to define habitats that can be developed on the site.

- Selection and implementation of appropriate methodology to reclaim each habitat type for the selected key wildlife species.



Some Regional Background

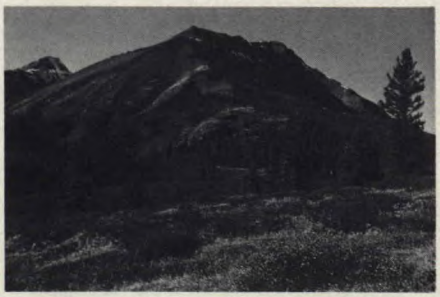
An appreciation of the regional context within which reclamation activities are being carried out is necessary for the operation to be a success. Reclaimed habitat should fit in with other, naturally occurring habitats in the region, and its structure and location should be appropriate to wildlife species already living in the area. For example, it would not be practical to develop habitat for mountain goats in the Aspen Parkland region or to create beaver habitat in an alpine meadow.

Mountains/Foothills Region

For purposes of this manual the Mountains/Foothills region is confined to the western part of Alberta (see page 12). The extreme elevational range and abrupt topography of this region result in a broad variety of habitats being available for use by wildlife, from unvegetated mountain peaks to closed-canopy forests very similar to those found in the adjacent Boreal Forest region.

Lodgepole pine forests form a continuous cover on well-drained to imperfectly drained sites, and are so extensive at low to middle elevations that they can be considered the predominant or typical vegetation type of the region. In areas where forest development has not been set back by fire or other factors such as logging, natural succession has gradually replaced the lodgepole pine forests with mature forests dominated by white and black spruce. Low-lying, poorly drained sites in this region are covered by black spruce and birch/sedge vegetation types. Other vegetation types occurring in specialized or restricted situations include Douglas fir/limber pine in warm mountain valleys, grasslands and aspen forests on warm, dry slopes, and alpine tundra above timberline.

Land use management in the Mountains/Foothills region is currently geared toward watershed and wildlife habitat protection; other important uses include recreation and seasonal livestock grazing. Industrial activities and other developments involving land surface disturbances and offering opportunities for wildlife habitat reclamation include logging, open pit coal mines, rock quarries, gravel borrow pits, oil and gas exploration/extraction and processing, recreational developments (primarily ski resorts), and linear right-of-ways including pipelines, power transmission lines, seismic lines, roads and railways.



Land reshaping, water impoundment and revegetation have all been shown to be feasible using existing technologies in reclamation situations in this region; there are also opportunities for incorporating special habitat features (e.g., highwalls, talus slopes, salt licks) into wildlife reclamation plans. Special care is warranted in planning revegetation due to restrictions imposed by limited topsoil supplies and short growing seasons.

Key wildlife species in this region include two wetland species (beaver and muskrat), four species associated primarily with shrublands, forests and/or forest edges (snowshoe hare, moose, caribou and spruce grouse), and four species associated primarily with mountain grasslands and alpine tundra (elk, bighorn sheep, mountain goat and white-tailed ptarmigan).

Boreal Forest Region

The Boreal Forest region extends across the northern half of Alberta through northern and central Saskatchewan and Manitoba (see page 12). It is characterized by extensive tracts of deciduous, coniferous and mixedwood forests made up of aspen, balsam poplar, paper birch, white spruce, black spruce, jack pine, lodgepole pine and balsam fir, the exact mixture depending on site moisture, soil conditions and stand age. Relief is generally subdued and large areas with poor or impeded drainage, and supporting black spruce muskeg, willow shrubland, sedge meadow or other wetland vegetation, are characteristic of the region.

The major form of land use in the Boreal Forest region is forestry, although forage and crop production and livestock grazing have become established where local conditions permit. Industrial activities involving major land surface disturbances, and thus requiring reclamation, include open-pit coal mines, open-pit and *in situ* oil sands extraction

sites, gravel borrow pits and linear right-of-ways such as pipelines, seismic lines and roads. To date, reclamation activities have focused on revegetation, but there are no major barriers to the use of topographic modification or watershed re-establishment techniques.

Key wildlife species in this region include two wetland species (beaver and muskrat), three species adapted to shrublands, forest edges and/or forest openings (mule deer, moose and sharp-tailed grouse) and one species adapted to mature coniferous forests (caribou).

Aspen Parkland Region

The Aspen Parkland region extends from central Alberta through Saskatchewan and into southern Manitoba, consisting primarily of a narrow band along the southern edge of the Boreal Forest region (see page12). Outliers of Aspen Parkland occur in the Peace River area and adjacent to the southern Mountains/Foothills region in Alberta, and within the Prairie Grassland region in both Alberta and Saskatchewan. This distribution reflects the status of the Aspen Parkland region as a transition zone between Prairie Grassland and Boreal Forest vegetation.

The distinguishing feature of the region is a vegetation mosaic of grassland and aspen forest developed on generally rolling topography, with shrublands and aquatic vegetation occurring in association with poorly drained sites. Small pothole wetlands are characteristic of the region and provide major wildlife habitat. Limited coniferous forests occur in cool, moist situations, primarily north-facing slopes of ravines.

Much of the Aspen Parkland region has been converted to cropland or is used for livestock grazing. Industrial activities amenable to reclamation for wildlife habitat include small open-pit coal mines, oil and gas extraction sites, gravel borrow pits and linear right-of-ways such as pipelines or roads. Moderate changes to landform features, creation of waterbodies and watercourses, and revegetation all are appropriate for habitat reclamation in this region.

Key wildlife species for this region are beaver and muskrat as representatives of aquatic species; mule deer/white-tailed deer and sharp-tailed grouse representing species requiring forest edge, shrubland and/or grassland habitat; and red squirrel representing species requiring coniferous forest cover.

Prairie Grassland Region

The Prairie Grassland region extends from the Rocky Mountain Foothills across southern Alberta and Saskatchewan, and into southwestern Manitoba (see page 12). The semi-arid climatic conditions (generally cold winters, warm summers and low precipitation) characteristic of this region are reflected in the predominant natural vegetation cover -- extensive flat to gently rolling grasslands made up of blue grama, spear grasses, wheatgrasses, rough fescue and a variety of other grasses and forbs. Patches of low shrublands composed of buckbrush and silverberry occur in moist areas such as seepages and depressions, and on cool slopes. Wetlands in the region are typically shallow and often alkaline. Topographic and vegetational diversity occur primarily in association with incised stream courses and river breaks, which support shrub and herbaceous vegetation on steep slopes, and stands of cottonwoods and tall willows on streambanks and over broad floodplains.

Much of the region is currently used for cereal crop production, although large expanses of native range used for cattle grazing still remain, primarily in the drier and/or rougher areas. Fenceline and shelterbelt vegetation, borders of irrigation canals, lightly grazed native grasslands, river breaks and residual wetlands provide most of the currently available wildlife habitat in the area. Industrial activities involving land surface disturbance, and thus providing opportunities for wildlife habitat reclamation, include open-pit coal and potash mines, gravel borrow pits, and linear right-of-ways such as pipelines and roads. Modification of landforms, revegetation, and particularly development and enhancement of wetlands all are appropriate techniques for wildlife habitat reclamation in the Prairie Grassland region.

Key wildlife species for this region include two wetland species (muskrat and Canada goose) and four species requiring grassland, shrubland and/or forest edge habitat (pronghorn antelope, sharp-tailed grouse and mule deer/white-tailed deer).

Reclaiming For Key Wildlife Species

Throughout this manual, we have based our discussion of reclamation on key or representative wildlife species, on the underlying assumption that focusing reclamation efforts on one or more selected wildlife species will benefit a whole spectrum of other wildlife species adapted to the same or similar habitats. We have chosen 16 potential key wildlife species to represent habitat conditions throughout the regions covered by this manual. In order to select key wildlife species and develop habitat appropriate to a given reclamation site, follow these steps:

1. From the figure on page 12, determine in which region (Mountains/Foothills, Boreal Forest, Aspen Parkland, or Prairie Grassland) the site is located.

2. Determine what landforms are or will be present on the site.

3. Referring to either Table 3 (Mountains/Foothills), Table 4 (Boreal Forest), Table 5 (Aspen Parkland) or Table 6 (Prairie Grassland), choose one key wildlife species for each landform to be reclaimed. Remember that a key wildlife species should be one that already occurs in the immediate vicinity. Government wildlife management personnel should be able to assist in identifying key wildlife species that will complement local wildlife management plans.

4. Select one or more plant communities and/or water forms to be developed within each landform unit. Refer to Chapter 9 for specifics on habitat features for each key wildlife species (the key wildlife species are listed in alphabetical order).

5. Formulate habitat reclamation plans. Refer back to Chapters 4 - 7 for appropriate techniques.

6. Initiate reclamation.

Table 3.
Key Wildlife Species for Habitat Reclamation in the Mountains/Foothills Region.

Prereclamation Landforms on the Site	Key Species for Reclamation	Potential Plant Communities and Water Forms
Steep slopes and ridgetops	Bighorn sheep	Grasslands
	Caribou	Grasslands, shrublands, coniferous forest
	Elk	Grasslands, shrublands
	Mountain goat	Grasslands, shrublands
	White-tailed ptarmigan	Grasslands, shrublands
Moderate to gentle slopes	Caribou	Grasslands, shrublands, coniferous forest
	Elk	Grasslands, shrublands
	Moose	Shrublands
	Snowshoe hare	Shrublands, deciduous, mixed and coniferous forest
	Spruce grouse	Coniferous forest
Bottomlands (including existing or potential wetlands)	Beaver	Waterbodies, watercourses, shrublands, deciduous forest
	Moose	Shrublands, aquatics
	Muskrat	Waterbodies, watercourses, aquatics
	Snowshoe hare	Shrub meadows, shrublands, deciduous, mixed and coniferous forest

Table 4.
Key Wildlife Species for Habitat Reclamation in the Boreal Forest Region.

Prereclamation Landforms on the Site	Key Species for Reclamation	Potential Plant Communities and Water Forms
Steep slopes and ridgetops	Caribou	Coniferous forest
	Mule deer	Grasslands, deciduous, mixed and coniferous forest
Moderate to gentle slopes	Caribou	Coniferous forest
	Moose	Shrublands
	Mule deer	Grasslands, shrublands, deciduous, mixed and coniferous forest
Bottomlands (including existing or potential wetlands)	Beaver	Waterbodies, watercourses shrublands, deciduous forest
	Caribou	Coniferous forest, shrublands
	Moose	Shrublands, aquatics
	Mule deer	Grasslands, shrub meadows, shrublands, deciduous, mixed and coniferous forest
	Muskrat	Waterbodies, watercourses, aquatics
	Sharp-tailed grouse	Grasslands, shrub meadows, shrublands and deciduous forest

Table 5.
Key Wildlife Species for Habitat Reclamation in the Aspen Parkland Region.

Prereclamation Landforms on the Site	Key Species for Reclamation	Potential Plant Communities and Water Forms
Steep slopes and ridgetops	Mule/white-tailed deer	Grasslands, coniferous forest
	Red squirrel	Coniferous forest
Moderate to gentle slopes	Mule/white-tailed deer	Grasslands, shrublands, deciduous, mixed and coniferous forest
	Red squirrel	Coniferous forest
	Sharp-tailed grouse	Grasslands, shrublands, deciduous forest
Bottomlands (including existing or potential wetlands)	Beaver	Waterbodies, watercourses, shrublands, deciduous forest
	Mule/white-tailed deer	Grasslands, shrub meadows, shrublands, deciduous forest
	Muskrat	Waterbodies, watercourses, aquatics
	Sharp-tailed grouse	Grasslands, shrub meadows, shrublands, deciduous forest

Table 6.
Key Wildlife Species for Habitat Reclamation in the Prairie Grassland Region.

Prereclamation Landforms on the Site	Key Species for Reclamation	Potential Plant Communities and Water Forms
Steep slopes	Mule/white-tailed deer	Grasslands, shrublands
Moderate to gentle slopes	Mule/white-tailed deer	Grasslands, shrublands
	Pronghorn antelope	Grasslands
	Sharp-tailed grouse	Grasslands, shrublands
Bottomlands (including existing or potential wetlands)	Canada goose	Waterbodies, watercourses, aquatics, grasslands
	Mule/white-tailed deer	Grasslands, shrublands, deciduous forest
	Muskrat	Waterbodies, watercourses, aquatics
	Pronghorn antelope	Grasslands
	Sharp-tailed grouse	Grasslands, shrublands, deciduous forest

CHAPTER 9

RECLAMATION OBJECTIVES FOR KEY WILDLIFE SPECIES

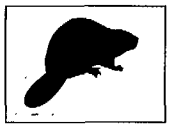


Table 7
RECLAMATION OBJECTIVES FOR BEAVER HABITAT

Synopsis of Habitat Requirements

Streams and lakes deep enough for year-round occupation, with adjacent, accessible deciduous woody growth for food and for lodge and dam construction.

Landform Features

- begin with gently to moderately rolling terrain.

Waterbody Features

- establish waterbodies over 10-50% of the total reclaimed land area.
- provide a minimum of 0.8 km of stream or 1.3 sq km of lake/marshland habitat.
- slopes within 30 m of waterbodies should be gentle to moderate (<25%).
- waterbodies should be at least 1.5 m deep and have stable water supplies.
- streams should have meandering channels (1.5-7.5 m wide) and low gradients (preferably <3%, and not more than 13%).
- large lakes should have islands and irregular shorelines; high density complexes of small, irregular and/or interconnected potholes also are suitable.
- banks should be constructed of clay or other heavy-textured material that permits burrowing.

Vegetation Features

- establish moderate to dense stands of deciduous trees and shrubs (preferably willow or aspen) within 30 m of shore.
- plant aquatic species such as yellow pond-lily to provide an additional food source.

Special Features

- no specific requirements.

Anticipated Benefits

New beaver colonies readily become established in suitable habitat. The ability of beavers to manipulate water levels through damming provides habitat for a number of other aquatic and semi-aquatic species.

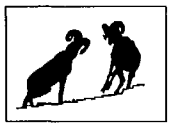


Table 8
RECLAMATION OBJECTIVES FOR BIGHORN SHEEP HABITAT

Synopsis of Habitat Requirements

Grassland slopes for feeding with adjacent steep, broken terrain and/or talus slopes for escape, bedding and lambing.

Landform Features

- begin with slopes of 20-70% for foraging habitat; provide steeper escape terrain (talus slopes or cliffs) within 0.8 km of all feeding areas.
- cliffs should be at least 8 m high and 200 m long for escape and bedding use. Cliffs and other broken terrain should cover at least 2 ha to serve as a lambing area.

Waterbody Features

- no special requirements.

Vegetation Features

- retain or establish grasslands (preferably composed primarily of fescues, wheatgrasses, june grass and sedges, with lesser amounts of composites, legumes and other forbs) on south and west-facing slopes to provide feeding areas.
- plant small clumps of spruce or aspen on other exposures to provide thermal cover.

Special Features

- use licks composed of loose, mineralized livestock salt (not salt blocks) mixed with equal amounts of soil to attract bighorn sheep into the reclamation area, but take care to avoid overgrazing of surrounding habitat.

Anticipated Benefits

Bighorn sheep readily use man-made habitats (such as seeded grasslands) located within their traditional ranges. Other species that may use reclaimed bighorn sheep habitat include pikas, ground squirrels, marmots, grizzly bears, elk, raptors and a variety of songbirds.

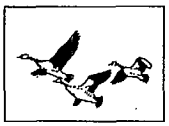


Table 9
RECLAMATION OBJECTIVES FOR CANADA GOOSE HABITAT

Synopsis of Habitat Requirements

Waterbodies providing nesting sites and emergent vegetation for food and cover, and adjacent grasslands or croplands for foraging.

Landform Features

- begin with broadly flat or gently rolling topography for optimum waterbody/cropland development and interspersion.

Waterbody Features

- retain or develop marshes, sloughs, lakes and reservoirs for nesting habitat and for resting stops during migration.
- establish waterbodies of 1 ha or larger on up to 50% of the reclamation area; several small waterbodies or a single large waterbody can be established, depending on engineering and economic considerations.
- ensure that extensive areas of shallow water (<1.5 m, over up to 100% of the waterbody) are available for the establishment of emergent vegetation and development of nesting islands.
- develop artificial earth/gravel islands for nesting; for optimal use, each should be rectangular in shape (25 X 40 m, with the long axis parallel to prevailing winds), surrounded by water at least 70 cm in depth throughout the nesting season, located >50 m (preferably >170 m) from shore and no closer than 100 m to each other.
- provide sandbars, mudflats and unvegetated stretches of shoreline for loafing.

Vegetation Features

- establish stands of aquatic vegetation (cattail, bulrush, spike rush, smartweed) as a source of food and nesting material and for brood and moulting cover. Dense emergent vegetation can be established as a visual screen between nesting islands, but each island should have a clear view and ready access to open water.
- seed a mixture of grasses and forbs on artificial nesting islands; aim for a canopy cover of 50-100% and a height of 30-70 cm.
- provide upland grazing habitat adjacent to waterbodies. Large, open fields of green forages and cultivated grains (clovers, birdsfoot trefoil, alfalfa, barley, wheat, rye, oats, brome, orchardgrass, bluegrasses, fescues, timothy, corn) are the most suitable grazing habitat. Stubble fields provide good habitat during spring and fall migration.

Special Features

- where available nesting habitat is fully occupied or island construction is unfeasible, provide artificial nest structures such as round hay bales or elevated nest platforms.
- retain islands, cliff faces and old raptor nests as potential nest sites along streams and rivers known to be used by this species; provide elevated platforms for additional nest sites.

Table 9 concluded
RECLAMATION OBJECTIVES FOR CANADA GOOSE HABITAT

Anticipated Benefits

Canada geese readily use reservoirs and other managed waterbodies, and respond well to the provision of artificial nest sites and to forage crops grown specifically for goose management. Other species that will benefit from reclamation for Canada geese include muskrats, ducks and a variety of other waterbirds.

Table 10
RECLAMATION OBJECTIVES FOR CARIBOU HABITAT

Synopsis of Habitat Requirements

Primarily mature habitats ranging from extensive alpine tundra to muskeg and old coniferous forests; lichen-bearing habitats are essential for winter foraging.

Landform Features

- begin with generally rolling terrain with a variety of aspects and slopes.
- shape open ridgetops to retain snowfields (e.g., in north-facing bowls and depressions) used in avoiding insect harassment and in summer for thermoregulation.

Waterbody Features

- no special requirements.

Vegetation Features

- retain stands of mature or over-mature coniferous forest 400 m or more in width within or adjacent to the reclamation site to provide escape cover and winter foraging habitat; black spruce muskeg also should be retained for foraging habitat whenever possible.
- plant meadow and shrubland habitat with a variety of grasses, forbs and shrubs adjacent to mature coniferous forest to provide summer foraging habitat.
- fully developed habitat should consist primarily of mature, closed canopy, lichen-bearing coniferous forests (Engelmann spruce/subalpine fir forest in the Mountains, lodgepole pine/white spruce forest in the Foothills, jack pine/white spruce/black spruce forest in the Boreal Forest region), with some open canopy, shrubby understory coniferous forest and forest openings.

Special Features

- establish salt licks to encourage early use of reclaimed sites.

Anticipated Benefits

Caribou are traditional in their area use patterns and generally make little use of new, man-made habitats. Reclamation will likely be most effective where additional summer feeding areas, providing succulent young forage, are interspersed within existing caribou habitat. Retention of large blocks of mature coniferous forest, avoidance of disturbance after site abandonment and establishment of salt licks all may encourage early use of reclamation sites, but reclaimed habitat may take 75-100 years to develop fully. Other species that will use reclaimed caribou habitat include red squirrels, spruce grouse, marten, fisher and a variety of songbirds.

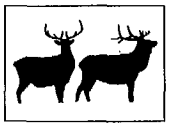


Table 11
RECLAMATION OBJECTIVES FOR ELK HABITAT

Synopsis of Habitat Requirements

Grasslands and shrublands interspersed with forested areas.

Landform Features

- begin with gently to moderately sloping terrain (slopes of 30% or less) but retain some steeper slopes (up to 100%) when available.
- provide smooth, steep western and southern exposures for winter use.
- screen reclaimed habitat from major roads and other disturbances with topographic features such as hills and ridges.

Waterbody Features

- no special requirements.

Vegetation Features

- establish open and sparsely treed grasslands (planted with fescues and sedges) as the major foraging habitat.
- plant willow shrubland and horsetails in poorly drained sites to provide additional foraging opportunities.
- develop 60-75% of the land area of a site as open foraging habitat, with the remainder under forest cover.
- maintain forested escape and thermal cover (coniferous and/or mixedwoods in blocks of at least 12 ha) within 100-250 m of all foraging areas.

Special Features

- establish artificial salt licks to encourage use of the site.

Anticipated Benefits

Elk readily use seeded grasslands and other reclaimed sites. Overuse of a site can be avoided by including unpalatable species in seeded grasslands and avoiding placement of salt licks in sensitive areas.

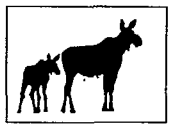


Table 12
RECLAMATION OBJECTIVES FOR MOOSE HABITAT

Synopsis of Habitat Requirements

Deciduous shrublands and forest edges.

Landform Features

- begin with generally flat to gently rolling terrain, and/or flat-bottomed drainage channels with wide floodplains.

Waterbody Features

- plant existing waterbodies with aquatics (yellow pond-lily and others) to provide a supplementary summer food source.
- retain existing streams and lakes on a site for escape from insect harrassment in summer.

Vegetation Features

- establish extensive willow shrublands as the major year-round foraging habitat.
- plant aspen, saskatoon, low-bush cranberry, red osier dogwood, choke cherry and pin cherry as additional forage, either in open regenerating areas or under deciduous, coniferous or mixed forest cover.
- for optimal use, open foraging areas should be irregularly shaped and 2-5 ha in size, although larger areas (>32 ha) can be used under low levels of harrassment.
- provide dense forest blocks at least 1 ha in size and interspersed throughout the site for escape and thermal cover.

Special Features

- provide artificial salt licks as a source of sodium where other sources such as aquatic vegetation are not available.

Anticipated Benefits

Moose respond favorably to regenerating logged areas and should show a similar response to well-planned reclamation sites. Reclamation of moose habitat also will provide habitat for small herbivores, upland game birds and songbirds. Reclamation requirements are highly compatible with those of snowshoe hare and beaver.

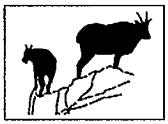


Table 13
RECLAMATION OBJECTIVES FOR MOUNTAIN GOAT HABITAT

Synopsis of Habitat Requirements

Mosaics of high elevation grass/forb meadows and tundra, low-growing shrublands, and broken, steep slopes and cliffs.

Landform Features

- begin with moderate to steep (primarily 60-100% or greater) south, east and north-facing slopes for development of summer foraging habitat, and with steep, broken, south to west-facing slopes or exposed ridgetops for development of winter habitat.
- develop steep slopes or cliffs (e.g., mine highwalls) as escape terrain and for bedding and kidding areas; these should have a network of ledges and narrow pathways.
- ensure that escape terrain is available within 400 m (and preferably within 200 m) of foraging areas.
- develop overhangs and small caves in escape terrain for shade and shelter from rain and snow flurries.

Waterbody Features

- no special requirements.

Vegetation Features

- retain or plant grass/forb vegetation (including wheatgrasses, bromes, sedges, fescues, hairy wild rye and june grass) and low shrublands (including silverberry, saskatoon and aspen) on suitable topography for foraging habitat.

Special Features

- provide artificial salt licks to encourage use of the site.

Anticipated Benefits

Reclamation will likely be of greatest benefit where it results in expansion of escape areas in existing mountain goat habitat. Other species that may benefit include pikas, ground squirrels and cliff-nesting raptors.

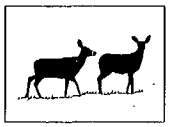


Table 14
RECLAMATION OBJECTIVES FOR MULE DEER AND WHITE-TAILED DEER HABITAT

Synopsis of Habitat Requirements

Browse- and forage-producing habitats for food, and dense shrub/tree growth or broken, steep topography for thermal and escape cover.

Landform Features

- begin with flat, rolling, or steep and broken terrain.
- ensure that south and west-facing slopes are available for development of winter habitat.

Waterbody Features

- no special requirements.

Vegetation Features

- establish a mosaic of grasslands, croplands, shrublands and forests (deciduous, mixed and coniferous woods) to maximize habitat edge.
- plant a selection of browse species (choke cherry, saskatoon, red osier dogwood, aspen, willows, black elder, dwarf birch, snowberry, green alder, rose) for year-round use.
- plant grasses and forbs in open meadow areas and/or establish small patches of cropland (cereal grains, legumes) to provide additional foraging opportunities. Grasslands established on south and west-facing slopes will provide winter and spring habitat.
- ensure that open areas are <200 m in width for optimum use.
- maintain dense shrub and forest growth (at least 1.5 m in height and >75% crown closure) for use as thermal and escape cover; stands should be 1-2 ha (minimum width 92 m) for thermal cover and 3-10 ha (minimum width 183 m) for escape cover. Wherever possible, retain forest and shrub stands in blocks of 40 ha or more.

Special Features

- develop salt licks to encourage use of reclaimed areas.

Anticipated Benefits

Both mule deer and white-tailed deer readily use regenerating logged areas and croplands, and should respond well to reclaimed sites offering both forage and escape cover. Reclaimed deer habitat also should be used by a variety of small mammals, furbearers, other ungulates, upland game birds, raptors and songbirds.

Table 15
RECLAMATION OBJECTIVES FOR MUSKRAT HABITAT

Synopsis of Habitat Requirements

Waterbodies providing aquatic and semi-aquatic plant growth for food and cover, and water depths adequate for year-round foraging.

Landform Features

- begin with depressional but broadly flat topography for optimum marshland development.

Waterbody Features

- establish standing waterbodies and/or low gradient streams over 50-100% of the reclamation area.
- design standing waterbodies with irregular shorelines and construct banks with heavy-textured soil suitable for burrow development.
- design streams with shallow gradients (3-5%), low water velocities, convoluted channels and well-defined clay or other heavy-textured soil banks.
- waterbody size can vary from <1 ha to 10 sq km or more.
- water depths should range between 0.6 and 2.1 m to permit both optimal growth of emergents and travel beneath ice during winter.
- water levels should be relatively stable but should be severely reduced in summer every 3-10 years to maintain vigorous growths of aquatic plants.

Vegetation Features

- establish extensive stands of emergents (bulrush, cattail and bur-reed, horsetails, sedges) over 10-60% of the waterbody area.
- establish submergents (water milfoil, pondweeds, duckweed) throughout.
- use shrub plantings (willows, dwarf birch and shrubby cinquefoil) to stabilize waterbody banks and to provide refuge habitat during floods.

Special Features

- no specific requirements.

Anticipated Benefits

Muskrats readily colonize new wetland areas that provide adequate vegetation cover and water depths. Development of muskrat habitat also will provide a water source for terrestrial wildlife and habitat for Canada geese, dabbling waterfowl, shorebirds, marsh-associated songbirds and semi-aquatic mammals. Muskrat houses provide good waterfowl nesting sites.

Table 16
RECLAMATION OBJECTIVES FOR PRONGHORN ANTELOPE HABITAT

Synopsis of Habitat Requirements

Extensive open rangelands.

Landform Features

- begin with flat to strongly rolling, expansive terrain broadly dissected by gullies and coulees. Upland slopes should not exceed 30%.

Waterbody Features

- ensure that a source of drinking water is readily available (within 1.5 km) in the form of a spring, creek, river, lake, reservoir or livestock watering facility.
- make certain that access to water is not impeded by barriers such as abrupt escarpments, bands of dense trees or shrubs, or woven wire fences.

Vegetation Features

- retain or establish open, treeless, subclimax grasslands as the major foraging habitat. Vegetation cover should generally be less than 40 cm in height, but taller stands (up to 120 cm) of sagebrush and other shrubs should be maintained for winter shelter.
- ensure that a wide variety of native grasses, sedges, forbs and shrubs is available for year-round foraging. Staple foods are sagebrush, pasture sagewort and buckbrush; others such as ball cactus, creeping juniper, wild tomato, prairie crocus, pussy-toes, knotweed, goldenrod, dock and rose are locally and/or seasonally important.
- encourage the growth of sagebrush wherever possible, as this palatable shrub maintains a high nutritional value throughout the winter; aim for an average sagebrush cover of 5-20%.
- use controlled burning to increase forage production and to improve forage palatability, especially in areas dominated by prickly pear cactus.
- plant small areas of crested wheatgrass, wheat and alfalfa as a supplementary food source, but avoid development of extensive monocultures.

Special Features

- where coulees and bottomlands are not available for winter shelter, focus range improvements on the lee side of roads, dikes and belts of dense shrubs or tall forbs; this will provide microhabitats sheltered from the wind.

Anticipated Benefits

Reclamation of pronghorn antelope habitat will be of greatest benefit where it results in improvement of winter forage and shelter, and where reclaimed sites are surrounded by large blocks of natural, ungrazed or lightly grazed rangeland. Other species that will benefit include hares and other small mammals, coyotes, deer, sharp-tailed grouse and a variety of raptors.

Table 17
RECLAMATION OBJECTIVES FOR RED SQUIRREL HABITAT

Synopsis of Habitat Requirements

Mature coniferous forests providing spruce or pine cones as a food source.

Landform Features

- begin with terrain suitable for the establishment of coniferous forests. In the Aspen Parkland, the only region for which the red squirrel has been selected as a key species, this is limited primarily to ravines and to scattered boggy areas in hummocky terrain.

Waterbody Features

- no special requirements.

Vegetation Features

- wherever possible retain islands of existing mature coniferous forest to provide immediate cover and food supplies, and as a seed source for natural invasion into reclaimed areas.
- establish white spruce or mixed white and black spruce stands as the primary habitat; tree plantings should be moderate to dense to maximize cone production at maturity.
- establish pine forests and/or mixed pine/spruce/aspen forests to provide buffer habitat during years of white spruce cone shortage.
- underplant beaked hazelnut and rose in mixed and deciduous forests to provide a supplementary food source.
- minimum habitat unit size should be in the order of 0.25-0.7 ha, but preferably much larger areas of continuous forest cover should be provided.

Special Features

- if existing red squirrel habitat can be retained in the area, large middens (accumulations of shredded cones used for shelter and food storage) should be preserved.

Anticipated Benefits

Natural dispersal of red squirrels should ensure that suitable reclaimed habitat is utilized. Reclamation of red squirrel habitat also will provide thermal cover for deer, and habitat for small mammals, raptors and songbirds.

Table 18
RECLAMATION OBJECTIVES FOR SHARP-TAILED GROUSE HABITAT

Synopsis of Habitat Requirements

Grasslands or croplands interspersed with shrublands and/or aspen forest.

Landform Features

- begin with gently rolling terrain.

Waterbody Features

- no special requirements.

Vegetation Features

- establish grasslands or croplands providing dense ground cover (at least 25 cm tall) over at least 60% and preferably >70% of the reclamation area; wheat, oats, rye, barley and native grasses and forbs all are suitable species.
- intersperse shrub meadows, shrublands and clumps of aspen forest throughout the remainder of the area; include several of juniper, silverberry, snowberry, rose, bearberry, choke cherry, saskatoon, pin cherry, buffaloberry, willow, aspen and balsam poplar in the planting mix.
- retain bogs when they occur in or adjacent to reclamation sites as they will provide habitat for this species; however, bogs should always be supplemented by establishment of adjacent grassland/cropland and shrubland.

Special Features

- provide dry, elevated, open sites (e.g., low hilltops in gently rolling terrain) for the establishment of communal male dancing grounds; these should have open ground cover and should be spaced at distances of 1.6 km or less from each other.
- use sound recordings of dancing males to attract sharp-tailed grouse to artificial dancing grounds on reclaimed sites.

Anticipated Benefits

Because sharp-tailed grouse use relatively simple, readily established vegetation cover reclamation for this species should have a high rate of success. Reclamation for sharp-tailed grouse also will benefit deer and a variety of small mammals and birds adapted to grassland and shrubland vegetation.

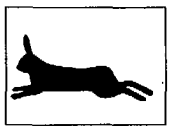


Table 19
RECLAMATION OBJECTIVES FOR SNOWSHOE HARE HABITAT

Synopsis of Habitat Requirements

Shrublands and forests with dense shrub understories.

Landform Features

- begin with flat areas or gentle to moderate slopes.

Waterbody Features

- use depressional areas and waterbody edges to establish dense shrub cover.

Vegetation Features

- establish dense, shrubby vegetation, either in extensive shrublands, in bogs, or under deciduous, coniferous or mixed forest cover.
- plant aspen and balsam poplar, paper birch, white spruce, black spruce, tamarack, lodgepole pine and Douglas fir as forest overstory species and willows, dwarf birch, green and river alder, gooseberry, raspberry, rose, high-bush cranberry, beaked hazelnut, red osier dogwood, bog cranberry, bog bilberry, buffaloberry, silverberry and white spiraea in shrublands or as forest understory.
- provide shrub and/or forest cover in blocks of at least 7-14 ha and preferably larger.
- create openings in large blocks of dense shrub cover or forests and plant with a variety of grasses and forbs (e.g., june grass, fireweed, horsetails) to provide additional foraging opportunities; openings should be small (no more than 200-400 m across).

Special Features

- provide deadfall (large fallen trees, brush piles) in shrublands and forests for use as thermal and hiding cover and bed sites.

Anticipated Benefits

Snowshoe hare populations readily expand into suitable habitat. Reclamation of snowshoe hare habitat also should benefit moose, deer, red fox, lynx, coyote, small furbearers such as weasels, other small mammals, and a variety of songbirds.

Table 20
RECLAMATION OBJECTIVES FOR SPRUCE GROUSE HABITAT

Synopsis of Habitat Requirements

Extensive coniferous forests for both food and cover.

Landform Features

- concentrate reclamation efforts in broad valley bottoms and on gentle slopes (generally <20%).

Waterbody Features

- no special requirements.

Vegetation Features

- provide lodgepole pine or jack pine forests as the major habitat; smaller areas of white spruce or other coniferous-dominated forests, spruce bogs and mixed forests can be retained or planted to provide additional habitat.
- manage pine forests to maintain an average stem density of 5000-6500 stems/ha, an overstory canopy cover of 25-75% and a mean canopy height of approximately 8 m; scattered white spruce should be available within pine forests as a food source for incubating hens.
- shrub understory cover should generally be less than 25%, but some dense thickets of willow, alder and juniper should be provided for moulting and nesting cover; conversely, some areas of open understory should be available for male display flights.
- underplant tall bilberry, bog cranberry, horsetails, sedges and forbs to provide food sources additional to the staple diet of coniferous needles.
- suitable coniferous forest habitat should be provided in blocks of at least 30 ha and preferably larger.

Special Features

- provide large deadfall logs for use as nesting cover.

Anticipated Benefits

Natural dispersal of spruce grouse should ensure that suitably reclaimed habitat is utilized. Other species such as moose, deer, red squirrel, snowshoe hare, and a variety of songbirds also should use reclaimed spruce grouse habitat.

Table 21
RECLAMATION OBJECTIVES FOR WHITE-TAILED PTARMIGAN HABITAT

Synopsis of Habitat Requirements

Open rocky slopes and alpine meadows above treeline provide year-round habitat; open coniferous forests and rocky stream courses with tall willows provide alternate winter habitat.

Landform Features

- begin with irregular topography strewn with scree or decayed bedrock for major feeding, nesting and escape habitat; boulders should be >30 cm diameter.
- provide south-facing slopes of <20% inclination and with areas of >40% scree or decayed bedrock cover for nesting.
- terrain should include windswept ridges for winter feeding and snow-catching depressions for thermal cover.

Waterbody Features

- retain or develop seeps and pond and stream edges as summer habitat (see below).
- develop or retain rocky stream courses through forested areas as winter habitat.

Vegetation Features

- ensure that moist, rocky alpine tundra is available for use as summer habitat; component species should include a mix of low willows, mosses, grasses, sedges, saxifrage, groundsel, cinquefoil, everlasting, heaths, fleabanes, bistorts, dryads and buttercups.
- retain or establish a variety of winter habitats: alpine tundra, open dwarf coniferous forests at treeline (subalpine fir, Engelmann spruce, whitebark pine and patches of willows up to 50 cm in height), open subalpine forests (spruce, fir and subalpine larch with scattered clumps of willows, dwarf birch and juniper), and rocky stream courses with dense 2-3 m high willows.
- plant cinquefoil, buffaloberry and rose as supplemental winter foods, either as underplantings in open coniferous forest or with willows in stream courses.

Special Features

- provide grain strewn on the ground during winter to attract ptarmigan to the reclamation site.

Anticipated Benefits

Because ptarmigan distribution is irregular and seasonal movements are erratic, the success of reclamation for this species is difficult to predict. Reclamation will likely be most effective where it concentrates on improving nesting cover (boulders and scree) and providing additional winter cover (tall willows in rocky stream courses) and food sources (shrub plantings and grain) within or adjacent to existing ptarmigan habitat.

CHAPTER 10

POTENTIAL WILDLIFE PROBLEMS AND METHODS OF CONTROL

Reclamation of wildlife habitat can generally be viewed as a problem of creating combinations of existing and man-made landforms, waterbodies and vegetation cover that are attractive to selected wildlife species. The ultimate measure of success is the degree to which wildlife utilize reclaimed habitat areas. However, reclamation may in some cases prove too successful, in the sense that too many animals are attracted to a site, thus resulting in overutilization and possibly setting back or negating the reclamation effort. Related problems are the attraction of wildlife to the reclamation site at the wrong time of year or too early in the reclamation process, and use of the site by unwanted and/or nuisance wildlife species. Also, wildlife that have become accustomed to human presence during site development, or that are attracted to an area by reclaimed habitat, may be susceptible to increased hunting mortality. These factors need to be considered during reclamation planning, and mitigative action taken when necessary. Anticipated problems and some potential solutions are outlined below.

Browsing Damage to Vegetation

Mice, Voles and Snowshoe Hares: Reduce ground canopy cover (grasses and legumes) in areas planted with tree seedlings; provide alternative foods (grain bait stations) in areas away from seedling plantations; apply chemical repellents to seedlings to directly reduce girdling damage.

Beaver: Plant conifers adjacent to waterbodies to prevent or reduce use of shoreline vegetation; livetrap and transplant or kill-trap animals from problem colonies.

Deer and Elk: Use fencing to prevent access to woody plants; interplant unpalatable species and apply chemical repellents to palatable species to directly reduce browse use; provide alternative foods (hay, green feed, alfalfa pellets); use controlled hunting to reduce site utilization.

Grazing Damage to Vegetation

Bighorn Sheep and Elk: Ensure that adequate areas of grassland vegetation (preferably snow free or with reduced snow depths) are available for winter use; avoid siting salt licks within important grazing habitat; use controlled hunting to reduce site utilization.

Canada Goose: Provide crops specifically for geese in proximity to waterbodies used for nesting; use exploders and other scare devices to control use of private cropland areas.

Trampling Damage to Vegetation

Bighorn Sheep and Elk: Use fencing to prevent access to newly planted or other sensitive areas.

Soil Erosion

Bighorn Sheep and Elk: Take appropriate measures to prevent overgrazing and development of bare patches; site salt licks on flat areas rather than slopes, and move as necessary.

Muskrat: Ensure that islands developed in wetlands have shallow sides slopes to discourage excessive burrowing by muskrat; incorporate subterranean wire mesh in chronic problem areas.

Flooding

Beaver: Avoid siting roads or other developments in low-lying areas likely to be flooded by beaver; livetrap and transplant or kill-trap animals from problem colonies.

Habituation to Human Presence

Bighorn Sheep, Deer and Elk: Avoid hand-feeding; site salt licks in areas away from public view; control public access where possible and use controlled hunts prior to site abandonment to condition animals.

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