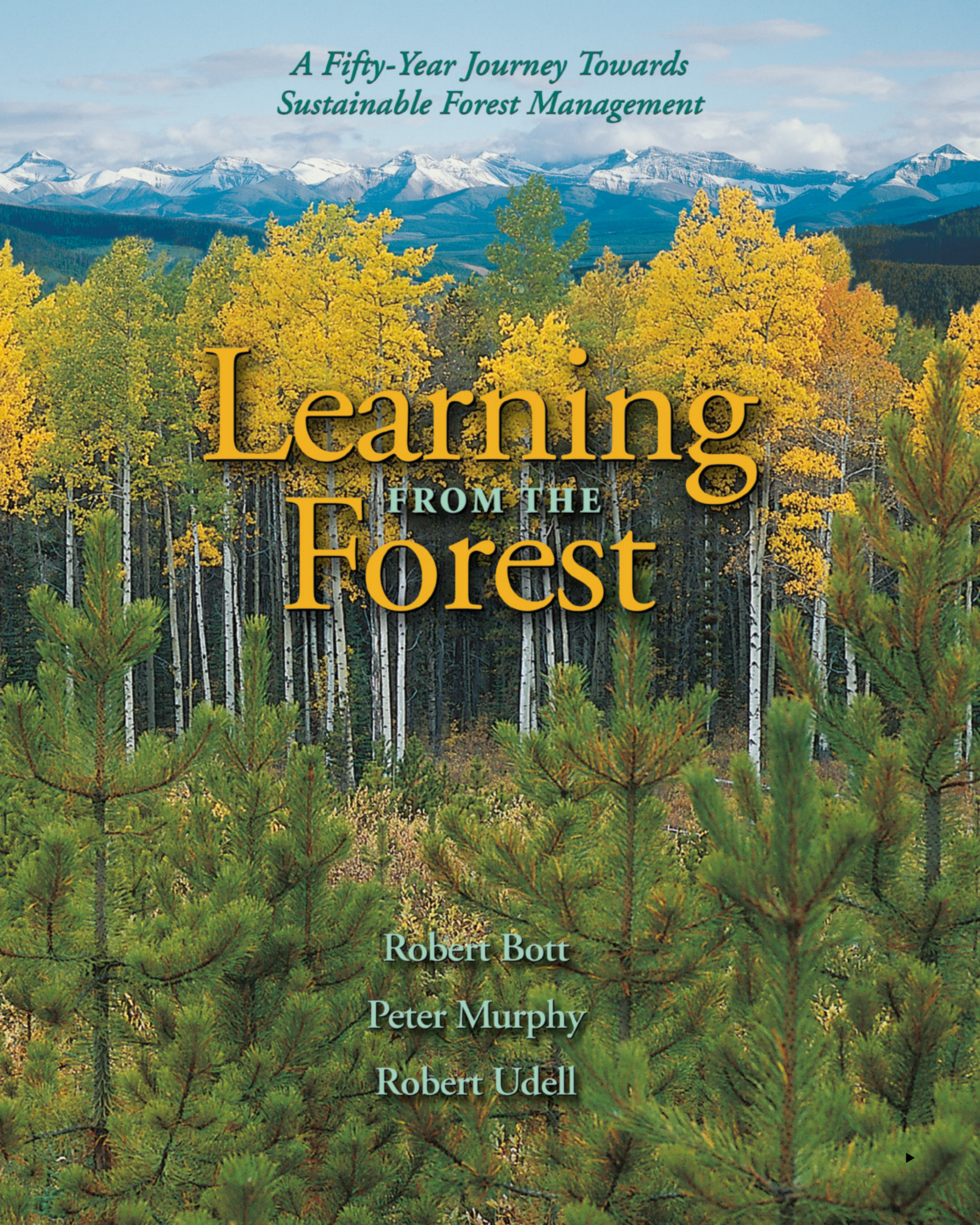
A Fifty-Year Journey Towards Sustainable Forest Management

Learning from the Forest



Robert Bott

Peter Murphy

Robert Udell

Learning from the Forest

A Fifty-year Journey in Sustainable Forest Management

Robert Bott, Peter Murphy, and Robert Udell
with Robert Stevenson (photo research)

Foreword by Gordon Baskerville

foothills model forest
a growing understanding

FIFTH HOUSE

Cover and interior design by John Luckhurst /GDL
Map and graph design by Toby Foord
Edited by Lauri Seidlitz
Copyedited by Roberta Coulter
Proofread by Geri Rowlatt

The publisher gratefully acknowledges the support of The Canada Council for the Arts and the Department of Canadian Heritage. We acknowledge the financial support of the Government of Canada through the Book Publishing Industry Development Program (BPIDP) for our publishing activities.

The Canada Council for the Arts since 1957 | Le Conseil des Arts du Canada depuis 1957

Printed in Canada by Friesens

03 04 05 06 07/ 5 4 3 2 1

First published in the United States in 2003

National Library of Canada Cataloguing in Publication Data

Bott, Robert, 1945-
Learning from the forest : a fifty-year journey towards sustainable forest management / Robert Bott, Peter Murphy, and Robert Udell ; with Robert Stevenson, photo research ; foreword by Gordon Baskerville.

Includes bibliographical references and index.
ISBN 1-894856-23-6

1. Foothills Model Forest—History. 2. Sustainable forestry—Alberta—Hinton Region. 3. Forest management—Alberta—Hinton Region. I. Murphy, Peter, 1930- II. Udell, Robert, 1943- III. Title.
SD146.A4B67 2003 333.75'097123'3 C2003-910561-X

FIFTH HOUSE LTD.
A Fitzhenry & Whiteside Company
1511-1800 4 St. SW
Calgary, Alberta, Canada
T2S 2S5

FITZHENRY & WHITESIDE
120 Harvard Avenue, Suite 2
Allston, MA 02134

1-800-387-9776
www.fitzhenry.ca

Contents

◀ ▶ CONTENTS INDEX

CONTENTS INDEX

Foreword

An awkward, sometimes frustrating, aspect of managing a forest is the long time horizon for planning necessitated by the slow pace of natural dynamics in forests. Managing a forest requires, at minimum, a one-hundred-year time horizon, and successive managers must hold a consistent vision of what the future forest is to become. The Hinton story illustrates how a succession of managers viewed one forest, how their view of the future forest and their management toward creating that forest evolved over time, and, perhaps most importantly, how they learned from what the forest became over time. The title, *Learning from the Forest,* is aptly chosen.

Learning from the Forest needs to be read thoughtfully by forest managers, by the collective owners of public forests, and by critics of forest management. The company—today called Weldwood of Canada Limited, Hinton Division—undertook management of a publicly owned forest in 1954 and, although boundaries of the forest management area and government policies have changed, the company has been the manager of the forest since then. They have managed the forest for timber and for non-timber values such as recreation and wildlife, to protect the wide range of values in the forest's future.

From the outset, the company adopted a multi-generation time horizon, and a whole-forest perspective for management planning. They recognized that forest management requires long-term commitment through a succession of managers. If there is a moral to this story, it is to begin long-term planning early, to implement the planned management in the forest (not just on paper), to keep at it consistently, to take advantage of technological advances, and to establish and maintain a complete temporal/spatial record of what the forest is becoming—all in an explicit context of what the particular forest is intended to become in the future. It is significant that after nearly a half-century of management, the authors consider management of the forest to be a work in progress.

Visiting the Hinton forest, one is impressed by the management progress, and the magnitude of the learning evident among company staff, in government agencies, and by other users of the forest. Actively improving knowledge of the tempor-al/spatial dynamics of the forest aided the evolution of forest management enormously, as the company promptly built emerging knowledge into planning.

The Hinton managers recognized that natural-stand dynamics prevented retaining any one value continuously at one place in the forest, and that those same dynamics made it possible for management to ensure that each value was always available at some place in the forest. The managers were able to "think forest/act stand"; that is, management thought in terms of creating a future whole forest that, in its variously developing stands, would continuously support an array of forest values. This book allows a reader to see what managers, and others, wanted from the future forest, and how the managers thought through the process of designing and creating a defined future forest.

The evolving management team recognized that integrating management of non-timber values with management of timber would not be a simple matter of applying constraint rules to management for timber. They recognized that integration of all values in management of the forest would require thinking, and acting, by an array of people, and that management had to be aimed at what the whole forest would become over time. Tools were selected based on their effectiveness in creating the desired future forest. The transition from managing timber, to managing timber and wildlife, to managing "everything" has been a natural progression, as the perspectives of the Hinton forest managers broadened.

The Hinton story shows management must be a continuous process of learning of and from the forest, as opposed to following "rules for tools." It exposes the complexity of managing a forest to serve the forest itself, as well as the mills, the community, and the province. Perhaps the most important messages of the Hinton story are that goals for what a forest is to become must embrace multiple values, that management must functionally address those goals in the forest, and that learning by people makes the difference between management success and management failure. Learning by generations of managers has been the basis of the very real success of management in the Hinton forest.

Gordon Baskerville
Professor emeritus, Faculty of Forestry, University of British Columbia,
and former Dean of Forestry, University of New Brunswick

Preface

FIFTY YEARS OF SUSTAINABLE FOREST MANAGEMENT

The landscape around Hinton, Alberta, includes some of the finest forests to be found on the east slopes of the Canadian Rockies, as well as abundant wildlife, scenic vistas, turbulent streams, a mighty river, and, beneath the surface, a wealth of coal, crude oil, and natural gas. Many thousands of people have passed through or settled here, shaping the landscape with hard work, hopes, and dreams.

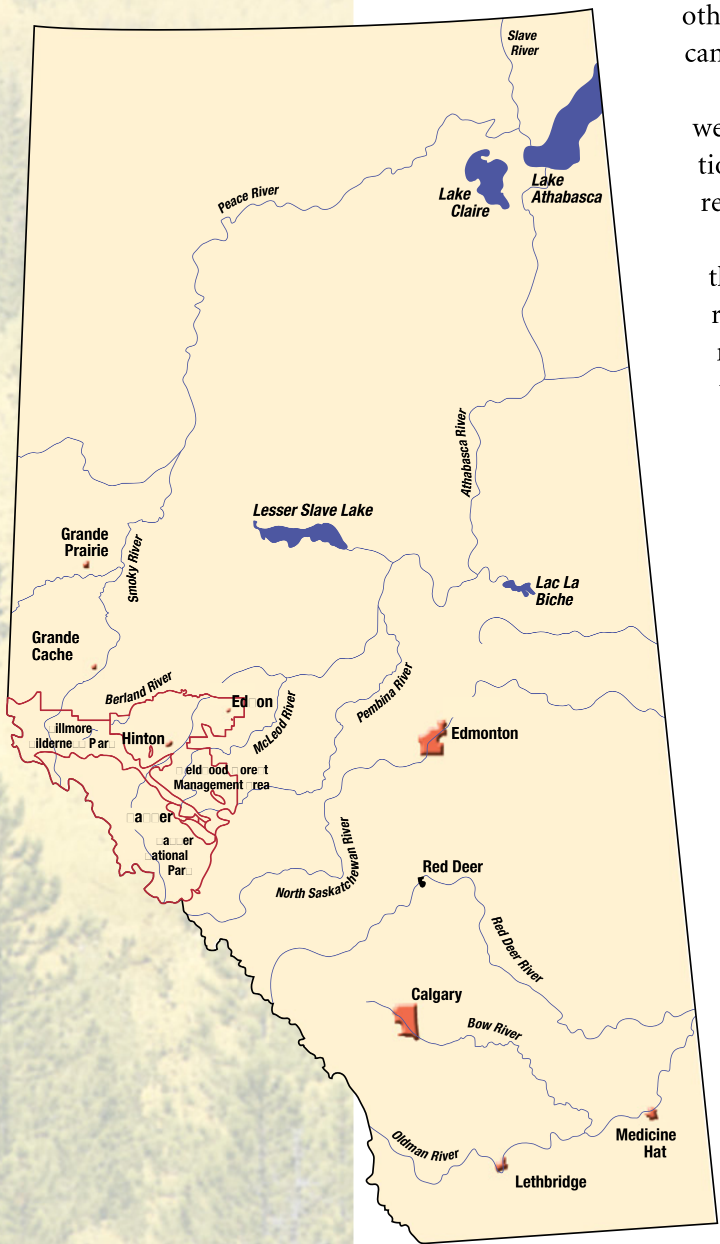
Managing the use of this landscape has been a special responsibility, shared since 1954 between a company (now known as Weldwood of Canada Limited, Hinton Division) and the Province of Alberta. We set out to document the story of the Hinton Forest Management Agreement, and it became evident that there were lessons that should be shared with the wider community of foresters and forest users across Canada and internationally. This book is the result.

Hinton foresters have blazed new trails in science, technology, and management for almost five decades. In the 1950s, company and government foresters developed a system of "adaptive forest management," long before the term entered forestry lexicon and nearly four decades before this practice became widespread. These foresters made a commitment to adapt scientific research and development into practice. Among other things, this commitment made the Hinton experience a true case study in continuous learning and improvement.

In addition, Hinton foresters have carved their initials in many ways on Albertan and Canadian forest policy through the years. People have come from all over the world to visit this outstanding forestry enterprise, and many foresters who worked here have absorbed the "Hinton land ethic" and exported it to other ventures and venues. More importantly, the legacy of their achievement and their dedication to their profession is written for all to see in the thriving forests blanketing the foothills of the Hinton area. These remarkable people, always working with their provincial government colleagues, set a standard and spawned a culture that will continue to guide and inspire foresters at Hinton. Their experience offers many insights to others who seek to understand how this all came to pass. This book is intended to make those insights accessible to anyone with an interest in sustainable forestry. Although these advances have been widely reported in books, journals, and other media, this book is the first comprehensive account of the story.

Many books and articles have been published about "bad forestry"—real and perceived—and how it can be remedied, but surprisingly little is ever said about the successes that might be emulated. There are some valid reasons for the omission. No forester would look at a landscape and say, "This represents perfection." The

The 2.75-million-hectare Foothills Model Forest in west-central Alberta includes Jasper National Park, Willmore Wilderness Park, and the Weldwood forest management area



natural and human processes affecting the land are far too complex and dynamic for that. As a result, failures are easier to identify and document, and books about crises are easier to sell. However, there are ways of approaching problems that are more likely to yield success than failure. It is not just a matter of avoiding mistakes, but of learning from one's own mistakes and those of others so that best practices can be pursued and harm can be addressed before it becomes irreversible.

Throughout the book, you may also notice an interweaving of three different perspectives—the practitioner, the scholar, and the concerned citizen—that reflect the authors' background.

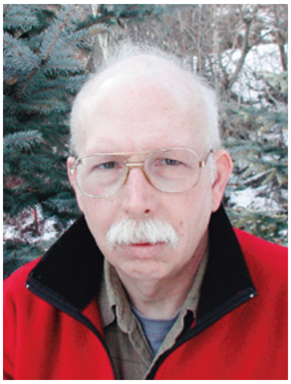
Peter Murphy, professor emeritus of forestry at the University of Alberta and respected forest historian, began compiling the history of forest management at Hinton in the mid-1990s. He knew the story well. From 1960 to 1973, he was director of the Forest Technology School (later Environmental Training Centre, now Hinton Training Centre) in Hinton and continued his close association with Hinton foresters after moving to the University of Alberta, where he later became chair of Forest Science and associate dean (Forestry). He also served on national and provincial committees related to defining and applying sustainable forest management.

As manager of forest policy for Weldwood Hinton and president of the Foothills Model Forest, Bob Udell worked closely with Murphy and served as project manager and contributing author for the history. He also knew the Hinton story intimately, having worked there as a forester from 1966 to 1970 and then rejoining the company in 1975 after a stint in Ontario. He is the author of two of the six management plans written for the Hinton forest and was a major participant in many advances in forest growth and yield studies and forest policy for the company and the province, including serving on the province's expert panel on forest management in 1990. Without his perspective as an "insider," a vital dimension would have been missing from this book.

Bob Bott is a Calgary-based writer, editor, and communications consultant who has specialized in environmental issues, industrial history, and the "political economy" of natural resources. He first became interested in the Hinton story while researching and writing *Our Growing Resource* for the Alberta Forest Products Association (1992) and learned more while working on Weldwood's *Environmental Performance Review* (1997) and, as co-author with Murphy and Udell, the "Living Legacy" booklet outlining the Hinton story. He collaborated with Udell, Murphy, and photo researcher Robert Stevenson in preparing this publication and other parts of the history project.

The primary sources for this book were Peter Murphy's taped interviews with key figures in the Hinton story, which he has been collecting since the 1980s, and public documents such as the six forest management plans written for the Hinton forest since 1961. As a result, we have not provided detailed annotation in the text. Quotations in the text are from interviews unless a printed source is given. See the Notes on Sources section for details of the interviews and chapter-by-chapter notes on other sources cited. Additional sources of information and details on most print sources are listed in the Bibliography and Internet Resources section.

Unless credited otherwise, all photographs are from the Weldwood collection.



Robert Bott

Peter Murphy

Robert Udell

CONTENTS INDEX ◀ ▶

Dedicated to the memories of Hinton foresters
Chief Forester Desmond I. Crossley (1910–1986)
and
Forestry Manager David J. Presslee (1952–2000)

Acknowledgments

The authors extend special thanks to the following people who contributed in many ways to this history.

David Presslee, an enthusiastic team member and contributing writer and reviewer for the project, passed away in 2000 before he could see its completion. He joined Weldwood in late 1992 after extensive silvicultural experience in British Columbia and brought a singular passion and enthusiasm for his profession. Presslee led major advances in silviculture and environmental practices at Hinton and was held in high esteem by the forestry community. A forester's forester and a devoted family man, he was a shining example of the values and spirit to which this book is dedicated.

Jack Wright, retired chief forester, patiently and exhaustively tapped his remarkable memory and records of people and events at Hinton to provide insightful comment on every chapter of the detailed history. His role in the Hinton story is well known and highly regarded. Two former woodlands managers, Stan Hart and Jim Clark, also provided a much-appreciated wealth of detail, insights, and anecdotes during the compilation of the history.

Robert Stevenson, a forester who retired after thirty-three years with federal and provincial governments, has observed forestry operations and research at Hinton since the 1960s—including forest biology, silviculture, fish, wildlife, and environmental issues. His longstanding maintenance of a forestry photo collection led to cataloguing the Weldwood photo collection. He selected the historical photographs for this book.

Weldwood employees, past and present: Rick Bonar, Jim Bowersock, Thomas Braun, Sean Curry, Paul Folkmann, Ken Hall, Dennis Hawksworth, Paul Hostin, Aaron Jones, Warren Kehr, Rick Ksiezolposki, Rosaire Lacroix, Don Laishley, Jim LeLacheur, Hugh Lougheed, Bob MacKellar, Sharon Meredith, Bryon Muhly, Raymond Ranger, Diane Renaud, Bill Sommerfeld, Rob Stauffer, Hank Van Zalingen, JoAnne Volk, Doug Walker, and John Welechuk.

Foothills Model Forest staff and contractors: David Andison, Rick Blackwood, Lisa Risvold, Gord Stenhouse, Mark Storie, Christian Weik, Fran Hanington, and Anna Kauffman.

Dennis Quintilio of Alberta Forest Service, Land and Forest Division, Alberta Sustainable Resource Development; Fred McDougall, retired deputy minister of Forestry, Lands and Wildlife; Robert Ruben, Athabasca Valley Development Corporation; Hon. Allan Warrack, former minister of Lands and Forests; Hon. Dr. Ian C. Reid, Hinton physician and former minister of Highways; Amelia Spanach, retired sawmiller; Dennis Radcliffe, retired sawmiller; Bob and Lynn Crossley; and Frank Appleby, retired member of the Legislative Assembly.

Bill Ayrton, consulting geologist; George Calihoo (board member) and Larry Matwie (general manager), Fox Creek Development; Hazel Hart, Hinton histor-ian; Gabriel Boulet; Sally John and Stan Navratil, consulting foresters; and Joan Udell, artist and cartographer.

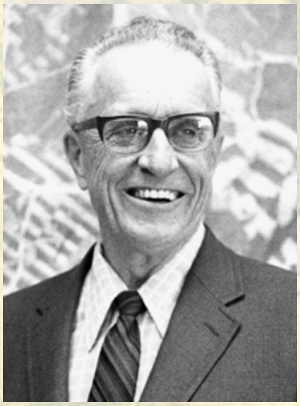
Beyond those named here, countless others played vital roles in the still-unfolding story. Ultimately, everyone who worked in, lived in, or studied the forests around Hinton left some footprints on the landscape, and we have attempted to reflect that record in this book.

Introduction

BIOGRAPHY OF A LANDSCAPE

I recall my first reconnaissance flight over the two million acres of choice timberland below that I was committed to manage. I was not so much overwhelmed, although that certainly gave me pause, as awed of its magnitude, the fact that it was relatively unspoiled and that I had been lucky enough to have been approached to become involved. The successful meeting of the challenges involved would depend a great deal on the calibre of the staff yet to be acquired and my ability to create the enthusiasm to fashion a successful program. I cannot deny the concern over what I had got myself into, but that was transient. There was too much to do to waste time dwelling on it.

—Des Crossley, 1984



Desmond I. Crossley, a Canadian Forest Service research scientist, was hired as North Western Pulp & Power's first chief forester in 1955 and led the program until his retirement in 1975..

There is no simple way to organize this story—too much was occurring on too many fronts, over widely varying time frames. It is, in one sense, the "biography of a landscape," but also the story of many people and activities. Desmond Crossley, chief forester at Hinton from 1955 to 1975, was a pivotal figure in almost everything that followed his arrival on the scene. However, as Crossley often stated, no one person can claim credit for successful forest management on any scale beyond a small woodlot. It took scores of individuals—at Weldwood and its parent company, in the provincial and federal governments, in the scientific community and the local community, among suppliers and contractors—to make possible the enterprise described on these pages. Rapid advances in science and technology, and major changes in the social and economic climate, played crucial roles too.

To provide some background, especially for the general reader, we begin by defining forest management and describing its main components (chapter one). The next three chapters deal with the "framework" within which forest management evolved at Hinton—the landscape as it existed before Crossley and his team arrived in 1955 (chapter two), the establishment of policies, laws, and regulations that entrusted management of a public resource to a private enterprise (chapter three), and the need to integrate multiple uses and values of the land and its resources (chapter four). The latter topic, managing a single landscape to provide multiple uses, is such a pervasive aspect of forestry at Hinton—and across Alberta generally—that only a few of the key elements could be contained in one chapter. Elsewhere in this book, you will find sidebars labelled "Multiple Uses and Values" describing additional ways that forestry interacted with the surrounding society and economy.

The next five chapters detail steps in the evolution of management at Hinton—gathering knowledge (chapter five), planning (chapter six), harvesting (chapter seven), manufacturing (chapter eight), and growing the new forest (chapter nine). These chapters correspond to stages of the "cycle of forest management activities" described in chapter one. Bear in mind, however, that all these activities are occurring simultaneously across the landscape. The chapters provide five views of the same enterprise from different perspectives.

"Assessment" is the final stage in the cycle of forest management, and it usually involves a rigorous quantitative analysis of what has been achieved by actions to date. Instead, chapter ten provides a more qualitative and impressionistic look at the past, present, and future of forestry at Hinton. Of course, the best way to assess the state of the forest is to walk or ski in the woods around Hinton and see for yourself.

CHAPTER ONE

Finding Our Way through the Thicket

We ride in a thicket. We grapple with difficulties; we are in a maze of routine. Letters, circulars, reports, and special cases beset our path as the logs, gullies, rocks, and bog holes and mosquitoes beset in the hills. We ride—but are we getting anywhere?

— Aldo Leopold, 1913

Mature spruce stands provide a shadowy background to young spruce reforestation south of Hinton. Brain Carnell

Change does not happen quickly or easily when we work with nature. Often we must choose between actions with immediate, tangible benefits and those with longer term, more uncertain payoffs. This is especially true in forestry, where the fruits of today's efforts may be enjoyed only by our grandchildren. The question "what to do next" is critical because it has both immediate and long-term consequences. In order to decide what to do next, we need some sort of system.

Aldo Leopold (1887–1948)

Aldo Leopold was one of the most influential North American foresters of the twentieth century. Through his work with the U.S. Forest Service, his teaching, and writings such as *A Sand County Almanac*, Leopold articulated a "conservation ethic" that encompasses all the values of the land and the life it sustains, not just the short-term economic value. His vision of "land health" continues to inspire people today. The measure of successful forestry, he said in 1913, "is the effect on the forest."

Traditional decision-making and management systems are hierarchical, top-down systems based on power. An authority makes decisions, however arbitrary, and others obey. Such rule-based systems have been dominant for most of human history. They can work well if the objectives are shared widely and the rules are enforced consistently. Unfortunately, rules and hierarchies are often inflexible and difficult to change.

In recent centuries, the forces of science, education, and democracy have fundamentally altered traditional rule-based systems. Modern decision-making systems establish rules too—ideally on the basis of knowledge rather than power—but now the focus has shifted to the goals that are intended to be achieved by our actions and decisions. In modern systems, both goals and rules evolve, changing over time as new knowledge accumulates and new situations arise.

Modern forest management systems are guided by four key components: values, goals, objectives, and indicators. *Values* are the qualities we hold necessary or desirable in our lives and environment. Values give rise to goals. A *goal* for sustainable forest management, as defined by the Canadian Standards Association (CSA), is "a broad, general statement that describes a desired state or condition, related to one or more forest values." An *objective* is a more specific and measurable future state: "A clear, specific statement of expected quantifiable results to be achieved within a defined period of time, related to one or more goals." The variables that are monitored to track progress toward the objectives are called *indicators.*

Forests: A Shared Resource

The CSA defines sustainable forest management as "management to maintain and enhance the long-term health of forest ecosystems, while providing ecological, economic, social and cultural opportunities." In Canada, where about 94 per cent of all forests are located on government-owned Crown lands, forest management is generally a shared responsibility between government and industry. Forest management goals and objectives are established through the tenure agreement negotiated between the parties and through consultation with other stakeholders such as the general public and Aboriginal peoples. The government's goals may include watershed protection, preservation of wildlife habitat, recreational opportunities, nonrenewable resource extraction, and economic diversification, as well as the direct revenues from forest products. Industry generally wants profits and good markets, an economical supply of wood for its operations, efficient and economical transportation routes, and a well-serviced, hospitable location for its operations and employees. The public, including industry employees, may want some or all of the government's goals, along with the secure knowledge that their forests are being managed sustainably and will be passed on to future generations in good condition with all their systems intact and functioning. Aboriginal peoples may have historical, cultural, spiritual, environmental, and economic interests in the land. Negotiations lead to a contractual sharing of benefits and responsibilities.

In addition to the specific provisions of the lease or tenure agreement, government legislation and regulations create a framework of goals, objectives, and rules for managing the forest.

Because harvesting and reforestation activities occupy only a small portion of the total land area at any given time, there are ample opportunities for multiple uses of the forest. Government and industry plan for other users by a process known as integrated resource management. This multiple-use strategy may involve co-operation and consultation with many interest groups such as Aboriginal peoples, hunters, anglers, trappers, wildlife enthusiasts, hikers, skiers, horseback riders, berry pickers, naturalists, snowmobilers, and all-terrain vehicle users, as well as other industries such as coal, oil and gas, and livestock. There are even multiple uses of the wood harvest for products such as pulp, lumber, panelboard, log buildings, utility poles, and fence posts. Integrated resource management ensures opportunities for these multiple uses and encourages their uses at times and places least disturbing to the forest ecosystem.

What Does "Management" Mean in Forestry?

Management of natural systems involves interventions in those systems, sometimes to alter system structure, and always to alter system evolution. When management is undertaken, it is, by definition, with the intent of causing some part of the system to evolve differently than it would without management. Because of the costs involved, management is undertaken only when it appears that value in some form can be gained/retained, commensurate with the costs of managing.

—Gordon Baskerville, 1997

Gordon Baskerville, professor of forestry at the University of British Columbia, kicked off a spirited discussion of forest management and ecological science a few years ago in the internet journal *Conservation Ecology*. He stressed that management involves considerably more than mere "problem solving." Management can be defined as "intentional intervention" in human and natural systems. The key to the meaning is the adjective *intentional*—the intervener has some goal or purpose in mind. Yet the most common flaw in management is the failure to monitor the results of intervention. A good manager asks continually, "Are we making progress toward our goals? Can we attain them more rapidly and efficiently?" A really effective manager also considers periodically whether the goals and objectives themselves are still valid and worth pursuing, and he or she restates the goals and objectives as new demands and circumstances arise.

◀ ▶ CONTENTS INDEX

Adaptive Management

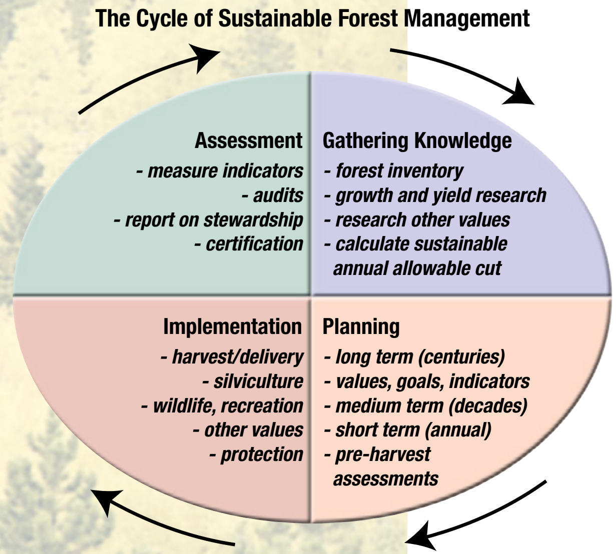
For many reasons—including the continuous involvement of scientists for the past forty-eight years and the willingness of managers to heed scientific findings—the forest around Hinton provides an excellent real-life case study of management evolution, with practical lessons for present and future generations of foresters and others who care about the environment.

As early as the preliminary forest management planning in 1955 and 1956, company and government foresters at Hinton developed an adaptive approach. This was explicitly stated in a set of operating ground rules, adopted in 1958, which exemplified the principles of adaptive forest management nearly four decades before the term was widely used in forestry:

> *The initial cutting system and variations thereof shall be on a trial basis. As many modifications of such cutting systems shall be adopted as possible in order, by experiment, to arrive at a system or systems best adapted to the silvicultural requirements of the species in question, the topography and the operational requirements inherent in economical timber extraction.*

This quotation from the 1958 ground rules captures the essence of the adaptive forest management definition offered by the CSA in its 1996 *Sustainable Forest Management Standard:* "Adaptive management is a learning approach to management that incorporates the experience gained from the results of previous actions into decisions."

Figure 1.1. The cycle of activities in sustainable forest management



The Cycle of Sustainable Forest Management

Forest management is challenging because trees have longer life spans than most other living things, including people. Only a small fraction of the forest can be harvested annually if the forest is to be maintained as a sustainable ecosystem and a renewable resource. Many activities—harvesting, reforesting, tending, protecting—must occur simultaneously across the landscape. Meanwhile, managers have to adapt to changes in science, technology, economics, politics, public expectations, and even weather and climate.

Adaptive management meets these challenges by a continual process of gathering knowledge, planning, implementation, and assessment (see figure 1.1). This process includes a number of distinct elements that together make up the cycle of forest management. However, it is important to remember that each element is an integral part of the whole, and a change in one element often necessitates changes in all the others. The ultimate goal is to sustain the forest as a healthy, functioning ecosystem.

Stage One: Gathering Knowledge

One of the first tasks is to find out about the forest itself—what kinds of trees there are, including the species, ages, sizes, and qualities. We call this the forest inventory. The inventory is a compilation of information about the stands that make up the forest. A stand is a relatively homogeneous unit of trees sharing similar characteristics. The inventory process typically begins with an analysis of aerial photographs and maps to identify the tree stands. The growth and yield rates of trees, stands, and forests are calculated using data from research trials and periodic remeasurements of permanent sample plots.

From this information, foresters will, among other things, determine an annual allowable cut (AAC). The AAC is the level of harvest that can be sustained over long periods of time, taking into account the growth, yield, and scheduled harvest of both the existing forest stands and the new reforested stands that replace them after harvest. This AAC forecast is modified based on inventories, research, and planning for non-timber values such as wildlife, watersheds, aesthetics, fisheries, biodiversity, and historic and cultural sites.

Stage Two: Planning

Planners translate goals, rules, and knowledge into reality. Like architects, planners must come up with practical steps to attain an envisioned future. However, forest planners deal with an ever-changing living ecosystem over a large area, rather than bricks and mortar in a single location. The envisioned future is multi-layered over time—today, next year, next decade, next century. Plans provide the context to answer that basic question, "What to do next?"

Forest management planning can be divided into three categories: long, medium, and short term. It is crucial that each level of planning be consistent with the others to ensure sustainability. Long-term plans—called forest management plans—identify the values to be sustained, goals for those values, and the strategies by which to achieve the desired future forest. They describe how the landscape will evolve over one or more "rotations" from harvest to harvest on the same site. This forecast can extend for a time span of centuries. The long-term plans show sustainable levels of harvest (the AAC). They describe how the productivity of the forest will be maintained or enhanced, and how other uses and values will be integrated and sustained. Finally, they identify indicators that will be measured regularly to track progress toward the desired future, applying the concept that "what gets measured gets managed." Many indicators are selected. Examples include the supply of long-term habitat (wildlife); application of good water management practices (environment); changes in the age of forest stands (forestry); education and training (stewardship); and expenditures on research and development (knowledge).

Medium-term plans lay out strategies and operational schedules over a time frame of one or two decades. Short-term planning is done year-by-year and provides precise details about road building, harvesting, and reforestation—where

Specialized Training

Government and industry forestry activities are generally planned and managed by professional foresters and biologists—graduates of four-year university programs, some of whom have specialized through master's and doctoral programs. Forest technologists—graduates of two-year technology programs with a more applied orientation—are also part of the planning and management teams. Foresters and technologists performing these services in Alberta must be registered under the Regulated Forestry Profession Act and are governed by a code of ethics. Forestry education programs typically include a solid grounding in biology and forest ecology, forest soils, silviculture, and forest management. These are underpinned by chemistry, calculus, statistics, and economics. Language and commun-ication skills and an understanding of social sciences and humanities are also required. As Weldwood forester Hugh Lougheed recalled about his introduction to forestry, "I went into forestry with some misconceptions about what forestry really was. I was quite amazed at the breadth of knowledge and technical skills that were required. There was so much to understand—biochemistry, wildlife, ecology, computer science, [and] calculus."

Now, with the increasing complexity of management, additional staff with specialized training in biological sciences and ecology—such as soil, water, wildlife, and fisheries scientists—have been added to the management teams. The work of these scientists is supported by basic research conducted by government, universities, and industry, often working together.

and when these activities will occur, and what methods and equipment will be used. Short-term plans also include details of such factors as wildlife and recreation programs.

One of the most important short-term plans is the pre-harvest assessment. This considers many factors, but most importantly decides the way the forest will be regrown. Regeneration plans differ from species to species and site to site. Foresters must consider the way different species renew themselves and grow, the availability of seed sources, the ability of some species to sucker or sprout, how much sun or shade the seedlings need, and their moisture requirements. From these assessments, foresters can determine the appropriate size and shape of cutting areas, and the type of harvest system, as well as site-preparation needs after harvest to ensure suitable conditions for regrowth. Other pre-harvest considerations are selection of the right species for reforesting the particular sites and ensuring suitable nursery stock if planting is to be done.

Forest planning is an ongoing process as new information is gathered and new situations arise. Plans can be altered profoundly, sometimes literally overnight, by natural events such as fires, the introduction of new technologies, the success or failure of past methods, and changes in economics, regulations, forest uses, and social values. Planning helps to reduce uncertainty, but cannot eliminate it.

Stage Three: Implementation

When all the planning is done and approvals are in place, the time for implementation arrives. Roads are built. Harvest occurs. Sites are prepared and reforested. Other activities related to wildlife, watershed, recreation, aesthetics, and protection take place either in concert with the harvest and silviculture operations or separately. Meanwhile, the forest must continuously be protected from threats such as fire, insects, and disease.

Harvest

Logging has two important purposes. The obvious one is to remove the trees from the site and deliver the wood to the mill. The other is to prepare the site for the new, regenerated forest. In this sense, logging is both the end and the beginning of forest stands. It is important to plan for both at the same time. Selecting the specific areas to be cut takes a lot of thought. There has to be enough wood in the area to cover the costs of roads and logging, and it should be of suitable quality for the intended mill—for example, larger trees for lumber or veneer and smaller or poor-quality trees for pulp. The hauling distance to the mill is another key factor. Once cutting areas have been selected and approved by the government, then the rest of the preparation involves a series of steps:

- develop the road systems
- lay out harvest areas, and mark the selected sites with flagging tape
- determine how specifically to fall the trees, remove the limbs, move the wood

to landings, sort it, load it, and haul it to the mills
- select the operator (contractor or company crew) to perform the work.

Logging involves people and machines, maintenance and service, and carefully choreographed scheduling. The wood itself is heavy and bulky—about eight hundred kilograms per cubic metre. After a tree is felled, the branches need to be removed and the trunk moved to the roadside for hauling to the mill. Removal of the branches (delimbing) can be done at the harvest site or at the roadside; the resulting slash is left on the forest floor. In the past, slash was often piled and burned—a practice dictated by economics and the type of equipment then in use. Slash burning has largely been eliminated today, except where needed to prepare certain sites for planting, because of the associated fire hazard and ecological impacts. Equipment and methods are determined by site conditions and reforestation requirements. At the roadside, logs are sorted and piled for their final destination: sawmill, pulp mill, veneer plant, and so on. The logs are then hauled to a mill yard for final sorting and processing. At the mill yard, the wood is weighed and measured. At Hinton, trucks are sent to the sawmill or pulpwood areas to unload, depending on the size and quality of the wood. All the trimmed wood from the sawmill is chipped and delivered to the pulp mill, so there is very little waste. Bark and similar waste, commonly known as hog fuel, is either sent to other mills for manufacturing into products such as panelboard or burned in pulp mill boilers to provide steam and electricity.

Silviculture

Just as agriculture is the art and science of growing field crops, silviculture is the art and science of growing forests. There are several ways the new stand can be established after harvest. For example, a suitable seed bed can be prepared on the cutover, or harvested site, by exposing mineral soil so that seeds from cone-bearing slash or from adjacent trees may establish the new forest. Alternatively, seedlings may be planted. In either case, the harvest area is usually treated to break down the slash; this treatment encourages decomposition, releases nutrients, and reduces fire hazards. It is best to get the new crop of seedlings growing as quickly as possible so they can successfully compete against the other natural vegetation that also establishes itself after harvest.

Stand tending is a general term for looking after the growing stands. On richer sites, competing hardwoods may threaten the survival of softwood regeneration and must be controlled, a process called cleaning. If seedlings are too dense, spacing may be necessary to allow the remaining trees to grow to their full potential. This juvenile spacing, also known as precommercial thinning, is normally done at an early age. Later in the life of the forest stand, a commercial thinning may remove a portion of the trees for processing in a mill; this type of thinning allows the remaining trees to grow faster and improves their value as sawlogs. Stand-tending treatments may also create new browse for wildlife.

Wildlife, Recreation, and Other Values

Harvest and reforestation activities provide many opportunities to enhance habitat or provide security for wildlife. Some of these opportunities are found in the design of harvest systems, such as block sizes and shapes, wildlife habitat trees, and islands of timber left in blocks. Other opportunities may be found through streamside protection, areas deferred from harvest, or active measures to increase wildlife habitat and use opportunities.

Many forest companies have recreation programs designed to conserve or enhance areas of high recreation value or create new opportunities in the managed forest landscape. The initiatives may include development of campsites, hiking and ski trails, day-use areas, and interpretative driving or walking trails.

Other values such as watershed, aesthetic, cultural, and historic features are addressed through various strategies. For example, modified harvest systems are sometimes used to maintain the visual qualities of sensitive viewscapes; stream crossings are improved by replacing culverts with bridges; cultural sites important to Aboriginal peoples are protected from harvest.

Protection

Forests are vulnerable to natural disturbances such as fire, disease, and insects. Most of the forests in the Alberta foothills began as a result of catastrophic mortality from such agents, especially fire. Today's society can no longer afford these stand-renewing events on such a large scale and must find ways to manage the forest to achieve the same ends while protecting human safety and property—including homes, backcountry lodges, and infrastructure such as power lines and oil wells—and jobs that depend on the forest.

More effective fire protection was one of the major developments of the twentieth century. The use of observation towers, lightning detectors, aerial surveillance, portable water pumps, water bombers, helicopters, and trained fire-control crews has greatly reduced the frequency of forest fires and the areas burned. After fires, salvage logging and silvicultural treatments can be used to ensure rapid regeneration. Disease and insects can be fought by biological or chemical treatments, or by removing the infested or infected stands in "sanitation" cuts.

Stage Four: Assessment

One of the most important features of adaptive management is monitoring and assessment to keep track of how post-harvest events are unfolding, followed by whatever "intentional intervention" is necessary to meet the goals and objectives. Opportunities for assessment are created during renewal of tenure agreements, forest management plans, annual operating plans, and ground rules, as well as during regular reviews within the company and by government agencies. Forest management plans typically include a description of the values to be managed—such as timber, wildlife, and water quality—and the yardsticks or indicators that

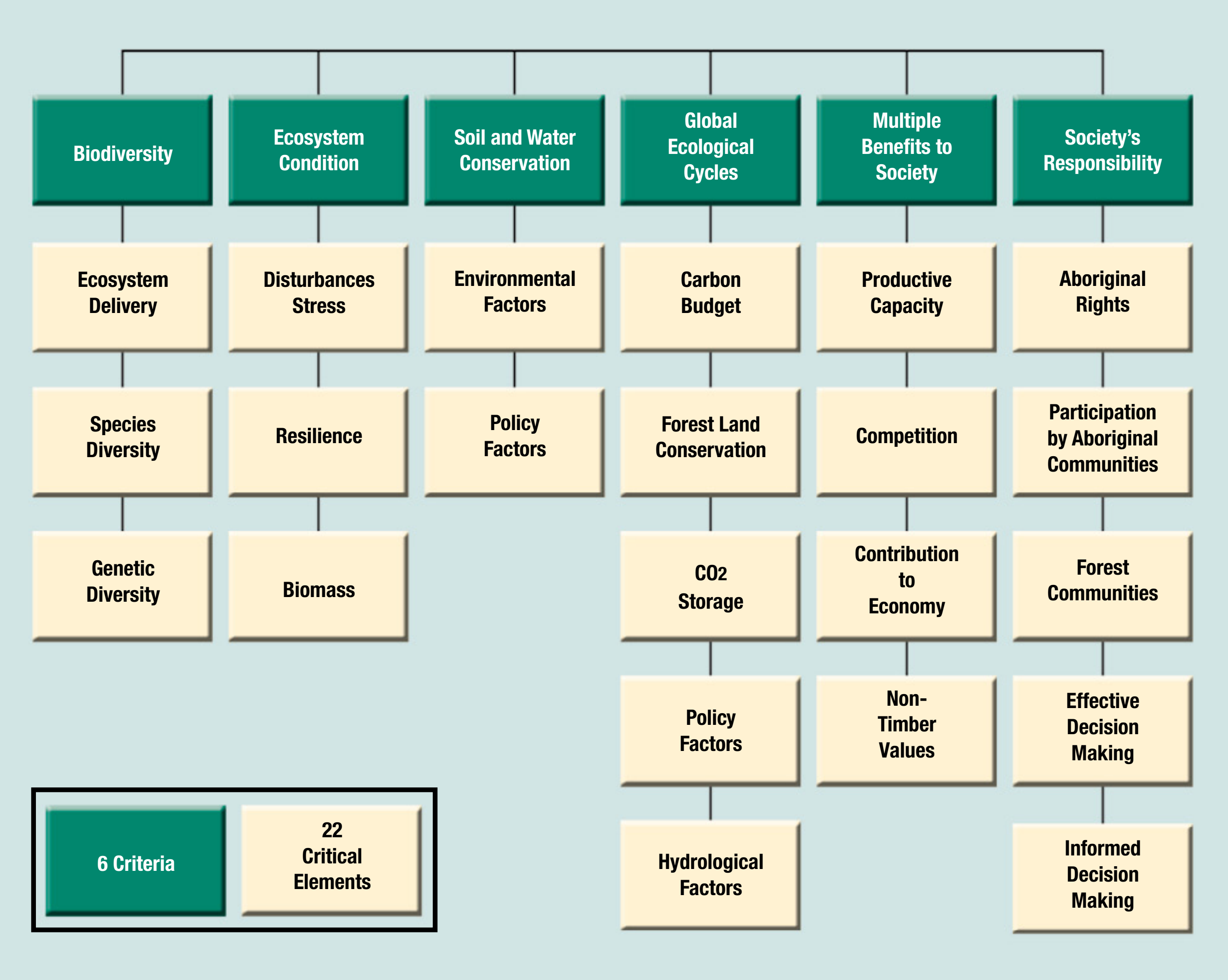


Figure 1.2. Criteria and indicators framework for sustainable forest management: Canadian Council of Forest Ministers (1995)

will be used to monitor change in those values over time. For example, Weldwood's plan for its Hinton forest identifies twenty-one values and forty-eight indicators.

More recently, additional reviews have occurred during integrated resource planning, stakeholder consultations, and third-party audits and certification programs. (At Weldwood Hinton, an annual Stewardship Report was initiated in 1994 to consolidate the reporting of performance indicators; the report provides the data needed for the various review processes.) The results of such assessments are incorporated into all the relevant elements of the management system. Rather than a single, linear cycle, the process is actually a continual series of overlapping cycles, evaluations, and feedback loops.

In 1995, the Canadian Council of Forest Ministers (CCFM) identified six criteria and twenty-two critical elements that should be addressed in sustainable forest management. Many companies now develop their long-term forest

management plans and their values, goals, and indicators in the context of these criteria and indicators. The CSA standard for sustainable forest management is also built to conform with the CCFM framework (figure 1.2).

The Evolution of Forest Management at Hinton

Each of the elements of forest management evolved greatly, and became vastly more complex, during the half-century since large-scale development began in the forests around Hinton. An ever-larger portion of the land area was directly affected by management activities, and a larger portion of the AAC was actually harvested. New technologies altered every aspect of forest management. Lessons from past successes and failures were incorporated into plans and operations. Scientific knowledge, about forestry in general and the Hinton forest ecosystem specifically, grew tremendously. Our very concept of the values inherent in the forest changed.

The Hinton story shows a progression of values:

1. *Sustained-yield management*—ensured a "perpetual" timber supply (circa 1951).
2. *Multiple use*—with timber production as the primary use (circa 1970).
3. *Integrated resource planning*—incorporated multiple uses with primary emphasis on timber production and wildlife (circa 1982).
4. *Sustainable forest management*—aimed to maintain a range of important values of the forest over the long term (circa 1991).

At each stage of the evolution, the previous values and goals were not abandoned but were merged into the new vision of the present and future forest landscape. The most fundamental change at Hinton occurred when the primary goal of forestry shifted to sustainable forest management. This new direction was outlined in general terms in the 1988 revision of the Forest Management Agreement and stated explicitly in the 1991 Forest Management Plan. The 1999 plan described, in detail, how the goal of sustainable forest management would be achieved. The 1999 document is unique in its extensive mapping and quantification of non-timber values, including subjective values such as aesthetics and cultural and historical assets.

Adaptive forest management is the *process* for achieving sustainable forest management. A long tradition of adaptation (continuous learning, continual improvement) enabled Hinton foresters to manage the transitions on the road from sustained-yield to sustainable forest management.

As Aldo Leopold said, the ultimate test of forestry "is the effect on the forest." That effect, and how it was achieved, is described in later chapters. First, however, we need to consider the natural landscape itself, and how it evolved during the hundred centuries before the arrival of modern forest management.

CHAPTER TWO

The Landscape

TEN THOUSAND YEARS OF TREES, FIRE, AND PEOPLE

The genius of the place is made up of the physical, biological, social and historical forces which together give its uniqueness to each locality or region.... Man always adds something to nature, and thereby transforms it, but his interventions are successful only to the extent that he respects the genius of the place.

—René Dubos, 1970

Located in Alberta's eastern slopes, the Hinton forest offers many views of natural and regenerated forests against the backdrop of the Rocky Mountains.

Understanding the relatively unmanaged "state of nature" in ecosystems during the preceding centuries and millennia has become particularly important today. As more of Earth's landscape is altered by human activities, we must make sure that the inherent values—the spirit or genius—of the landscape are not lost.

The Landscape

The Hinton forest management area today occupies about one million hectares of west-central Alberta and includes parts of four natural subregions—upper foothills (54 per cent), lower foothills (30 per cent), subalpine (15 per cent), and montane (1 per cent)—along with a trace of the alpine subregion. The subalpine southwestern edge of the management area abuts the Rocky Mountains, and average elevation decreases to the northeast in a series of diminishing ridges and hills.

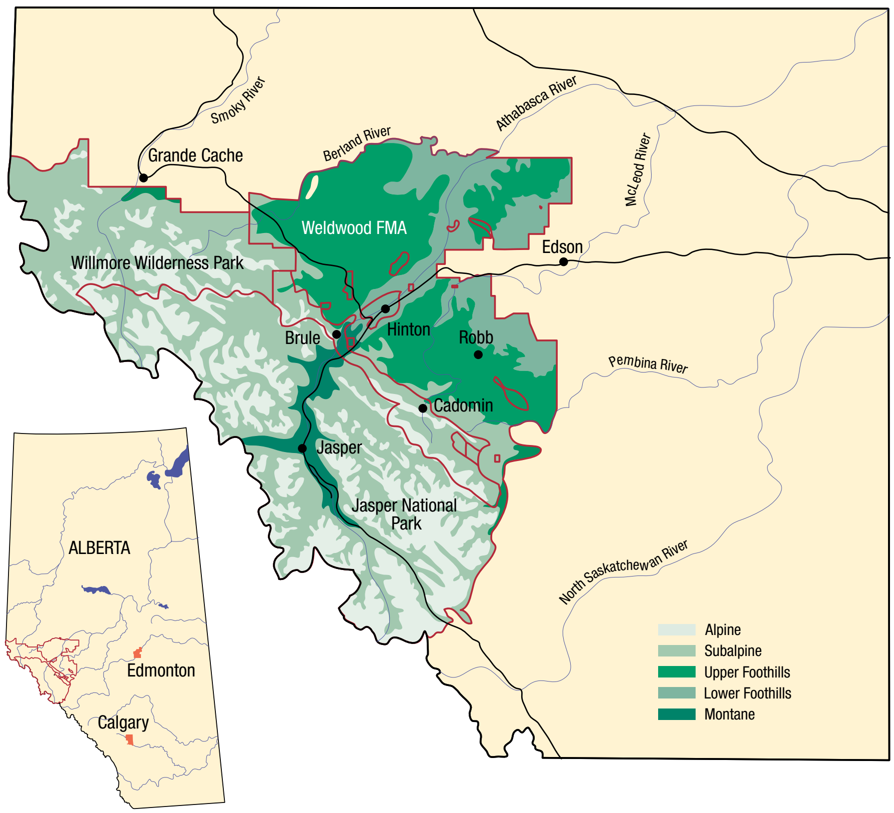


Figure 2.1. Natural subregions in the Foothills Model Forest, including Weldwood's forest management area.

Below: A small area of the montane natural subregion extends into the Athabasca River valley outside of Jasper National Park. The Hinton flying club air-strip, built by the Alberta Forest Service in the 1950s, is in the foreground.

Below right: The subalpine natural subregion is characterized by rolling terrain and extensive areas of even-aged lodgepole pine. Reforestation usually features the same species.

The area is bisected by the mighty Athabasca River, flowing out of the mountains on its long journey from the Columbia Icefields to the Mackenzie River and the Arctic Ocean, and there are numerous smaller streams and rivers.

Aside from the topography itself, the most visible feature is the forest that covers more than 90 per cent of the land. Conifers predominate at higher elevations, while more deciduous trees appear in the lower foothills. Extensive even-aged stands of lodgepole pine *(Pinus contorta)* bear witness to the effects of fires. White spruce *(Picea glauca)* is present on many sites, and black spruce *(Picea mariana)* on wetter terrain. Trembling aspen *(Populus tremuloides)* is the most widespread hardwood. Other tree species include Engelmann spruce *(Picea engelmannii)*, subalpine fir *(Abies lasiocarpa)*, balsam fir *(Abies balsamea)*, tamarack *(Larix laricina)*, balsam poplar *(Populus balsamifera)*, and white birch *(Betula papyrifera)*. Grasslands and open forests, featuring the occasional Douglas fir *(Pseudotsuga menziesii)*, occur mainly in the montane subregion where the Athabasca flows out of the mountains.

Genesis

Millions of years ago, this land lay beneath a warm inland sea. Marine life thrived, coral reefs abounded, and layer upon layer of sediments accumulated on the sea floor. As the sediments became more deeply buried, they were compressed and eventually formed limestone and sandstone. Some of the organic matter trapped in the sediments was converted into crude oil and natural gas that was trapped in the rocks. Later the land hosted forests and swamps that also were buried and became rich seams of coal interspersed with shale and sandstone. The slow but inexorable movement of Earth's crust eventually thrust this multi-layered sandwich of rock and hydrocarbons sideways and upward—the strata sliding and tilting and folding as they pushed against each other—to form the peaks and ridges of the Rockies and foothills. Wind, rain, snow, and ice then ground down the jagged edges of the rocks, and the resulting sand, silt, and gravel filled the valley bottoms.

The landscape around Hinton was carved by grinding glaciers during the long, cold Pleistocene epoch that lasted for more than a million years, and then by rushing meltwater when a warm climate returned. During the Pleistocene, the mountains and foothills were buried under ice sheets several kilometres thick. The most recent peak glaciation occurred about eighteen thousand years ago. Just six millennia later, a sharp increase in the sun's radiation triggered a dramatic warming period. Average temperatures peaked ten thousand to six thousand years ago.

As this warming melted the great North American ice sheets, plant and animal life flourished. Sedges, grasses, and shrubs predominated initially—as they do today in alpine areas after glaciers retreat—but forests became established over a few hundred years. Most of the major species in the region, including humans, appeared by about ten thousand years ago. The forests hosted moose, elk, and beaver, while bison roamed the grasslands along the rivers.

Climate and Hydrology

The main elements of local climate and hydrology have also been present for about ten thousand years. Prevailing westerly winds from the Pacific Ocean lose much of their moisture as they are lifted over British Columbia's mountain ranges, and dry winds often cascade down the eastern slopes. Typically, more than half of the area's annual precipitation falls as rain during June, July, and August. Aside from the distant alpine glaciers and snowfields feeding rivers such as the Athabasca, the crucial water supply comes from summer rains and the slow melting of snow from shaded and sheltered forest areas. Where snow falls in open areas, it melts or evaporates quickly under the combined effects of sun and wind. Torrents from cloudbursts or rapid melting can cause erosion of land and siltation of rivers. Water from slow-melting snow or a gentle steady rain percolates through the soil, nourishes plants, and feeds clear mountain streams. Towering storm clouds are common from spring to fall, but they often bring only lightning, without rain.

Fire

The combination of an often-dry climate, lightning strikes, and abundant fuel brought frequent fires during the last ten thousand years. Evidence in the Hinton area—fire scars, lake sediments, tree rings, and historical records—indicates that in recent centuries an average of 1.1 per cent (6,200 hectares) of the upper foothills forest and 1.5 per cent (4,700 hectares) of the lower foothills forest burned annually. In the 1880s, smoke from widespread fires in western Canada darkened skies over London, England, typifying the kind of devastating fire that probably occurred at least once a century during the preceding millennia. Some sites were affected more frequently, others less often. Depending on moisture, fuel, and wind conditions, a fire might be contained to a small patch or might envelop millions of hectares. Also, the forest does not burn uniformly; recent research indicates that a single thousand-hectare fire creates an average of about sixty distinct burn patches.

Dry conditions can occur at any time of the year in Alberta's eastern slopes. This burn started from highway brush burning in December 1997.

Repeated fires of various sizes have shaped the structure of the forest. Most evident are the large patches of even-aged lodgepole pine. The sun-loving, fast-growing lodgepole pine is perfectly suited to this environment. Its serotinous cones can remain sealed by resin for up to thirty years before being opened by the heat of fire, releasing a profusion of seeds. Intense fires burn away the dry organic material, or duff, on the forest floor, exposing the moisture-retaining mineral soil below, which makes an ideal seed bed. Sometimes the response is so prolific that more than a million lodgepole seedlings spring up on a single hectare and crowd together in a dense, slow-growing thicket known as "dog hair." Sometimes subsequent

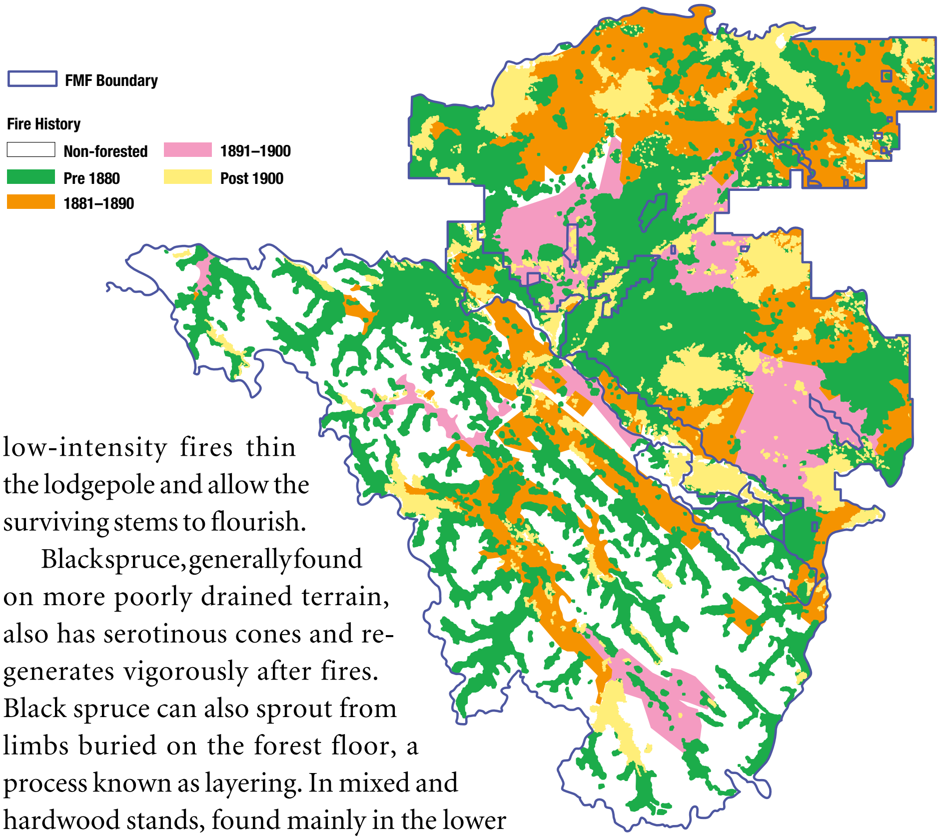


Figure 2.2. Dates of origin of forest stands in the Foothills Model Forest by period (from the 1961 fire history map and model forest research)

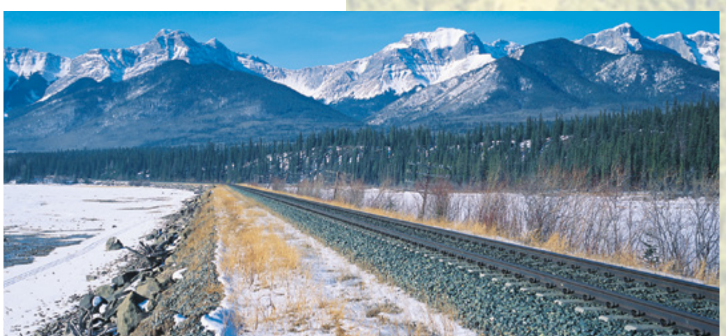
low-intensity fires thin the lodgepole and allow the surviving stems to flourish.

Black spruce, generally found on more poorly drained terrain, also has serotinous cones and regenerates vigorously after fires. Black spruce can also sprout from limbs buried on the forest floor, a process known as layering. In mixed and hardwood stands, found mainly in the lower foothills, aspen and balsam poplar can regenerate from seed or sprout from buried roots, and thrive in the sunlight after disturbance.

Other species regenerate more slowly. White spruce and balsam fir, which lack the resin-protected serotinous cones, depend on wind to spread seed from the surviving trees. Birds and small mammals eat most of the seeds, but at intervals (typically once or twice in a dozen years) white spruce trees produce a superabundance of cones, which seems to ensure their eventual propagation. Though slowest to

A series of fires in the late nineteenth century left this stand of older spruce unburned and shaped remarkably like a black cat.

Fires in the early part of the twentieth century removed parts of the "Cat." The passage of time and the influx of new growth have combined to blur its outlines.



The Black Cat

West of Hinton, near the hamlet of Brule, there is a rocky ridge known as the Black Cat. How it got the name is evident in the upper right of a 1927 photograph of the area. The story of the Black Cat vividly illustrates the interaction of fires and forests that repeatedly alters the foothills landscape—in this case, at least fourteen times in three centuries.

The old forests that formed the body of the Black Cat originated after a fire around 1808, and an extensive fire sculpted the feline shape in 1896. Between these dates, at least six other fires burned in this immediate area—in 1830, 1840, 1860, 1869, and 1885. (Despite all these fires, some remnants of the 1808 forest remain as patches of timber in the valley to the left and in ragged stands on the hill.) The 1808 growth itself was the result of at least four earlier fires in 1705, 1735, 1760, and 1795.

Another fire in 1936 missed the Cat, but a fire in 1946 burned away parts of the head and tail. Regrowth after the fires has made the silhouette barely distinguishable today.

Forest Dynamics

The seemingly tranquil forest is actually a complex association of plants and animals, all with distinct characteristics and existing in a state of constant change in response to the forces of growth, death, disturbance, and renewal. To understand the ecology of this landscape, it may be useful to highlight four important concepts.

Disturbance—When an event or force such as fire, wind, snow, hail, flooding, disease, insect infestation, or human intervention alters the structure of a stand by killing some or all of the trees, this disturbance sets the stage for new growth of the forest's plant communities.

Succession—Because humans have shorter life spans than trees, and often observe an individual forest stand only once, they tend to perceive forests as stable entities. In reality, forest communities are in a continual state of change. After a disturbance, communities of plant species recolonize the site and are in turn replaced by other communities. For example, a stand of spruce burned in a high-intensity fire could go through a succession from grass and forbs to willow and poplars, finally seeding to spruce again. The process of colonization and rep-lacement on a specific site is called succession; the full transition from bare site to old forest is called a sere, and the arbitrarily defined stages of this process are called seral stages. One or more of these stages may be skipped on some sites.

Periodic heavy rainfalls in the eastern slopes result in flash floods that alter stream courses and take out trees, bridges, and roads.

Convergence—Each type of disturbance leaves forest sites in a distinctly different state, but over time the structure and composition of the post-disturbance sites become similar. The time period for convergence varies according to the forest type and the nature and severity of the disturbance. For example, lodgepole pine stands originating from fire and those originating from reforestation after harvest typically reach convergence after thirty to fifty years, depending on a number of site characteristics and other environmental factors.

Ecotone or "edge"—An ecotone is a transition area of vegetation between two different plant communities, such as forest and grassland, or between two different stages of forest succession. The edge area has some of the characteristics of each bordering community and often contains species not found in either of the adjacent communities. The influence of the two bordering communities on each other is known as the edge effect. An edge habitat often has a higher density of individuals of some species and a greater number of species than either flanking community. Certain species require these transitional areas—year-round, or at particular times of year—for activities such as courtship, nesting, or foraging for food. The frequent fire disturbances in the Hinton forests, and more recently logging and other human disturbances, have created a lot of edge in the region.

recover after fire, white spruce grow taller than the other species and live longer, so they tend to dominate the oldest stands.

At each stage, from blackened soil to old growth, the forest hosts a different community of flora and fauna. Elk crowd the meadows during the first decades of regeneration, feasting on grasses, forbs (non-grass herbaceous plants), and aspen shoots. Moose munch tender shoots of willow and aspen. Caribou nibble lichen on mature black spruce. Predators lurk in the vibrant areas between young and old stands. Woodpeckers nest in mature poplars affected by heartwood rot. Marten haunt the mature conifers. Small mammals scurry here and there. Insects pollinate plants and provide morsels for birds and fish. The closer the focus, the more life becomes visible, and the more dynamic the forest seems.

The Human Presence

Fire not only shaped the landscape, but also destroyed most signs of human use. The small number of archaeological artifacts found in the Hinton area renders any discussion about early human presence in the area somewhat speculative. Future archaeological finds may eventually tell us more about early peoples. Evidence from a few campsite remains in the Athabasca Valley indicates the presence of Aboriginal people near Hinton as early as ten thousand to eleven thousand years ago, although there is little to suggest there were ever any permanent settlements. Rather, the area seems to have served as a corridor for people passing through. Initially, travel could have been north-south along the foothills. As the dense forests became established in the area, most travel was likely east-west along the river valleys. However, there is evidence of at least one trail system that paralleled the front ranges of the Rockies.

Based on early European contacts in the eighteenth and nineteenth centuries, and later linguistic mapping, the Hinton area appears to have been at the edge of the territories occupied by three distinct Aboriginal peoples: Athapascan language groups of the Dene in the boreal forest to the north and east, Algonkian language groups of the Stoneys to the south and east, and Salishan language groups of the Shuswaps to the west. The pre-contact population density of the foothills is believed to have been quite low compared to many other parts of North America, especially compared to areas west of the Rockies.

The frequent fire cycles must have played a major role in the lives of Aboriginal people in this area. Although burned-over areas soon support a wealth of plants and animals, the immediate aftermath can be bleak and barren. This was another reason for people to keep moving, perhaps to return later when wildlife feasted on new growth. Judging by later customs in nearby areas, as well as research on fire history, the early peoples appear to have deliberately set fires to create habitat for favoured species such as bison and moose, to encourage growth of berries and other food plants, or to clear travel routes along streams and rivers. Fire was essential to these people for cooking and warmth, and their survival depended on

A cavity-nesting species, the pileated woodpecker excavates its nests in large trees such as mature aspen.

Lodgepole pine originates from seeds contained in serotinous cones. A waxy seal prevents the cones from opening unless heat in excess of 50 degrees (Celsius) is applied. This normally only happens during forest fires or through reforestation operations.

◀ ▶ CONTENTS INDEX

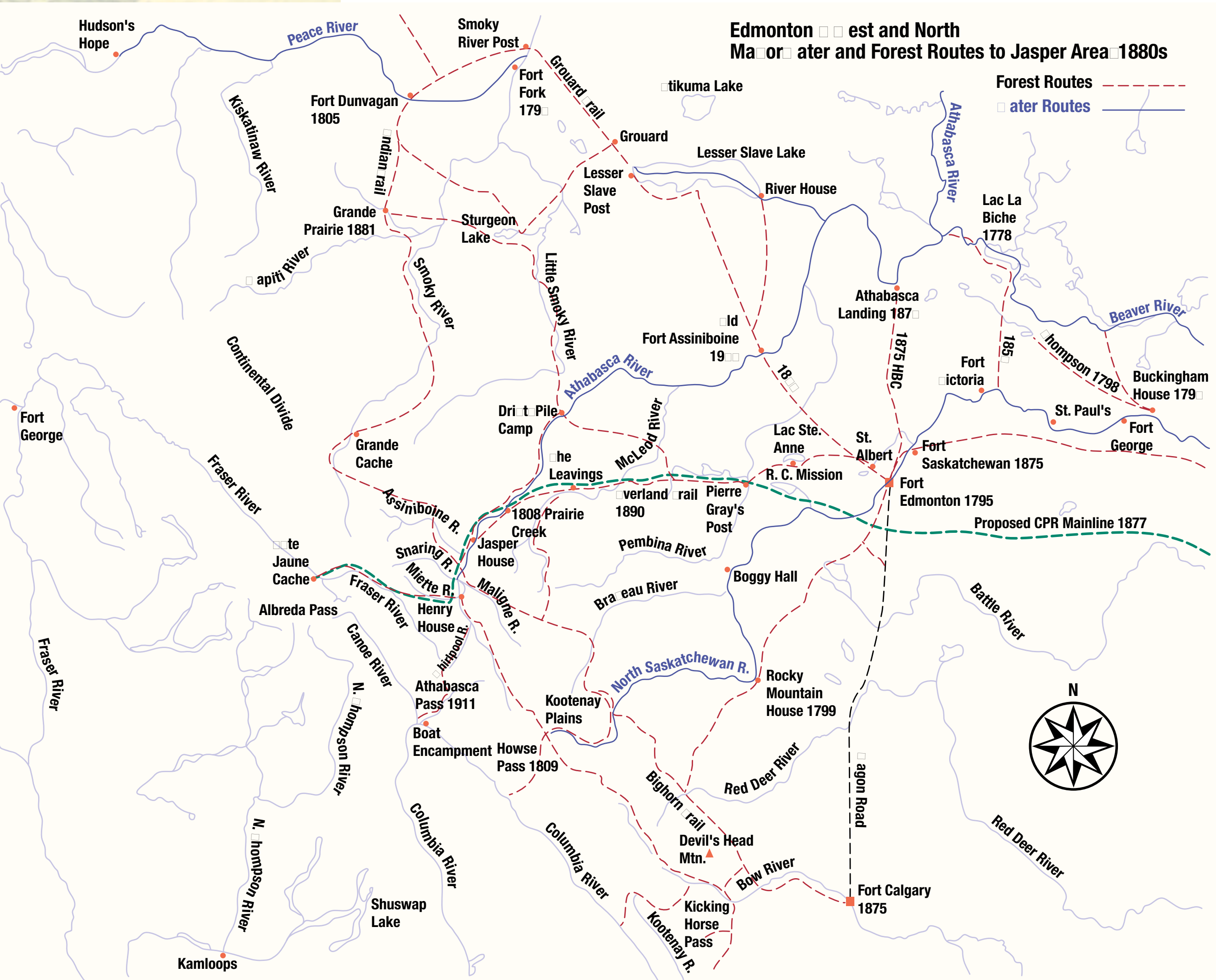
the ability to light or carry it. There were undoubtedly instances when they accidentally ignited wildfires.

In addition to fuel for campfires, the forests provided many vital resources—lodgepole pine for tepee and travois poles, saplings and bark to make canoes, conifer gum to seal seams, split spruce roots for sewing—and foods such as birch syrup and berries. Equally important, the forests offered habitat for animal species, from rabbit to moose, which were valued for skins as well as meat.

Trappers, Traders, and Travellers

The first European known to have entered present-day Alberta was Anthony Henday of the Hudson's Bay Company, in 1754, travelling with some Cree to encourage distant Aboriginal peoples to engage in trade. He was followed by Peter Pond in 1778, Alexander Mackenzie in 1789, and David Thompson in 1798.

Figure 2.3. Forest trails and water routes to the Jasper area in the late 1880s. Joan Udell



They took a circuitous northern route to avoid encountering hostile nations such as the Blackfoot on the Great Plains. Initially, the trader-explorers approached the Rockies by routes up the North Saskatchewan River. Europeans did not reach the Hinton-Jasper area until late in 1810, when Thompson opened up the Athabasca Pass route over the mountains. One of Thompson's men, William Henry, became the first European to overwinter in the Jasper area in 1810–11. Compared to the previous route over Howse Pass to the south, Athabasca Pass was longer and more difficult, often clogged by deep winter snows, but it avoided encounters with hostile Aboriginal people in the Howse Pass area. Athabasca Pass became the preferred trade route to the Columbia River for four decades. Traffic switched to the more northerly Yellowhead Pass (the route of the present Canadian National Railway and Highway 16) by the time that the Cariboo gold rush began in British Columbia in 1859.

An Aboriginal trail system, first mentioned by Alexander Mackenzie, ran parallel to the Rockies. One trail apparently followed high ground from the Peace River to the present-day Grande Prairie area and then to Entrance, west of Hinton, where it connected with the Bighorn Trail running south toward Rocky Mountain House and into the Stoneys' territory. These trails subsequently connected with the trails east to Lac Ste. Anne and Edmonton.

Outfitters George Brewster (left) and Dick Harrington (right) were among the first entrepreneurs to take advantage of the influx of tourists following the arrival of the railroads in the early 1900s. Glenbow Archives PA-472-6

In 1812, the North West Company built a trading post at the north end of Brule Lake. Seventeen years later, this post was moved upstream to the intersection of the Rocky and Snake Indian river valleys near the north end of Jasper Lake. Travel on or along the Athabasca was long and daunting. Henry John Moberly established an overland trail from Lac Ste. Anne to Jasper in 1858. Travellers on this route faced boggy muskegs in the foothills and lowlands east of Hinton, as well as many risky river fords and the steep and perilous path over Disaster Point off Roche Miette in what is now Jasper National Park. The trail was close to the route used by the railway and highway in the twentieth century.

Moberly was the Hudson's Bay Company chief factor at Jasper House from 1858 to 1861. He married Suzannne Cardinal and had two sons, Ewan and John. Their families settled and farmed in the Jasper area. The Moberlys and other Métis families were expelled from Jasper after it was made a national park in 1907 and moved to lands in the Hinton, Entrance, and Grande Cache areas. The Moberly and Cardinal families—many of whose descendants can be found around Hinton today—may have been the first permanent residents of the area.

Several parties of the gold seekers known as the Overlanders used Moberly's

Edmonton-Jasper trail in 1862 and continued over the Yellowhead Pass into British Columbia. The Yellowhead Pass was considered as a possible route for the Canadian Pacific Railway when surveying began in the 1870s. However, a more southerly route was chosen through Calgary and the Kicking Horse Pass, so the Hinton-Jasper area remained remote for another three decades. Edward Moberly, grandson of Henry John Moberly, recalled that at the turn of the century it could still take three months for the family's annual trading and supply run to Lac Ste. Anne.

Railways and Highways

In the first decade of the twentieth century, a decision in distant Ottawa ended the long isolation of the Hinton area. Prime Minister Sir Wilfrid Laurier announced in 1903 that a second transcontinental railway, the Grand Trunk Pacific, would be built across Canada on a route passing through the location that would become Hinton. Soon about 450 men, using more than a thousand packhorses, were involved in surveying for the railway west of Edmonton. Coal leases were staked southwest of Edson beginning in 1906. Parliament established Jasper National Park in 1907. The Grand Trunk reached Edson in 1910, and in that year work began on the Coal Branch railway spur line from Edson to the coalfields south of Hinton. The Grand Trunk finally reached Prairie Creek, just west of present-day Hinton, in 1911 and continued through Jasper and over the Yellowhead Pass en route to Prince Rupert.

The boundaries of Jasper National Park changed several times between 1907, when it was established, and 1930, when the present boundaries were set. *GLENBOW ARCHIVES PA-471-10*

The railway brought a new kind of visitor—tourists—who were drawn to the hiking, climbing, and horseback riding amid spectacular mountain scenery, and after 1919 to the comforts of Jasper Park Lodge and the Miette Hot Springs. British author Sir Arthur Conan Doyle visited Jasper twice, in 1914 and 1923. "The mighty voice of Canada will ever call to me," he rhapsodized in a poem celebrating "The Athabaska Trail." Like most tourists, he merely glimpsed Hinton's hills and forests through a train window. Hunters were also attracted to the game-rich area, and some settlers set up outfitting and guiding businesses. Small horse and cattle ranches were established in the valleys around Hinton, and a number of residents ran traplines.

A second railway, the Canadian Northern, was built westward in 1913 through Hinton and over the Yellowhead Pass and then southwest toward Vancouver. However, there was not enough traffic to support the two railways, and both went broke. The federal government intervened, and duplicate track was scrapped to recover the steel during the First World War. The lines were amalgamated and incorporated as the Canadian National Railway in 1922. In June 1922, Charles Neimeyer used the abandoned railway grade for the first automobile journey from Edmonton to Jasper, an arduous trip that took six days. Although there was a good road from Jasper to the east park gate, a passable road was not built between Edson and Hinton until 1933. The Icefields Parkway, constructed between Lake Louise and Jasper as a Depression relief project, provided another circuitous road access. However, the first all-weather road through the Hinton area was Highway 16, completed in 1951, relocated and paved in 1956. Until then, the railway was the principal means of access to and from the "outside world."

The town of Hinton, named after a Grand Trunk executive, housed up to 550 people during the height of railway construction in 1912, but the population dwindled quickly thereafter and was below 100 by 1921. Coal mining brought another influx of residents in the late 1920s and 1930s, reaching a peak of about 1,000 in 1939. After the principal mine closed in 1941, the population again dropped to a few hundred, bolstered somewhat by oil and gas exploration in the mid-1940s. In 1954, the year before construction began in Hinton on Alberta's first pulp mill, there were only 380 residents.

The Forest Resource

Forest Protection

The Dominion Forestry Branch (DFB) managed the forests from 1899 to 1930. It first focussed on prevention and control of fires. The arrival of people and industry brought many more fires ignited accidentally or intentionally. This trend started with the campfires of railway survey parties, and continued with other campfires, sparks from railway engines and steam-powered sawmills, fires set to clear land for various purposes, and even careless smoking. The widespread influence of natural and human-caused fires was evident when J. A. Doucet of the DFB conducted the first timber survey northwest of Edson in 1913. His report noted:

> *Here the Athabasca Valley was, at one time, very well timbered with the best of lodgepole pine, spruce, birch and poplar. Repeated fires have swept over it in such a way that there are, at the present time, only a few remaining patches of the old stand. These are found scattered along its flats, and mostly at the entrance of streams.*
>
> *The young growth, however, is generally abundant over the old brule [burned-over forest], to which large and healthy patches of forest, 35 to 50 years old, give a certain value. But no one will ever know how many millions of dollars worth of national wealth, represented by the virgin forest, were turned into ashes by recurring forest fires and washed away with the best of the soil by the rapid current of the Athabasca River.*

The DFB launched an extensive public education program to reduce the number of fires caused by humans. DFB rangers put up posters, lectured railway workers, and acted like fire-prevention circuit preachers as they toured camps and

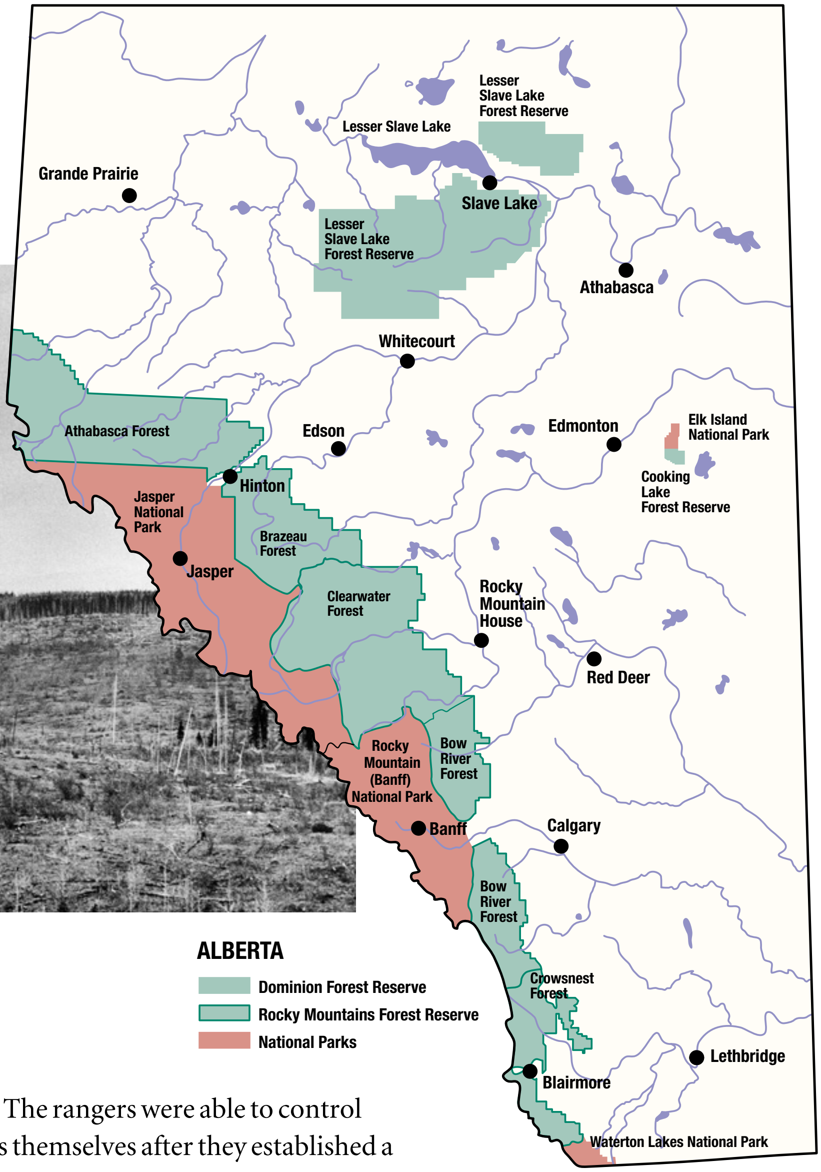
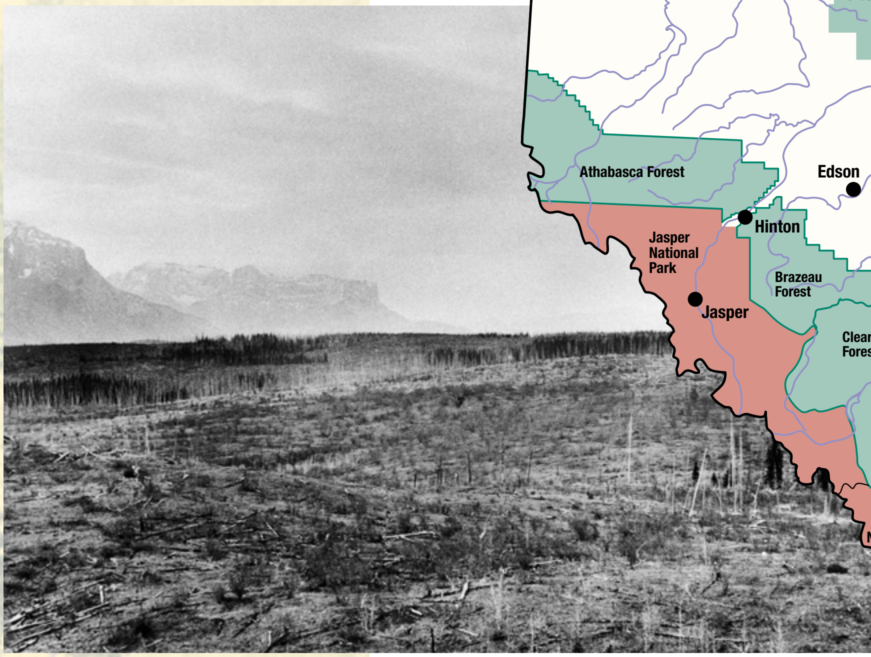


Figure 2.4. The Athabasca and Brazeau forests were two of the five forests included in the Rocky Mountains Forest Reserve, established in 1911



In the early part of the twentieth century, visitors to west-central Alberta travelled through landscapes ravaged by fire, like this area of burned timber on a watershed between the Athabasca River and Prairie Creek in 1911. R. E. Stevenson, Alberta Forestry Collectionå

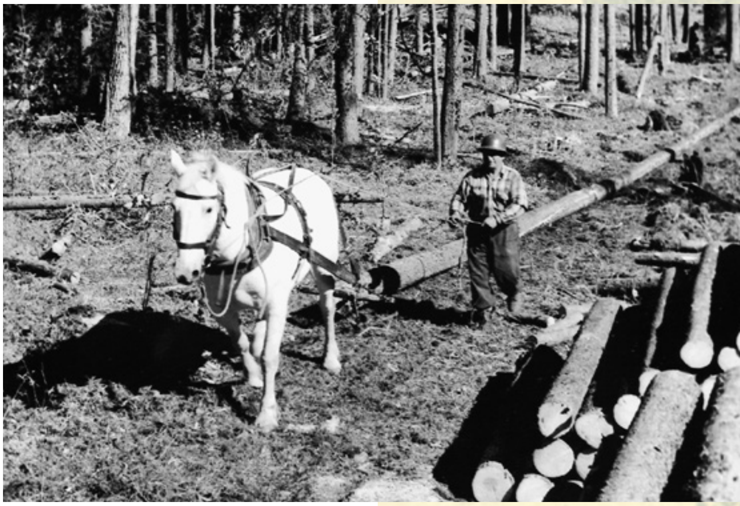
sawmills. The rangers were able to control some fires themselves after they established a network of trails, observation towers, and telephone lines in the 1920s. The rangers used grub hoes and gasoline-powered portable water pumps to extinguish a fire if they could reach it in time, but more effective fire control was not possible until roads and helicopters gave firefighters better access to the forests in the late 1950s. Nonetheless, the average area burned annually appears to have been reduced during the first half of the century. Without the rangers' efforts, the burning would undoubtedly have increased.

The Use of the Forest

The other key task of the DFB, and of the Alberta Forest Service after 1930, was to manage use of the forest. This was done through sale of "timber berths," which licensed operators to harvest a given amount of wood from a given area. Before the Hinton lease agreement in the 1950s, there was no requirement for operators to reforest harvest sites. Reforestation was nominally the responsibility of the government, but in fact little was done because nature was expected to do the job. Neither government nor timber operator did any kind of management planning.

Railways, coal mines, and prairie settlers had a voracious appetite for wood products—ties, trestle timbers, pit props, and lumber. The first commercial logging in the Hinton area was "tie hacking" for the railways. Tie contractors acquired berths and set up camps for workers, who were usually farmers seeking winter income. Hackers felled and delimbed trees with crosscut saws and axes, then hewed two sides flat with a broad axe. Sleighs hauled ties to a railway siding, where the remaining bark was peeled with a draw-knife. One man could hack an average of forty ties a day. Tie hacking continued in the area until the 1940s, when specialized tie mills were built to saw ties that were sent to Edmonton to be treated with creosote. Only pine was used for ties because it held nails better than other species.

Until the second half of the twentieth century, horses were the primary means of moving logs from stump to roadside in Alberta.



Coal mines also needed a lot of ties and timbers. The arrival of the railways set off a coal boom in the foothills south of Hinton, and the Coal Branch spur line served a string of mine communities including Robb, Coalspur, Mercoal, Coal Valley, Luscar, Cadomin, and Mountain Park. The region's coal production peaked in the late 1920s when there were about fourteen mines operating. (The last of the Coal Branch underground mines closed in 1959.) Mines also operated west of Hinton at Brule and Pocahontas from 1912 to 1928, and thereafter the Drinnan mine continued until 1938 and the Hinton Collieries until 1941. These underground mines had a special reason to prefer very dry wood—it would crack audibly under stress, warning of possible collapse. One way to obtain such wood was to harvest fire-killed wood. It is possible that some forest fires near coal mines were deliberately set for this reason. In any case, loggers supplying mines harvested fire-killed wood if they could find it.

Other small logging operations sprang up to supply lumber for local and distant markets. In the Hinton-Edson area, logs for sawmills were hauled with horse-drawn sleighs, or sometimes in long tractor trains, to central steam-powered sawmills. Some logs were also floated down rivers to sawmills in "log drives." Ties were driven on the Whirlpool and upper Athabasca rivers to a boom on the Henry House Prairie in Jasper National Park during the 1920s. Some drives also took place on the Wildhay River north of Hinton. A trial on the Embarras River confirmed that it and most of the other rivers were alternately too swift, causing logs to break through the holding booms, or too shallow, leaving logs caught on rocks along the way. A railway spur line several kilometres long was built in the 1920s from Hargwen, east of Hinton, to serve a large sawmill at Corral Creek.

In the 1930s, small mills using gasoline engines were set up to cut rough lumber in the forests around Hinton, Edson, and the Coal Branch. The rough boards were then hauled by truck or sleigh to central planer mills along the railway. One large sawmill in the Hinton area was the Brule Lumber Company, which flourished from 1941 to 1957 due to the strong demand for lumber during and after the Second World War.

The early logging had several unfortunate effects. For one thing, operators tended to select only the largest, straightest, soundest trees in a stand. This is a reasonable practice in multi-aged forests, but in even-aged forests it meant that the best genetic stock was being removed, leaving inferior strains to reseed the site. The portable sawmills also left behind huge piles of sawdust and debris, which effectively sterilized sites that were formerly productive forest. Natural regeneration on logged sites was slow and haphazard because few seeds could germinate and sprout in the layer of dry duff left on the forest floor. (However, in some cases, the already-established regeneration, such as shade-tolerant juvenile white spruce and balsam fir, flourished if the logging did not damage it.) The effects might have been devastating if such practices had continued for long, but damage was limited due to lack of access and the slow pace of labour-intensive logging with axe, saw, and horses.

The Genius of the Place

Dynamism and capacity for renewal characterize the land around Hinton, with fire as the historic agent of change. The community of flora and fauna—the biodiversity—has changed little during the last ten thousand years, if you look at it from a million-hectare perspective. But on any one hectare, change has been constant and dramatic—from scorched earth to meadow to flourishing forest to decay. In fire-origin lodgepole pine stands, some of these stages might be skipped or omitted. Until the twentieth century, the human footprint on the landscape was relatively light.

The challenge for managers has been to understand and preserve the special characteristics of this resilient place while using and enjoying its bounty of renewable and nonrenewable resources. First, however, it was necessary to create a policy framework that would allow more interventions in the ecosystem and yet respect its "genius." The next chapter describes the evolution of policies, laws, and regulations surrounding forest management at Hinton and across Alberta. This social and economic context was as important as the natural environment in facilitating forestry at Hinton.

CHAPTER THREE

The Policy Framework

The future forest industries … must be supported by the timber growth on the logged-over and burned-over non-agricultural lands. Looking at these lands we should see, not wastes, holding no promise for the future, but productive lands, needing only protection from fire to enable them to support logging camps, pulp mills, rural and industrial communities of a type which has done much for Canada.

—H. R. MacMillan, 1914

Reforestation following harvest is a requirement under Alberta law. Uncut forest, various ages of harvest, and regenerating forest provide a backdrop for young pine reforestation. Brain Carnell

Harvey Reginald MacMillan (1885–1976) was one of western Canada's first professional foresters. A graduate of the Ontario Agricultural College and Yale University's Forestry School, MacMillan was assistant inspector of forest reserves for western Canada from 1908 to 1912. He was serving as British Columbia's first chief forester when he penned his vision of the future forest industry in a letter to the first president of the University of British Columbia, Frank Fairchild Wesbrook. In 1919 MacMillan left government to found the company that would become

MacMillan Bloedel (now part of Weyerhaeuser Company), a major component of the industry he envisioned.

MacMillan was describing sustained-yield forest management, which ensures continuing economic benefits from the timber resource. It would take another half-century before this practice became widely accepted in Canada and much longer before it was transformed into sustainable management of all the values and resources of the forest. Until the 1950s, forests were generally "mined"; loggers harvested the best stands and moved on, assuming that nature would regenerate the forest and that there would always be another forest to be exploited.

As the twentieth century unfolded, the old attitude became increasingly untenable for a number of reasons:

1. An almost insatiable demand developed for forest products, in Canada and worldwide.
2. Mechanization facilitated much bigger harvests, from more remote forests.
3. Modern mills required large capital investments, and owners wanted assurance of long-term viability before going ahead.
4. Poor regrowth occurred on many logged-over lands, although foresters were developing methods to improve regeneration.
5. Early fire detection, better roads, helicopters, water bombers, improved communications and training greatly increased the effectiveness of fire control, its cost to taxpayers, and their awareness of the value of the forest.
6. Public pressure to improve forestry practices mounted.
7. Forestry organizations, particularly the Canadian Forestry Association (founded in 1900), identified problems and lobbied for improvements.

These factors convinced governments, the owners and managers of about 94 per cent of Canada's forest lands, to recognize that the resource was finite but renewable and could benefit both present and future generations of citizens. The two key requirements of sustained yield were gradually put into place:

1. The annual harvest in a single, managed area would not exceed the approximate amount of new growth occurring in the area, a calculation known as the annual allowable cut (AAC).
2. Harvested land would be reforested, either by government or by industry.

In 1943, as demand for lumber, plywood, and paper soared during the Second World War, the British Columbia government appointed a royal commission under Chief Justice Gordon Sloan to examine forestry issues. His report in 1945 recommended sustained-yield and long-term tenure arrangements, which were adopted in the British Columbia Forest Act of 1947.

Similar thinking led to a sustained-yield clause for forest management licences in the revised Alberta Forests Act of 1949. The Alberta law evolved separately and distinctly from British Columbia's, and the two systems often differed in implementation and results. Most other Canadian provinces adopted systems similar to Alberta's in the 1970s and 1980s (including Ontario in 1979, New Brunswick in 1982, and Quebec in 1986).

The Hinton pulpwood lease agreement—later known as the Forest Management Agreement—was first signed in 1951 and updated in 1952 and 1954, with the final lease boundaries established in 1955. It was one of the first industry-government partnerships in Canada to contain explicit provisions for sustained-yield management. A great deal was learned as the theory was put into practice on this large forest area.

Loomis and Crossley

When I was there [in eastern Canada], I thought to myself, if I ever had the opportunity of setting up a plan, I'd make damn sure that sustained yield would be the basis of the operation.

—Reg Loomis, 1987

Reginald D. Loomis (1904–1992) grew up on a farm in the Eastern Townships of Quebec, where his family took lumber and fuel from a small woodlot on a sustainable basis. After obtaining a degree in forestry from the University of New Brunswick, he worked for government and industry in that province, and in Ontario and Nova Scotia. Looking back in a series of interviews with Peter Murphy between 1987 and 1989, Loomis said that he had been appalled by the unsustainable practices he saw in eastern Canada and brought that consciousness with him when he moved to Alberta in the fall of 1949.

Loomis's boss, Eric Huestis, Alberta's director of forestry, had already made sure that the province's 1949 Forests Act included a commitment to "growing continuously and perpetually successive crops of forest products to be harvested in approximately equal annual or periodic cuts adjusted to the sustained-yield capacity of the lands." Both the government and the company apparently accepted this principle as they negotiated the Forest Management Agreement, then known as a pulpwood lease, between 1951 and 1954. However, it was Loomis who insisted on more explicit provisions for sustained yield in the final draft of the agreement. He subsequently worked closely with the company's chief forester, Desmond Crossley, to implement those provisions.

In 1958, Loomis and Crossley forged a unique set of operating ground rules for operations that epitomized "adaptive forest management." The views of the two men often clashed, but out of their disagreements came solutions that put Hinton in the forefront of modern forestry. Their most notable disagreement was over the choice of silviculture system. Loomis was raised on a farm where the woodlot—selectively logged—was a perpetual source of sawlogs and once provided ready cash to prevent foreclosure on the farm mortgage. Later, while working in Nova Scotia and northern Ontario, he observed many cases of "cut and run" forestry

Reg Loomis, head of forest management for the Alberta Forest Service, played an important role in the development of sustained-yield forest management in Alberta. This photograph was taken in 1991, when Loomis was eighty-seven. R.E. STEVENSON, ALBERTA FORESTRY COLLECTION

Eric Huestis, director of forestry for the Alberta Forest Service, rewrote the Forests Act in 1949 to include provision for long-term forestry agreements with industry. R.E. STEVENSON, ALBERTA FORESTRY COLLECTION" where loggers clear-cut the forest and left it to recover on its own. Crossley, however, had spent most of his career as a silvicultural researcher and, based on his own experiments, was convinced that clear-cutting followed by immediate reforestation was the only reasonable system for the lodgepole pine and spruce forests in the Hinton area. Loomis grudgingly agreed to allow Crossley to implement his systems provided he treat them as a large experiment and support his strategy with related research. To the end of their careers, these two pioneers continued to differ on this fundamental issue, although on a personal level they remained the best of friends.

For their many contributions to forest science and practice, both forestry pioneers were subsequently awarded honorary doctorates, Crossley by the University of Toronto in 1982 and Loomis by the University of Alberta in 1991. In 1997, Weldwood Hinton named the two major halves of the forest management area, north and south of the Athabasca River, the Loomis Forest and the Crossley Forest, respectively.

Tenure, Policy, and Regulation

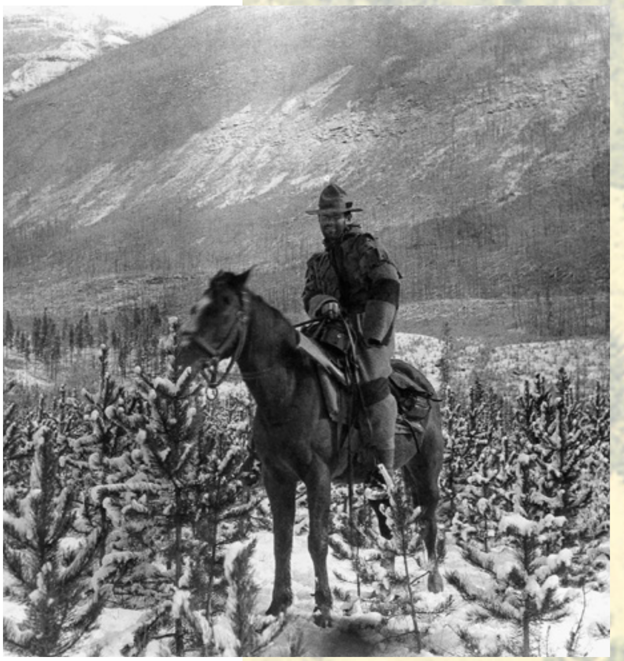
People have practised forest management—protecting forests and directing their use and development to achieve defined goals—throughout human history. Ancient examples include the biblical Cedars of Lebanon and the imperial forest reserves in China. Writers such as Theophrastus, Homer, Pliny, and Plato, along with the Old Testament, provide documented accounts of the once richly forested mountains of Lebanon, which provided vital timber for ships and temples throughout the Near East. Modern practice can be traced with some continuity back to Europe in the late Middle Ages. The first people to be called "foresters" were gamekeepers as well as timber stewards. In that sense, modern forestry's emphasis on ecosystem management has brought the profession back to its roots.

Forests had been a key strategic resource as early as ancient Egypt, but became especially important from the sixteenth to nineteenth centuries as navies and merchant fleets roamed the globe in wooden ships. This was why Britain and France reserved vast forest lands in the name of the Crown when they colonized North America. The British "Broad Arrow" blaze, setting aside the best pines for the Royal Navy's ship masts, was one of the irritants that led to the American Revolution. After France lost the Napoleonic Wars, naval demand for timber eased. The Crown Timber Act of 1849 set precedents that still govern most timber leasing in Canada today: cutting rights were offered to the highest bidder; the Crown retained ownership of the land; and leases were renewable if conditions were fulfilled.

Canadian authorities recognized watershed protection as another facet of forest management after settlers streamed onto the arid western prairies in the late nineteenth and early twentieth century. Frank Oliver, federal minister of the Interior, made this clear during parliamentary debate in 1911 on the Forest Reserves and Parks Act that expanded the forest reserve system and included the foothills around Hinton in the Rocky Mountains Forest Reserve. Oliver said: "The primary object is to conserve the sources of water supply by the protection and production, or reproduction, of timber or wood around the sources of the water supply … [and] to reproduce the timber growth for the benefit of the dwellers on the prairies surrounding these areas."

This was the basis for the system of management—fire protection and leased timber berths, with limited settlement and some cattle grazing—that the Dominion Forestry Branch (DFB) practised until the transfer of resources to the western provinces in 1930. The Alberta Forest Service (AFS, now known as the Land and Forest Division of Alberta Sustainable Resource Development) then inherited and refined this system. The AFS also acquired most of its initial staff from the DFB, including Eric Huestis, who had studied forestry at the University of British Columbia and joined the branch in 1923. After various field positions, Huestis transferred to AFS headquarters in Edmonton in 1939 as assistant director of forestry for the province. He and then-director Ted Blefgen, whom Huestis succeeded in 1949, laid the groundwork for Alberta's future forest policies.

W. N. Millar, chief inspector of forest reserves in Alberta, in young pine regeneration, Jasper Forest Park, 1913. R. E. Stevenson, Alberta Forestry Collection



During the Great Depression, which hit very hard in Alberta, the AFS was continually strapped for funds and barely able to carry out its day-to-day responsibilities. However, the economic value of forests grew even more apparent. The province's lumber production tripled during the 1930s. Winter logging income helped many people in the hard-pressed farm sector to survive. To ensure sawmill jobs stayed in the province, Alberta banned the export of raw logs and encouraged development of the domestic sawmill industry.

The war years from 1939 to 1945 brought different challenges. There was a huge demand for wood products, and prices soared, but labour shortages hampered both government and industry. Nevertheless, lumber production doubled again during the war years. In 1944 and 1945, the government eased its log export ban to allow sale of fire-killed timber, which was shipped by rail to a U.S. pulp mill. This alerted Huestis to the possibility that the province might someday host a pulp and paper industry.

Alberta's coming oil and gas boom—which began with the Leduc discovery in February 1947—was not yet evident when the provincial government drew up its post-war reconstruction plan. Based on input from Huestis and Blefgen, the plan envisioned forest industry development as a key means to reduce the economy's dependence on agriculture. The first major step was a 1948 order-in-council designating about 60 per cent of the province as the "Green Area" in which settlement would be severely restricted. This area encompassed the foothills forest reserves and much of the northern boreal forest.

In 1948, the government also signed a joint federal-provincial agreement to establish the Eastern Rockies Forest Conservation Board to share costs of increasing protection and management on the southern forests of the Rocky Mountains Forest Reserve—the Crowsnest, Bow River, and Clearwater forests (but not including the Brazeau and Athabasca forests). One of their major projects was construction of the Forestry Trunk Road, now Highway 40, which opened up access to the foothills forests for fire protection, logging, other resource development, and recreational uses.

Three pivotal events occurred in 1949:

1. The provincial legislature passed the new Forests Act, including provisions drafted by Huestis to permit long-term exclusive agreements with industrial developers, based on sustained-yield "perpetual" growth and harvest.
2. Huestis recruited eight young foresters from the graduating class at his alma mater, the University of British Columbia, to bolster the capabilities and expertise of the AFS.
3. The government commissioned the first comprehensive inventory of the province's forest resource, based on aerial photography and ground sampling, and Huestis hired experienced forester Reg Loomis to oversee the contractor performing the inventory.

Before the year was out, the new legislation attracted interest from would-be pulp mill developers. In December 1949, an agreement covering nearly 400,000 hectares was signed with R. O. (Bob) Sweezey, a Montreal engineer and investment dealer. He and two partners formed a company called Edmonton Pulp and Paper Mills Limited, but they were unable to obtain financing for the project and the lease was revoked two years later. Sweezey tried again in 1952 with a venture called Beverly Pulp and Paper Mills, but again was unable to raise the necessary funds. His second lease, including part of the forest near Hinton, expired in January 1954. By that time, the Hinton lease agreement was rapidly taking shape—although its initial "shape" was quite different from the final one.

The First Successful Agreement

The first version of the present Weldwood agreement was based on a proposed pulp mill at Edson, eighty kilometres east of Hinton, and would have harvested the surrounding forests, mostly in the lower foothills natural subregion. The mill would have drawn its water supply from the McLeod River rather than the Athabasca, and would have been powered by coal rather than natural gas. Government and industry participants needed patience, tenacity, and vision to shepherd the agreement through its four-year evolution.

Frank Ruben, a Calgary-based entrepreneur, obtained the original lease in 1951. He had come to Alberta in 1936 from California, where he had been active in construction and wildcatting for oil, and he subsequently helped to develop

Alberta's oil and coal industries. In 1949, Ruben visited his newly purchased Bryan Mountain mine near Robb, in the Coal Branch area south of Hinton (so named after the Grand Trunk Pacific's "branch" line to the area).

The vast, seemingly untouched forests in the region impressed Ruben. It occurred to him that the forests could feed a pulp mill, and this might also provide a market for coal from his mine. With oil rapidly replacing coal as a primary energy

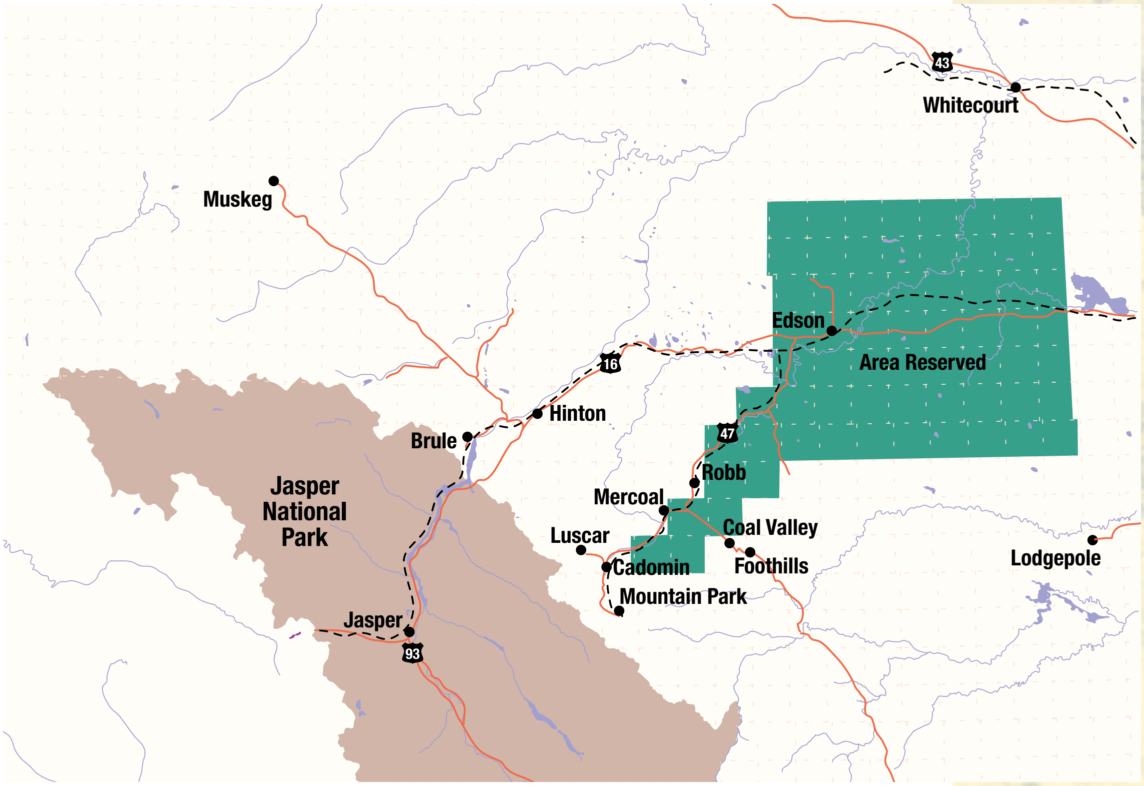
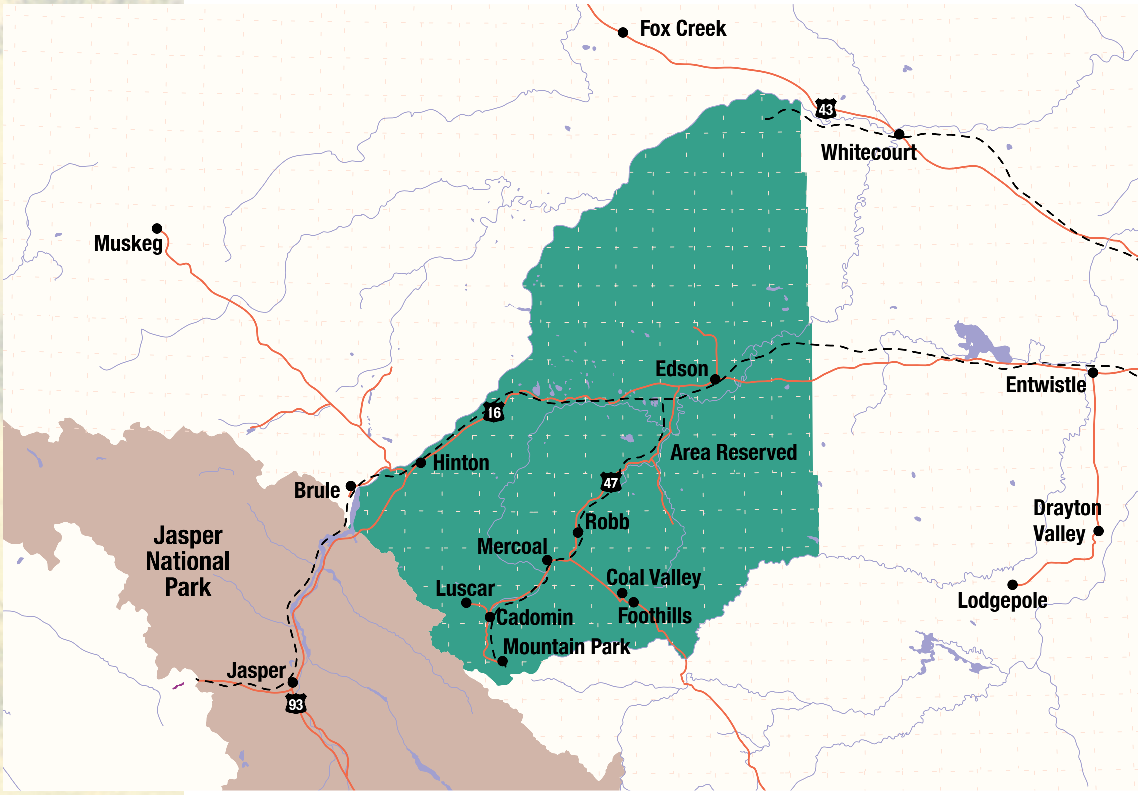


Figure 3.1. First NWPP lease area, 1951, granted to supply a pulp mill at Edson

source, and the loss of federal subsidies for coal transportation, he recognized that new markets were needed to make Coal Branch mining viable. Edson was the nearest big town with good transportation links, so it seemed logical to plan the mill there.

Ruben approached Nathan E. Tanner, then minister of Lands and Forests, and Deputy Minister John Harvie, who confirmed the government's interest in industrial development. On 23 May 1951, Ruben incorporated North Western Pulp & Power Limited (NWPP), the name symbolic of his two interests. Two weeks later, on 8 June, the government approved a lease covering up to 518,000 hectares, supplying up to 180,000 cubic metres of wood per year to a mill producing up to 180 tonnes of pulp per day. The agreement outlined the management area as a rectangular block with Edson at the centre. An additional area was included to the southwest, along each side of the Coal Branch railway line, giving access to a source of mine timbers and additional conifer pulpwood.

Figure 3.2. NWPP lease area revised in 1952 to remove agricultural lands and include more coniferous timberZ



With the agreement in hand, Ruben and his associate Clive Reid set out to assess the timber supply and determine the best processes and products for the mill. Among those with whom they discussed the project was Reg Loomis, then head of the AFS Forest Surveys Branch. The provincial survey begun in 1949 had not yet produced detailed maps and inventory information for the proposed lease area, so Ruben asked Loomis if an inventory could be prepared from the aerial photographs. By this time, Loomis was becoming quite familiar with the province's forests, and he said he could make a "reasonable estimate based on photo point sampling."

With permission from the government, Loomis began preparing inventory data for NWPP and quickly determined that the original agreement boundaries were not going to work. The proposed area around Edson did not conform to the natural boundaries of landscapes and forest types, and it contained some agricultural lands east of Edson as well as a high proportion of deciduous species, which were not considered suitable for pulp mills at that time. Loomis outlined a new million-hectare block of land further to the west, using the Athabasca and Pembina rivers as natural boundaries, which would include a higher proportion of coniferous timber. From this, a 518,000-hectare management area would be designated later. Loomis envisioned a generally downhill, northeasterly flow of wood to the mill.

As a condition of the 1951 agreement, Ruben posted a ten-thousand-dollar bond that would be forfeited if mill construction did not begin by May 1952. This work did not occur. However, Ruben's persistence in pursuing the venture convinced the government to grant an extension, and a revised lease was signed on 12 July 1952, incorporating Loomis's revised boundaries. The agreement was extended yet again in 1953.

Ruben realized his venture would need a forest industry partner to provide capital and expertise. In a search that lasted more than two years, he approached many companies, but they either did not need additional supply or thought the location too remote. In April 1954, Ruben finally met in New York with Roy K. Ferguson, president and chief executive of St. Regis Paper Company, who was impressed by the revised lease agreement and Loomis's inventory estimates. Ferguson sent seven experts, led by Florida-based forester George Abel, to Edson for ten days in May 1954 to assess the project. Stanton G. V. (Stan) Hart, a member of the timber-cruising party and later the company's woodlands manager from 1962 to 1968, recalled:

> *We made our base at the Sunset Motel in Edson. A Bell 47J helicopter was our main access to the woods. We also rented some rather beat-up Power Wagons and Jeeps from local people. Our objective was to check out the area in general, particularly the accuracy of the stand-typing and volume estimates shown in the "government cruise." It was really a very superficial look but it served the purpose at the time. [The "government cruise" was actually the estimate that Loomis had prepared for Ruben.]*

George Abel's report in June 1954 was very positive, concluding: "The timber resources of this reserve offer a splendid opportunity for a sustained-yield operation considerably expanded over that now contemplated."

St. Regis and Ruben's company, North Canadian Oils, announced jointly on 17 June 1954 that plans had been finalized for financing and constructing a bleached kraft sulphate pulp mill in Alberta. The proposed mill's capacity was 270 tonnes per day, 50 per cent larger than Ruben previously envisaged. St. Regis and North Canadian Oils agreed that each would supply about half of the equity capital for NWPP (actually 50.009 per cent from St. Regis) and that St. Regis would direct the design and construction of the mill, undertake the forest management responsibility, and market the product. NWPP also signed an agreement with Bryan Mountain Coal, a subsidiary of North Canadian, to supply hard coal for the entire fuel requirements of the pulp mill for fifteen years. Land was purchased near Edson for the mill site, and planning began in earnest.

On 14 September 1954, the government approved yet another agreement on the basis of the company's plan. The lease area was the same as in 1952, but there was an additional "provisional reserve area" that could be granted to the company if it committed to expansion of the mill by 1968. Reg Loomis's influence was

The Name Game

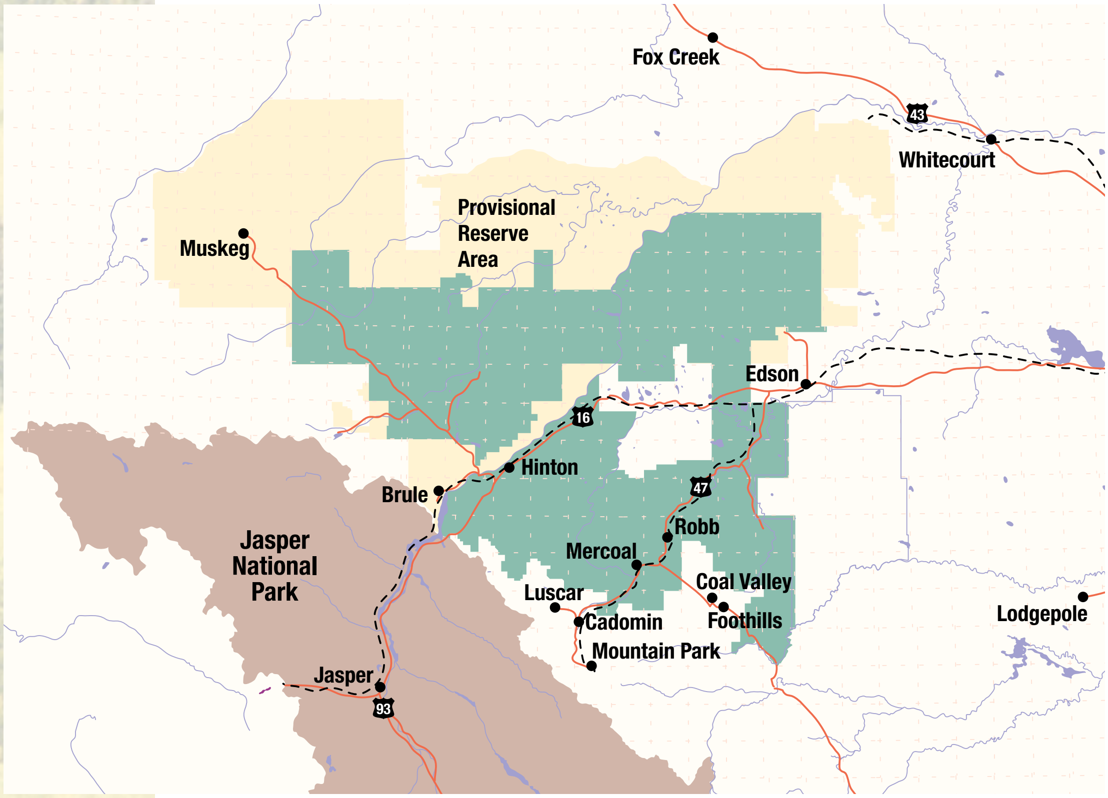
To avoid confusion about the various names it has borne, throughout the book we often refer to the leaseholder of the Hinton Forest Management Agreement as "the company." Despite the name changes, there has in fact been a continuity of corporate parentage since 1954, when entrepreneur Frank Ruben recruited the St. Regis Paper Company of New York as his partner in **North Western Pulp & Power Limited** (NWPP).

That name stuck until 1978, when it was changed to **St. Regis (Alberta) Ltd.** This change recognized that in 1969 the parent company had acquired Ruben's NWPP interest, held by North Canadian Oils Ltd. of Calgary.

Champion International Corporation of Stamford, Connecticut, subsequently took over St. Regis Paper in a friendly merger, and the Hinton operation was renamed **Champion Forest Products (Alberta) Ltd.** in 1985.

The current name, **Weldwood of Canada Limited, Hinton Division**, was adopted in 1988 when Champion consolidated the management of its Canadian operations (in Alberta, British Columbia, and until 1997, Ontario) at the Vancouver headquarters of Weldwood. In May 2000, International Paper Company of Purchase, New York, acquired Champion, including Weldwood. However, the Canadian operation continues to use the Weldwood name.

Figure 3.3. Final NWPP lease area, 1955, revised to service the final mill location at Hinton, with a reserve area for future expansion



evident again in this agreement, re-emphasizing the sustained-yield obligation on the company's part.

St. Regis engaged contractor H. A. Simons Ltd. of Vancouver to supervise the construction of the mill, but the project immediately encountered huge obstacles. Tests at the proposed Edson site showed that the ground was too unstable for the footings required to support a mill of that size. Furthermore, the water supply in the McLeod River was judged to be inadequate for the mill. To guarantee a year-round water supply, the newly formed company would have to build a dam, at an estimated cost of four million dollars, and buy all the land sixteen kilometres back from the water line. This was financially inconceivable and stalled all plans instantly. (Part of the company property near Edson, known as the Tollerton Properties, was donated to the Town of Edson in the late 1950s and is now Willmore Town Park; the remainder was sold in 1973.)

Searching urgently for a way to rescue the venture, Frank Ruben remembered travelling west on a previous visit and noting a small settlement where the highway and railway met the much larger Athabasca River. On 25 January 1955, Ruben and his son Robert headed west on a fateful jeep ride with H. V. (Pete) Hart, general manager of St. Regis Northern Woodlands Division, and Justin McCarthy, St. Regis vice-president and chief engineer. They wondered if the hamlet of Obed might be a possibility, but it was not. The next location that combined water availability, stable soil, and rail access was at Hinton. They quickly launched studies to confirm its suitability, and decided to build the mill there instead.

When the decision was made in early 1955 to move the mill to Hinton, there was apparently an understanding with the government that the lease area would be redesigned to reflect the new location. Again, Frank Ruben enlisted Reg Loomis's expertise—with approval of the department—to develop a conceptual lease area outline. Loomis dropped some southern areas and included major areas to the north so the mill at Hinton would be more centrally located within the lease. The area was also increased to ensure a larger wood supply, as the proposed mill cap-acity had been increased again to 360 tonnes per day. Pulp mill construction began in May 1955 and the first bale of pulp rolled out of the new mill in April 1957.

A team of St. Regis foresters visited Alberta from 8 March to 6 April 1955 to check on the new location suggested by Loomis. The group included future woodlands manager Stanton G. V. (Stan) Hart, Pete Hart's son. They focussed on the new areas north of the Athabasca, checking on volumes and quality of timber, availability of existing roads, and possible sites for camps. On the basis of their own and Loomis's work, the company foresters drew up maps and descriptions of the management area they wanted. This latest draft of the lease established an initial management area of 770,000 hectares and set aside a provisional reserve of an additional 770,000 hectares to be made available if the mill capacity expanded by 1968.

S. G. V. Hart, assistant woodlands manager for NWPP, donated this "skidshack"—a walkthrough with a door at each end—to serve as temporary quarters for Hinton's first bank. BANK OF NOVA SCOTIA, HINTON

The final modification of Alberta's first successful forest management agreement was approved by the government on 13 July 1955—a three-page document outlining the boundaries of the new area and clarifying a few conditions. The significance of this achievement is highlighted by the fact that during the 1950s, the government signed four other tenure agreements with other parties, but none got beyond the proposal stage. (At the time, these were simply called "agreements"; the NWPP Pulpwood Agreement referred to two types of tenure, the Pulpwood Lease Area, or PLA, and the Provisional Reserve Area, or PRA.)

Ironically, Frank Ruben's original motive for seeking the agreement—a new market for his coal mine—was thwarted when engineering studies showed coal was not a viable fuel for the mill. For one thing, coal specks in the pulp might hurt its marketability. The relative cost of coal was also a concern. Instead, Ruben's company found a natural gas supply at Wabamun and constructed a four-million-dollar pipeline to supply the mill and the town. (The pipeline was later extended to Jasper.) Ruben and his son Robert also established a development company that built much of the housing and commercial infrastructure, including the Athabasca Valley Hotel, for the new town that grew around the mill.

Expanding the Forest Management Agreement

In 1968, the government approved a revision of the agreement (now referred to as the Forest Management Agreement) that doubled the lease area to 1.6 million hectares, by bringing in the provisional reserve set aside in 1955. However, this larger land base was conditional on a major expansion of the mill to use the additional wood supply. The company could not marshal financing in time to meet a January 1971 deadline for starting construction of an addition to the pulp mill. As a result, the option was lost and the forest management area reverted in 1972 to its original 770,000 hectares. By then the company was already committed to, and had begun building, a sawmill as the first phase of the expansion project. This sawmill began to produce two-by-four framing studs in 1972, and attained its design cap-acity of fifty million board feet annually in 1973.

A second, more ambitious expansion plan was developed a decade later in response to an Alberta government call for proposals for a large block of timber north of the Hinton forest management area, near Grande Cache, known as the Berland–Fox Creek block. The company proposed to build Alberta's first paper mill at Hinton, along with a sawmill and log-home manufacturing plant at Grande Cache. A rival bid for the same timber proposed a newsprint plant and sawmill at Knight, near Whitecourt, as well as a large sawmill at Grande Cache. In 1981, the timber was awarded to British Columbia Forest Products (then 28 per cent owned by the Alberta government). The Grande Cache sawmill was built, but a downturn in markets precluded completion of the other commitments, and that forest management agreement was revoked, setting the stage for the Hinton operation's next, successful, attempt to expand.

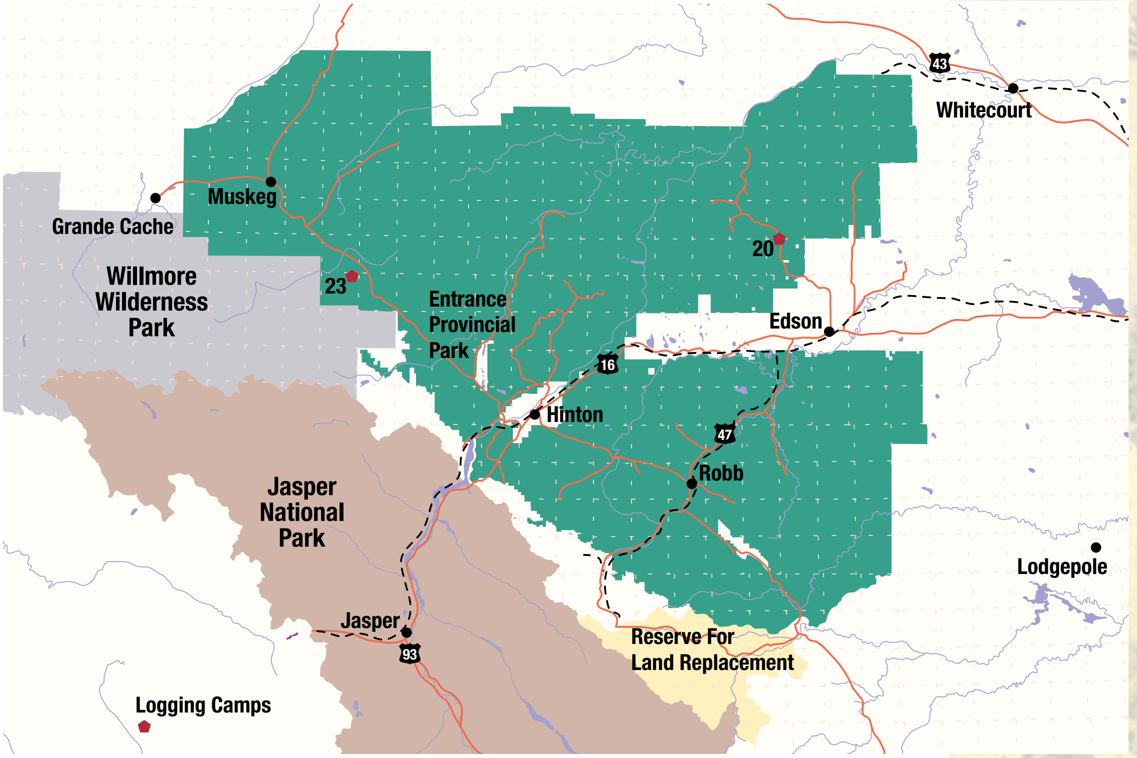


Figure 3.4. NWPP lease area, 1968, doubled in size to support a major expansion of facilities. In 1972 the area was reduced to the original 1955 boundary when expansion was not started.

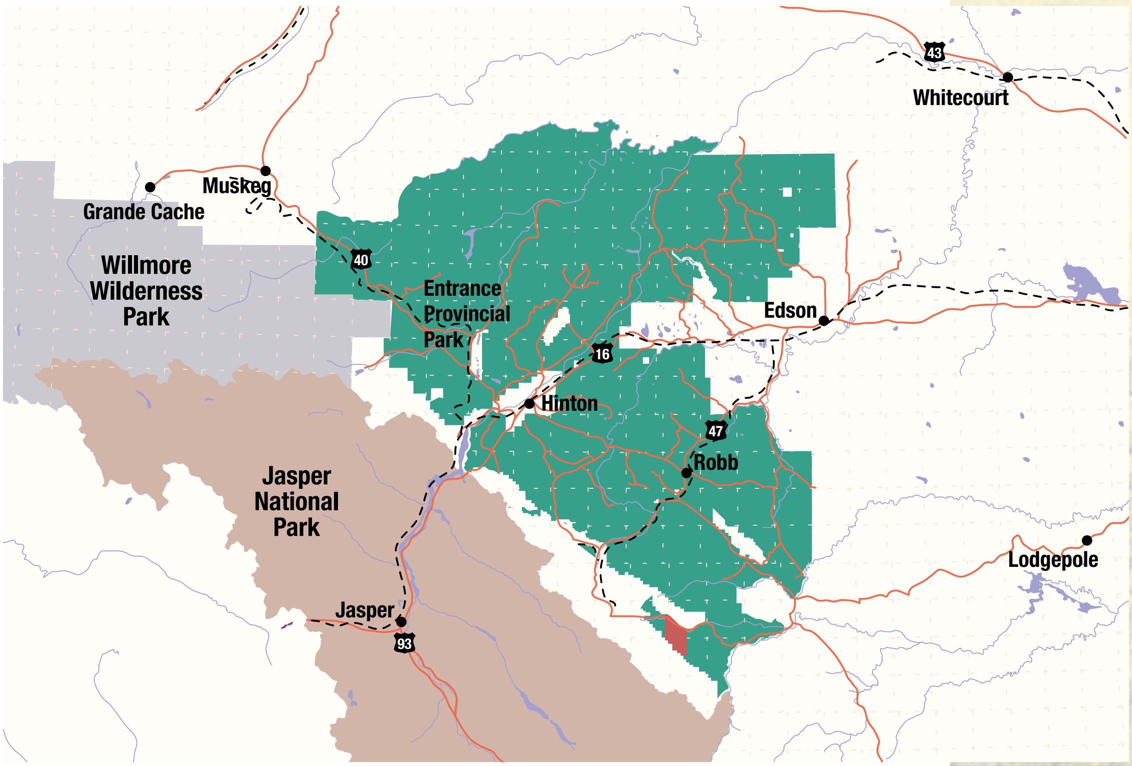


Figure 3.5. Weldwood forest management area, 1988. Major expansion led to a 25 per cent increase in the original forest area under management.

The third proposal for expansion, to the current area of approximately one million hectares, won approval from the government in 1987 and was signed in 1988. A pulp mill expansion, which doubled capacity to about 1,000 tonnes per day while reducing environmental impacts, was completed in 1990. Three years later, the high-tech HI-ATHA sawmill replaced the earlier sawmill and began producing more than 200 million board feet per year of lumber, in various dimensions, for domestic and export markets.

Building an Industry

At the time of the original Hinton lease agreement, the rest of the Alberta forest products industry continued to rely on licensed timber berths and other short-term permits. These were volume-based licences, auctioned periodically to the highest bidder and therefore providing no security of tenure to the holder. Any reforestation was the responsibility of the government, and most logged-over areas were simply left to regenerate naturally. While large operations after 1949 could obtain long-term security through forest management agreements, smaller operations had no incentive to make large investments in permanent mills or forestry programs.

Based on the success at Hinton, Reg Loomis was determined to “set up the whole province on a sustainable basis.” After he was named superintendent of the Forest Management Branch in 1959, Loomis accomplished this by inserting more explicit sustained-yield requirements in the 1961 Forests Act and then by developing the quota system adopted by Alberta in 1966 for the larger non-forest-management-agreement logging operations. The quotas were renewable, volume-based licences—thus providing the encouragement for long-term investment—and the quota holder was responsible for reforesting logged-over land, or had to pay the government to do so. A distinctive feature of the process leading to the quota system was the ongoing participation of the Alberta Forest Products Association in negotiations. Extending sustained-yield management to all forest users was the crowning achievement of Loomis’s distinguished career.

However, the forest management agreement concept was slow to spread. The second successful agreement was awarded to Canadian Forest Products Ltd., in 1964, for its Grande Prairie sawmill. Alberta’s second pulp mill, originally built by Procter and Gamble and now owned by Weyerhaeuser, obtained a forest management agreement for a lease area near Grande Prairie in 1968, although it did not begin production until 1973. The lumber industry, bolstered by the security of tenure under the quota system, expanded vigorously in the 1970s, but there were no more pulp mills built until the late 1980s.

The 1980s brought dramatic changes. The government wanted to reduce Alberta’s economic dependence on petroleum and agriculture, and actively sought forest industry investment. World markets for wood products were strong. New

Table 3.1. The Hinton Forest Management Agreements

Order-in-Council dated	Key features
8 June 1951	Original agreement, based on a mill located in Edson
12 July 1952	Major change in area, mill in Edson
14 September 1954	Same area, larger mill, still located in Edson, revisions to ensure sustained yield
13 July 1955	Area moved west to reflect mill location in Hinton
26 April 1956	Amendments to specify dues rate and interim annual allowable cut
30 August 1968	Major revision based on expanded mill and area; expansion cancelled by government 4 February 1972
26 May 1988	Major revision based on sawmill and pulp mill expansion; only 70 per cent of wood supply to come from forest management area

technologies improved productivity and permitted use of deciduous species such as aspen and balsam poplar, formerly regarded as "weeds" in the forest. The result was a rapid development of the province's pulp, paper, panelboard, and lumber industries. By 1992, about 50 per cent of the commercial forest area was assigned to forest management agreements, and much of the remainder was managed under quotas. This brought new pressures—from within government and industry, as well as from academics and the general public—to make sure the industry truly operated on a sustainable basis.

During this period of expansion, the government heeded a key recommendation of the Environment Council of Alberta's 1979 report on the environmental effects of forestry operations, that future timber dispositions should be granted for less than the total needs of the proposed manufacturing facilities. This would reduce waste in the woods, encourage the purchase of by-product chips for pulp and panelboard production, and provide a reliable market for private woodlots.

The 1988 Hinton Forest Management Agreement and the resulting mill expansions reflected this new reality. The lease area was only large enough to supply about 70 per cent of the mills' wood requirements, and the remainder would have to be obtained from other forest-management-agreement and quota holders and private woodlots. Meanwhile, other mills could use a significant portion of the harvest within the forest management area, especially the deciduous species. As a result, the company entered into numerous "fibre-trading" arrangements with industry partners, some of them located hundreds of kilometres away. These agreements ensure that maximum value is extracted from each tree felled, and waste is minimized.

In 1998, Weldwood purchased Sunpine Forest Products Co. Ltd., based in Sundre, Alberta—a lumber and specialty-products operation that had been awarded a forest management agreement in 1992 covering 573,610 hectares in west-central Alberta—and this opened up additional opportunities for integration and fibre trading.

By the late 1990s, a total of seventeen forest management agreements were in place for an area of about 20 million hectares, equivalent to 57 per cent of Alberta's managed forests. The agreement areas ranged in size from 56,000 hectares to 5.8 million hectares.

A notable feature of all the Alberta tenure agreements is the requirement to integrate multiple uses and values of the forest lands. This was already a complex task in the 1950s due to the presence of coal mines, crude oil and natural gas exploration, hunting, fishing, trapping, grazing, and recreational activities in the Hinton area. The next chapter describes how these activities proliferated, and new ones arose, over the ensuing decades.

CHAPTER FOUR

Sharing the Forest

MULTIPLE USES AND VALUES

A comprehensive land-use program must . . . make allowances for the interrelationship of all resources, and provide a co-ordinated plan of utilization that will avoid making changes detrimental to any one of them, and if possible, be beneficial to one or more.

—Des Crossley, 1951

Fire protection and suppression efforts gained momentum with the increase in large-scale industry, tourism, and forest-based communities in the latter half of the twentieth century.

Des Crossley was still a researcher for the Dominion Forestry Branch (DFB) when he addressed the annual meeting of the Canadian Institute of Forestry at Banff in 1951. He warned Canada's foresters that they must prepare to meet the ever-increasing needs and demands of a growing population. "For a great many people," he said, "the comparative solitude to be found in our forests, and on our lakes and streams, holds great recuperative powers. This relief from tension, whether during a hunting or fishing expedition, or simply in a quiet sojourn in the wilds, is a tremendous safety-valve, whose therapeutic effects we should not readily relinquish."

Crossley was not the first to make this observation. As early as 1910, Abraham Knechtel, a forester and DFB inspector of forest reserves, recognized what he called "other blessings of the forest," which included their capacity to "feed springs, prevent floods, hinder erosion, shelter from storms, give health and recreation, protect game and fish, and give the country aesthetic features." The view reflected Knechtel's European training and upbringing. It took decades longer for foresters such as Aldo Leopold to spread similar awareness in North America.

Although the Forest Management Agreement was primarily a contract between two parties—the company and the government—as Crossley foresaw, such a large and far-reaching partnership affected many other stakeholders, and the values of the forest landscape extended well beyond commercial use of timber. Integrating other interests became increasingly important as the Forest Management Agreement matured and expanded.

The Hinton area was relatively unpopulated and undeveloped when mill construction and forest planning began in 1955, but there were already other users and uses present on the land:

Fishing continues to be a popular pastime in the eastern slopes.

- residents and businesses in Hinton and environs
- coal mining
- crude oil and natural gas exploration and production
- sawmills and logging
- ranches, guiding, outfitting, hunting, and trapping
- recreational activities

The company's pulp mill and forestry operations affected all of these interests, and were affected by them. Before 1955, recreational activities were mainly hunting, fishing, camping, and horseback riding, plus the odd social event in town. The arrival of hundreds of company employees and contractors changed all that. Social life in town blossomed. Many of the fast-growing community's new residents also enjoyed hunting and fishing, and they engaged in these and other outdoor activities—hiking, canoeing, horseback riding, wildlife viewing, berry picking, or just going for a picnic. Other activities came later: cross-country skiing and snowmobiling in the 1970s, mountain biking and driving off-road vehicles in the 1980s.

Forestry roads opened access to formerly remote parts of the region. As a result, managing recreation and its impacts became an important part of forest management. One crucial preoccupation for the company and the government was to reduce the risk of people causing forest fires. This early interest of company, government, and citizens in the area's recreational and wildlife resources evolved into a wider concern about ecological integrity and biological diversity, major components of sustainable forest management.

However, the text of the first pulpwood lease included only a passing reference to other users. The key provision was the requirement that all company roads be open to the public free of charge. The agreement also allowed the government to set aside lands for "townsite, mining, petroleum, natural gas or summer resort purposes … [or otherwise] deemed by the Minister [of Lands and Forests] to be essential to the industrial development of the province." The latter phrase seemed vague at the time, but in the 1960s it turned out to include greatly increased oil and gas industry activity, new coal mines, and a railway line through the northwestern part of the lease.

In 1968, the revised Forest Management Agreement added a specific reference to "the right of others to travel, hunt, fish or otherwise use the said lands for recreational purposes." However, the 1968 agreement also recognized that "on the Forest Management Agreement area, timber growing is the prime use in keeping with the policy of providing for multiple uses of the same public land."

The eastern slopes are heavily used by all-terrain vehicle enthusiasts, which occasionally presents challenges for environment, wildlife, and protected-area management. R. E. Stevenson, Alberta Forestry Collection

Integrated Planning and Consultation

In the 1970s, as industrial and recreational activities proliferated in the Hinton area and elsewhere in the foothills, the provincial government was developing a formal process for integrated resource planning. This began in 1970 with two planning studies in the Eastern Slopes—the Foothills Resource Allocation study and the Hinton Yellowhead Regional Land Use Study—followed by Environmental Conservation Authority (ECA) hearings in 1973, which in turn led to the 1977 Policy for Resource Management of the Eastern Slopes. The studies and consultations brought together stakeholders—government ministries and agencies, municipalities, commercial and industrial interests, environmental and recreational organizations, and the general public—to develop plans for multiple uses of each area. One of the results was the revision of the government's Eastern Slopes Policy in 1984 to establish regional land-use zoning for various categories of protection, management, and development. More detailed subregional plans followed.

In addition to these formal consultation processes, the company and the government always encouraged informal contacts with the general public and other stakeholders, and their advice was often helpful in planning and operations. Direct public input into forest management planning began in 1989 when the company formed the first public advisory committee for an Alberta forest operation. The committee included government, professional, industrial, recreational, youth, and other interest groups. Originally known as the Forest Management Liaison

Figure 4.1. (see sidebar) Total and net areas of the FMA, showing the distribution of volume by species (small circle) within the 72 per cent merchantable and operable area

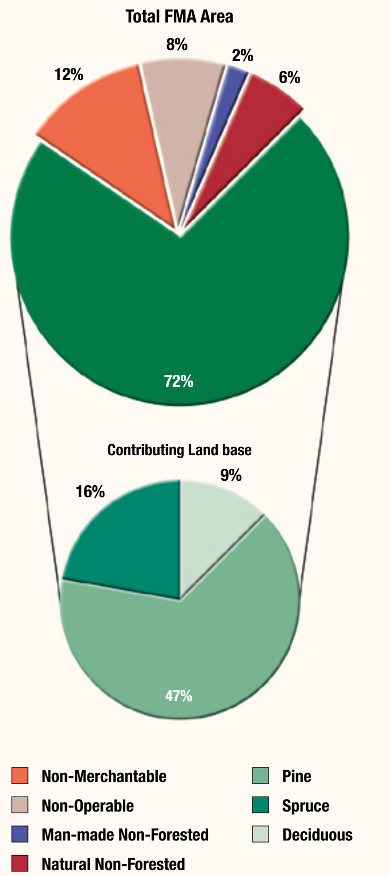
Multiple Uses and Values

Land Base: Not quite a million hectares

Integrating multiple uses and values has had a major impact on forest management. Of the 1,038,564 hectares within the perimeters of the agreement area in 2000, only about 715,000 hectares are considered "contributing land base"—the economically useful and available forest area contributing to the annual allowable cut.

About 33,000 hectares have been withdrawn for purposes such as townsites, parks and protected areas, coal mines, and other leased or freehold lands, and another 6,000 hectares are covered by water. This leaves about one million hectares in the company-managed area. About 940,000 hectares are forested, although about 130,000 hectares are not considered commercially "contributing" due to factors such as unsatisfactory site productivity, lowland black spruce stands, and steep slopes.

Environmental, industrial, and social considerations have removed another 95,000 hectares. Buffer zones to protect watersheds, totalling about 53,000 hectares, account for the largest single reduction in the contributing land base. Oil and gas industry activity ranks second, with 6,000 hectares for facilities and pipelines, and 16,000 hectares for seismic lines. Roads—including those built for the oil and gas industry as well as forestry—are the third biggest factor, totalling more than 15.000 hectares. The other 28,000 hectares of withdrawals are due to a wide variety of environmental and social factors, from recreation to wildlife habitat to aesthetics.



Committee, the group was reconstituted in 1993 as the Forest Resources Advisory Group (FRAG) with a broader membership and mandate. Members were recruited to include as wide a range of interests as possible within a moderate-sized group. The company also solicited input from the community at large through public open-house presentations.

In 2000, FRAG included representatives of nineteen stakeholder groups:

- community groups from Hinton and the surrounding area, including the forestry workers' union and an Aboriginal co-operative
- non renewable resource industries, principally, coal, crude oil, and natural gas

- renewable resource users, including trapping, fishing, hunting, and other recreation interests
- environmental organizations
- government agencies, including Jasper National Park, the Canadian Forest Service, Yellowhead County, and the Town of Hinton

The Land and Forest Division of Alberta Sustainable Resource Development serves as an advisor to FRAG, and there is, of course, a great deal of overlap among the interests represented. Many people in the area could fall into several categories.

In 1997, as part of its commitment to sustainable forest management, Weldwood established an Aboriginal Round Table to further develop its relationship with Aboriginal people in the area. The consultative body included representatives of eleven Aboriginal communities and groups and was chaired by Ritchard Laboucane, company logging operations manager. Key projects included developing an employment strategy, planning a youth career fair, raising cultural awareness, initiating a project to gather traditional ecological knowledge, and exploring opportunities beyond Weldwood's forest management area.

Early seismic exploration lines provided convenient access routes for timber cruising and reconnaissance work.

Nonrenewable Resources

Alberta has a rich endowment of coal, crude oil, and natural gas resources, and there has always been some conflict between mineral extraction and the renewable industries such as agriculture, forestry, and tourism. The fact that the Crown owns most of the mineral rights, as well as much of the land and timber, does not necessarily simplify matters. Industrial, bureaucratic, and political interests all come into play. The general goal of government policy in Alberta has been to find and develop mineral resources as early as economically and technologically feasible, then afterward to restore the land to economic and biological productivity. This is easier said than done.

As the first sustained-yield forest management area in a region where coal, crude oil, and natural gas development were already well established, the Hinton operation had few precedents to draw on when inevitable conflicts occurred between mineral extraction and forestry. Although the relationship continued to be challenging, both sides learned to compromise and adapt.

The expansion of the oil and gas industry put pressures on wood supplies and sustainability for the forest industry.6

Exploration, extraction, and facilities for the crude oil and natural gas industry posed a particular challenge because they changed, and cut into, the land area contributing to the annual allowable cut. The fragmentation of forests by oil and gas activities, especially seismic cutlines, made it more difficult for the company to meet its commitment in the 1990s to sustainable forest management. While multiple openings and linear developments present minor physical barriers to forestry operations, the larger concern was the impact on wildlife habitat needs. For example, some species require large intact blocks of forest, and other species become vulnerable if roads and cutlines provide travel corridors and hunting grounds for predators. In the long run, cash payment for timber losses is no compensation for loss of forest lands and reduction of the annual allowable cut.

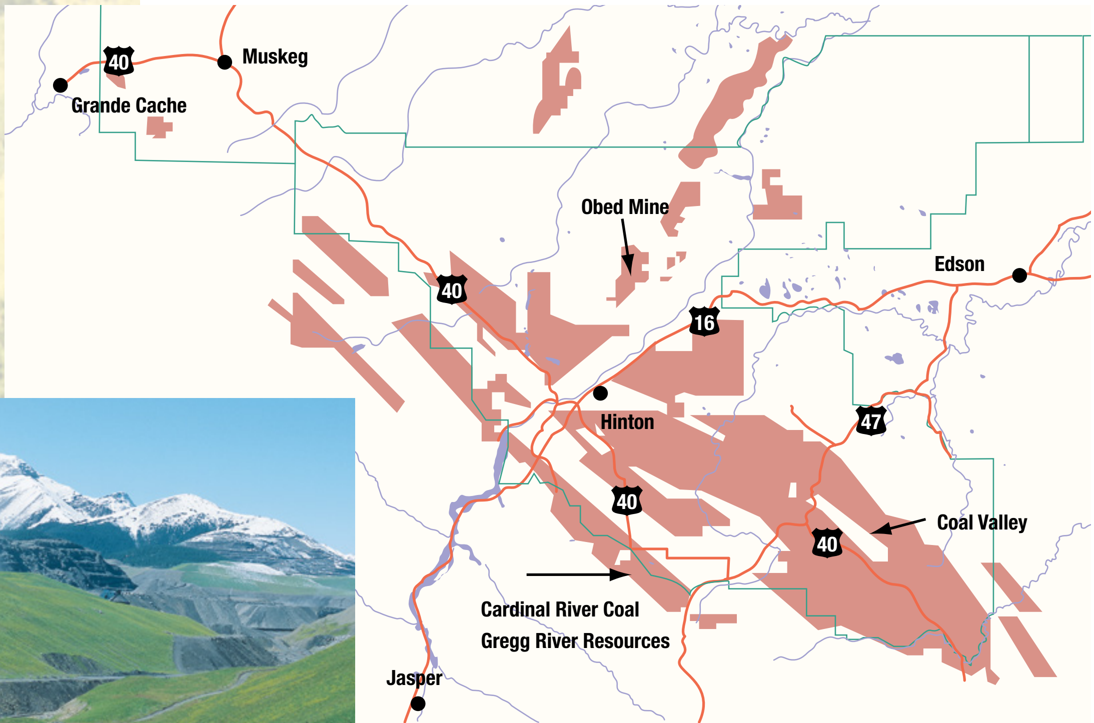
Yet another potential challenge loomed in the late 1990s when diamond exploration began on the Forest Management Agreement area, but to date no discoveries have been reported.

Coal Mining

The once-booming Alberta coal industry went into severe decline in the 1950s. Railways switched from coal-fired steam to diesel engines, while refined oil products and natural gas became the main fuels for homes and industries. The underground mines in the Coal Branch area and around Hinton were all shut down soon after pulp production began in 1957. However, new demands for coal emerged in the late 1960s, along with new methods of coal mining. The coal and forestry industries had to find new ways to coexist.

In 1969, Cardinal River Coal Ltd. (CRC) opened a large open-pit mine in the

Figure 4.2. Coal leases and active coal mines in the Hinton forest in 1986



Coal mining on the eastern slopes began to rebound in the late 1960s, starting with the development of the Cardinal River coal mine.

Luscar area, mainly to supply Japan with bituminous coal suitable for steelmaking. Because the government would not support development of a new "company town" in the Coal Branch region, the operation was set up on a commuter basis. A new highway was built between Hinton and the mine to support buses and commuter traffic. The Gregg River mine, adjacent to the CRC mine and also producing bituminous coal for steelmaking, opened in 1983. These mines were hard hit by poor markets, depleting reserves, and low prices in the late 1990s. After an unexpected reduction in estimated coal reserves at Gregg River, that mine closed on 31 August 2000, with the loss of around three hundred jobs.

In the 1990s, with only a few years of mineable reserves remaining at Luscar, CRC proposed the new $250-million Cheviot mine to continue supplying coal for steel making markets. The new mine would be located twenty kilometres south of the Luscar mine, at the old Mountain Park townsite and mine that operated from 1911 to 1950. After prolonged hearings and a court battle spearheaded by environmental groups such as the Alberta Wilderness Association, the mine received approval to proceed in 2000, but in the meantime contracts with purchasers of the coal had lapsed and prices had weakened. Without assured markets to justify the development, CRC decided in October 2000 to defer the plan indefinitely and to close the Cardinal River coal mine at Luscar by mid-2002. However, in early 2003 the mine continued to operate, and CRC was again pursuing options for the Cheviot development.

Two other open-pit mines in the area produce thermal coal used for electricity generation. The Coal Valley mine, located about one hundred kilometres south of Edson, opened in 1978. Although it was originally located in an old coal reserve embedded within the forest management area, subsequent mine expansions have extended into the surrounding forest management area.

The Obed Mountain mine, located thirty kilometres northeast of Hinton, opened in 1984. A unique feature of Obed Mountain is an eleven-kilometre overland conveyer system carrying coal from the mine to the Canadian National Railway (CNR) mainline. The Obed mine was approved over the objections of the company, which lost 3,200 hectares of productive forest land, much of it newly reforested. A similar area nearby has been identified as a reserve for future coal development.

Reclamation

Before mining begins, usable timber is harvested. Engineers now use elaborate water-diversion and treatment systems to reduce the impacts of open-pit mining on surface and ground water. From a forestry perspective, the big issue has been—and continues to be—whether healthy forests can be re-established after the mine pits are reclaimed.

As an active contributor to forestry and conservation debates, Des Crossley was very critical of the government's "almost incomprehensible" decision to allow open-pit mining in the forest management area. He asserted in a 1984 interview that successful reclamation, including re-establishment of forests, "has never been accomplished under Alberta conditions at these altitudes."

In 1970, the company established a land-use section under Ray Ranger to deal with the increasing loss of timberland, mainly to crude oil and natural gas activities and coal mining. In addition to reforestation issues, Ranger was concerned by the impact that pits up to ninety metres deep might have on groundwater flows and the water table. However, he and other company officials were unable to change the government's policy during hearings on mine proposals in the 1970s and early 1980s. "We weren't adverse to taking those lands back [after mining ceased] but we wanted to make sure that they were in reasonable shape for the growing of trees," Ranger recalled. Crossley suggested that mining should only occur when forests were mature and could be harvested before development, then reforested promptly after mining ceased. The government rejected this suggestion, based on the argument that mine developers need to develop their leases when the market is there, not await the maturing of a forest which could take up to eighty years.

At Cardinal River Coal, south of Hinton, reclamation after mining emphasizes the creation of wildlife habitat, particularly for bighorn sheep.

The issue became more crucial after the 1988 revision of the Forest Management Agreement that enabled expansion of the pulp mill and construction of the HI-ATHA sawmill. For the first time, the company needed every cubic metre of wood from its annual allowable cut, and any loss of land base added directly to costs. In a Forest Management Agreement revision in 1998, the province agreed to a new clause specifying that when lands had been excepted from or withdrawn from the Forest Management Agreement and again became available for disposition, such as at the end of a mining operation, they should be returned to the lease area in a "potentially productive state."

The coal industry invested substantially in research to reduce the effects of mining and improve the success of reclamation. However, the long-term effects on land productivity are still being determined. The Coal Branch mine sites are in or near the subalpine natural subregion, where forests are sparse and slow growing in any case. The Cardinal River and Gregg River mines have created some recreational lakes and have had good success in establishing grasses and shrubs on reclaimed sites. Reclamation has thus provided some excellent habitat for species such as bighorn sheep and elk, which the government has agreed should be the primary management goal in the alpine and subalpine natural subregions.

The real test of reclamation will come as more mined-over lands from the upper and lower foothills natural subregions are returned to the forest management area. It could, however, take many years before the lands receive reclamation certificates and responsibility is transferred from the mining companies to the Crown.

Alberta Resources Railway

The existence of large coal resources around Grande Cache, 125 kilometres northwest of Hinton, led to another unexpected loss of productive forest in the 1960s. The provincial government was eager to see the coal resource developed, but at the time there was no way to get the coal to export markets. Then, in 1965, the government established the Alberta Resources Railway (ARR) as a Crown corporation to build a rail line to Grande Cache from Swan Landing on the CNR mainline near Brule, west of Hinton.

Much to the dismay of Des Crossley and his forestry staff, the ARR right-of-way cut a forty-metre-wide swath through the northwestern part of the Hinton forest management area. It was not a very large area, but little timber was salvaged during construction because the government wanted the project completed quickly, and the land was summarily withdrawn from the company's forest lands. The company was never reimbursed for the full extent of land taken out of forest production. An invoice to the railway for $130,000, based on analysis of aerial photographs, was not paid.

In 1969, the ARR was extended from Grande Cache to Grande Prairie. In that same year, heavy rains and flooding caused serious erosion problems along the rail line in the forest management area, and this became a continuing concern for Hinton foresters until the railway found better ways to stabilize slopes along the line.

Crude Oil and Natural Gas

Crude oil and natural gas exploration began in the Hinton area in 1944, and Imperial Oil Co. Ltd. drilled the first well in 1948. The well did not strike commercial amounts of crude oil or natural gas, but Imperial and other companies continued to explore the area and eventually found significant quantities of natural gas. The road to the first well at Muskeg later became part of the Forestry Trunk Road, now Highway 40, from Hinton to Grande Cache.

Ray Ranger, who joined the NWPP staff in 1956, recalled that company foresters initially welcomed the oil and gas industry presence. The roads, and especially the hundreds of kilometres of cutlines for seismic surveys, made it a lot easier to conduct the first forest surveys and inventories. However, in 1956 Imperial Oil struck natural gas at a well in the northwest portion of the forest management area, beginning a stepped-up pace of exploration and development that continues today.

In 1999 alone, Weldwood received about four hundred applications for consent to conduct their government-authorized programs from companies planning oil and natural gas developments such as well sites, power lines, pipelines, and processing plants, and about fifty applications for seismic programs. Because the company is the primary land occupant under Alberta law, other industries planning activities on the forest management area must acquire authorization from the company prior to doing so. From 1988 to 1998, an average of eighty kilometres of pipeline per year was laid in the forest management area, and twice that much in 1999. Seismic programs during the decade averaged about one thousand kilometres per year, disturbing an average of 485 hectares of land per year. Seismic lines are not treated by the province as a land disposition and remain in the contributing land base for the forest company's annual allowable cut calculation. Hence, timber cut by the seismic company is a direct drain against the annual allowable cut of the forest company. The cutlines also disrupt wildlife habitat, making it more difficult for forest companies to meet their sustainable forest management commitments.

Timber damage assessment

By the late 1960s forestry staff were alarmed about the losses of both mature timber and young growth—losses that were increasing every year. Yet the oil and gas industry was certainly a pre-existing user of the land, specifically exempted by the terms of the Forest Management Agreement, and the industry was politically influential as the largest single "engine of growth" in the provincial economy. Change came slowly, and initially there were few controls on activity. From 1956 to 1970, no compensation was paid for timber loss, nor was any timber salvaged.

In the 1990s, about eighty kilometres of pipeline per year were constructed in the Hinton forest management area.

Ranger said the initial contacts with the petroleum industry in the 1960s came as a rude shock to Des Crossley, who thought of himself as "master of the forest" at Hinton. Crossley seemed to meet his match in the oil patch, as the oil and gas executives in Calgary were also accustomed to getting their way with the government and landowners. "All of a sudden," Ranger recalled, "here was this upstart from out of the north country telling them they couldn't go cut these trees."

The catalyst for change was a new set of aerial photographs in 1969 showing the full extent of disturbance. The five major oil companies with interests in the Hinton area argued their only obligation was to pay the government a stumpage fee for loss of timber. Moreover, the pace of development was so rapid that the companies did not even have complete documentation on how much forest they had disturbed.

Crossley did not give up easily. In June 1970, after unsuccessful attempts to negotiate a settlement, NWPP asked the Edmonton law firm of Shtabsky and Tussman to begin legal action for compensation.

During the discovery process (when witnesses are questioned by lawyers before trial) NWPP presented evidence from forest economist David Haley of the University of British Columbia, who used documented values for actual costs such as wood loss and reforestation. These data indicated timber values were far higher than the estimates presented by the oil and gas companies. Haley's work would later become the basis for the government timber damage assessment tables that were accepted by both the Alberta Forest Products Association and the Canadian Petroleum Association, and he continued to review timber damage assessment methodologies into the 1990s. However, another development signalled a change in government attitudes and also helped to settle the legal action before it went to trial.

At a meeting with the petroleum association in 1970, Robert G. Steele, the deputy minister of Lands and Forests, confirmed that the Forest Management Agreement definitely gave NWPP rights to timber and therefore to compensation. This was precisely what the oil companies had been disputing in their legal arguments, so Steele's assertion took the wind out of their sails. The legal action was dropped, although there continued to be problems about record keeping. The actual areas disturbed by oil and gas activities often were not the same as the ones for which they had obtained permits. There were fewer disputes when NWPP, which had the most accurate maps, became responsible for collecting the government's stumpage fees as well as the company's timber compensation.

As a result, the government revised the Forests Act in 1971 to recognize forest management agreement holders as owners of the timber, subject only to rights of the Crown. The Surface Rights Act also was amended to include forest management agreement holders as "occupants" entitled to compensation. These rights put Alberta forestry companies in a stronger legal position than they had in other jurisdictions such as British Columbia. In the meantime, the government's adoption of the timber damage assessment table created a basis for determining damages.

Funds paid to the forestry industry from the timber damage assessments are intended to replace the timber lost. Such replacement can be in the form of purchased wood, or investments in the land itself designed to increase its productivity and therefore the annual harvest it can sustain.

Consultation, co-operation, and salvage

Working directly together to facilitate record keeping and compensation payments led to opportunities for further co-operation, such as on the construction and use of roads in the forest management area. Ray Ranger recalled that the oil companies "saw very readily why it didn't make sense to build twenty miles of road if there were twenty miles of road already here." By this time, in the 1970s, NWPP was building all-weather roads able to carry loads up to one hundred tonnes—a much higher standard than the typical oilfield road. Co-ordinating schedules and planning, and sharing costs of construction or maintenance, led to savings for both the forestry and energy sectors.

Ranger said the issue of salvaging timber was another bone of contention in the 1970s. "The oil companies simply paid the timber dues [stumpage] and the timber was cut and left to one side and bucked up so it wouldn't be an undue fire hazard and away they went," he recalled. This was replaced by an agreement to recover felled timber within a "reasonable distance of a road" and eventually any timber felled in an area where there were active logging operations. Ranger said the latter "was quite a major undertaking because you didn't always have a road." Sometimes the timber had to be skidded a considerable distance around swamps and ravines.

Woodlands manager James Clark made a flat declaration about pipeline rights-of-way in the late 1970s: "From now on if there is any cutting [for pipelines] on our forest management area it will be utilized." Ranger said this led to a new level of co-operation with the oil and gas industry because the salvage cutting had to be co-ordinated with the tight construction timetables for the pipelines. Previously, the oil and gas companies had considered wood disposal more as a nuisance than an integral part of their planning and operations. As an incentive, the forest company agreed to forgo timber damage payments, other than the government stumpage. For the foresters, these arrangements helped to established the key principle that if timber was cut in the forest management area, the wood had value and should be used.

Despite these improvements, a considerable amount of timber continued to be cut without salvage, especially along the numerous seismic cutlines criss-crossing the forest management area. Early in the twenty-first century, this remains a contentious issue between the forest companies and the oil and gas industry, although new low-impact exploration methods are reducing the impacts.

As with coal mining, the loss of forest land to oil and gas industry activity became a much more crucial issue after the 1988 Forest Management Agreement. As a result, Weldwood participated in negotiations with government and other stakeholders, including the oil and gas industry, to develop a new method to assess and appraise timber damage. The valuation system, adopted in 1995 and still in use in 2003, is based on three components: standing timber value, future reforestation costs, and long-term effects on annual allowable cut.

Funds collected for timber damage helped Weldwood pursue more intensive reforestation methods on reclaimed oil and gas sites and throughout the forest management area. For example, the company previously had not reforested seismic cutlines because the young trees would be destroyed if the cutlines were reused, but in the 1990s Weldwood decided to replant cutlines anyway if there were silvicultural operations in the area. Hog fuel (a mill by-product comprised of bark, shavings, and sawdust) was used to restore the soil at some hard-to-reclaim sites such as former gravel pits.

Reducing impacts

Weldwood also encouraged exploration companies to use new technologies, such as helicopter-portable seismic equipment, and new methods such as hand-cut lines to reduce the impact of seismic programs. By the late 1990s, this was starting to have a significant effect. Although the number of kilometres increased dramatically, the area affected grew much more slowly. This change was due to a sharp reduction in the average width of cutlines, from 6.98 metres in 1988 to 3.04 metres in 1998.

This reduction was offset, however, by an alarming increase in "three-dimensional" seismic programs, which involve multiple parallel cutlines, and a steady increase in overall exploration activity. Activity levels for exploration and production of crude oil and natural gas on the forest management area have more than doubled since 1993, reaching historic highs in recent years (see figure 4.3).

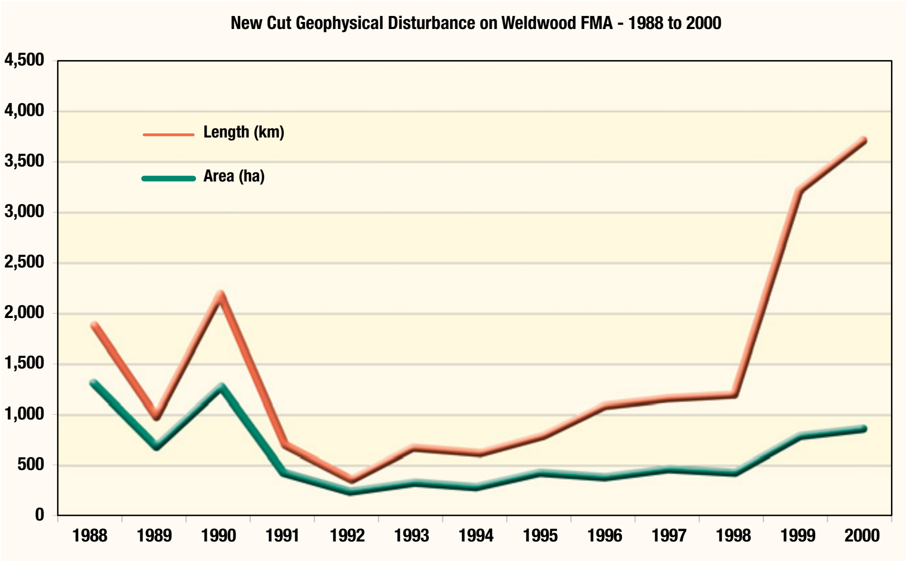


Figure 4.3. Seismic activity on the Weldwood forest management area, 1988–2000, showing both the area and length of disturbance per year

Renewable Resources and Recreation

The existing lumber industry was, of course, one of the most important renewable resource interests affected by the opening of the pulp mill and the company's lease agreement. The company's first public consultation occurred when a team of St. Regis foresters—visiting Alberta in March and April 1955 to assess the new location—held a public information meeting in Edson on 18 March. Those present included area lumbermen as well as Norman Willmore, the new minister of Lands and Forests, who was also the member of the Legislative Assembly (MLA) for Jasper-Edson. The St. Regis team reviewed project developments for the group and hosted a social hour.

It is not surprising that local lumber people were the first external stakeholders to be consulted. Their interests were directly and immediately affected. Chapter seven deals with this topic in more detail. Other stakeholders in the area's renewable resources, such as recreational users and livestock grazers, became increasingly prominent (and vocal) over the ensuing decades.

Livestock Grazing

Horses were a traditional way of getting around in the region. They were used for hauling, riding, packing, and early logging activities. Guiding and outfitting with horses was also an established business. Horses roamed loose throughout the forested areas, and some of them ranged free as "wild" horses. There were about five hundred feral horses in the Camp 1 area west of Hinton in 1957.

Outfitting in Willmore Wilderness Park continues as an important local industry. R. E. Stevenson, Alberta Forestry Collection

On some sensitive reforestation sites, Crossley became concerned that horses grazing, trampling, and rolling were causing undue mortality to the seedlings. The government responded by authorizing "wild horse" roundups, but it was still necessary to find grazing for the large numbers of domestic stock. Ray Ranger said the first plan was to use the corridor along Highway 16, which was outside the forest management area, but this was not sufficient. "Most of the recreational riders were accommodated in small plots here and there," Ranger recalled, "but the commercial operators were another matter."

Historically, outfitters had centred their activities inside Jasper National Park or at its eastern gates near Brule. As the park did not allow winter grazing, outfitters' herds were simply taken to the eastern park gate and allowed to graze unhampered in what later became part of the forest management area. To further complicate matters, outfitters were reluctant to report the exact number of horses being deposited in the area because they were subject to a grazing head tax. This problem was partly solved in 1974 by converting about nine hundred hectares of cut-over near Brule, known as Camp 54, into a fenced community pasture. This land was removed from the forest management area in the 1988 agreement.

The forest service continued to issue grazing permits within the forest management area as the need arose. Company policy was to support these permit applications in those areas where regenerating stands were not threatened, and where no harvesting was scheduled in the short term. However, as noted in the 1999 Forest Management Plan, "non-permitted grazing continues to be a problem in the forest management area, despite periodic roundups and fines levied by Alberta Agriculture."

In the late 1990s, Ph.D. candidate Barry Irving, with the assistance of Weldwood's Sherry Maine, and the co-operation and advice of local outfitters John Groat and Bill Gosney, examined grazing preferences and resulting damage to reforestation when horses were allowed to range free. He found damage to seedlings occurred primarily during the summer months, particularly if the trees were less than fifty centimetres high or growing on moist sites. The damage was generally confined to trampling or scarring. This project may provide guidance as the company and government try to find ways to accommodate grazing use while maintaining the health and vigour of reforested sites.

Parks and Camping

Government and company officials recognized from the start that outdoor recreation would be a component of forest management at Hinton, but they could not have imagined how big that component would become.

The Alberta Forest Service, now known as the Land and Forest Division of Alberta Sustainable Resource Development, played a leading role in forest recreation until 1998 when recreation programs and responsibility for facilities were transferred to the Natural Resource Services Division of Alberta Environment and subsequently to the parks and recreation branches of Alberta Community Development.

In the early years of the Forest Management Agreement, the company focussed on its forest management responsibilities and left recreation planning to the government. This changed gradually as the company realized the need to integrate recreation into its planning, and as its own employees became directly involved in many recreational activities. Then there was a major shift in the 1990s when financial restraint limited the ability of government to deliver recreation programs.

By 1997, the first edition of Weldwood's popular Recreation and Activities Map identified thirty-three facilities such as campgrounds and picnic sites within the forest management area and another six facilities in William A. Switzer Provincial Park, nestled within the managed forest just northwest of Hinton. There were also thirty-three fishing lakes, many rivers suitable for canoeing, a downhill ski area, several multi-use trails, and hundreds of kilometres of seismic cutlines suitable for all-terrain vehicle use—all brought within easy reach by more than two thousand kilometres of company-maintained roads. (A new edition of the map, published in 2002, identifies even more recreational opportunities.)

Several key decisions in the early days helped to facilitate later recreational development:

1. Between 1952 and 1954, some versions of the lease area showed the management area extending right up to the eastern edge of Jasper National Park. However, the final boundaries in 1955 established a buffer zone of about eight kilometres between the park and the forest management area—everywhere except the land right next to Highway 16 at the park gates and at the junction of the Southesk and Brazeau rivers. The buffer zone included currently popular

◀ ▶ CONTENTS INDEX

recreation areas such as Cardinal Divide, Whitehorse Creek, and Cadomin Caves, all of which became part of Whitehorse Wildland Provincial Park in 1998.

2. In 1957, the company agreed to set aside, as a protective buffer against unrelenting wind and advancing sand dunes, a 1.6-kilometre area along the east side of Brule Lake. The Brule Dunes later became a favoured site for off-highway vehicle enthusiasts, although new land-use zoning in 1999 imposed some restrictions on this activity.
3. Due to concerns about watersheds and fisheries, the company and the gov-ernment agreed from the beginning to maintain buffer zones of forest along waterways. These riparian zones enhanced the value of streams and rivers for subsequent recreational activities such as fishing, canoeing, and camping.

In addition, the 1955 agreement set aside about 25 per cent of the area that would later become Switzer Park along Highway 40 northwest of Hinton. Initially earmarked as a potential water reservoir for Calgary Power, it was also included in the forest reserve area for possible future expansion by the company. The elements of Switzer Park then came together over a ten-year period beginning in 1958 when the company backed a proposal by local sportsmen and the Hinton Chamber of Commerce to create a new provincial park near Jarvis Lake. In 1968, the government established the permanent boundaries and renamed the park to honour William A. Switzer, Hinton's first mayor and later MLA.

In 1959, the province established a new 555,645-hectare wilderness park in the mountains and foothills north of Jasper National Park and west of the forest management area. This was later named Willmore Wilderness Park to honour Norman A. Willmore, MLA from Edson (1944–1965) and the former minister of Lands and Forests. The boundaries were altered in 1963 and 1975, and the Willmore Wilderness Park Act of 1980 reinforced the protected status of the park. In 1998 it was declared a protected area under the province's Special Places 2000 program. The park's current 459,700 hectares contain 750 kilometres of trails.

As roads began to reach into the areas around Hinton, more and more people headed for the hills with tents and coolers. The associated fire risk and other land-use conflicts alarmed the Alberta Forest Service (AFS), which developed forest recreation areas as a way to concentrate campers on designated sites. The recreation areas were free public campsites with picnic tables, firewood, fire pits, and privies adjacent to major streams along forestry roads. Surface fuels (dry wood, branches, leaf litter) were removed from the sites to prevent campfires from spreading into the forest. The first such recreation area was the Big Berland, built in the mid-1950s. A half-dozen more AFS recreation areas were built during the 1960s in the forest management area, and Alberta's highways department also developed two recreation areas at Roundcroft and Johnson's Point (now Maskuta Creek) early in the decade.

By 1979, the network of forest recreation areas included thirteen sites that were proving very popular with the public. In that year, the government approved a new set of regulations to formalize the legal authority of the AFS to manage the recreation areas. The sites were then withdrawn from the company's forest management area. In later years, the AFS charged a token camping fee to cover some costs, but this had little effect on use of the recreation areas. Then in the mid-1990s, the provincial government decided, as a cost-cutting measure, to privatize the management of the sites. The resulting increase in fees—and, in some cases, decline in service—deterred some users, and there was a notable increase in random camping outside of designated campsite areas.

In 1999, a random camper's unattended campfire started a wildfire that was extinguished only by the quick action of Weldwood and the forest service.

Weldwood, in co-operation with Alberta Community Development, manages thirteen provincial campsites in or adjacent to the Hinton forest management area.

Original concerns about the fire risks and land-use conflicts from random camping resurfaced. In spring 1999, for example, a camper's fire on the Jarvis Creek meadows north of Hinton started a wildfire that nearly destroyed a large tract of forest. Human waste and litter also became an increasing problem. Recreation areas managed by private operators often sat partially empty while random campers filled the landscape around them. Moreover, some private operators were concerned about the impact of forestry operations on their business and lobbied the company and government to modify or suspend forestry operations in the area around their sites.

In an effort to restore the campground program to its original intent of concentrating camping in organized campgrounds where fire risk could be minimized, Weldwood offered in the late 1990s to take over the privately operated sites and maintain them for public use, if and when the private operators gave them up, or to submit proposals for them when they became otherwise available. The company already managed two sites, Emerson Lakes and Little Sundance, under a 1995 agreement with the Crown. In 2000, Weldwood took over eight more sites in the old Coal Branch area, in partnership with Alberta Environment (now Alberta Community Development). These included the Whitehorse Creek site, outside the forest management area, which is managed in partnership with Cardinal River Coal. In managing these sites, the company provides campground services and maintenance, while the provincial government retains ownership as well as enforcement

Emerson Lakes

A discussion in the Athabasca Hotel lounge in early 1969 led to the development of the first company-sponsored recreation area at Emerson Lakes, near the Athabasca River north of Obed. Peter Murphy, then head of the Forest Technology School in Hinton, recalled talking with Jim Clark, then woodlands manager for NWPP: "During the discussions I talked about the school's relatively new Junior Forest Rangers work program, and that we were always looking for new opportunities. I think it was at this point Jim mentioned Emerson Lakes. Eric Marrison was quick to identify the main esker [ridge of glacial debris] as a neat ready-made road grade. Jim suggested that we should consider a co-operative project."

Jack Macnab, then taking an advanced forestry course at the school, submitted the plan that became the basis for development. The Junior Forest Rangers began work in the summer of 1970 and for three years built trails, cleared campsites, and developed the site. The company did the earth-moving and provided camp stoves and privies.

In 1982, the provincial government assumed management of Emerson Lakes as a forest recreation area. In 1995, Weldwood signed an agreement with the province to take over responsibility for the site and facilities–hiking trails, several campsites, roads, a dock and boat launch. The complex, expanded to include the Emerson Creek Valley, became part of the new Sundance Provincial Park in 1999.

responsibilities. Weldwood set a modest five-dollar camping fee (ten dollars at Whitehorse) to cover the costs of two conservation officers assigned to patrol the sites. In late 2002, Weldwood agreed to assume responsibility for an additional large government campsite at Rock Lake, as well as the group campsite on the Wildhay River.

In June 2001, Weldwood Hinton's recreation enhancement program received an Emerald Award from the Alberta Foundation for Environmental Excellence, in the category of large-company projects costing less than one million dollars. The three-year program was developed in 1999 and included a detailed assessment of recreational activities, facilities, and opportunities in the forest management area. "I think we made very progressive steps in systematically upgrading Weldwood's existing recreation infrastructure, as well as providing new recreation opportunities," said Aaron Jones, public affairs forester, who co-ordinated the project.

Hiking Trails

In the 1970s, the company became very active in recreational development; most of the trails it maintains today were built, or at least started, in that decade. Jack Wright, who joined the forestry staff in 1957 and served as chief forester from 1975 to 1987, initiated the program. Company staff, along with other Albertans, had a keen interest in backcountry recreation, and company management recognized the need to participate with the province and others in providing these opportunities. In addition, company foresters saw an opportunity to get people out into the forest management area to see the positive effects of the forest management program. Beginning in 1973, the company offered some tree planters—then mostly university students—the opportunity to spend time each summer developing hiking trails. This set in motion a decade of company trail development not seen before or since on the forest management area.

Wright described the recreation program's significance in a 1975 address to the Rocky Mountain Section of the Canadian Institute of Forestry:

> *We are confident that our forest management policies will result in a continuous availability of areas of prime recreational condition that will contrast markedly with areas that are being maintained in near-wilderness conditions outside of our boundaries.... If the present policy of maintaining our national parks and our provincial wilderness parks in their so-called "natural" condition prevails for the next several decades, those stands which are presently overmature will become decadent slums.... When this happens, the tourists and recreationists will cast longing glances at those healthy immature stands within the neighbouring [forest management] areas. With this in mind, we are constantly keeping a lookout for areas of high recreational value, not only to develop them for current use, but to protect them for future generations.*

These were prophetic words, as Parks Canada's subsequent restrictions on development and activities, along with a proliferation of recreational vehicles and off-highway vehicles, would result in a virtual explosion of recreational use and activity on the forest management area in the 1990s.

The 1977 Forest Management Plan laid out, for the first time, the company's vision for recreational development on the forest management area. Four key goals were:

1. Location and protection from damage of old forest service patrol trails.
2. Rehabilitation of these trails as time and funds allowed.
3. Recognition, protection, and development for wildland recreation of certain unique areas such as Sundance Valley. (Wildland recreation is non-intensive use such as hiking, cross-country skiing, wildlife viewing, backpacking, and camping in primitive campsites; by contrast, intensive recreation might include developed campsites, paved trails, interpretive centres, and heated washrooms with running water.)
4. Development of hiking and ski trails within operating areas to demonstrate to the public the company's management program.

The first two goals were difficult to achieve. However, one successful project restored a twenty-kilometre section of the Dominion Forestry Branch's historic Bighorn Trail south of Hinton to the Gregg Cabin, an early ranger cabin built around 1917 and one of the few remaining Dominion Forestry Branch cabins on the eastern slopes. The Hinton Junior Forest Wardens club reclaimed this trail in 1971, with company support, and the Junior Forest Wardens maintained the trail for some time until the company accepted this responsibility. In 1996, Weldwood

Weldwood developed and maintains two hundred kilometres of hiking and ski trails in the Hinton area.

*The Gregg Cabin, south of Hinton, was built in 1917 by the Dominion Forestry Branch. R. E. Stevenson, Alberta Forestry Collection^*

built an extension to link to the Town of Hinton trail network at Maxwell Lake. The trail is used today for hiking, mountain biking, horseback riding, and off-road vehicles, although there is growing concern about the impact on the trail from motorcycles and the all-terrain vehicles known as quads.

In the 1990s, the Gregg Cabin site became the central focus of the company's forest resource department events such as the fifty-millionth and one-hundred-millionth tree planting celebrations. The whole Gregg Valley, with its thirty-year-old reforestation, became increasingly popular for fishing and camping. In 1999, a large picnic shelter was built to avoid overuse of the historic cabin, and in 2002 a few campsites were added.

The company also interpreted photos, field checked, and mapped the Dominion Forestry Branch and Alberta Forest Service network of old horse patrol trails on the forest management area. Attempts to use these trails as cutblock boundaries to preserve their integrity proved impractical, except in rare circumstances. Since the locations were known and mapped, it was thought to be easier, if the need arose, to re-establish them after harvest and reforestation. However, the main long-distance trail users today are all-terrain quad or snowmobile riders, who favour old roads and seismic lines, rather than long-abandoned horse trails, so the old trails were not re-established.

Jack Wright was particularly interested in the recreational potential of the Sundance Valley with its network of lakes and spectacular wind-sculpted hoodoos in the northeast part of the forest management area, north of Obed. The company first became aware of the features of this valley in 1961 when forestry crews doing inventories visited the areas. Wright later took the area out of the forest management planning land base with the expectation that someday it would be developed for wildland recreation. Tree planters worked on this trail every year from 1973 until 1979, when the trail network was completed to the Sundance Creek outlet at the far end of Sundance Lake, nine kilometres from the trailhead. The company extended the trail further in 1994. In 1999, this trail and the whole valley became part of Sundance Provincial Park, and the company agreed to a continuing role in maintaining the recreation facilities in co-operation with the provincial government.

The last hiking trail built by the company was the Canyon Creek Trail. Development work began in 1980. This short, three-kilometre trail travels down one side of a spectacular canyon to the Athabasca River and a small picnic site. It returns up the opposite side to the trailhead on the Emerson Creek Road, about eighteen kilometres northeast of Hinton.

Skiing

In the early 1960s, company staff and local people from Hinton collaborated in the construction of a modest ski hill south of Hinton. A rope tow and small chalet were erected, and volunteers helped keep the hill clear of brush, groomed the hill, and ran the rope tow on weekends. This hill operated until 1975, when the facilities were vandalized, about the same time that the popularity and accessibility of downhill skiing in Jasper reduced clientele and interest. Meanwhile, private operators built the Silver Summit ski area north of Edson, withdrawing about 580 hectares from the company's forest management area for this purpose.

Cross-country skiing also became popular in the 1970s. In 1975, company forester Bob Udell joined the local cross-country ski club, then using a ski trail above the Pedley Dam in the Athabasca Valley just east of Hinton. However, warm chinook winds frequently melted the snow and scattered branch litter on the trail. Udell suggested to chief forester Jack Wright that cross-country ski trails would be a welcome addition to the company's recreation program and could also serve the need for public education about forestry.

In 1976, Udell began developing the Pine Management Cross Country Ski and Hiking Trail complex centred at the Gregg Cabin. The trail went through older fire-origin pine forests and various stages of reforestation, along with a series of research sites and operational trials. The core six-kilometre loop featured a series of numbered stops and a brochure for interpretation. Additional connecting loops were added in subsequent years. The local ski club, Hinton Nordic Skiers, adopted the trail as its home base for several years and held annual races there, including the Western Canada Cross Country Ski Championships in 1979.

In the late 1970s, when ski marathons were becoming popular in Canada, the ski club and company agreed that it was timely to consider holding a marathon in the Hinton area. The trail was located and clearing began in the summer and fall of 1979. Starting at Beaver Lake, ten kilometres south of Hinton, the trail climbed to the top of the Bighorn Ridge and along the Bighorn Trail until it again descended into the Gregg and McLeod river valleys and onward to Robb. Sixty kilometres long, with elevations ranging from twelve hundred metres to eighteen hundred metres, it was the most challenging and scenic trail developed before or since in the forest management area.

On 24 February 1980, the first St. Regis Marathon drew about three hundred skiers from across Alberta. One participant later wrote that "until I skied this trail, I would never have said that forestry and recreation could co-exist, but I have to admit that my experiences this day have forever changed my mind on that."

For the next year, the company and the ski club continued to maintain the marathon trail. But the scheduled 1981 event had to be cancelled due to the destruction of sections of the trail by seismic and coal exploration programs as well as the snow-destroying effects of chinook winds.

The success of the Pine Management Trail then led to development of the Spruce Management Trail, a similar ski trail system at Camp 29 (named after a nearby company horse-logging camp that closed in the late 1960s) in the northern part of the forest management area. Oliver Hannula, woodlands superintendent and former Canadian Olympic Team skier, suggested the development and helped

Joanne Mann, forest technologist for Weldwood's Hinton operation, finishes the 1982 St. Regis Marathon on the Spruce Management Ski Trail.

to design a road system appropriate for later use as cross-country ski trails. The high elevation (fifteen hundred metres) guaranteed deep snow and extended ski seasons. The Spruce Management Trail, also known as Camp 29, hosted ski marathons from 1982 to 1985 and reached its peak usage in 1984 when the Canadian Cross Country Ski Championships were held there.

In 1985, a local committee began to look at sites for the Jackrabbit children's ski program. The committee—including Jack Wright and Oliver Hannula—settled on the Athabasca Tower, at the south end of Switzer Park, as the best site. The provincial government then provided a major grant that led to establishment of the new Athabasca Nordic Centre at the same location. The high quality of its facilities and its proximity to town made the centre highly popular with local people as well as many from other areas. Use of company trails fell off, which eventually led to the company's decision to step away from its own ski trail program.

The company gave a large grant to the ski club to help with the development of the Nordic Centre. In 1988, when the Alberta Forest Service and the company were redefining the forest management area boundary, the company agreed to the removal of the area from the Forest Management Agreement land base. The forest service also played a role in the development and maintenance of the Hornbeck ski trails west of Edson and partly within the forest management area, as well as the development of snowmobile staging areas. The company provides financial support to the Edson Ski Club toward the maintenance of the Hornbeck system.

A small core of loyal users, led by Jack Wright, continued to champion the Camp 29 (Spruce Management) trail system after most skiers switched to the Athabasca Nordic Centre. After his retirement in 1987, Wright became the volunteer chief of maintenance on the trail system. The company continued to plough the road and provide snow machines for trail grooming. In 2000, the company stepped up its support for the trail system and printed brochures, erected trail map signs, and installed lunch shelters and toilet facilities.

Managing recreational facilities may seem far removed from the "business" of forestry, but in fact it is a necessary part of sustainable forest management in a multiple-use forest such as Hinton. Recreation is one of the values of the publicly owned forest, and either company or government must maintain and enhance recreation opportunities if management is to be considered sustainable. Recreation is particularly valued by the company's "community" of employees and local residents. Thus, when the government was no longer willing or able to support recreational programs, company officials felt that the company should assume the responsibility. The programs are maintained using a combination of company funds plus monies contributed through the Forest Resource Improvement Association of Alberta.

River rafters and kayakers travel down the Brazeau River, south of Hinton. Donna LeLacheur

Canoe Routes

From the 1950s to the early 1970s, canoe outings on the Athabasca River from Hinton to Whitecourt and Jasper to Hinton were popular annual events for forestry and woodlands staff. Prime forestry movers in this activity were Bill Hanington, a former Alberta Forest Service ranger and keen local historian, and Jack Wright, an easterner raised near the Ottawa River with canoeing in his blood. By the late 1970s, these social events became more sporadic and eventually ceased, but canoeing on the Athabasca and other rivers continued as a popular sport in the forest management area.

The Wildhay River in the north end of the forest management area became particularly well known in the 1970s through its use as a training river by the new Blue Lake Centre in Switzer Provincial Park. The Alberta government built the Blue Lake Centre as an outdoor leadership-training centre, and it became very popular with locals and many others. It was later sold to private interests.

A canoe club (later named the Hinton Strokers), formed in Hinton in the late 1970s, and enthusiastic paddlers and kayakers began exploring the larger rivers and streams in the area. Particularly popular were the McLeod River, Gregg River, Wildhay River, Athabasca River, and Berland River.

In the late 1970s, the Alberta Forest Service began a series of inventories of these rivers, classifying and mapping the rapids as well as potential campsites along them. *Wild Rivers*, a book published by Parks Canada in 1974, listed the Brazeau River among the nation's canoeing assets. Travel Alberta began promoting the Athabasca, McLeod, Berland, and Wildhay rivers for canoeing, as well as the Jarvis Creek to Gregg Lake route.

Wildlife

It happens that most of the species that we wanted to put on the wall or in the freezer are the ones that like early successional forests, so it was thought that if you did forestry right that that would be good for wildlife.

—Rick Bonar, chief biologist, Weldwood Hinton, 1997

The early stages of forest regeneration, after a forest fire or a clear-cut harvest, provide lots of food and habitat for species such as moose, elk, deer, and grouse. As a result, large-scale forest operations were seen at first as a huge benefit for wildlife. However, roads and seismic cutlines also gave a growing population of hunters and fishers easy access into formerly remote areas. Managing impacts on game became increasingly important over the decades. Ecologists meanwhile began to focus on the ways that forestry affected all species, not just the ones that are hunted and fished.

Des Crossley observed that the early forest operations around Hinton created many kilometres of "edge," a favoured habitat for many species. The increasing volumes of grasses, herbs, and shrubs that invaded the harvested areas provided an attractive source of forage, particularly for ungulates such as elk, moose, and deer, while the residual stands remaining after harvest provided the protection they required from their predators. "The wildlife habitat was vastly improved on the harvested areas and as a result there was a gross increase in ungulate populations," Crossley said.

Studies by government fish and wildlife officers confirmed this increase. However, local hunters were unwilling to recognize any increase and in fact claimed that game was becoming more difficult to get. They failed to recognize the amount of poaching that was occurring. As Crossley put it:

> *The roading created by the advent of industry in the area provided easy access, particularly to those so-called "hunters" with pickup trucks who cruise the roads and shoot from the windows. Poaching rapidly became a way of life that the authorities were unable to control. The result of our contribution to ungulate management was a definite gross increase in populations, but a standstill or less in the net increase. This was a situation beyond our control.*

Crossley's remarks especially reflected the situation at Camp 1—the first harvest operation and the first to demonstrate the response of wildlife. Populations of ungulates seemed to increase markedly for the first decade, during which approximately 50 per cent of the area had been harvested in a series of alternating strip cuts (long, narrow strips interspersed with uncut long, narrow strips). Despite the continual hunting, numbers seemed to increase, or at least sustain themselves at high levels.

However, about ten years later, when seedlings became established on the cut-overs, logging began on the uncut strips. Since the seedlings and other vegetation on the cut-overs were not yet high enough to provide enough cover for deer, elk, and moose, their numbers began to decline through a combination of hunting and migration out of the area.

This situation was becoming common in several parts of Alberta, and the resulting vigorous debates among hunters, wildlife biologists, the Alberta Forest Service, the Alberta Fish and Wildlife Division, and the forest industry led to the development in the 1970s of a new rule, the so-called "six-to-eight foot rule." The rule required that the regeneration reach heights of six to eight feet (1.8 to 2.4 metres) before the residual strips could be harvested. The concept was that once regeneration was that high, the large ungulates would find adequate hiding cover.

This large experimental clear-cut north of Hinton is pictured soon after cutting in 1979. The green strips are old exploration trails, left for wildlife purposes.

The same area shows well-established pine reforestation in 1998.

The results were mixed, but the rule represented a positive step toward refinement of management techniques for wildlife. From 1975 to 1977, the company also experimented with a so-called continuous clear-cut in which harvesting would proceed continuously through a large block, except for specified buffers and corridors laid out by wildlife biologists. The idea was to extract the wood from the designated area, reforest it, and then take out the roads. This would let regeneration proceed naturally and minimize human disturbance of the animals. However, subsequent exploration for oil and gas in the area precluded road closures, so the theory was never fully tested.

During the Environment Council of Alberta's public hearings on forestry in 1978, some hunters argued that the six-to-eight foot rule should be replaced by a fifteen-foot (4.6-metre) standard before the second cut, but this was never adopted. Foresters noted that such a standard would require major changes in operations—including, among other things, a great deal more road building and much more rapid development of entire management units, because more areas would have to be opened up while the first-pass cuts put on more height growth.

Integrated Management of Timber and Wildlife

In April 1982, the Alberta Forest Products Association (AFPA) and Alberta Department of Energy and Natural Resources hosted a workshop in Jasper to address the theme "Timber Harvesting in the Boreal Forest: Capitalizing for Wildlife." The keynote speaker was Jack Ward Thomas, chief biologist of the Range and Wildlife Habitat Laboratory of the U.S. Forest Service at Portland, Oregon. Thomas explained the integration process he had developed for managing timber and wildlife in Washington and Oregon.

Jim Clark, the company's woodlands manager, then serving a term as president of the AFPA, had been instrumental in arranging Thomas's presentation at the Jasper workshop. With company support, Clark offered the Hinton forest management area as a pilot project for implementing a similar program in Alberta. A nine-member task force of industry and government representatives, including Clark, submitted their report in 1987, setting the stage for the wildlife program that began in 1988. This report, *Integrated Forestry-Wildlife-Fish Resource Management Approach for the Champion Forest Products (Alberta) Ltd. Forest Management Area, Hinton, Alberta,* drew on earlier work by consultants Rainer Ebel and Beth McCallum in 1984.

Twenty years after a 1956 fire north of Hinton, chief forester Jack Wright inspects young "dog hair" pine growing amid a sea of burned timber.

Clark retired in 1985, and Don Laishley became the company's manager of forest resources in January 1986. Originally from Nelson, British Columbia, and a graduate of the University of British Columbia forestry program, Laishley worked in thirty-five countries before joining Weldwood. He headed the forest resources department until 1994, when he moved to a senior position with the company in Vancouver.

Laishley said his own epiphany to the wildlife cause occurred about a year after he arrived in Hinton, during a visit to the woodlands with Ray Ranger and Bob Udell. They saw a big clearing, full of willow, "the nicest looking piece of moose pasture I have ever seen in my life," Laishley recalled. None of them could explain why there were no moose to be seen, and he realized they would need an explanation if hunters arrived one fall and found no moose. That same year, the govern-ment/industry task force indicated that, with dedication and willingness to adapt harvest practices, the company should be able to sustain habitat for all wildlife species in the forest management area. "I think we'd better get into the wildlife biology business," Laishley decided. Company executives agreed that having a biologist on staff would provide "an insurance policy" to ensure that the company's forest management program also supported healthy populations of wildlife and fish. Laishley said the result of this decision "is that Weldwood probably has the strongest wildlife biology program in Canada, if not in North America."

Rick Bonar, a wildlife biologist with solid experience in British Columbia, was hired in May 1988. He was responsible for the company's wildlife management, including fish, and ultimately for the broad issue of biological diversity. Bonar immediately began collecting a huge amount of information on selected species that were representative of almost all the above-ground species in the forest management area.

Bonar's work, along with the company's other research activities, contributed significantly to the establishment of the Foothills Model Forest as a major research centre in 1992. This institution is one of eleven model forests across Canada, bringing together Weldwood, the Alberta government, the Hinton Training Centre (formerly the Environmental Training Centre), Jasper National Park, the Canadian Forest Service, and nearly fifty other companies, government agencies, community organizations, universities, and research organizations. The original five-year mandate for the model forest was renewed in 1997 and again in 2002, and the annual budget has grown to about three million dollars. The Foothills Model Forest conducts a broad range of research into forestry, forest ecosystems, and human use of the forest on a 2.75-million hectare area centred at Hinton.

Along with that tangible company commitment to wildlife, other changes were occurring. The ground rules negotiated after the 1988 Forest Management Agreement incorporated recommendations made by the 1986 task force. The next step was to decide what was needed for the integrated wildlife/forestry program. A new government-industry committee was formed, called the Integrated Resource Management Steering Committee (IRMSC), comprising Rick Bonar and Doug Walker from the company, Richard Quinlan from Alberta Fish and Wildlife, and Tony Sikora from the Alberta Forest Service. IRMSC decided that government and company would work on wildlife plans jointly, but Weldwood would have primary responsibility for managing habitat and the government for managing wildlife populations.

Habitat Preservation

The approach used by Jack Ward Thomas in the Pacific Northwest was based on maintaining populations of species, but the Hinton group decided this would not fit with the dynamic nature of the forest around Hinton. It was more important, they decided, to focus on habitats rather than individual species. "That was when we came up with the concept of taking all of the vertebrates and seeing if we could associate each species with a certain kind of habitat," Bonar said. The group prepared a species list and looked at their association with sixteen habitat types. If each species could be associated with a habitat—young or old stands, of various species and age—then conserving the habitats was expected also to conserve the species. "At the time we were not calling it biodiversity, but our strategy was basically a biodiversity conservation strategy."

Models and software were developed for the habitat approach, but the proto-

The mixture of rivers, meadows, willow swales, and mature timber along rivers in the eastern slopes provides ideal habitat for many wildlife species.

types were not completed in time to include in the 1991 Forest Management Plan. However, a year later, the establishment of the Foothills Model Forest provided an opportunity to push ahead with the research. The work on species and habitats also dovetailed nicely with other research, gathered for forest planning purposes, on historic patterns of natural disturbance in the foothills forests. "Really what we're looking at when we talk about habitat is various forest types and various seral stages of those forest types," Bonar said. The approach was incorporated fully in the 1999 Forest Management Plan. Wildlife research has become an established part of planning and operations. In 2000, forester Rob Stauffer, manager of the company's Loomis District, observed, "I can't imagine *not* having a biologist on the team."

Special Places Programs

Although Alberta already contains numerous national and provincial parks and wilderness areas, there were growing pressures in the 1990s to protect more areas for various reasons—recreation, aesthetics, cultural and historical resources, wildlife, and biological diversity. This led to a provincial program, Special Places 2000, and an innovative Weldwood program to manage certain areas primarily for non-timber values, known as Special Places in the Forest.

In 1996, the government advised Weldwood that it was contemplating the removal of a 60,000-hectare block of land from the forest management area for protection under the Special Places 2000 program. The potential loss of 6 per cent of the Forest Management Agreement land base was alarming to Weldwood. The company reminded the government that such a removal would place both parties in a difficult position.

Multiple Uses and Values
Trapping

Trapping is another well-established use of the forests around Hinton. In early years when funds were scarce, Dominion Forestry Branch rangers often supplemented their seasonal wages by spending winters on the trapline. Traplines covered much of the forest management area in 1955 and continued through the years. In 1999, the forest management area included all or part of sixty-four registered fur management areas. Sizes vary, but the average size is 15,800 hectares, which is not large enough to provide a living. According to one set of statistics, trapping revenues in the forest management area from 1977 to 1996 would have totalled about $920,000 (based on 2001 fur values), an average of about $14,000 for each trapline over the two decades, or about $700 per year per trapline.

Licensed trappers have the right to establish and maintain traplines and necessary supporting structures such as cabins. While a few trappers with larger lines derive their living from trapping, most in the Hinton area achieve their primary income from other employment. Some use the lines as an excuse for a backcountry lodge. The species trapped include beaver, marten, fisher, fox, timber wolf, coyote, lynx, weasel, muskrat, mink, wolverine, red squirrel, black bear, and otter.

Foresters worked with trappers to avoid conflicts between their operations and to main-tain habitat for fur-bearing animals. When forestry operations are planned in an area with traplines, the trappers are consulted directly to identify their needs and concerns. Trappers are also represented on the company's Forest Resources Advisory Group. In addition, the company participates in a provincial program to compensate trappers for lost income due to forestry activities.

In the 1990s, as Weldwood was developing its biodiversity strategy, it recognized that trappers' fur-returns data could provide an additional way to monitor the health of species and habitat.

Most trapping of fur-bearing animals occurs during the winter. JOHN LUCKHURST

For its part, the company faced serious problems from the loss of both allowable cut and of areas already approved and developed for harvest. The proposal directly contradicted the minister's direction to the Provincial Co-ordinating Committee for Special Places 2000 that it was to "honour existing commitments" and "not pay compensation." However, the nominated area included sites already approved for harvest, as well as an active natural gas field development. Moreover, the Forest Management Agreement required the province to compensate the company for land withdrawals in excess of 2 per cent of the agreement area (0.5 per cent had already been withdrawn for various reasons).

The company proposed an alternative solution: allow it to inventory its forest management area and identify sites that would meet the needs of the Special Places 2000 program, while allowing the company to continue operations with a minimum of disruption. This was accepted, and Weldwood embarked on a quest for suitable areas.

In the 1970s, Weldwood began developing hiking trails into the Sundance Valley, now part of Sundance Provincial Park.

In 1998, Bob Udell and David Presslee appeared before the Special Places co-ordinating committee to present Weldwood's proposal for removing approximately 12,500 hectares from several unique areas within the forest management area; these areas would receive full protection under the program. Combined with areas already nominated or removed for other purposes, the total nomination was more than 14,000 hectares. One such site, Sundance Lakes, was already being reviewed and was subsequently declared a provincial park. The proposed list of sites was accepted by the co-ordinating committee and the minister, and was then sent to a local committee of Yellowhead County representatives for consideration. The local committee sent its report to the minister in July 2000, recommending all but one of the sites initially proposed. After further discussions with the company on the impact of the proposals on its operations, the government enacted the new site designations on 20 December 2000.

Weldwood meanwhile announced its Special Places in the Forest program in 1998. This program proposed that areas with unique and special value be given unique and special management consideration ranging from official protection to intensive treatment of unique areas representing higher than normal values for such things as wildlife, water, and recreation. Special Places in the Forest was an important part of the company's biodiversity and landscape management program. The program included protected areas connected by special management zones (typically along river valleys; for example, Switzer Provincial Park and the Wildhay Glacial Cascades Natural Area are now connected by a special management zone along Jarvis Creek and the Wildhay River), unique areas of historical significance, recreational trails, provincial recreation areas, and company-developed campsites.

In the 1950s, company cruisers discovered a canyon-dwelling herd of mountain goats near Pinto Creek, now the Pinto Creek Canyon Natural Area.N

Among the areas in the 1998 proposal that were later protected by Special Places 2000 were:

- *Rivers and canyons*—fast mountain streams, steep-banked canyons with craggy outcrops and unique collections of plants and wildlife, including, on one site, the only known forest-dwelling herd of mountain goats in Alberta. (Thunder Creek/Brazeau; Pinto Creek Canyons; Solomon Creek)
- *Landscapes sculpted by glaciers*—unique landscapes with broken, convoluted terrain, kettle and esker formations, small lakes nestled in pockets created when embedded blocks of ice melted and the land collapsed into the resulting holes. (Glacial Cascades of the Wildhay River; Emerson Lakes)
- *Landscapes sculpted by wind*—narrow valleys with open west-facing slopes featuring an imposing array of "hoodoos," unique outcrops, columns, and caps. (Sundance Valley)
- *Meadows, bogs, patterned fens, and ponds*—a crucial part of the forest ecology and landscape, often used as gathering and resting places for travellers and for Aboriginal cultural ceremonies. (Switzer Provincial Park extensions)
- *Sites of historic and cultural value*—historic cabins, travel routes, and Aboriginal cultural sites. (Switzer Provincial Park extensions)

Although Weldwood has taken inventories of the forest management area to identify and protect known assets, some features of historic, cultural, geological, or ecological importance may have been overlooked because they are small or

WELDWOOD OF CANADA LIMITED
SPECIAL PLACES
in the forest ®
SPECIAL MANAGEMENT FOR SPECIAL VALUES

The Wanyandi meadows on the west side of Switzer Provincial Park are used by Aboriginal people for ceremonial purposes.

previously unknown. Company foresters, technicians, and woodlands workers watch for these, and once discovered they are assessed and, if deemed important, protected and managed accordingly. One example of such a discovery is a tufa spring—a spring surrounded by porous rock, formed from minerals in the water; the spring was protected by leaving a stand of trees uncut around it.

Meeting Goals and Objectives

During its first forty-five years, the goals and objectives of the Forest Management Agreement multiplied, as did the number of stakeholders. Fortunately, knowledge about the Hinton forest lands also increased at a phenomenal rate. This growing knowledge about both the timber resource and the environment made it possible to develop plans for achieving the goals. Several discussions elsewhere in this book also relate to the multiple-use topic; they are identified by the "Multiple Uses and Values" heading.

CHAPTER FIVE

Gathering Knowledge

It so happened that I was becoming disenchanted with my research position [in the Canadian Forest Service], the lack of effective leadership from head office in Ottawa, and also the fact that no one in the province, including the [Alberta] Forest Service, was showing much interest in our research results, and this seemed an excellent oppor-tun-ity for me to put some of them to the ultimate test in industry. I therefore indicated my interest.

—Des Crossley, 1984

Research into the growth and yield of both fire- origin and regenerated lodgepole pine has been the essential foundation of forest management planning at the Hinton forest. Stan Navratil

In 1954, when St. Regis Paper agreed to join the NWPP partnership, the U.S.-based forest company's executives knew there were risks. The project was Alberta's first large-scale forest industry development, the first based on sustained-yield management, and the first pulp mill anywhere to rely primarily on lodgepole pine. One way to reduce the risks was to recruit a chief forester who was intimately acquainted with the local landscape.

The St. Regis executives first offered the job to Reg Loomis, who had already worked with them in preparing preliminary inventories and mapping the lease area. In February 1955, he was on the verge of accepting when his boss, Eric Huestis, asked him to stay in government. Loomis liked the idea of pursuing his vision on a larger scale, the entire province, so he went back to Pete Hart of St. Regis "and he let me off the hook—and offered it to Des, which worked out well."

Des Crossley was an equally logical choice because he was then the leading authority on lodgepole pine regeneration in Alberta foothill conditions, and in that capacity had prepared a report on silviculture for the new enterprise. "Apparently St. Regis had been impressed with my silvicultural report and approached me regarding my interest in the position," he recalled. The chance to put his knowledge to practical use was too good to pass up. He left his position as a federal forestry scientist in southern Alberta and began the new job in Hinton on 1 May 1955.

Des Crossley: A Commitment to Science

Des Crossley's lifelong commitment to scientific research has continued effects on Hinton forestry research even today. Born in Lloydminster, Saskatchewan, in 1910, Crossley graduated with honours in forestry from the University of Toronto in 1935, and shortly thereafter joined the federal Department of Agriculture at Indian Head, Saskatchewan. For five years he supervised shelterbelt tree planting projects under the Prairie Farm Rehabilitation Act while continuing his academic studies, receiving a Master of Science degree from the University of Minnesota in 1940. From 1940 to 1945, he served as a navigation instructor in the Royal Canadian Air Force, in Canada and England, rising to the rank of squadron leader. He then

Des Crossley and his forestry team at the McLeod River AFS campsite in the early 1960s: (back row, left to right) Steve Ferdinand, Bill Hanington, Ray Ranger, Jack Wright, and Des Crossley; (front row, left to right) Eric Marison, Phil Appleby, and Hank Sommers.

became a forest research officer with the federal Forestry Branch (now Canadian Forest Service) in Calgary.

During his ten years in Calgary, Crossley conducted numerous studies of the coniferous species in the Alberta foothills. The forests west of the city offered a wide variety of stands, and Crossley's work ranged over them all.

His major project was a landmark study of lodgepole pine that he designed and conducted on the Strachan Experimental Block near Rocky Mountain House. This area is now the Des Crossley Demonstration Forest, an interpretive forest maintained by Weldwood's subsidiary, Sunpine Forest Products. There he tested a number of harvesting and site treatments, and demonstrated clearly the regeneration success of clear-cutting followed by scarification to replicate the natural cycle of lodgepole pine renewal after forest fires. He recommended the latter strategy for the new industrial project at Hinton.

Crossley brought energy and commitment as well as knowledge. "This was an opportunity to satisfy my obsession to demonstrate that our forests should and could be managed as a renewable resource without pillaging the land," he said. "The fact that this could be undertaken on the finest piece of timberland in Alberta was an obvious plus."

Working closely with both the St. Regis team and the provincial government, usually represented by Loomis, Crossley developed the systems that would put sustained-yield management into effect at Hinton. These included inventories, growth and yield studies, and harvest planning, as well as silviculture. The flexibility of the operating ground rules negotiated by Loomis and Crossley allowed the systems to evolve as knowledge was gained and circumstances changed.

The impact of Crossley's knowledge, experience, and enthusiasm extended beyond Hinton. As an executive of the Canadian Institute of Forestry (CIF), for example, he led the preparation in 1968 of the first definitive report on the status of forest management across Canada. In 1970, he was awarded the CIF Canadian Forestry Achievement Award, its highest honour. The award citation said that at Hinton he "has systematically introduced a level of forest management that is unsurpassed on any area of similar size in Canada. Research is not only encouraged, but demanded, and when useful results are available there is no hesitation in trial, innovation and implementation."

In addition to his managerial responsibilities, Crossley continued his scientific work through his retirement in 1975 and until his death in 1986. He produced more than forty publications, including an invited paper, "Application of Scientific Discoveries and Modern Technologies in Silviculture," at the Sixth World Forestry Congress in Madrid in 1966. He also served at various times on the senate of the University of Alberta, the regional advisory board of the Canadian Forest Service, the advisory committee of the provincial Environmental Conservation Authority, the federal Arctic Land Use Research Advisory Council, and the Alberta Forest Service Research Advisory Council.

After retirement, he was a member of the Environment Council of Alberta panel on forestry and a guest lecturer at the Universities of Toronto, Alberta, and British Columbia. In 1982, he received an honorary doctorate from the University of Toronto. His final paper, "Toward a Vitalization of Canadian Forests," was prepared for the National Forest Congress in 1986.

The commitment to rigorous scientific research that Crossley established at Hinton continues to this day. The resulting knowledge, extending back over more than four decades, has proved invaluable as managers work to incorporate multiple goals, uses, and values into ecosystem-based sustainable forest management. The knowledge needed for this kind of forest management can be divided into three broad categories:

1. *Forest inventories*—what are the resources on the land, and where are they located?
2. *Growth and yield*—how fast are the old and new forests growing, and how much can be cut sustainably?
3. *Forest science, ecosystems, and people*—what are the processes, values, and needs affecting the forest landscape and all of its species, including humans?

Forest Inventories

The most important requirement for the preparation of a sound sustained-yield plan of regulation is a good inventory by species, types, sites, and age class from which sufficient information as to growth can be readily derived.

—Reg Loomis, 1955

Inventories are essential both for conducting day-to-day forest operations and for planning long-range forest management. For current operations, foresters want to know the species, size, and volumes of timber on a specific area (operational inventories). For long-term planning, information is aggregated for the entire forest (management inventories). Operational inventories require specific and detailed information on relatively small areas to be harvested in a short period of time, whereas management inventories require somewhat less detailed information on the entire forest area. Ideally, foresters would like to map and measure every tree in the forest—the species, height, diameter, age, and soundness; placement on the landscape; role in the ecosystem; and value to society. This is a daunting task even on a small woodlot, and thus far impossible on a large scale. Instead, foresters have learned to extrapolate reasonably accurate inventories from relatively small samples.

The number, species, and distribution of trees can be estimated from ground surveys or interpretation of aerial photos. The volume of wood in individual trees is calculated from measurement of the diameter and height. Diameter is generally measured at 1.37 metres from the ground, a standard called breast height (diameter at breast height, or DBH), so all trees are measured at the same point. Heights

Company forester Ritchard Laboucane uses an increment borer to extract a small cylinder of wood from a tree, from which he derives the tree's age and growth rate by counting the growth rings.

are measured using instruments called clinometers—from a known distance, the angle between the top of the tree and its base enables calculation of the height. Age can be determined by counting the annual rings on cut stumps, or on a thin core removed from standing trees with a device called an increment borer. Age can also be calculated from other data such as fire scars on trees.

In addition to wood volumes, soil types are often mapped because they greatly influence nutrition, rates of growth, and wind-firmness of trees. Soils are also important when locating and building roads and selecting harvest and silviculture methods. Hydrological data—watersheds, groundwater, permanent and seasonal surface water flows—are likewise important for both operational and management planning. Inventories today also include moisture, elevation, and vegetation types, information about wildlife and their habitats, and historical and cultural resources. To meet the needs of sophisticated modern mills and markets, data on wood qualities such as density and moisture content have recently become more important.

Advances in measurement, mapping, and information-storage technologies—and in methodologies for interpreting data—have permitted increasingly accurate, sophisticated, and multi-dimensional inventories.

Timber Cruising

Until the 1950s, knowledge about Alberta's forest resources was very sketchy. Most of the information came from timber cruisers who would walk, snowshoe, or ride a horse through forest stands observing the diameters, heights, and shapes of trees. From the heights, they could judge how many sixteen-foot logs the trees would yield, and from the diameters they could estimate how many logs would be needed to produce one thousand board feet of lumber. (A board foot or "foot board measure [fbm]" is twelve inches by twelve inches by one inch; a common unit of lumber volume is one thousand feet board measure or one Mfbm, equivalent to 2.36 cubic metres of lumber.) The accuracy depended on the skill and experience of the cruiser, but was usually adequate to determine the timber supply for a sawmill.

A more reliable method involves a combination of measuring and estimating the diameter of all the trees in a representative sample plot (typically ten metres by one hundred metres) and recording the species, diameters, and a sampling of tree heights. This is known as mechanical strip cruising if the plots are laid in a systematic (mechanical) grid. As early as the 1920s, federal researchers began developing stand volume tables that would enable cruisers to convert such sample plot information into wood and lumber volume estimates. This standardized approach was less dependent on the abilities of the individual cruiser, and accuracy depended mainly on the validity of the volume tables, how many plots were sampled, and how representative they were. However, such cruising methods were not widely used in Alberta until the 1950s.

Another method, known as photo point sampling, uses high-quality aerial photographs in a similar fashion to sample plots on the ground. In this case, a grid of photo points is identified on the maps and aerial photos, each point representing a proportion of the area being sampled—for example, if ten points were interpreted in a hundred-hectare forest stand, each point would represent ten hectares. A skilled interpreter, studying photos with a viewer called a stereoscope, identifies the species composition, density, and height of the forest stand at that point. Stand volume tables are then used to establish the volume per hectare of the stand at that point which, multiplied by the area it represents and combined with parallel calculations for all other points, gives an estimate of the total volume of the area being sampled. This was the method employed by Reg Loomis for his preliminary estimates of timber supply for the NWPP pulpwood lease area in 1951 and again when he revised the area in 1952.

Getting Started

The Province of Alberta had begun a large-scale inventory of its forests in 1949, but the information gained through photo interpretation of broad stand categories was not sufficiently detailed for operational planning, nor was there sufficient time to measure each stand on maps of forest types to derive the quick management inventory that Loomis derived from his innovative approach. The inventory estimate prepared by Loomis confirmed there was enough wood to supply the pulp mill, but the information was not detailed enough for developing management and operating plans. As soon as Des Crossley began work as chief forester in 1955, he recognized the need for a new set of larger-scale aerial photographs from which to develop more detailed inventories. Philip Gimbarzevsky oversaw rephotographing of the entire lease area in August 1955, and detailed mapping was well underway by November of that year, when staff moved into their just-constructed offices. Crossley was so impressed by his team's progress that he recommended a pay raise.

In 1956, St. Regis sent two experts from the United States to work with Canadian staff on the first inventories at Hinton. John Miller led the management inventory, Frank Laduc the operational inventory. Both returned to the United States in 1958, once the programs were up and running, and Jack Wright thereafter directed the inventories until he became chief forester on Des Crossley's retirement in 1975. The company recruited Wright in 1956 because of his previous experience in the use of aerial photographs for the forest inventories division of the Canadian Forest Service. (Wright was actually offered the job first in 1955 but turned it down because there was inadequate housing in Hinton then for him and his family.)

Timber cruiser Pete Dzwenko uses a Haga altimeter to measure tree heights on a CFI plot in 1963. Note the use of a tape recorder to record tree information, an innovation pioneered by NWPP.

Management Inventories

Continuous Forest Inventory

For the first management inventory, Miller adopted a system called Continuous Forest Inventory (CFI), which had been used in Europe for some time and had been tested recently by St. Regis in its eastern U.S. operations. CFI meant simply that permanent sample plots, located at regular intervals throughout the lease area, would be measured rigorously and remeasured frequently, always using the same methods. This would provide information about the amount of standing timber as well as about growth and yield and changes in forest conditions.

Timber cruiser Dzwenko marks the boundaries of a plot with paint in 1963. The paint alerted others that the research plot should be avoided.

Each of the three thousand permanent sample plots surveyed for CFI was one-fifth of an acre (0.08 hectares), and there was one plot for each square mile (259 hectares) of the lease. From 1956 to 1961, foresters and forest technologists struggled to locate and measure each plot, however steep or brushy or boggy it might be. This involved driving as close as possible in one of the company's Land Rovers—often an adventure in itself on the primitive road system—and then using map, compass, and aerial photographs to reach the precise spot by foot or snowshoe. In the 1960s they began to use off-road motor scooters called Tote Gotes and early types of snowmobiles. In the first inventories, cruisers averaged about half a plot surveyed per working day. This work included locating and tagging the trees in the plots.

Long-time employee Ray Ranger started his career working on the permanent sample plot program and related that in those early years he spent an average of 290 days per year living under canvas and working in the woods, in all seasons and all conditions. One day, returning to the office after a particularly long spell, sporting a beard and still wearing the clothes he started with, the receptionist (who had known him for five years) did not recognize him and asked him to state his business. The cruisers were mainly young and single, recruited from all across Canada. Stories of their exploits and misdemeanors, in and out of the woods, continue to regale many a forestry reunion.

The measurements from the sample plots were entered on then state-of-the-art

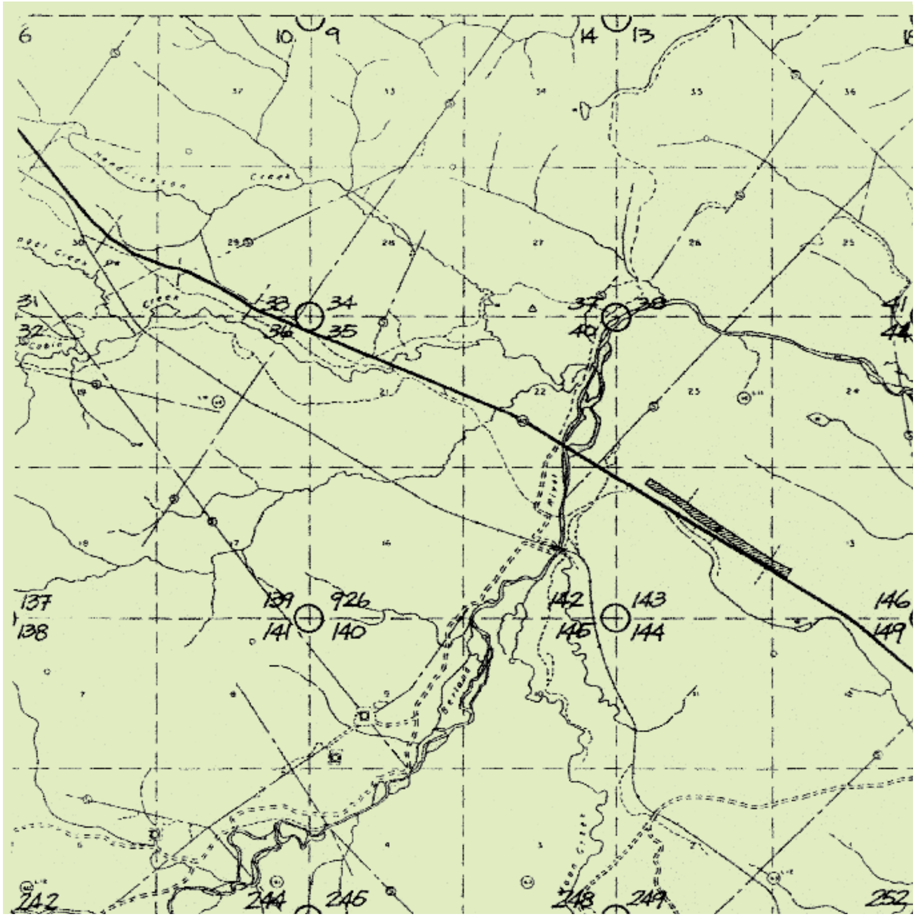


Figure 5.1. Location of permanent sample plots relative to the Dominion Land Survey grid. There are four plots in a "cluster," each plot five "chains" (about 100 metres) at 45° from the survey pin.

"Mark Sense" cards for processing in a mainframe computer located at the IBM centre in Edmonton—the start of a never-ending trend to automate and digitize data-handling at Hinton. The Mark Sense cards were replaced by punch cards in 1963. The company acquired its first mainframe computer in 1974, and by 1975 all the permanent sample plot data were relocated to the Hinton site. Since 1988, the plot data have been stored and analyzed on high-capacity personal computers.

Another technological innovation in 1961 was the use of portable tape recorders by timber cruisers, enabling them to dictate measurements as they went along. This followed thorough testing to determine which model could withstand field conditions, including temperatures as low as minus-35 degrees Celsius. In the 1990s, hand-held field data recorders replaced the portable tape recorders, and plot measurements are now downloaded directly to the computer back in the office.

Jack Wright recalled that many foresters at the time questioned the use of CFI because the sample plots were located solely according to the grid, regardless of timber type. The suggested alternative was a "stratified" system in which plots are selected to be representative of each type of forest stand. However, Wright often pointed out that the necessary information about stand types was not available when the inventory started, and therefore it probably would have taken five years longer to complete the first inventory if a stratified system had been used.

"One concession to advocates of stratified sampling was to move the plots in the field a sufficient distance so that the entire plot was located within the stand type in which the plot centre fell—usually one chain (twenty metres) forward or back," Wright noted. "This of course disturbed those proponents of systematic sampling, but enabled us and others to use the CFI plots for many related and nonrelated purposes." Each plot was then wholly contained in one stand type (a classification established and mapped from aerial photo interpretation) and could therefore be used in developing growth and yield information based on that particular type classification.

One of the first valuable products from the CFI program was the analysis of the tree and plot data to develop a set of "aerial stand volume tables" relating interpreted forest stand features (species, height, density) to merchantable wood volumes per acre for harvest planning. Wright developed these tables, applying his government research work to an actual commercial forest. Other CFI products included stand and stock tables (i.e., trees per acre and volume per acre according to forest types, densities, and heights). Volume/age curves developed from the program were also used to forecast growth and yield over time for forest management planning purposes. The CFI provided the management inventories for the first two forest management plans in 1960 and 1966.

Photo-point sampling

In 1968, the company was preparing for a major expansion under a new Forest Management Agreement with the provincial government. The expansion did not in fact occur, but the prospect of preparing a management inventory for an additional 800,000 hectares led to a re-examination of inventory methods. The labour requirement for extending the Continuous Forest Inventory to the additional area would have been very large. Meanwhile, continual improvement in the development of volume tables linked to photo-interpreted type classes gave company foresters confidence that this method could also be used for the management inventory.

Wright asked forester Russ Powell to conduct a photo-point study of several operating compartments that had already been "fine typed" (detailed mapping of stands from aerial photographs). An eight-hundred-metre grid was overlain on the fine-type maps, and forest type information for each point was noted, and assumed to represent a mathematical proportion of the total area sampled. From this, a new inventory was calculated and compared to the inventory results from fine-typing and mapping. The results were remarkably consistent, and Wright determined that a photo-point sampling system would be a cost-effective and accurate approach to developing inventories for forest management plans on the expanded area.

This new management inventory system was adopted in 1970 after the first remeasurement of the three thousand original Continuous Forest Inventory plots was completed. In effect, inventory reverted to the method first used by Loomis in the early 1950s, albeit with much more detailed photographs and much more accurate statistical tables.

Draftsman Ed Starko uses a stereo plotter to transfer details from interpreted aerial photographs to a map, circa 1960. Using the plotter, photos are corrected to the scale of the map on the table. The draftsman then transfers details directly onto the map. P

This decision signalled the conversion of the CFI permanent sample plots into permanent growth sample plots. That is, the three thousand permanent sample plots were used after 1971 mainly for volume tables, growth and yield studies, and research on forest ecosystems. This new program tapped into the real power of permanent sample plots in providing a firm foundation for studies of forest growth and yield and forest-ecosystem change over time.

An expansion of the forest management area in 1988 was followed by another management inventory for the new areas, and as will be seen later in this chapter, was the beginning of the end for the photo-point sample inventory system.

Photogrammetrist Philip Gimbarzevsky prepares original base maps, corrected to scale, using 1955 aerial photos. Common reference points in overlapping photos were identified and adjusted to the correct map scales.
GIMBARZEVSKY COLLECTION†

Operational Inventories

Operational cruising

Within the active harvest areas, strip cruising was used for the first operational inventories from 1955 to 1958. Like the Continuous Forest Inventory, this involved on-the-ground measurement of all the trees in plots (strips) located along a systematic (mechanical) grid. Operational surveys in 1955 covered about 20,000 hectares at a "cruise intensity" of 1.2 per cent. This meant that trees were actually measured on 1.2 per cent of the surveyed area—about 240 hectares in this case. The first operational cruise covered the area between Highway 16 and Brule Lake, commonly known as Camp 1, and an area around Peppers Lake just north of Hinton. This provided information necessary to plan the first logging operations.

After the first year, the cruise intensity was increased to 2.5 per cent, but the results were still not sufficiently accurate. The margin of error between estimates and actual cut volumes was plus-or-minus 25 per cent, while the goal was accuracy within 10 per cent. This system was modified in 1958 to use a more stratified approach, varying the sampling intensity according to the forest type—a forest type that occupied a large percentage of the area would require relatively fewer samples per hectare to achieve accurate results compared to a type that occupied relatively little area. For example, approximately one-third of the entire forest management area was occupied by an even-aged lodgepole pine monoculture

Forestry crews relied heavily on four-wheel-drive vehicles, such as this early Toyota Land Cruiser shown crossing the Little Berland River in 1967, to move around in forests largely without roads.

arising from the huge fires of the 1880s, and a few samples in this type/age class could be extrapolated to relatively large areas of the same type and age.

In 1960, the operational cruisers switched from measuring entire strips to "wedge-prism cruising," also known as "variable-radius plot sampling." The cruiser holds a specially calibrated prism over a point on the ground, and circles around it counting each tree that is larger than the prism refraction. The number of trees is then multiplied by the "prism factor" (the number of square metres of trunk area each tree so recorded represents) to arrive at a trunk area per hectare. This result, multiplied by a conversion factor based on the average height of the stand, produces the wood volume per hectare. In effect, a fixed angle is projected from the plot centre, and only the trees wider than that angle are included in the estimate. Depending on the number of plots measured and the angle chosen, this method can produce results as accurate as measuring all the trees in strips or plots. Wedge-prism cruising reduced the staff requirements for on-the-ground measurement but did not improve accuracy significantly. It was only used for a short period, until the completion of fine-type mapping and—later—the refinement of a photo-point sampling system patterned after that used by Loomis in his first rough estimates.

By 1963, photo interpretation, sampling systems, and volume tables were refined to the point where annual harvest volume estimates had a margin of error of less than 10 per cent. All operating compartments (at the time, a block of forest land of sufficient size to support a fifty-man logging camp for twenty years) scheduled for harvest were then "fine typed."

Fine typing

In fine typing, a skilled photo interpreter, using sequential pairs of aerial photo-graphs and a stereoscopic viewer that allows the analyst to see features in three dimensions, maps the boundaries of forest stands directly on the photos. These stands are generally interpreted to three-metre height classes and further refined based on proportions of tree species present and the density of trees per hectare of the stand. These stand boundaries and type classes are then transferred directly to topographically corrected maps, the areas by type class calculated, and volume and product breakdowns prepared using various tables derived from permanent sample plots and other analysis.

Once these fine-type maps were done, on-the-ground cruising (using the wedge-prism method) was only used to supplement results from photo interpretation. One experienced technician could then prepare the operational inventory for the entire year's harvest—a task that formerly required ten people working in the office and the field.

The original type maps prepared in the 1949 forest inventory recognized only four height classes (0 to 9 metres, 9.1 to 18 metres, 18.1 to 24 metres, and above 24 metres) and did not provide any age-class information—a rough estimate known as "broad typing." Today even more refined information is gathered, sometimes to a one-metre height-class breakdown and including much more detail on species breakdowns. Digital photographs, corrected for topography, are also used and can be directly transferred to computer-based mapping systems to produce details on area and volume/product detail as needed.

Photo-point sampling

Wright was also interested in streamlining operational inventories. Although these could be prepared relatively quickly from "fine type" maps, the interpretation, transfer, and production of the maps themselves was very time-consuming and costly. Forester Ken Smith, using the same methology as Russ Powell's earlier work but a more intensive sample, conducted a photo-point sample inventory using a four-hundred-metre grid superimposed on fifty-nine cutblocks for which "fine type" inventories had already been done. The resulting estimate of volume differed by less than 1 per cent from the fine-type estimate, but the labour requirement for photo interpretation was less than half of that for fine typing and mapping.

From that point (1971) the company used photo-point sampling for all operational inventories, although a large amount of additional information was gathered by various means for inventories after 1988. The sample points were located on a four-hundred-metre grid for operational inventories, interpreted to three-metre heights; an eight-hundred-metre grid was used for management inventories using broader height classes. To conduct a photo-point sample inventory, a technician simply identified the stand type, height, and tree density at each sample point. Each point represented a proportion of the total area being sampled.

Stand volume tables then permitted accurate calculation of the timber resources.

"Timber cruising has always been a costly, monotonous and time-consuming experience," observed Jack Wright in a paper he wrote on the subject in the *Pulp and Paper Magazine of Canada.* Wright said photo-point sampling "combines the information available on aerial photographs with data from past inventories to produce a cheap and reliable inventory system. This method can be applied to both general and more intensive inventories simply by varying the sampling intensity."

In the late 1980s, the photo-point sample method could no longer provide the detailed information required for forest operations, and as will be seen, the entire inventory system for both operational planning and management planning was converted to an enhanced form of "fine typing."

Enhanced Inventories for Sustainable Forest Management

Three developments in 1988 led eventually to a complete rethinking of inventory requirements:

1. The new Forest Management Agreement expanded the forest management area.
2. The planned new dimension-lumber sawmill would need more information about age, species, dimensions, and wood quality.
3. The new emphasis on wildlife and integrated resource management meant that more values of the landscape needed to be inventoried in addition to timber.

Sean Curry, the forester who took over responsibility for inventories in that year, continued to use photo-point sampling for the main inventory of timber resources in the expanded forest management area, but he supplemented it with more intensive inventories of regenerated stands and fine typing of operat-ing compartments scheduled for harvest in the near future. A new sawmill was planned, which would require much more detail on tree characteristics that could affect lumber recovery and quality such as diameter, straightness, the amount of taper from bottom to top of the tree, and any visible defects such as disease. He began the major task of including these new sawlog requirements as well as non-timber values into the inventory process.

The first attempt to address sawlog requirements was the use of a computer-ized sawmill simulation model, SAWSIM, developed in 1990. This necessitated extensive on-the-ground cruising in the 1990s to "ground-truth" fine-type inventory results and improve knowledge of tree diameters, stem shapes, and wood qualities. Somewhat ironically, just as photo-point sampling in the 1970s reverted to the methods used two decades earlier by Loomis, the 1990s saw a return to methods used by even earlier cruisers to estimate the amount of lumber contained in standing timber. In both instances, of course, the maps and measurements had become much more sophisticated. Modern cruisers are also aided by global

Multiple Uses and Values

Des Crossley was a proud forester, so he initially argued that operations should be in plain view where people could see for themselves what was occurring. Camp 1, the company's first logging operation, was located in the Athabasca Valley close to the railway and highway. Unfortunately, many people missed the educational intent. They saw only "devastation" instead of the genesis of a new forest. The fact that Camp 1 proved to be one of the most challenging sites to regenerate did not help matters.

As tourism and recreational use increased in the forest management area, and as each year added to the area harvested, the aesthetic impacts became increasingly problematic. In the rolling topography of the foothills, disturbances are often visible many kilometres away. In 1979, an Environment Council of Alberta panel on forestry noted that citizens expressed "a near-unanimous dislike for the appearance of recent cut-over areas."

In the 1980s, the company began incorporating some aesthetic considerations into cutblock design, especially those visible from Highways 16 and 40. "Feathering" the edges of cutblocks gave them a more natural appearance, and leaving clumps of trees within the blocks reduced the visual impact. During this decade, less logging activity occurred in areas

continued on page 89

positioning system (GPS) satellite navigation, and they typically travel with much-improved snowmobiles or all-terrain quads.

Significant portions of the land base were now occupied by reforestation on areas previously harvested. These new stands were growing quickly and were considered distinctive enough for a separate inventory, leading to the development of a new "regenerated stand inventory."

Jim Beck and Barbara Beck, professors in the University of Alberta Department of Renewable Resources, meanwhile developed a computer model called CRITTERS to analyze the effect of forest management on wildlife in the Hinton forest management area. Along with research by company biologist Rick Bonar and others, this model provided a preliminary evaluation of how forest management could better manage wildlife resources. Because the work was still underway, it was not possible to include a "wildlife inventory" in the 1991 Forest Management Plan. In the next year, however, Weldwood and the Foothills Model Forest began to expand wildlife, fisheries, and bird inventories and research for the forest management area.

Between about 1988 and 1992, as the commitment to wildlife management evolved into a broader concept of sustainable forest management, it became evident that a key company responsibility was to maintain the range of species habitats in the forest management area. Multiple uses, recreational needs, aesthetic values, and cultural assets also had to be included in forest management. All of these required new kinds of inventories.

The company, along with the rest of the forest industry, adopted the Alberta Vegetation Inventory (AVI) for forest inventories. The AVI—developed originally by the Alberta Forest Service for the "White Area" of the province, (the area considered suitable for private land sale and agricultural development) and later expanded for use in the forested "Green Area"—provided more detailed forest inventory information that moved beyond tree cover to include other information. Based on previous photo-sample inventories, for example, foresters had little data on the plants growing beneath the forest canopy, yet such data was becoming increasingly important for wildlife management, harvest planning, and silviculture. The AVI addressed some of these gaps, and was used to inventory all forest types for the 1999 Forest Management Plan.

Silvicultural needs, identified in a 1993 consultants' report, meanwhile led to the development of a more refined and comprehensive system of ecological site classification. David Presslee, the company's forestry manager, worked with Ian Corns of the Canadian Forest Service, and others, to update and adapt an ecosite classification guide developed earlier by Corns for west-central Alberta. This new classification filled in many remaining gaps relating to harvest planning and wildlife habitat needs (such as moisture, minor vegetation, soils, and productivity). Harvest planners, biologists, and silviculturists were extremely pleased with results of the first trials, covering 74,000 hectares in 1994 and 100,000 hectares in

Table 5.1. Evolution of personnel requirements for management planning inventories

Management Plan	Person-years for inventories	Description
1961	25	Establish and measure three thousand permanent sample plots, 0.5 plots per person-day
1966	0	No new inventory required (AAC redetermined based on change in rotation age)
1977	1	One year to photo-interpret twelve thousand photo points (800,000 hectares)
1986	1	One year to photo-interpret twelve thousand photo points (800,000 hectares)
1991	6.5	Three-quarters of a year to interpret nine thousand photo points (600,000 hectares) 3.8 years to fine type near-term operating compartments (300,000 hectares) Two years for inventory of regenerated stands (100,000 hectares)
1999	12	310,000-hectare operational/management inventory to Alberta Vegetation Inventory (AVI) standard with 40–50 per cent ground checking for near-term operating areas. 55,000-hectare regenerated stand inventory 646,000-hectare management inventory to AVI standard, but minimal (1–2 per cent) ground truthing

1995. Classification of the entire forest management area began in 1996, and by 2000 about 637,000 hectares had been classified, with completion scheduled by 2004. From this ecological platform, harvest planners, silviculturists, and biologists work together to produce integrated and ecologically appropriate plans.

By 2001, "natural disturbance" research at the Foothills Model Forest was shedding new light on the historic origin and range of variability in the natural forest. Some of this work was adapted for the 1999 Forest Management Plan and became the foundation for a new "natural forest management" system under development for the forest management area.

Table 5.2 provides a brief description of these and other inventories that are fundamental to the development of a plan for the sustainable management of the range of values contained in the forest.

visible from Highway 16, and this also helped to reduce public concern.

In the 1990s, Weldwood addressed the aesthetic issue by surveying visible areas along highways and major river valleys in the forest management area, using a visual quality inventory method developed in British Columbia.
This information was incorporated into the planning process and 1,653 hectares in the highest visual quality class were removed from the operational land base. Most of these areas are along Highway 16, which now carries more than two million visitors through Hinton annually.

Table 5.2. The complexities of inventories for sustainable forest management

1960 Forest Management Plan:
"Sustained-yield Forest Management"

Forest inventories (for determination of sustainable AAC)

- Permanent sample plots (continuous forest inventory)
- Inventory listing all forest types, based on the continuous forest inventory
- Age classes of the forest

1999 Forest Management Plan:
"Sustainable Forest Management"

Forest inventories (for determination of sustainable AAC)

- Permanent growth sample plots
- Inventory of forest types based on Alberta Vegetation Inventory
- Age classes of the forest
- Regenerated stand inventory
- Ecological site classification

Additional Inventories for the 1999 Forest Management Plan: "Sustainable Forest Management"

Visual landscape inventory
- Basis for developing "visual quality objectives" (similar to B.C. visual landscape inventory)

Cultural/historic inventory
- Basis for protecting sites of unique historic or cultural value

Seral stage/Forest type classification
- Basis for "natural forest management" program
- Basis for determining wildlife habitat supply

Riparian corridor inventory (river valleys)
- Basis for special management zones
- Physical landform (active channel, floodplain, terrace, fluvial slopes, etc.)
- Site sensitivity (high, medium, low)
- Management history pre-1956
- Basis for appropriate silviculture design

Regional hydrology study
- Stream characteristics, fish habitat and water flow, quality and yield
- Hydrologic "triggers" (i.e., threshold limits of management activities)
- Hydrologic operations manual (Foothills Model Forest)

Fish and stream inventory
- Identify streams with fishery management concerns
- Primary use for operational planning

Wildlife inventory
- Species grouping of 153 habitat-related species into 17 "habitat associations"
- 30 representative species selected for habitat supply analysis spanning 16 terrestrial habitat groupings
- Development of Habitat Suitability Index (HSI) models for 18 species linked to habitat associations
- Preparation of habitat inventory from Alberta Vegetation Inventory (AVI)
- Habitat yield and change forecasting
- Habitat supply analysis models

Measuring Growth and Yield

We needed an ongoing record of growth, volume, and yield, basic information on which to work out our allowable cut. I think the lack of good information has been the curse of forest inventories across Canada.

—DES CROSSLEY, 1985

Perhaps the information most essential for long-term forest management is how much new growth is occurring in the forest, and how much timber it will yield. This information forms the basis for determining the annual allowable cut and for planning harvest and silviculture operations. In the beginning, the key task was determining growth rates in the existing forest. Then, as regeneration got underway on more harvested sites, it became crucial to establish growth and yield rates for the new stands.

When Reg Loomis was recruited to Alberta in 1949 to oversee the first provincial forest inventory, he strongly urged that the contractor measure the ages of trees in the sample plots they surveyed. It would then have been possible to correlate age with height for various stand types identified from the aerial photographs, and thereby produce maps showing the distribution of age classes, and graphs of volume over age for major forest types. This information, combined with information about growth rates, could then be used to establish the rotation time for the site (the time from harvest to harvest on a single site). Unfortunately, this was not done due to limitations in time and funds. As a result, very little was known in 1955 about age-class distribution and natural growth and yield rates on the Hinton lease area.

It was well known, however, that most of the forests around Hinton consisted of even-aged stands of trees that had grown back after fires. This fact simplified the collection of age-class information considerably. The annual growth rings on trees within the stand (visible on sawn stumps or in thin cores removed from living trees) revealed the age. The year of the fire was determined by locating a charred ring in adjacent older trees that had survived the fire. Three major forest fires on the lease area in 1956 provided foresters with a first-hand case study of nature's regeneration methods.

Des Crossley was committed to building a forest management system upon a foundation of reliable information on forest growth and yield, and he set in place a program to get it. This legacy continues, and time has shown that subsequent increases in annual allowable cut on the Hinton forest management area have generally resulted from a combination of improved knowledge of growth and yield, as well as improved forest growth from reforested stands and improved utilization (i.e., less waste) of the trees harvested.

Timber cruisers began collecting age-class data as soon as the first inventories began in 1955, and the Continuous Forest Inventory (CFI) program gathered an enormous amount of age data between 1956 and 1961. As this information accumulated, forest technicians mapped the boundaries of past forest fires on aerial photographs. This effort culminated with the production of a "fire origin" map of the forest in 1960.

It soon became evident that about one-third of the stands in the forest management area originated from fires in the 1880s and 1890s, and about one-third from more recent fires. In the other one-third, there were both even-aged stands resulting from pre-1880 fires and multi-aged stands in which shade-tolerant species were growing up within the canopy of older trees near the end of their life cycle.

The age-class distribution revealed a great deal about the natural processes of regeneration and growth in the principal species to be harvested. Lodgepole pine was believed to mature in about ninety years, white spruce in about one hundred years. A stand is considered "mature" when the trees' average annual growth rate reaches a peak, after which it gradually declines. In sustained-yield management, the age at which this occurred was defined as "rotation" age, when a forest stand would be harvested. A forest under full management would have an equal distribution of age classes from zero to "rotation"; this was termed a "regulated forest." Modern thinking on sustainable forest management (management for all values, not just timber as in sustained-yield forest management) has departed from the concepts of regulated forests and rotation ages, recognizing that all parts of the forest are not treated the same way—some parts will never be harvested, some stands will be harvested at earlier ages, others will be sustained well past traditional "rotation" age before harvesting.

Based on the first growth and yield studies in the late 1950s, the annual allowable cut in 1961 was determined to be 1.07 cubic metres per hectare of productive forest. This was revised to 1.38 cubic metres per hectare in 1966 when the first analysis of the CFI plots showed the proper rotation age of the forest to be eighty years, not the one hundred years chosen for the first plan in 1960.

On a net productive area of 650,430 hectares, the 1966 annual allowable cut was 899,316 cubic metres per year. Since the average annual harvest in the 1960s was just 623,000 cubic metres, the company was assured of meeting its commitment to sustained yield. The growing backlog of unused annual allowable cut from previous years led to a 17 per cent increase in the annual allowable cut in 1977, to 1.72 cubic metres per hectare.

In 1971 and 1972, analysis of the permanent growth sample plots showed that trees on regenerated harvest sites were growing considerably faster than similar stands in the pre-existing "natural" forest. The plot analysis suggested, but was not definitive enough to prove, that fire-origin stands were also growing faster than expected.

By this time, the massive records from multiple measurements of the sample plots were becoming widely recognized as the largest repository of growth and yield information about lodgepole pine in North America. Between 1975 and 1985, the company allowed experts from both the British Columbia Ministry of Forests

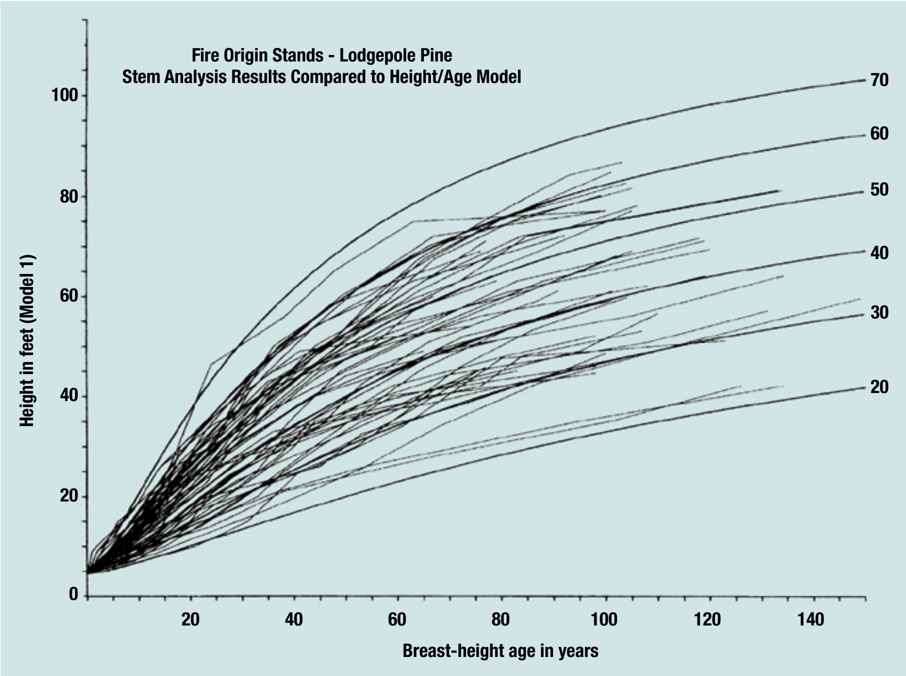


Figure 5.2. 1986 stem analysis project results in fire-origin lodgepole pine. The smooth curves represent height growth for six site index classes based on tree heights at "breast height" age fifty years, with heights ranging from 20 to 70 feet. Jagged lines show individual tree measurements.

and Washington State University to use the data as they attempted to develop computer models for predicting growth and yield in managed forests. In British Columbia, the resulting models were used for lodgepole pine stands throughout the province.

In 1985, the company conducted another major study of lodgepole pine growth and yield. Bob Udell, who had taken over responsibility for forest management in 1975 when Jack Wright became chief forester, worked with consultant W. R. (Dick) Dempster on the study. Using a combination of permanent sample plot analysis and stem analysis (cutting trees in short sections, counting and measuring growth rings by section) in matched pairs of regenerated harvest sites and fire-origin stands, Dempster and Udell developed a system for more accurate forecasting of height growth and resulting yield. Largely because the density of the newly established stands was closer to the optimum, stands originating from reforestation efforts were estimated to be 25 per cent taller than fire-origin pine stands at age eighty years.

Dempster adapted and tested a "growth intercept system" from earlier red pine research in the north-central United States. The growth intercept is the measure of five- and ten-year height growth above breast height (1.37 metres) in the largest trees. Through analysis of these measures, they could derive a "site index" for the stand—that is, the anticipated average top height (one hundred largest-diameter trees per hectare) of the stand at fifty years of age at breast height.

A check of this method using data from the company's permanent sample plots confirmed that the growth intercept method was a remarkably accurate forecasting tool. The two authors documented their work in an award-winning 1986 scientific paper, "Predicting Growth and Yield of Regenerating Lodgepole Pine," in the journal *Canadian Forest Industries.* This field approach to site index determination was subsequently adopted and adapted by other management agencies, most notably the British Columbia Ministry of Forests, and is now widely applied in western Canada.

Further examination of the permanent sample plots showed that the old "empirical" volume/age curve based on single observations of wild stands at various ages, which had been used for management plan projections, was a poor reflection of actual stand development. Accepting a recommendation from Valerie LeMay of the Alberta Forest Service, Udell and Dempster used the successive measurements of the permanent sample plots to produce two new growth curves for height/age and volume/height by major species type for the forest management area.

Dempster developed a new planning model, the Forest Yield Projection System, for determining the annual allowable cut on the Hinton forest management area. In 1986, this produced a further 23.7 per cent increase over the 1977 calculation. The new annual allowable cut was 2.31 cubic metres per hectare of productive forest.

Between 1988 and 1990, as the goal shifted from sustained-yield to sustainable forest management, company foresters adapted an advanced computer simulation model (FORMAN) to predict the effects of a wide variety of alternative harvest levels and management strategies. Yet another 10 per cent increase in allowable cut, to 2.37 cubic metres per hectare, was justified in 1991 by using the new simulation model and applying the growth intercept methodology to all regenerated pine stands on the forest management area older than ten years. This would not have been possible without the solid base of growth and yield data and analysis built up since 1955.

For the 1999 Forest Management Plan, the FORMAN model was abandoned in favour of a new planning model (Woodstock) that allowed much more detailed examination of alternative strategies for the management of timber and non-timber values. Management forester Hugh Lougheed completely recalibrated the growth models to be used in the 1999 plan, based on more detailed analysis of permanent sample plot growth on the forest management area. This led to a further increase to 2.71 cubic metres of annual allowable cut per hectare of productive and "contributing" forest. The increase, partially achieved by improved utilization of each tree harvested, allowed the company to maintain the total annual allowable cut in the face of a decrease of almost 100,000 hectares in the contributing land base. Previously, utilization was based on a minimum thirteen-centimetre stump diameter and ten-centimetre top diameter. The new standard used for the plan and allowable cut is a ten-centimetre stump and an eight-centimetre top, resulting in more volume recovery from each tree harvested.

Figure 5.3 is a summary of the evolution of allowable cuts per contributing hectare of forest land base for each of the forest management plans since 1960. Better knowledge of forest growth and yield has made a major contribution to the maintenance and increase of annual allowable cut on the forest management area, but there have been other contributing influences. Many factors and circumstances have played a role in this evolution, primarily:

1. change in rotation age from one hundred years to eighty years (1966)
2. accumulation of unused annual allowable cuts (1977)
3. improved growth and yield information from permanent sample plots (1986)
4. new information on regenerated stand growth and yield (1991)
5. improved growth and yield information, better tree utilization (1999)

The figure also shows changes in the land base contributing to the annual allowable cut over time. There was a gradual decline in contributing land base from 1961 to 1986 as other uses (coal mines, oil and gas, railroads, etc.) removed areas; then a large increase in 1988 when the forest management area was expanded; finally a substantial reduction in 1999 as the contributing land base was reduced by about 100,000 hectares to reflect the new sustainable forest management system being implemented.

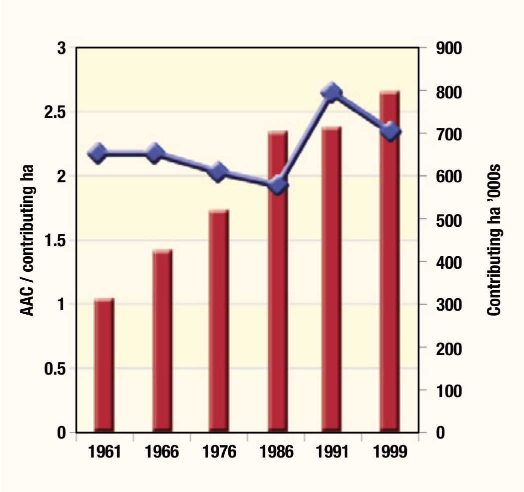


Figure 5.3. Changes in annual allowable cut (AAC) per contributing hectare (bars), and in the land base contributing to the AAC (line) by management plan

The next challenge will be to develop tools to forecast growth and yield for the enhanced forest management (EFM) strategies that Weldwood began to implement in the late 1990s, and that will be reflected in the next forest management plan in 2008. These strategies—such as tree improvement, silvicultural treatments, pre-commercial thinning, and commercial thinning—are expected to increase yields significantly. New efforts are underway to forecast and calibrate the alternative strategies for the Hinton forest management area.

Forest Research: Science, Ecosystems, and People

No knowledge beyond that of the law was required of [French foresters], hence no development of silvicultural methods resulted during the 17th and 18th centuries.

—BERNHARD EDUARD FERNOW (1851–1923)

Bernhard Fernow was commenting on the Colbert Ordinance enacted by France in 1669—some five hundred detailed regulations in the grand spirit of Cartesian rationality—that remained in effect until a new law was passed in 1827. Fernow said the ordinance brought near paralysis to French forestry, formerly the most advanced in Europe, because it "removed from the officials all spirit of initiative and desire or requirement of improving." Only when the unfortunate results of

Founding Dates for Canadian Faculties of Forestry

- University of Toronto 1907
- University of New Brunswick 1908
- Laval University 1912
- University of British Columbia 1921
- University of Alberta 1970
- Lakehead University 1971
- University of Moncton 1985
- University of Northern British Columbia 1993

rigid, rule-based forest management became evident could a more science-based, adaptive approach begin to develop.

Throughout the nineteenth century, schools in France and Germany were world centres of forestry education and research. These schools and their students played a major role in the subsequent development of forestry in North America, including eventually Hinton.

Fernow, born and educated in Germany, became the first professionally trained forester in North America when he immigrated to the United States in 1876. As a growing population spread across the continent—the era known as "the closing of the frontier"—Fernow ardently promoted fire prevention, watershed protection, reforestation, and multiple use of forest lands. He later became the first director of the Division of Forestry in the U.S. Department of Agriculture in 1886 and went on to found several university forestry faculties, including those at Cornell University in 1898 and Canada's first at the University of Toronto (Des Crossley's alma mater) in 1907.

The other founding father of North American forest science was Gifford Pinchot (1865–1946), an American who studied in France, Switzerland, Germany, and Austria, and then in 1892 began systematic forestry research on the estate of George W. Vanderbilt in North Carolina. He replaced Fernow as head of the U.S. Division of Forestry in 1898, founded the Yale School of Forestry in 1903, and became the first chief forester of the U.S. Forest Service in 1905. He later was chief forester of Pennsylvania and served two terms as governor of that state.

Disciples of Fernow and Pinchot, such as Aldo Leopold, abetted by a growing influx of European-trained foresters such as Abraham Knechtel (who also served in Alberta early in the twentieth century), rapidly advanced the status of forest science in U.S. and Canadian government and academic circles through the first half of the twentieth century. The lumber and paper industries were mainly preoccupied with economics and engineering during this period, and were slower to become involved in forest science until demands for sustained-yield management emerged after the Second World War. It was not until the 1950s, for example, that an industrial forester was elected president of the Society of American Foresters.

By the 1950s, a great deal of basic forestry research had been performed in Canada by the Dominion Forestry Branch (now Canadian Forest Service), provincial forest services, and the Universities of Toronto, New Brunswick, Laval, and British Columbia, as well as the provincial agricultural colleges. The universities were also producing a growing number of professional foresters.

A key advance in Alberta forestry occurred in 1949 when Eric Huestis recruited eight graduating foresters from the University of British Columbia to the Alberta Forest Service. The group included James D. Clark, who joined NWPP in 1955 and later became the company's woodlands manager; Owen Bradwell, who joined the company in 1957 to take charge of road development and forest engineering; Charles Jackson, who helped Reg Loomis work out details of the Hinton agreement; and Robert G. Steele, later director of forestry and deputy minister of Lands and Forests.

Forest Research at Hinton

When operations began at Hinton, research into inventories and growth and yield was of course fundamental to the company's sustained-yield commitment, and got underway immediately. The next priority was to find the best ways to reforest harvest sites. Des Crossley's previous research established the basics of lodgepole pine regeneration, but there were continual refinements as his techniques were applied to a large and varied landscape. Spruce silviculture was more problematic, and this became a focus for years of research by company, government, and academic scientists. The evolution of silviculture at Hinton is discussed further in chapter nine.

Crossley brought not only his own scientific knowledge, but also two decades of contacts with scientists throughout government, industry, and academe across North America. He knew where to find talent and expertise as it was needed and how to share new knowledge. Crossley was particularly aware of a common frustration for forest scientists when, far too often, their research trials were not maintained and protected over the long term. "Nothing irritates these specialists more when working on long-range research than to find—suddenly find—that the field plots have been destroyed," he remarked.

As a result, he worked with the Canadian Forest Service (CFS) and the Alberta Forest Service (AFS) to facilitate research activities at Hinton. The CFS set up lab-oratory and service trailers in a camp on the road to Entrance, on land provided by the AFS. Research trial areas were carefully mapped, and scientists worked with company staff to make sure the sites were protected. The chance to conduct research in suitable facilities on a "working" forest, combined with the co-operative atmosphere and often the opportunity to see their findings applied directly in operations, attracted scores of scientists to Hinton over the years. This continues today. Altogether, approximately two hundred scientific studies have been conducted on the forest management area since 1956.

Crossley also encouraged company foresters to engage in what he called "sore-thumb" research to address problems they ran into during their work. "This provided some immediate results that would identify the problem and indicate how it might best be resolved," he said. "We could then turn it over to the appropriate agency to initiate [the research] properly and take it through to conclusion." Examples of this kind of research included reforestation methods, stand development, commercial thinning, spacing of young regenerated stands, and alternative harvest systems, among others.

The Gregg Burn, site of a 9,325-hectare forest fire in 1956, became a particular focus for research. Very dense stands of lodgepole pine, up to one million stems per hectare, sprang up on some burned-over sites. This overachievement by nature

Selected Scientific Studies at Hinton

- Bob Ackerman and Wayne Johnston, Canadian Forest Service (CFS), on lodgepole pine silviculture, growth, and yield (1960s, 1970s)
- Bob Swanson, CFS, on the effects of forest harvesting on watersheds and hydrology (1960s, 1970s)
- Andy Radvanyi, Canadian Wildlife Service, on ways to reduce the impact of mice eating seed from aerial seeding projects (1960s)
- Dave Kiil, CFS, on use of controlled burning to reduce deep duff that was insulating the soil after harvest and presenting difficulties in planting projects (1960s, 1970s)
- Stan Navratil, CFS, on mixed-wood management and silviculture (1980s)
- Dave McNabb, Alberta Research Council, on soil compaction and amelioration following harvesting (1990s)
- Peter Blenis, University of Alberta, on the impact of pathogens on forest regeneration (1990s)

In the 1960s, Des Crossley and his foresters tried a number of experiments to thin out the slow-growing "dog hair" pine originating from the 1956 burns.S

posed a challenge because without treatment the "dog hair" pine patches would grow as stunted as carrots in an overstocked patch.

Company foresters, CFS scientists, and others such as Professor William Corns from the University of Alberta studied many different methods to improve growth through density control in the Gregg Burn stands. The goal was a density of 2,500 stems per hectare on any stands with more than 4,900 stems per hectare. Techniques studied included hand-pulling excess trees, thinning with machetes, brush axes, and clearing saws, light burning, selective herbicide application, and applying fertilizers to accelerate stand development. These studies began in 1962 and continue today. The results showed that thinning was effective but expensive; fertilizing appears to be a more cost-effective way to accelerate development on some sites. Research on this option continues.

Adjacent regenerated sites from company harvests in the 1960s and from the earlier McCardell Burn of 1938 provided useful comparisons for the Gregg Burn trials. (Many of these sites can be observed from the Pine Management Interpretive Trail near the Gregg Cabin, about twenty kilometres south of Hinton.)

The fires of the late 1950s, and the presence of the new forest industry growing at Hinton, led to another key development in forestry research in the Hinton area. In 1960, the Alberta Forest Service relocated its training centre from Kananaskis to Hinton. The Forest Technology School (now Hinton Training Centre) became a leading facility for training forest technologists and fire management specialists, and its staff joined company foresters and other scientists for many research projects.

Collaborative Studies

The University of Alberta established a Department of Forest Science (now part of the Department of Renewable Resources) in 1970, and this became another source of research and collaboration. Crossley played a leading role in establishing the University of Alberta forestry program and was a frequent lecturer there. University of Alberta foresters were regular visitors to Hinton, and many of the program's graduates came to work for the company.

Co-operative research projects became a hallmark of forestry at Hinton. One such project in the 1980s involved the Alberta Forest Service, the Canadian Forest Service, the Forest Engineering Research Institute of Canada (FERIC), and a number of companies. In a mixed stand of mature aspen and spruce with an understorey of young spruce, the project used modified harvest techniques to cut the older trees while preserving the young trees to form a new stand. This experiment won the Canadian Forest Service Forestry Innovation Award in 1989. The company and the Foothills Model Forest established a similar trial in 1994.

In the 1990s, the Canadian Forest Service decided to scale back the forest growth and yield research program that had been conducted since the 1950s by the Northern Forestry Centre in Edmonton. Weldwood foresters did not want to lose this valuable source of basic knowledge. The federal agency accepted a company proposal to co-operate in continuing the program. Weldwood took over measurement and analysis of the research plots. Notable results would be published jointly with the Canadian Forest Service. In 2002, broader interest in these trials led to a wider partnership through the new Foothills Growth and Yield Association, a multicompany group that shares responsibility for ongoing measurement and analysis of these plots in partnership with the CFS.

In 1994, the Alberta government and industry established a new stumpage system, linked to the selling price of lumber. As prices rise, industry pays an additional contribution to the Forest Resources Improvement Program (FRIP). Through an administrative body called the Forest Resource Improvement Association of Alberta (FRIAA), FRIP supports forest improvement in areas not normally the responsibility of industry (e.g., recreation development). The program is also used to fund research into forest management issues and challenges. In the 1990s, the challenges of developing a new sustainable forest management plan led to a major expansion of research, using both company and FRIP funding (see figure 5.4). Among the projects undertaken at this time were research into the role of natural disturbance in forest stand origins and patterns, wildlife and fisheries studies, forest growth and yield in natural and regenerated stands, intensive forest management, and socio-economic aspects of forest management.

Weldwood's investment in research, combining company- and FRIP-sponsored funding, exceeded $1.5 million annually from 1995 to 1998 and rose to more than $2.5 million in 1999. "We are trying to find answers," said Don Laishley, the company's now-retired director of forest strategy, explaining the commitment.

A Strange Experiment

Perhaps the strangest research project at Hinton occurred in 1966 at the height of the Cold War. As part of the North American Treaty Alliance, Canada had troops stationed in Germany, and the Department of National Defence wanted to prepare them for field conditions in a "European-style managed forest" after a nuclear attack. The Army attempted to simulate these conditions by first thinning a block of trees and then exploding fifty tonnes of dynamite in a block within the lease area north of Hinton.

The two adjacent cutblocks had been logged in 1963, and the block selected for the test was the residual block that would normally have been scheduled for harvest about ten years later. Alastair Fraser of the British Forestry Commission had agreed to come to Hinton and mark the trees for thinning, but the Canadian Army decided not to wait and did its own thinning in the chosen block. When Fraser arrived, he observed that the result bore little resemblance to a European forest, but the explosives were already in place and the Army was determined to carry on with the test. Many Hinton residents turned out to witness the dramatic blast. The site was salvaged and scarified in 1967 and regenerated satisfactorily with no further treatment or planting.

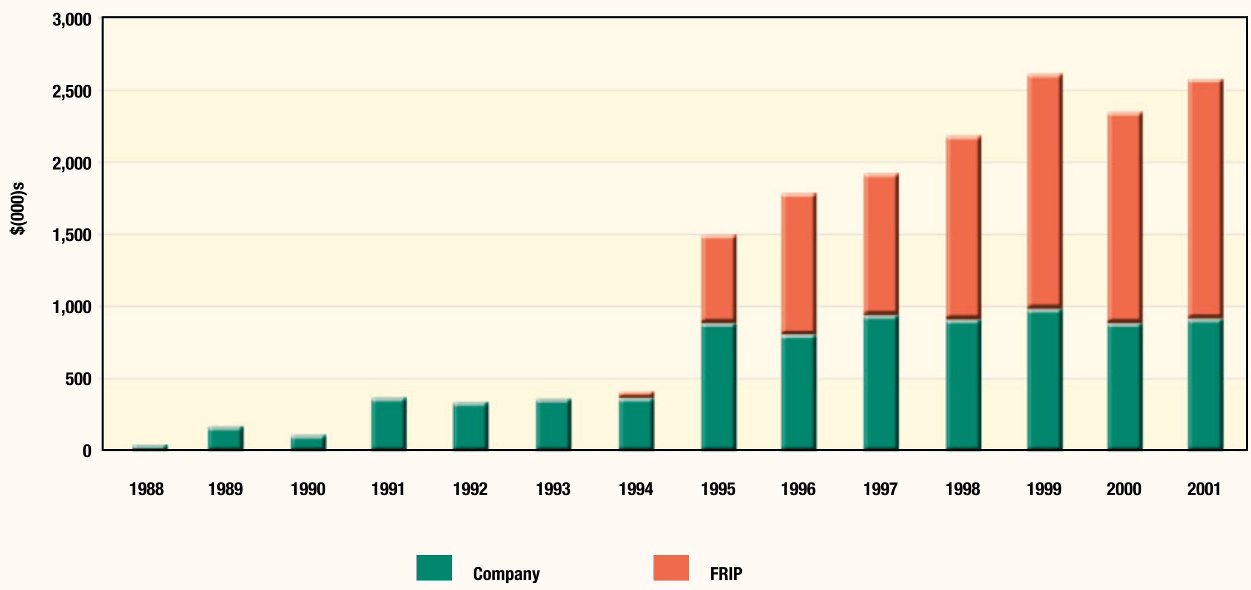


Figure 5.4. Weldwood and Forest Resources Improvement Program investment in research on the Hinton forest, 1988–2001ÿ

"If there is an issue, study it. Let's understand it better. How do we use that to adapt for the future better? Understand the past better and you can probably manage the future better."

At Weldwood's urging, senior CFS silvicultural scientist Stan Navratil took a year's leave of absence in 1996 to work on a major study of how enhanced forest management techniques could increase productivity on the Hinton forest management area. On the basis of his findings, Weldwood decided to proceed with such a program and hired Navratil to provide scientific guidance. Echoing the words of Des Crossley four decades earlier, Navratil said, "This is the high point of my career as a forester, to work with the Weldwood foresters and put all those years of forestry science and research into practice."

Understanding the Ecosystem

Biologist John Stelfox, a research scientist with Alberta Fish and Wildlife (1955–1966) and the Canadian Wildlife Service (1966–1986), established a series of research plots on some of the first spruce, pine, and mixed-wood cut-overs at Camps 1, 5, and 9 as operations commenced in 1956. His main purpose was to determine the effect of logging on ungulates, but his records also included careful documentation of the vegetation and non-ungulate wildlife on the sites. He returned to measure these plots six times in the next four decades, even after his retirement. The last measurement in 1995 was made with the assistance of his son Brad Stelfox, also a biologist. The study has provided fundamental insights into the long-term response of the forest ecosystem to management activities.

Stelfox's work shows, in detail, how plants respond after logging. He and other biologists have compared these ecosystem responses to the natural process of succession after forest fire. The results to date suggest that the responses are quite similar. Stelfox was the first to point out that retaining "structure" from the original stand benefits biodiversity conservation. Structure may include live and dead trees, individually or in clumps, as well as shrubs and immature understorey trees. It would be fair to say that John Stelfox planted the seed forty years ago for today's programs to retain structure in cutblocks.

Many other research efforts contributed to knowledge about how forest operations affect ecosystems. Bob Swanson of the Canadian Forest Service established early experiments to examine the impact of forest harvesting on watersheds. This research later inspired the Tri-Creeks Watershed study on the forest management area, a major initiative begun in the late 1960s and spanning almost thirty years, looking at the effects of forest management and public use on water yield and quality, as well as fish stocks. Ongoing studies by various government agencies—including Alberta Fish and Wildlife, Alberta Forest Service, Alberta Research Council, Canadian Wildlife Service, and Canadian Forest Service—provided additional information about fish and wildlife and their habitats, soils, erosion, and water flows on the forest management area. University scientists also contributed to this body of knowledge. During periodic reviews of operating ground rules, company and government officials incorporated the applicable results of this research into operations.

Foothills Model Forest

After 1992, research performed by Rick Bonar and scientists from the Foothills Model Forest also contributed significantly to knowledge about forestry ecosystems. Research focussed initially on individual species of wildlife and their habitats—a narrow scale approach to research. Although about three hundred vertebrate species are found in the forest management area, they can be divided into about sixteen terrestrial groupings and one aquatic grouping, each dependent on a particular habitat. With the support of the company and Foothills Model Forest, Bonar himself did a Ph.D. research project on the pileated woodpecker.

More than sixty wildlife studies have been conducted in the Foothills Model Forest. Research to date suggests that maintaining the range of habitats should also maintain the range of species. Sensitive or at-risk species such as woodland caribou and grizzly bears are monitored as indicators of ecosystem health.

"The data indicate that grizzly bears continue to use areas that are becoming increasingly industrialized," observed biologist Gord Stenhouse in 2002, after the third year of a five-year study monitoring grizzly bears in the Foothills Model Forest area. Population densities appeared to be similar to those found in a study twenty-two years earlier. "The presence of grizzly bears is considered to be a sign of a healthy ecosystem. The assumption is that grizzly bears require a large,

Table 5.3. Program areas of the Foothills Model Forest Program, 2001

Development of GIS (Geographic Information System) tools for research and management

Biodiversity and conservation:
- biodiversity monitoring
- fish and aquatics research
- woodland caribou
- grizzly bear
- harlequin ducks
- the Bridgland survey: changing landscapes of Jasper National Park through photographs

Communication and knowledge transfer:
- Forest history project and case studies

Forest practices, products, and planning development:
- Natural Disturbance Program
- Foothills Growth and Yield Association
- criteria and indicators of sustainable forest management
- the ecological classification of juvenile stands (and their development over time)
- Canadian Wildland Fire Growth Model
- climate change impacts on forest productivity
- other impacts of climate change

Land use and traditional ecological knowledge:
- traditional cultural study of Foothills Model Forest

Socio-economic research:
- community sustainability and sense of place
- understanding public participation in sustainable forest management
- economic impacts of resource sectors on the regional economy
- quantitative measures of local and provincial attitudes and users
- the value of wilderness/wilderness-use preferences

undisturbed area to survive. They take a long time to mature sexually, and they produce relatively few cubs in their lifetime. So they are believed to be vulnerable to stress and presumably to changes in the ecosystem."

Another focus of company and Foothills Model Forest research is understanding the historical patterns of natural disturbance—fire, wind, erosion, disease, insects, and so on—that created the forest landscape and its ecosystems. This type of research, termed a "coarse filter" approach, holds that managing to provide the range of forest ecosystem diversity conditions that existed in the past should provide the conditions necessary to conserve biodiversity and ecosystem function today and into the future. Other species-specific research, such as the grizzly bear program or Bonar's pileated woodpecker study, is called "fine filter" research, because it does not rely on the broad assumptions inherent in "coarse filter" research but looks at direct linkages between individual species or species groups and the habitat on which they depend. Both approaches are considered important in sustainable forest management and the research that supports it.

Scientists have studied tree rings, fire scars, lake sediments, and other evidence to determine the long-term history of the forests. The research confirms that fire has long been the dominant natural disturbance in the forests around Hinton, although the nature and frequency of local impacts vary widely. Some locations might burn every few decades, others only once in several centuries, and a few sheltered spots seem to escape fires entirely. However, the historical research shows a wide range of variability—for example, the proportion of "old growth" spruce (more than 180 years old) in recent centuries ranged between 2 per cent and 23 per cent on the model forest area.

Foothills Model Forest research today covers everything from songbirds to global climate change. While research continues on the elements of sustainable forest management, Rick Bonar notes two important points: "There are still significant stands of 'old growth' timber similar to those that would have existed before settlement, and some of these will continue to be retained. And, so far as we know, we still have all the species that we started with when operations began. Our challenge is to pass them on to future generations."

People in the Forest

In the early 1990s, as the new concept of sustainable forest management emerged, it soon became evident that the goal of maintaining species, habitats, and ecosystems could not be pursued in isolation. Economic, social, and cultural values must also be incorporated into the vision of sustainability. This led to more research into the impacts, needs, and values of forest users.

For the company, a key priority was determining the effects that other users and uses—particularly oil and gas development, coal mining, transportation corridors, and recreation—were having on the commercially productive forest. In ad-dition, the other uses had a considerable impact on the company's ability to implement sustainable forest management. Assessing these effects, and finding ways to reduce them, became a major focus of research in preparation for the 1999 Forest Management Plan and for the company's sustainable forest management certification in 2000.

Research by the Foothills Model Forest, particularly through the social sciences group of the Canadian Forest Service, provided crucial underpinnings for the new thrust. One study involved the development of local indicators for sustainable forest management. Other major studies included analyses of camping and big game hunting, a review of public participation mechanisms, a study of local perceptions of sustainable forestry, and a socio-demographic study of community sustainability. Although the research is continuing, one important conclusion is that consultation, co-operation, and public education will continue to be vital parts of sustainable forest management.

◀ ▶ CONTENTS INDEX

Based on recreation research at the Foothills Model Forest, for example, it is clear that random camping serves a need that cannot be met by organized campsites (e.g., solitude, opportunity for group camping, all-terrain vehicle use) but also provides challenges to management that must be addressed (human waste, garbage, risk of fire). As well, people show a profound lack of understanding about forestry management practices as they travel through or camp in the managed forest. For industry, this lack of understanding indicates the need for much greater communication efforts.

Applying Knowledge

There are few million-hectare forest areas anywhere that have been studied as intensively as Hinton has for nearly half a century. Practitioners and scientists both recognized the value of research on a commercially managed forest where findings could be put to use as soon as their value was demonstrated. The essence of forest management is the systematic application of knowledge to obtain a desired future result. The next chapter describes how foresters developed plans and ground rules to govern their "intentional interventions" in the ecosystems around Hinton.

CHAPTER SIX

Planning

YEARS, DECADES, AND CENTURIES

I said, "You've got to assure me that you are going to carry out meaningful forest management." Pete Hart looked at me and said, "Why shouldn't we?" I said, "Well, nobody else in Canada does."

—Des Crossley, 1984

South of Hinton, a collage of mature forests and reforested areas of various ages are arrayed against the backdrop of the Rocky Mountains.
Stan Navratil

Pete Hart, northern and Pacific woodlands manager for St. Regis Paper Company, assured Crossley before he was hired in 1955 that the company fully intended to live up to its commitments to the Alberta government, including the promise to design operations for "perpetual" sustained yield. Translating these commitments into action required an enormous amount of planning, which began at once and continues today. The task became more complex as knowledge about the forest

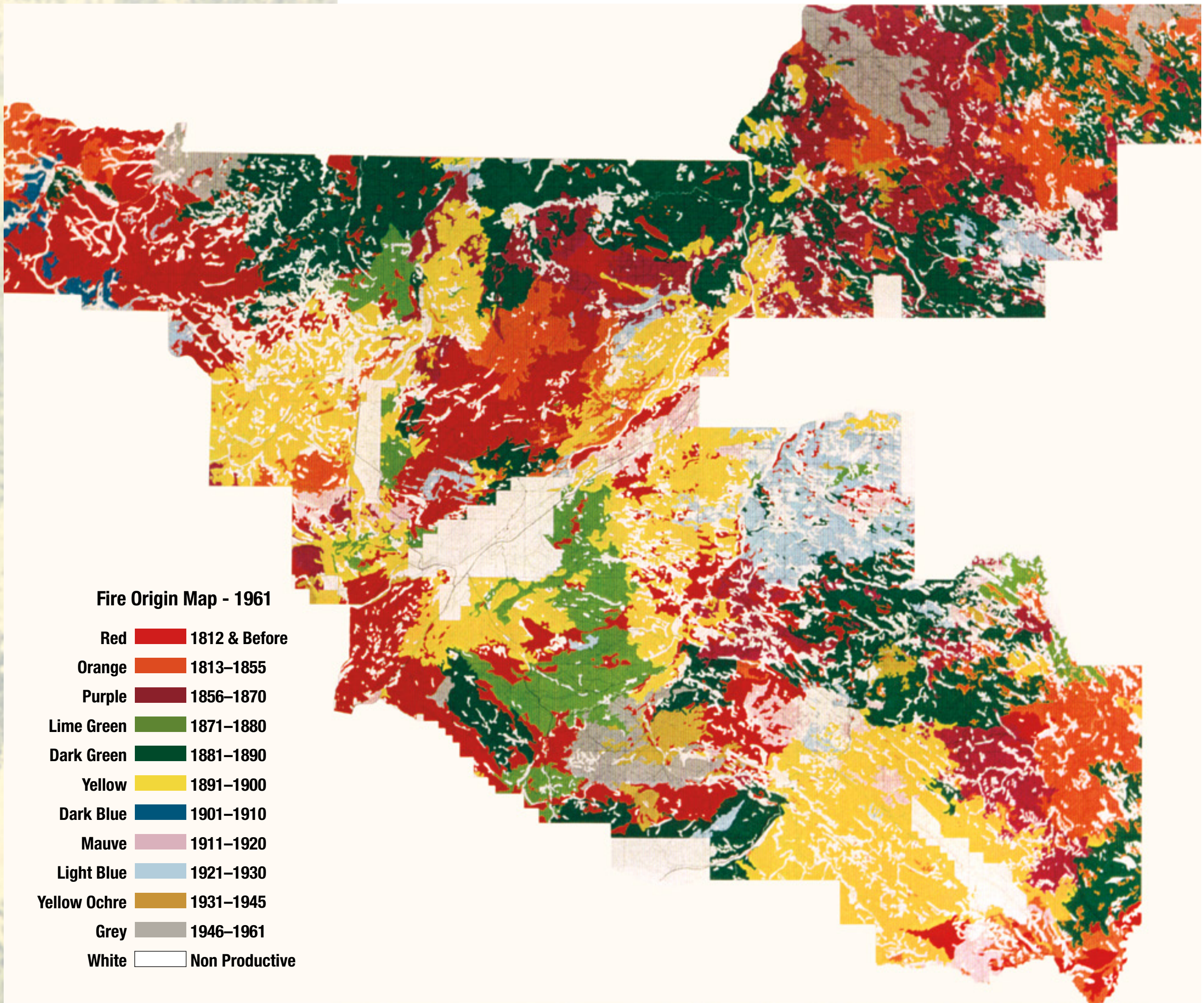


Figure 6.1. 1961 fire origin map, showing the dates at which forest stands originated following fire

increased and the goals of management expanded. But it was never simple, even in the beginning.

The 1954 lease agreement required the company to prepare a "general working plan for the first rotation," then estimated to be about one hundred years. This evolved into the requirement for a detailed forest management plan, extending two rotations into the future, which would then be renewed at least once every ten years. However, many of the key planning decisions had to be made immediately. The first roads and camps were built in 1956, and the first harvest got underway. These developments had to fit into some overall scheme for managing the forest.

At that time, it was still common for forest companies to begin cutting all the commercial timber (typically everything over a given diameter limit) closest to the mill and work outwards in concentric circles. If the operation endured long enough, a new crop would theoretically be maturing in the inner circles as the most distant parts of the lease area were harvested. This seldom worked in practice, and it made poor use of the forest's regenerative capacity because many young and vigorous stands were harvested early while many mature or overmature stands were left to stagnate for decades. Furthermore, the ever-increasing distance of the operations from the mill sites meant ever-increasing costs and declining competitiveness, often leading to closures.

The St. Regis team and Crossley, soon joined by other Canadian foresters such as Jim Clark and Jack Wright, recognized that a "nearest-first" approach would not meet their sustained-yield management objectives, nor would it support sustained cost-competitiveness. Instead, they adopted the approach originated in Europe by Johann Judeich (1828–1894) based on the age and composition of stands within the forest. Judeich's "stand projection" method, the first to apply biological principles to forest management, was well suited to the predominantly even-aged, fire-origin forest stands around Hinton.

The mature timber in 1955 was in those stands, scattered across the lease area, which had survived fires of the 1880s. If these stands were harvested first, the foresters reasoned, then stands generated by the great fires of the 1880s would have time to mature. Then attention could turn to stands resulting from more recent fires. As those were harvested, new forests would be growing on the earlier harvest sites. At the same time, the average distance from annual operations to the mill site would be maintained over time, an objective supported by the distribution of age classes across the lease area.

Spreading the harvests out over one entire rotation would make optimum use of the forest's growing capacity and ensure sustained yield over the long term. "Oldest first" would be the rule.

Crossley said the first priority in 1955 and 1956 was to locate and map the oldest forest stands on the lease area: "The reason for this immediate age-classing program was to establish the location of the overmature and the decadent timber. It was our considered opinion that it was vital to harvest these as rapidly as possible in order to avoid the possibility of future insect infestations and disease epidemics, and to get such static areas back into wood production again."

The long-term goal was a future productive forest "normalized" to contain approximately equal ten-year age classes from seedlings to maturity. This vision formed the basis for planning at Hinton until the 1988 Forest Management Agreement and the resulting 1991 Forest Management Plan. In fact, the goal continues to be a maximization of timber production, while sustaining the biological productivity of the forest landscape. The concept of management has merely been broadened to include all species and ecosystems, not just trees and forests.

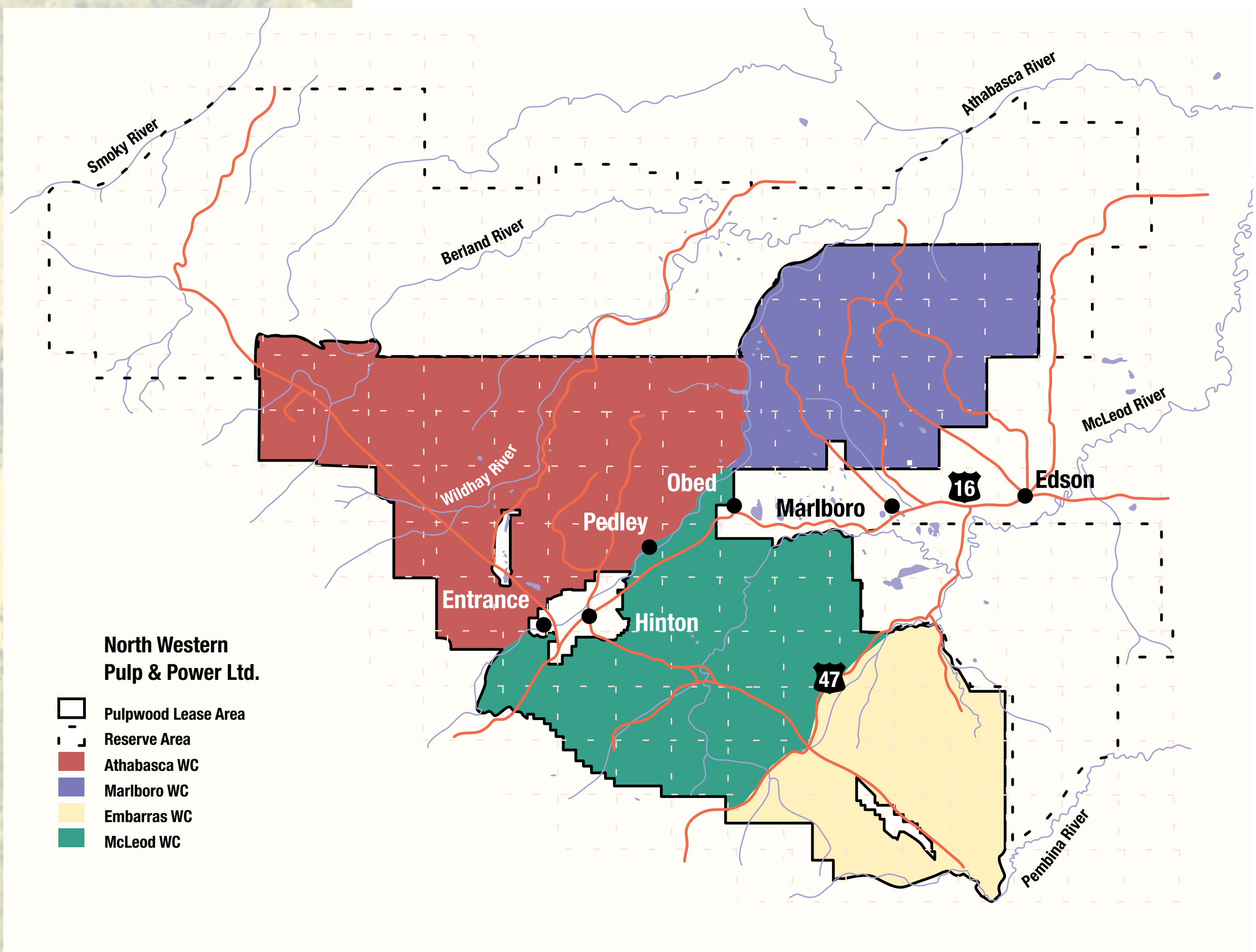
As the need for more complex planning processes increased over the years, so did knowledge and technology. The sophistication of today's plans and planning processes would amaze earlier practitioners.

Crucial First Decisions

Based on preliminary inventories and the "oldest-first" stand-based approach to management, company planners made a series of key decisions in 1955 and 1956 that set the stage for future development. First, they delineated the lease area according to the general priorities for management and operations:

1. The lease area was divided into four (later five) "working circles" (a term adopted from the national forest system in the USA) that would each be regarded as a separate sustained-yield management unit. These land management units were not circular.

Figure 6.2. NWPP lease area, divided into four working circles for management planning, 1960



2. The working circles were then divided into a total of 65 (later 120) roughly equal operating compartments based on topography, age class, and volume, each containing about 1.2 million cubic metres of wood, which would be sufficient to supply a fifty-worker camp for twenty years.
3. The operating compartments were then assigned to one of five (later four)

"cutting cycles," each representing a twenty-year block of time in which the compartment would be harvested, i.e., 1956–1975, 1976–1995, and so on.

Second, they chose a two-pass system for harvest. This meant that roughly half of the timber in an operating compartment would be harvested, in blocks of about twenty-five to thirty hectares, during the first ten years of a cutting cycle—the "first pass." After the first cutblocks were harvested and reforested, the remaining blocks would be cut in a "second pass" during the following ten years.

Third, as a condition of accepting the chief forester's position, Crossley convinced company executives that a fixed percentage of the total annual wood supply budget should be allocated to forest management spending such as inventories, growth and yield studies, planning, and silviculture. (For many years, the figure was 10 per cent of the mill's total wood supply costs, and Crossley husbanded these funds scrupulously.) At the time, forest companies generally treated forest management as a capital cost, which meant it was often deferred during lean times. By considering forestry as an operating expense from day one, rather than capitalizing it, the company made a concrete commitment to ongoing forest renewal.

These decisions added to start-up costs, compared to typical operations of the day, but they paid long-term dividends. One result of the management scheme, for example, was that the average haul distance from harvest sites to the mill remained almost constant at about sixty-five kilometres throughout the next forty-five years, even after the 1988 expansion of the forest management area. Another result was that the company was able to keep its promise to the government, not only to maintain the productivity of the forest, but to increase it.

Planning and Review Processes

The 1954 lease agreement specified two kinds of plans—annual operating plans and forest management plans—that the company was required to prepare and submit to the provincial government for approval. These continue to be the key planning documents, but they are now linked together with other types of plans and reports.

The annual operating plan describes harvesting, road construction, and reforestation plans for a given year. The forest management plan, updated at least once every ten years, establishes the annual allowable cut and elaborates the management strategies and methods to be employed on the forest management area. It includes inventories of resources and describes how they are expected to evolve over the long term. It details how the goals of the plan will be achieved. The planning horizon extends for two rotations—about 180 years into the future. The lease agreement itself was renewable at twenty-year intervals, which would create yet another opportunity to review long-term goals and responsibilities.

In addition, the 1954 agreement required discussions between the company and the Alberta Forest Service on "a plan of forestation of denuded and untimbered lands." However, there was little guidance about how actual harvest and silviculture operations would be carried out. Des Crossley, Reg Loomis, and their staffs had to work these matters out on their own. Out of their negotiations arose a unique set of operating ground rules. The ground rules provide guidelines for a wide range of field practices, from cutting systems to hazard control, and they proved to be a crucial component of forest management at Hinton and eventually across Alberta.

The planning and review processes at the Hinton operation involved many aspects of forestry—timber supply, forest renewal, operational methods, and resource use—over various time frames. They all had to be complementary and compatible, fitting within the same overall framework, and they often had to be developed in parallel. Until recently, however, operations did not have to be planned and implemented exactly in sync with the forest management plans because the harvest was well below the calculated annual allowable cut and variances were easy to accommodate in the periodic revisions. Now, such departures from forest management plan assumptions can no longer be so easily accommodated. But from day one, if the company did not comply with the ground rules there were immediate consequences, which could range from a verbal or written reprimand to harvest plan rejections or penalties.

After 1988, when the company was using the full annual allowable cut and obtaining wood from outside the forest management area, it became critical to ensure that assumptions contained within the management plan and the annual allowable cut would be fully consistent with operations and annual plans. Disconnects could have serious consequences in the sustainability of the annual allowable cut. For example, the sequencing of harvests in the plan is partly based on harvesting older, slower-growing age classes in preference to younger ones. The plan assumes that they are harvested and replaced with fast-growing reforested stands. All stands growing on the net forest area are considered in the annual allowable cut calculation. If, however, operational planning began bypassing older stands and focussed on faster-growing younger ones, it would leave a portion of the land base in a slower-growing condition than that assumed by the forest management plan and reduce the average growth per hectare across the entire land base. The annual allowable cut, based on the original sequencing assumption, would therefore be overstated.

The requirements of sustainable forest management—conserving species and habitats, integrating multiple uses and values, consulting with the public—require a continuous consistency between plans and operations. As a result, Weldwood and the provincial forest service developed a "linked planning process" in the early 1990s to provide continuity and ongoing checks and balances between planning and execution.

Types of Plans and Approvals

Based on the Forest Management Plan, the company now produces a development plan and compartment operating plans, which in turn form the basis for annual operating plans. All these plans are linked together in a continuous feedback loop (see figure 6.3).

The development plan is updated annually and is a ten-year projection of the proposed compartments to be harvested and the main road development plans required to meet assumptions of the Forest Management Plan. At Hinton, the development plan also shows how the constant average-haul distance will be maintained.

Compartment operating plans are prepared and approved in two stages—a preliminary plan and a final layout report—and are reviewed every three years.

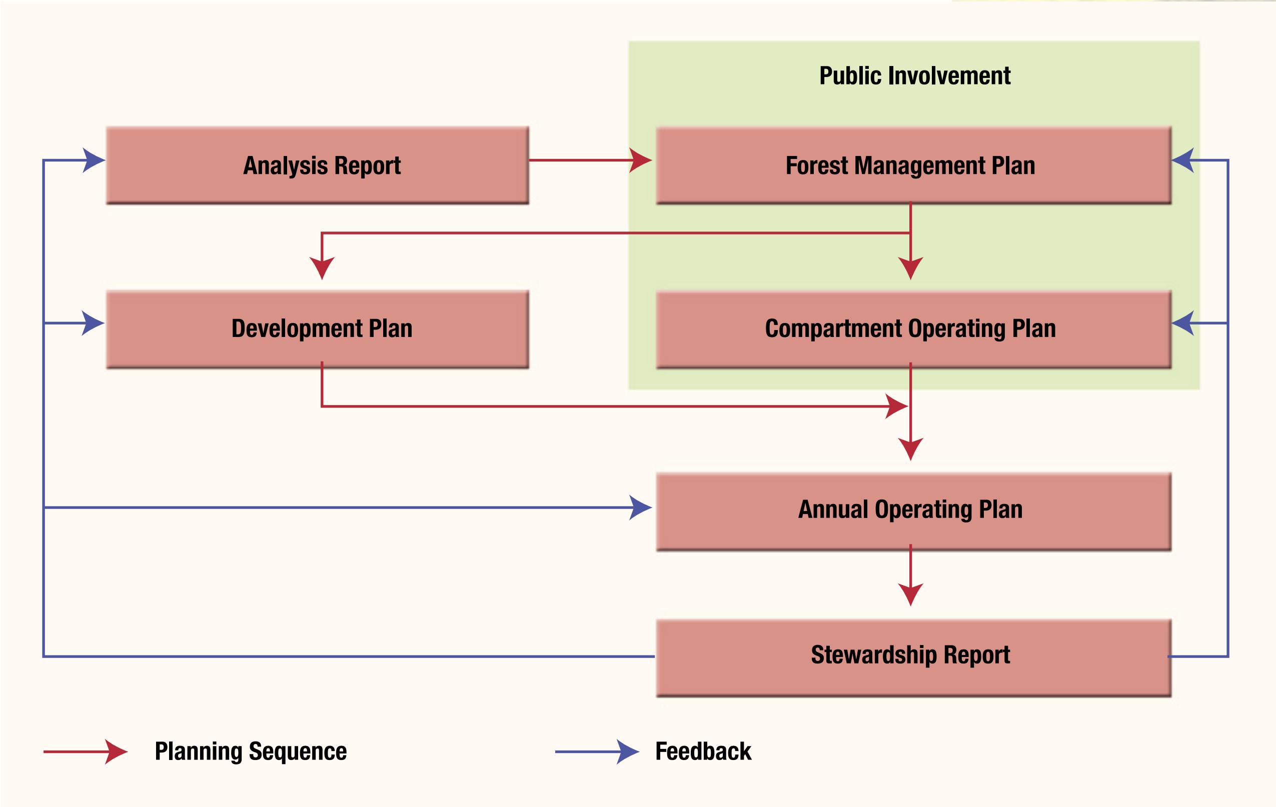


Figure 6.3 The linked planning process at Hinton

They provide the details of harvest operations, road locations, reforestation, wildlife, watersheds, aesthetics, and other resource values for the compartments where harvests are scheduled.

An annual stewardship report describes how the objectives stated at all levels of planning are being achieved. It consolidates the annual and cumulative results of performance monitoring. This forms the basis for both changes in practices and revisions of the affected plans.

During preparation of a forest management plan, an analysis report is prepared to document the inventories and methodologies underlying the plan's assumptions.

The Forest Resources Advisory Group provides ongoing public input into the planning process. Additional public consultation occurs through open house events, personal contacts, and a toll-free telephone line. Organized public involvement is sought at the forest management plan and compartment operating plan stages.

Implicit in planning for the Hinton forest since the 1950, the linked planning process is now an explicit structure for implementing adaptive forest management.

Plans are submitted in varying levels of detail. They also require review and approval at different levels of the provincial government as illustrated in figure 6.4. This presents a challenge to both company and government foresters who must ensure that communication, awareness, and support for the plans take place at all levels within each organization.

Operating Ground Rules

Rules and regulations are for the guidance of the wise, but for strict adherence only by fools.

—Reginald D. Loomis, slogan pinned on his office wall, circa 1955

Although the 1954 lease document described the company's responsibilities and laid a philosophical framework for forest management, it quickly became evident that many details still needed to be discussed. The Forests Act bound the company's actions, but most of its rules had to do with the administration of timber for the sawmill industry. There were no rules that were sufficiently specific, and yet flexible enough, to meet the spirit of the pulpwood lease agreement, especially with respect to forest regeneration.

Some rules were certainly needed. Government and company foresters, led by Reg Loomis and Des Crossley, disagreed on many key issues such as harvest methods and the need for riparian corridors, yet they were professional enough to acknowledge there might be merit in the other side's position. They found a means to deal with these disputes through mutually agreed-upon operating ground rules. These were consensus-driven understandings under which it would be possible to apply professional judgment about what was actually done on the ground. The ground rules evolved over several years of discussion.

The first formal ground rules were dated 11 March 1958, under the title "Guiding Principles and Ground Rules for Cutting Practices on the Pulpwood Lease Area." The document was only three pages long. A more formally presented

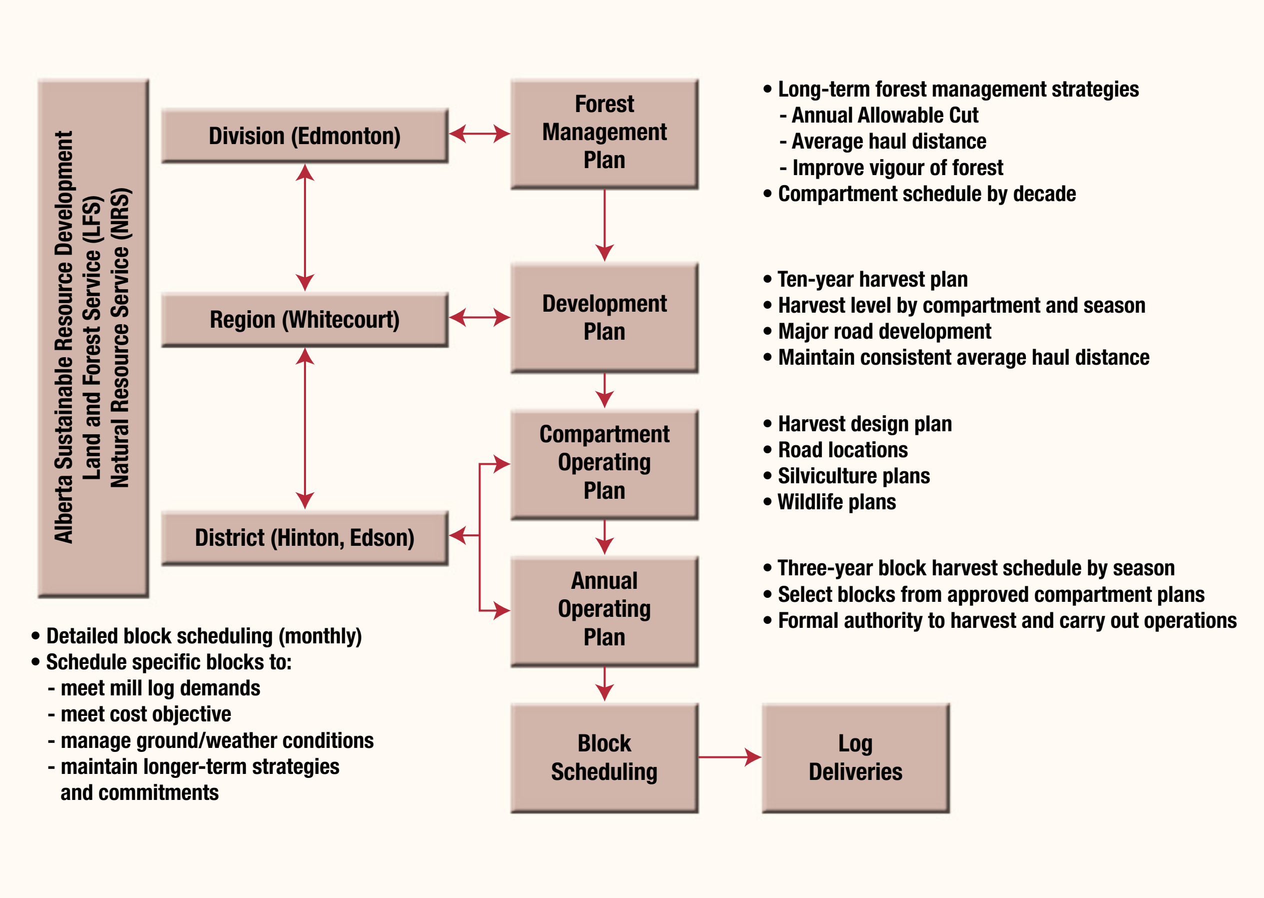


Figure 6.4 The forest management planning process in 2000

philosophy and approach were outlined in the opening paragraphs of a revised version dated August 1958. It clearly described an adaptive approach to forest management:

> *The following initial guiding principles for cutting practices are hereby established to aid in the achievement of planned perpetual yield.*
>
> *The initial cutting system and variations thereof shall be on a trial basis. As many modifications of such cutting systems shall be adopted as possible in order, by experiment, to arrive at a system or systems best adapted to the silvicultural requirements of the species in question, the topography and the operational requirements inherent in economical timber extraction.*

It would take almost four decades for such a process of continuous hypothesis testing and adaptation to become conventional wisdom in the Canadian forest industry.

The original ground rules were presented under seven headings: cutting systems, fringe timber (buffers), roadside cleanup, slope accessibility, field modifications, hazard control (scarification to reduce fire risk), and the approval process for the annual operating plan. In 1967, new paragraphs were added to cover erosion control in road construction and stream crossings, including streambed protection.

These ground rules became an integral part of the subsequent forest management agreements. Before any forest management plan could be approved, the 1968 Forest Management Agreement stipulated that "the parties hereto must formulate by mutual agreement a set of ground rules." The Hinton ground rules became the model for subsequent forest management agreements in Alberta. Government and industry later developed ground rules for volume-based quota harvests and eventually for all other logging operations on Crown land in the province.

Well-designed and properly installed culverts are important to ensure unobstructed passage of water and fish.

Company and contract graders maintain all-weather roads in the forest management area.

The Hinton ground rules negotiated in 1973, 1980, 1986, 1988, and 1996 contained increasing amounts of detail. The document trebled in size from six pages in 1968 to twenty-one pages in 1973, forty-four pages in 1988, and one hundred and nine in 1996. The subjects expanded to include additional stream protection, road construction standards, minimum levels of productivity on timberlands, minimum diameters and lengths to be utilized, and the order of priority for cutting stands of timber.

Key to the success of these ground rules is that they are the result of negotiation between government and industry. (Since 1974, the Alberta government has been able to impose rule changes unilaterally only by a formal cabinet edict—an order of the Lieutenant Governor in Council.)

In 1988, the ground rules were extended to cover most aspects of forest management practice, including wildlife management and integrated resource management. The government's Eastern Slopes Policy was identified as a guiding document. The rules introduced and defined a wildlife management process, including the zoning of the forest management area, and established the role of the joint company/government Integrated Resource Management Steering Committee.

A remarkable step forward then occurred in development of the 1996 Hinton ground rules. The company's Forest Resources Advisory Group was actively involved in the process, and the document reflects their input as well as Weldwood's commitment to sustainable forest management. It includes a complete set of community, economic, and environmental goals, and then elaborates on the intent of the goals, standards, and practices to achieve those goals. Written in plain English (including an eighteen-page glossary), the pocket-sized booklet also describes the linked planning process and the rules for public consultation. The government and the company have agreed to maintain the rule book as a "living document"—a joint committee oversees changes on an ongoing basis.

The system of negotiated ground rules developed in Alberta, initially at Hinton, became one of the key distinctions between this province's approach and the more rigid regulatory framework and rules-based practice adopted for forest management in British Columbia. Bernhard Fernow's observations about the strangulation of creativity by rigid governance are as relevant today as they were in the nineteenth century.

Watersheds and Fisheries

Both Reg Loomis and Des Crossley, the lead foresters for government and company in early forest management planning at Hinton, were concerned about watershed protection. This reflected their own experience as well as historic concerns about the role of the east slopes of the Rockies in prairie water supply. A key factor in their ground rules negotiations, and in subsequent forest management planning, was the treatment of watersheds and streamside (riparian) areas. From the beginning, the layout and approval of cutblock designs reflected watershed concerns.

Fortunately, the scarification used to prepare sites for regeneration also controlled surface water runoff, the biggest potential cause of erosion. As Crossley noted in 1984:

> *Close observation of our cut-overs during the initial years revealed no serious erosion anywhere on the lease. This can be credited to the rough and untidy nature of the surface debris. As the melt progresses and water starts moving down the slope, it is continually encountering soil ridges, upturned stumps and broken chunks of slash. During each interruption it drops its silt load. This leaves little pans of silt of varying sizes and depths that result in excellent micro-sites for the establishment of subsequent regeneration.*

Roads through the cutting areas, however, could seriously affect erosion and stream siltation. This was a source of friction between the company and the Alberta Forest Service for a time, but was subsequently addressed by ripping up inactive roads and roughening them so they were impassable to normal vehicle traffic.

Loomis also insisted that buffer zones of uncut forest should be left along every permanent watercourse. Crossley initially disagreed, arguing it would reduce the annual allowable cut for no good reason. "The fishing fraternity think that overhanging trees provide the shade that is necessary to keep the water cool for good fish habitat," Crossley said later. "This is probably true in most of our country but our streams were generally of glacial origin and at this elevation in the foothills of the Rockies the waters are too cold to result in the best habitat." Fish never grow to much size in such mountain streams. In fact, Crossley argued, the habitat could be improved by allowing more sun to reach the stream's surface. He asserted that trees in the buffer zones, if not harvested, "are going to blow down eventu-

When operations began in 1956, a 1.6-kilometre buffer zone was established along the east side of Brule Lake in an effort to stabilize and contain drifting sands that resulted from strong west winds over the often-dry lake bed.

ally, many falling into and across the stream and destroying the fishing potential. Nevertheless our concerns were not accepted."

Biologists later found that forested riparian areas have an additional value because they maintain species biodiversity by providing thermal cover and food sources for overwintering animals, as well as key habitat for many species of birds. Some downed woody debris in streams is now seen as desirable for fish habitat. However, recent research on natural disturbance patterns indicates that riparian ecosystems would benefit from some management intervention, including harvests, so in a sense Crossley's views have come back into vogue.

Because of such water-related concerns, Crossley encouraged the Canadian Forest Service to conduct watershed and hydrology studies on the forest management area. Beginning in the 1960s, the Tri-Creeks experimental area expanded this work to include the examination of fisheries. Watercourses and fisheries were studied in much greater detail after the establishment of the Foothills Model Forest.

Until the 1990s, the operating ground rules set aside arbitrary buffer zones, the width dependent on the size of the stream. Everything else would normally be cut. But the actual streamside ecosystems or "riparian zones"—generally the flats on both sides of the stream influenced by periodic flooding—usually exceeded the width of the mandated buffers, and there were subsequent challenges with reforestation. A company experiment in the early 1990s treated the whole riparian area (buffer and non-buffer) as a "special management area" in which some timber harvesting took place but wildlife habitat was the primary object of management.

Weldwood, as part of its biodiversity conservation program and the 1999 Forest Management Plan, inventoried and mapped the riparian zones along all permanent watercourses on the forest management area. These were identified as special management areas in the plan, which meant that management objectives in the areas would place priority on other values above timber production. Besides buffers already removed, an additional 45,000 hectares such as water source areas were removed from the commercially managed land base because of their sensitivity to disturbance. However, some harvests could eventually occur in these areas as a result of the new research on natural disturbance patterns.

The 1999 Forest Management Plan also included an explicit examination of the impact of planned forestry activities on hydrological resources, the first time such an examination was deemed possible. This built on earlier watershed work as well as that begun by the Foothills Model Forest, and it was expanded for the Forest Management Plan by consultants at Golder Associates.

Ecosystem Integrity

Health is the capacity of the land for self-renewal. Conservation is our effort to understand and preserve this capacity.

—ALDO LEOPOLD, 1949

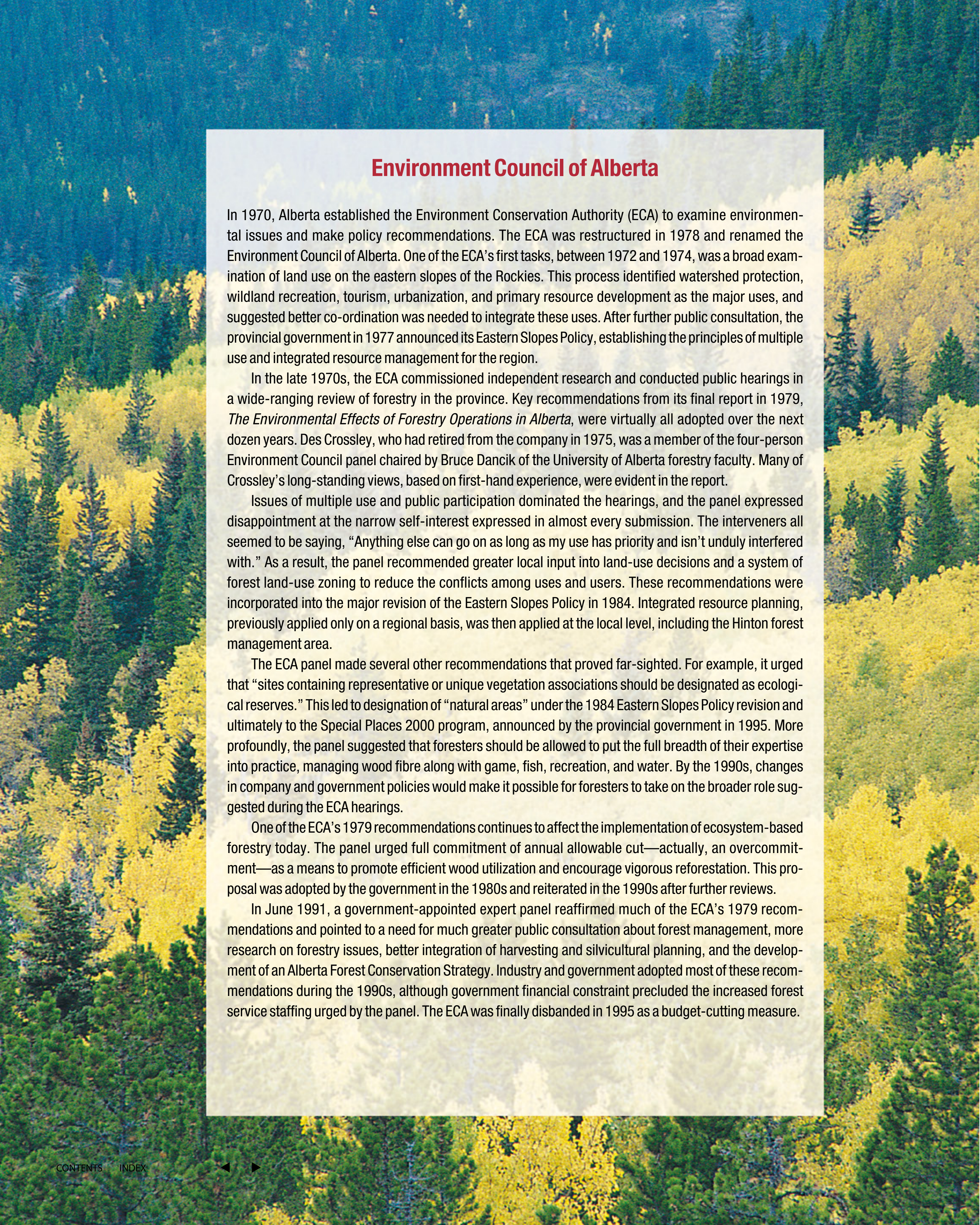
Modern environmentalism, considering the whole Earth as a "habitat" for all species including humans, emerged over several decades. Initially, environmentalists tended to focus on specific issues such as air and water pollution, pesticide use, waste management, protection of wild lands, and endangered species. These concerns led to legislation such as Alberta's Clean Air and Clean Water Acts in 1971 and the Land Conservation Act in 1973, as well as wider application of federal laws protecting fisheries and migratory birds.

Over the years, the definition of environment has widened. In 1987, the World Commission on Environment and Development (the Brundtland Commission) popularized the idea of "sustainable development" in its landmark report, *Our Common Future.* This is development "that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainable development became the central theme of the second Earth Summit in Rio de Janeiro in 1992. The outcome directly affecting forestry was the international treaty to protect biological diversity. New legislation passed by the federal government in 1988 and the Alberta government in 1993 also embraced this more holistic view of the environment, including impact assessment for most new developments.

To put these visions into effect, in 1992 the Canadian Council of Forest Ministers developed a National Forest Strategy and an important framework document, *Defining Sustainable Forest Management: A Canadian Approach to Criteria and Indicators,* in 1995. Based on these criteria and the International Standards Organization's ISO 14001 standard for environmental management systems, the

◀ ▶ CONTENTS INDEX



Environment Council of Alberta

In 1970, Alberta established the Environment Conservation Authority (ECA) to examine environmental issues and make policy recommendations. The ECA was restructured in 1978 and renamed the Environment Council of Alberta. One of the ECA's first tasks, between 1972 and 1974, was a broad examination of land use on the eastern slopes of the Rockies. This process identified watershed protection, wildland recreation, tourism, urbanization, and primary resource development as the major uses, and suggested better co-ordination was needed to integrate these uses. After further public consultation, the provincial government in 1977 announced its Eastern Slopes Policy, establishing the principles of multiple use and integrated resource management for the region.

In the late 1970s, the ECA commissioned independent research and conducted public hearings in a wide-ranging review of forestry in the province. Key recommendations from its final report in 1979, *The Environmental Effects of Forestry Operations in Alberta*, were virtually all adopted over the next dozen years. Des Crossley, who had retired from the company in 1975, was a member of the four-person Environment Council panel chaired by Bruce Dancik of the University of Alberta forestry faculty. Many of Crossley's long-standing views, based on first-hand experience, were evident in the report.

Issues of multiple use and public participation dominated the hearings, and the panel expressed disappointment at the narrow self-interest expressed in almost every submission. The interveners all seemed to be saying, "Anything else can go on as long as my use has priority and isn't unduly interfered with." As a result, the panel recommended greater local input into land-use decisions and a system of forest land-use zoning to reduce the conflicts among uses and users. These recommendations were incorporated into the major revision of the Eastern Slopes Policy in 1984. Integrated resource planning, previously applied only on a regional basis, was then applied at the local level, including the Hinton forest management area.

The ECA panel made several other recommendations that proved far-sighted. For example, it urged that "sites containing representative or unique vegetation associations should be designated as ecological reserves." This led to designation of "natural areas" under the 1984 Eastern Slopes Policy revision and ultimately to the Special Places 2000 program, announced by the provincial government in 1995. More profoundly, the panel suggested that foresters should be allowed to put the full breadth of their expertise into practice, managing wood fibre along with game, fish, recreation, and water. By the 1990s, changes in company and government policies would make it possible for foresters to take on the broader role suggested during the ECA hearings.

One of the ECA's 1979 recommendations continues to affect the implementation of ecosystem-based forestry today. The panel urged full commitment of annual allowable cut—actually, an overcommitment—as a means to promote efficient wood utilization and encourage vigorous reforestation. This proposal was adopted by the government in the 1980s and reiterated in the 1990s after further reviews.

In June 1991, a government-appointed expert panel reaffirmed much of the ECA's 1979 recommendations and pointed to a need for much greater public consultation about forest management, more research on forestry issues, better integration of harvesting and silvicultural planning, and the development of an Alberta Forest Conservation Strategy. Industry and government adopted most of these recommendations during the 1990s, although government financial constraint precluded the increased forest service staffing urged by the panel. The ECA was finally disbanded in 1995 as a budget-cutting measure.

Canadian Standards Association (CSA) developed a system for certifying operations that practise sustainable forest management. ISO 14001 describes the management system, while the CSA standard incorporates specific performance criteria. The Canadian standard is described in the 1996 publication *A Sustainable Forest Management System,* the *Guidance Document* (CAN/CSA Z808 96) and the *Specification Document* (CAN/CSA Z809 96).

The Alberta Forest Products Association embraced sustainable development in its FOREST*CARE* Codes of Practice in the early 1990s, and the Alberta government later produced two visionary documents, the *Alberta Forest Conservation Strategy* (1997) and *Alberta Forest Legacy* (1998).

The direct result across Alberta of these shifts in thinking about the environment was that operating ground rules became more comprehensive and demanding. Meanwhile, government downsizing thrust more of the planning and implementation—as well as the costs—onto the shoulders of corporate foresters and the forest industry.

The Hinton Forest Management Plans

Each of the six management plans at Hinton reflected the goals and objectives of its era, the uses to which the forest was put, and the state of knowledge about the landscape. They were also shaped by the foresters who wrote them—Jack Wright, the 1961 and 1966 plans; Bob Udell, 1977 and 1986; Doug Walker, 1991; and Hugh Lougheed, 1999.

1961 Forest Management Plan

Under the 1954 lease agreement, the company's first management plan was due in 1959, but at that time the inventory was still underway and it was not practical to present a complete plan. Instead, a preliminary plan was prepared in 1958, and the final detailed plan was submitted and approved in 1961 (although deemed effective in 1959). Like all its successors, the 1961 Forest Management Plan provides a fascinating snapshot of the era—the management philosophy, forestry methods and technologies, the status of the land base, knowledge about the forest and its processes—beyond the pragmatic assumptions underlying determination of the annual allowable cut. It was the first such plan submitted in Alberta.

The 1961 plan was a classic statement of Loomis's and Crossley's sustained-yield philosophy. Among the stated goals were "to remove over-mature timber as rapidly as possible" and "to mould the present distorted age class pattern into a more regular distribution of classes by twenty-year age groups." Crossley then held a classic view of the "normalized" or "regulated" future forest in which there would be a uniform distribution of age classes between zero and rotation age. The Hinton forest management area, in contrast, was dominated by forest stands already well beyond rotation age, and Crossley was determined to correct this "distortion."

Based on preliminary growth and yield studies, the plan prescribed a ninety-year rotation age for pine and subalpine fir and one hundred years for white and black spruce. Allowing for a five-year delay between harvest and regeneration, and pro-rating the distribution of species, the average for conifers was "98.3 years, or for all practical purposes, a 100-year rotation." (The second measurement of continuous forest inventory plots began in 1961, providing improved information about growth and yield. The results indicated that a younger rotation age was appropriate. The company proposed adoption of an eighty-year rotation age, and this was approved at a meeting with the Alberta Forest Service on 9 December 1964. The eighty-year rotation age served as the basis for subsequent planning until 1986.)

The 1961 plan described the cutting plan, based on working circles and compartments, which had already been applied since 1956 and was now supported by the inventory results and recent completion of the fire-origin inventory for the entire land base. The company expressed concern about planning when other operators still held forty licensed timber berths and eight special timber permits covering about 3.5 per cent of the lease area, although it turned out that these would all be phased out by the late 1960s.

The predicted new growth and yield was offset by allowance for a twenty-year average annual burn rate at the time of 0.32 per cent, equivalent to an annual loss of 2,500 hectares, a far cry from the maximum allowable annual burn target of 0.001 per cent established in later years. The high burn rate calculation in the plan reflected the recent experience of three large fires in 1956 and one in 1961. The document described the government's limited fire protection capacity, which included an Edmonton-based "air force" of one helicopter and two small fixed-wing aircraft. (This was a bit harsh, since the government had additional aircraft available on contract for firefighting, and contract water bombers were used in the Hinton area as early as 1959.) In addition, there were only 551 kilometres of all-weather roads in the entire lease area, which affected both fire protection and log hauling.

The plan described a forest renewal strategy based largely on natural seeding after clear-cuts, but it also reported on research projects that would lead to the silvicultural strategies adopted later in the 1960s. Scarification trials had already been conducted on more than one thousand hectares of cut-overs, and this would soon prove the key strategy for pine regeneration. Scarification also prepared sites for spruce regeneration and reduced the fire hazard by reducing slash left on the ground. The company planned to begin regeneration surveys shortly, and the results of these surveys would lead to establishment of the company greenhouse in 1965 and a strategy of planting seedlings on spruce sites and some pine sites. Thinning and fertilization trials were also underway, and both of these strategies would eventually play an important role in silviculture.

1966 Forest Management Plan

Soon after approval of the 1961 plan, a great deal more information became available. New aerial photographs taken by the government in 1963 and by the company in 1965 permitted more accurate operational inventories, although the management inventory for the 1966 plan was still based on the permanent sample plot system. The new plan redetermined the annual allowable cut to reflect the eighty-year rotation age adopted in 1964 and the compartments were reallocated into four twenty-year cutting cycles instead of five.

New statistics highlighted the need for fire control. They showed that the average annual burn rate in the previous twenty-five years was 0.28 per cent of the total lease area. However, the ten-year average, including the 1956 and 1961 fires, was 0.64 per cent. Based on the age-class inventory completed in 1964, the average annual loss of the previous 105 years was 0.72 per cent or 11,200 hectares.

Regeneration surveys had been completed on the first five years of cutting (1956–1960), and these showed 73 per cent of the 30,380 hectares were considered adequately reforested, a status described as "Satisfactorily Restocked" or "SR" in government regulations. (See chapter nine for a more complete description of regeneration surveys.) The plan said "Not Satisfactorily Restocked" areas would be addressed through a combination of seeding and planting with containerized seedlings from the company's new greenhouse. (Seeding was eventually abandoned, because of uncertain results as well as rodents eating most of the seeds.) Silviculture forester Bob Carman developed a new system of post-harvest "management opportunity surveys" to prescribe appropriate silvicultural treatments following harvest. By this time, fourteen co-operative research projects and five company research projects were underway on the lease area.

1977 Forest Management Plan

The next revision reflected another decade of experience and major changes in company operations, forestry knowledge, industrial activity, and public opinion. These developments included mechanization of logging operations, construction of the company sawmill, new growth and yield studies, a huge increase in oil and gas industry activity, growing recreational use of the forest management area, and concerns about the environmental impacts of forestry.

Instead of sustained yield, the 1977 plan restated the goal as "sustained or increasing yield" and "to sustain into perpetuity, and through better management, to increase the annual yield of coniferous wood from the Forest Management Area." This change in emphasis followed increasing evidence that growth and yield rates were considerably higher for regenerated cut-overs compared to fire-origin sites. Maintaining a uniform average haul distance was now explicitly stated as a goal, although it had been a company objective since start-up in the 1950s.

Compared to earlier plans, the "areas removed from management" section was notably larger. The productive forest was reduced 4.6 per cent due to roads, transportation corridors, seismic lines, and environmental considerations. The company expressed concern about the rapid increase in crude oil, natural gas, and coal development. For the first time, there were land base reductions for non-timber values such as sensitive sites, horse grazing, recreation, sand dune stabilization, and wildlife. A strategy was outlined for recreational development.

By 1974 all operations were increasingly mechanized and supported by a growing network of improved roads. Logging and hauling continued year-round. Workers no longer lived in camps at the logging sites, instead commuting to work each day. Because the operating compartments no longer had to support a camp, they were restructured to conform more closely to age class and topography. The number of compartments increased from 65 to 120, and the working circles increased from four to five.

Improved fire protection was evident in the sharp decline in the twenty-year average annual burn rate, from 0.32 per cent in 1966 to 0.07 per cent (525 hectares) in 1977. Along with improved inventories and new growth and yield studies, and a backlog of undercutting from previous plans, this contributed to a considerable increase in the annual allowable cut.

The Forest Management Plan described a continuing improvement and refinement of silvicultural techniques. Between 1973 and 1976, the company reported planting seedlings on an average of 2,000 hectares a year, with an 80 per cent success rate. A tree improvement forester was hired in 1976 to develop a tree improvement program through selection and breeding of genetically superior trees. The plan reported that twenty-eight research projects were underway—thirteen company projects and fifteen collaborative ones with government and university scientists.

1986 Forest Management Plan

The 1986 revision of the Forest Management Plan reflected the Environment Council of Alberta's 1979 report on forestry, the provincial government's subsequent emphasis on integrated resource management, and the company's commitment to wildlife management. The plan included a notable addition to the management objectives: "To manage the forest management area in such a manner that a variety of other uses may be accommodated. These uses may occur simultaneously or sequentially within the context of prime use for timber production."

A preliminary wildlife management approach emphasized maintaining habitat for elk, caribou, and sport fish. The company also reported additions to its recreational programs.

Despite further land base reductions, including 4,440 hectares for coal mines, there was a 23.7 per cent increase in the annual allowable cut. This increase was largely due to more refined analysis of the growth and yield of fire-origin as well as regenerated stands, through the permanent sample plots as well as other company field research. Most of the increase came from fire-origin stands. There was an additional small increase due to the further reduction in the twenty-year average annual burn rate, to 0.006 per cent. New computer-based methods were used for the timber supply analysis.

Analysis of data from the permanent growth sample plots also showed that vigorous growth continued well beyond the previously chosen "rotation age" (generally considered to be the age when the mean annual growth increment peaks). This led to a proposal to change the rotation age from eighty to ninety years and allocate the forest management area to three cutting cycles instead of four.

New rules required that regenerated stands reach a height of two metres on first-pass cut-overs before the second pass could occur. The plan suggested this was not feasible in a twenty-year cutting cycle but would fit in a thirty-year cycle.

The company reported on a major effort to reduce its backlog of cut-overs awaiting reforestation, from 6,450 hectares in 1980 to 1,978 hectares in 1985. A juvenile spacing program, to reduce competition in young regenerated stands, was in place, averaging 400 hectares per year. A total of twenty-two research projects was underway on the forest management area.

1991 Forest Management Plan

The 1988 Forest Management Agreement, which expanded the forest management area by 200,000 hectares, made the 1986 Forest Management Plan obsolete, and work began that would culminate in the 1991 revision. In keeping with the Environment Council of Alberta's 1979 recommendation to maximize use of harvests, the 1988 agreement increased the management area by 25 per cent, substantially less than the area required to meet the wood needs of the planned facilities. In addition to using the annual allowable cut fully, Weldwood would need to obtain a lot more wood from outside the lease area. The plan also reflected an increased emphasis on public input and integrated resource management.

While sustaining or increasing the coniferous wood yield continued to be a key objective, the 1991 plan abandoned the previous concept of the "normalized" forest eventually consisting of equal age classes from zero to rotation age. "Ecosystems, including mature and older stands, will be managed through space and time to conserve wildlife species in the forest," the plan stated.

A computer-based timber supply model was used to examine management strategies and compartment sequencing over a two-hundred-year planning horizon. The concept of "cutting cycles" was dropped, and compartment sequencing was prioritized according to rules developed from growth and yield and inventory programs. It was assumed there would be a fifteen-year interval between passes in two-pass harvest systems. Although wildlife management models were not ready in time for inclusion in the 1991 plan, an extended period was assigned between first and second passes in part of the Berland working circle (the fifth working circle) to enhance caribou habitat. For the first time, an annual allowable cut was determined for deciduous species, reflecting the average volume of deciduous trees encountered in the course of harvesting the coniferous annual allowable cut over a twenty-year period.

The plan expressed particular concern about loss of productive land base to coal mines and oil and gas development. It noted that 95 per cent of the timber destroyed during seismic surveys was being left to rot.

The continued success in fire control was reflected in a twenty-year average annual burn rate of 0.006 per cent. The company decided no longer to include a fire allowance in calculating the annual allowable cut, but to record fire losses as equivalent to harvest for purposes of the annual allowable cut. Research indicated that a fire-loss allowance was actually counterproductive, because extending the time over which harvest is scheduled increased the probability of fire getting to the timber first.

As more of the harvest moved into mixed wood lower foothills forests, the plan noted an increased need to control deciduous competition, which was shading out coniferous regeneration on some sites. An estimated fifteen thousand hectares required such treatment. This became increasingly important under the provincial government's new "free-to-grow" regeneration standards, which took effect in 1991. The free-to-grow standards meant that sites could only be considered "Satisfactorily Restocked" if the young trees had grown well clear of the surrounding vegetation. (See chapter nine for further details.)

1999 Forest Management Plan

The 1999 Forest Management Plan was the first based explicitly on sustainable forest management and the first to use quantitative analysis of non-timber values. It was developed over a four-year period and involved an unprecedented amount of stakeholder consultation as well as development of sophisticated technology for analysis of multiple resource values. The plan's goals, with a heavy emphasis on biodiversity and watershed protection, were established on the basis of two key considerations: public input through the Forest Resources Advisory Group, and the sustainable forest management framework established by the Canadian Council of Forest Ministers.

In addition to sustained forest yield, the plan addresses issues such as biodiversity conservation, water resources, cultural and historical resources, recreational opportunities, and visual aesthetics. It states the overriding goal is "providing for the needs of society today, without impairing the use of the resource for future generations."

The plan uses both "coarse-filter" and "fine-filter" approaches to biodiversity conservation. The broad coarse-filter approach, sustaining representative ecosystems across the landscape, was based on natural disturbance research conducted by the Foothills Model Forest. The species-specific fine-filter measures provided a check on the broader approach, as recommended by the Forest Resources Advisory Group. Habitat supply analyses for thirty-two species were based on computer

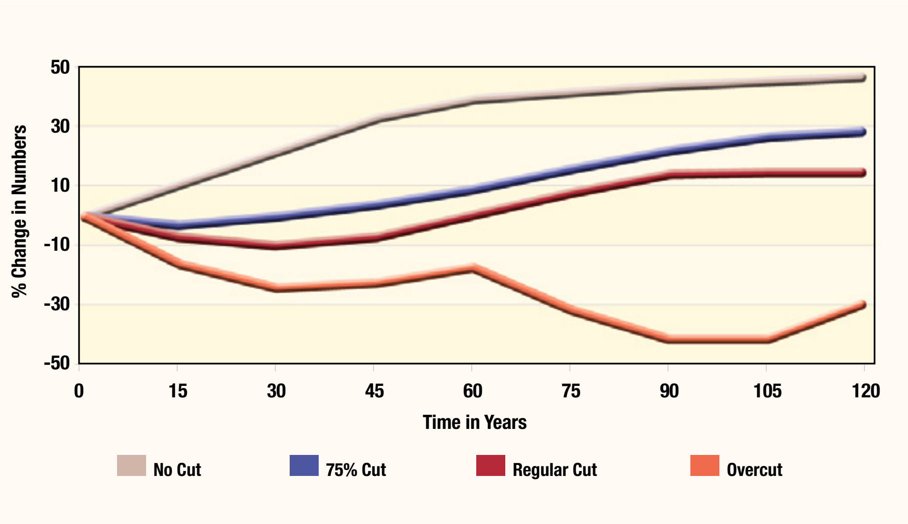


Figure 6.5 Habitat model for pine marten, used to assess impact of management strategies on marten habitat over time

models of habitat suitability developed by University of Alberta scientists Jim Beck and Barbara Beck for the Foothills Model Forest.

A Weldwood contractor, Golder Associates, adapted the Foothills Model Forest watershed model to develop a hydrologic assessment model to evaluate the effects of future landscape changes on watershed values such as fish habitat, stream geomorphology, and infrastructure. The model evaluated change within basins and the potential impact on identified values. Eleven of the 143 basins in the forest management area were identified as having potential concerns, and commitments were made in the plan to investigate these concerns in more detail as activity is proposed in the basins.

Although the annual allowable cut was almost unchanged from 1991, the timber supply analysis was very different. The conifer utilization standard—the minimum size tree to be harvested—was reduced from "13/10" (13-centimetre stump diameter, 10-centimetre top diameter) to "10/8" (10-centimetre stump, 8-centimetre top). This increased the annual allowable cut per hectare, but merely offset the loss of nearly 100,000 hectares from the contributing land base.

A computer model simulated the way the forest grows and is harvested. This simulation was based on the available land base, standing inventory, yield projections, and management practices. Various combinations of these variables were tested, and the results of each compared with the others and compared against desired results, including the impact of the alternatives on other resource values. Company planners determined the desired results in consultation with government agencies, the Forest Resources Advisory Group, and other stakeholders.

The plan included 119 specific "commitments to action"—many of them assumptions implicit in the computer simulation—that set the stage for sustainable forest management certification. Several key commitments were intended to ensure that forestry practices approximate natural disturbance patterns on the landscape. Identification of sensitive areas requiring special management or protection was also a high priority.

The Integrated Resource Management Steering Committee (IRMSC)—including representatives of Weldwood, the Land and Forest Service, and Fish and Wildlife Service—played a vital role in the plan's development and ultimate approval. The government agencies provided feedback throughout the process, ensuring "no surprises" for either side when the plan was finally presented. The IRMSC has an ongoing role in ensuring that the detailed commitments in the plan are met.

Implementing Plans

Out in the forest, "where the rubber hits the road," even the best-laid plans encounter the complexities and uncertainties of the real world. The challenges include recruiting, training, and leading labour; selecting and deploying machinery; dealing with the vagaries of terrain and weather; coping with social, political, and economic change—to name a few. By learning from mistakes and adapting to change, managers and workers built an enduring enterprise at Hinton. The next three chapters describe the three main tasks in implementing plans: harvesting timber (chapter seven), manufacturing products (chapter eight), and growing the new forest (chapter nine).

CHAPTER SEVEN

The Harvest

HORSE LOGGING TO FELLER-PROCESSORS

We need industry, the type of industry that is going to hire a lot of people.

—Eric Huestis, 1972

The managed forest has supplied the fibre needs at Weldwood's Hinton operation for almost fifty years. Stan Navratil

Eric Huestis, who retired as deputy minister of Lands and Forests in 1966, gave a wide-ranging talk six years later at the Forest Technology School in Hinton. While the oil and gas industry provided short bursts of employment, he pointed out, forests brought long-term jobs to the province, in both the bush and the mills. This would continue as more of the forest resource was utilized and more value extracted from each tree felled. He noted that pulp, panelboard, and lumber could all be produced from the waste burned or buried by traditional sawmills. "If you have a pulp mill, you're utilizing everything except the bark," he said. "Maybe something can be done with the bark."

He correctly foresaw the enormous growth in both utilization and value that would occur in the Alberta industry over the following decades. In 1972, one important step had just been taken at Hinton with the construction of a sawmill adjacent to the pulp mill, and a second pulp mill was about to begin production in Grande Prairie. Productivity per worker also rose very rapidly, as did the quality of the jobs—especially the comfort and safety. In the early days, however, logging jobs were physically demanding and often dangerous.

The Horse-logging Era

Shortly after the lease agreement was signed with the provincial government in September 1954, St. Regis assigned staff from its woodland division in Deferiet, New York, to examine logging systems for the new project. H. V. (Pete) Hart, Dyer Phillips, and Stan Hart toured operations in the western United States and eastern Canada to observe the various approaches then in use. They visited Alberta from 21 October to 15 November 1954, to gather more information about the forest, meet with the Alberta Forest Service, and talk to local timber operators. At this time, it was still assumed that the mill would be located at Edson.

Although mechanical systems showed promise for the future, there was no time for experimentation. The mill site was relocated to Hinton in January 1955; St. Regis foresters visited Alberta again from 8 March to 6 April, and the first forestry and woodlands staff began work at Hinton in May. Plans called for the first harvest to begin in 1956, so there would be a substantial inventory on hand when the mill began production in the spring of 1957.

The first woodlands manager was Gordon McNabb, former logging superintendent at one of St. Regis's operations in Ontario. While Des Crossley's forestry staff worked on the long-term harvest design, McNabb established the first logging

Below: Nick Tomkiw, one of the first company contractors, was in charge of operations at Camp 1. His pride and joy was a team of matched Belgian horses that he often entered in parades.

Below right: Camp 1 opened in 1956 and, with a capacity of one hundred men, was one of the largest camps built by the company. STANTON G. V. HART

camps on either side of Highway 16 west of Hinton. Two experienced contractors, Nick Tomkiw and Webb Frissel, set up Camp 1 and Camp 2 during the fall and winter of 1955–56. These were large camps, designed to house up to one hundred men and nearly as many horses. Other camps followed soon after, as operations ramped up production. Only one or two supervisors were present at each camp, along with a camp clerk and other staff. There was little need for active supervision because workers were paid "piecework" for each cord (2.4 cubic metres), plus "walking time" based on the distance to the harvest site. Company employees called scalers lived in the camps and measured the stacks of wood at roadside landings to determine government stumpage fees and workers' pay. From 1959 to 1965, the chief scaler and some other supervisors toured operations in Volkswagen Beetles.

McNabb also hired contractors to begin the huge task of road building. At that time, there were hardly any good roads in the lease area aside from Highway 16 (which was paved as far as Hinton in 1956) and an oil company road to Muskeg in the north. The only access to southern areas in the 1950s was a circuitous route through Edson and down into the Coal Branch. One of the first priorities was a road south from Hinton to Robb, built in 1956.

A hand logger stacked an average of five tonnes of wood per day.

The approximate harvest areas were selected on the basis of existing maps and aerial photos, and men were assigned to cruise the timber on the ground and mark out the first cutblocks by stapling surveyor's tape to trees along the boundaries.

Thanks to the rapid mechanization of agriculture in western Canada after the Second World War, there was an ample supply of first-class draft horses for the contractors and the company camps. The horses were well cared for and soon learned the job so well they needed little direction from the man holding the reins. The Camp 1 contractor, Nick Tomkiw, had a string of matched Belgians that he took to horse shows and used in parades.

For the men, however, it was extremely hard work. They walked to and from the work site, and used their muscles all day. Each two-man crew worked on a small patch or strip within about one hundred metres of the road, well away from the next team's strip. The pulpcutter used his chainsaw to fell the trees and cut off the limbs and tops. His partner then hooked up one or more trees to drag them down the skid trail to the roadside landing, where he would buck the logs into

2.5-metre lengths and pile them in stacks. The crews often carried handsaws so they could continue working if a chainsaw broke down.

The average production per worker was about three cords (7.2 cubic metres) per day. With wood weighing about eight hundred kilograms per cubic metre, each man was handling an average of more than five tonnes of material daily.

A pulpcutter's work was even tougher at Camp 1. Because of the Athabasca Valley's strong winds and sandy soil, the bark of the trees there was heavily impregnated with fine sand particles. Cutting was slow and saw chains had to be sharpened frequently. Some men chopped away the bark with axes before felling the tree. Men at Camp 1 often struggled to produce two cords (4.8 cubic metres) per day. The company recognized this hardship and provided free saw chains for Camp 1 crews (normally workers had to supply their own equipment).

The first load of wood from Camp 1 was delivered to the mill's woodyard on 9 January 1956.

Camp Life

Camp life followed an austere tradition that was typical across North America. It was, among other things, a virtually all-male world. A few women logged as teammates with their husbands, but none of the couples lived in the camps. The woodlands labour force also included some notable women such as truck drivers Emma Nickerson and Lucy Berube, who lived in town.

Here is how Hank Van Zalingen, who spent four decades on company logging crews before retiring in 2000, recalled the routine at Camp 8, in the northern part of the lease area beyond the Wildhay River, where he worked from 1956 to 1960:

> *We stayed at camp from Monday to Friday, and had to make our own way home on weekends. This was quite an expense, and many would share rides. We paid $2.35 a day for room and board.*
>
> *The camp had propane heat, an electric generator, and running water. A "bullcook" looked after the washrooms and swept and washed the floors in the dining room and bunkhouses. Four bunkhouses, each holding about twenty men in a large common room, formed the arms of an H, with the washhouse connecting them. Staff and the foreman had separate buildings from the workers. There were no showers, but our foreman, Helge Nelson, was a Swede and had a sauna in a small building, which was fairly popular. Otherwise, we had to wait until we went to town to shower. In later years, camps were equipped with showers.*
>
> *Our day began at 5:30 with a wake-up call. Breakfast in the cookhouse was hearty—bacon, eggs, sausages, pancakes, fried potatoes, etc.—and was eaten in silence, as was every meal. The cooks discouraged talking because they wanted the dining room cleared out as quickly as possible. Every man ate quickly, then made his own lunch from supplies placed on tables in a room off to the side.*

Multiple Uses and Values
A Transformed Community

When the first company employees arrived in Hinton in May 1955, they found a community of 380 people, served by one hotel, a general store, a two-room school, and two gas stations. The company initially expected that married men would leave their wives at home while operations were established, but the wives did not agree, "and that was the end of that," Stan Hart recalled. The uninsulated cabins of a former tourist camp became temporary residences—through a brutally cold winter—and the survivors, calling themselves "the 55ers," formed lifelong bonds. In fact, the company's first secretary, Doris Taylor, soon married one of the first woodlands staff members, Bob MacKellar, who had been delegated to drive her back to the comforts of Edmonton each weekend. She became a vigorous member of the new community, especially the theatre groups for whom she served as a one-woman costume department.

The original unincorporated hamlet was centred in the "Hill" district of present-day Hinton. Work on the mill project started a two-year boom of unprecedented proportions. At the height of construction in 1956, there were about 900 workers on the mill site. That fall and winter, more than 1,000 additional people flooded into the area looking for seasonal logging work. Hundreds more signed on for permanent jobs in the mill and woodlands.

Many businesses, from banks to beauty shops, set up to provide goods and services for the company, the workers, and their families. Rival developers, one controlled by NWPP's founding Ruben family, built housing and shopping centres in the Hill and Valley districts. Unwilling to have two municipalities just five kilometres apart, the provincial government incorporated the New Town of Hinton as a single entity in 1957. "New Town" status was an arrangement whereby the province assisted new or rapidly expanding communities such as Hinton.

The company and its employees were intimately involved in creating the new community. For example, they realized that the pulp warehouse would not be needed until production began, so it was loaned as a huge classroom while a new school was being built. School enrolment in Hinton soared from 58 in 1953 to 669 in 1957. Company employees and their wives served on the school board and were active in school affairs. A company administrator, Wayne Sawyer, even served as volunteer funeral director in the early years.

Company employees also sat on the hospital board that lobbied for several years to get the community a hospital. The first twenty-five-bed hospital was finally built in 1959 (and later replaced by a forty-bed facility in 1980). Before the hospital opened, the company's clinic was the town's major medical facility. Employee volunteers and company-donated materials made possible the construction of facilities such as the first recreation centre and swimming pool. A company forester, Owen Bradwell, served two terms as mayor in the 1960s, and other employees were elected to the town council. The mill also provided the community's water supply and sewage treatment—still the only mill in Alberta to do so.

The partnership between the company and community continued to strengthen and deepen over the years, and the company supported numerous charitable, educational, and recreational activities. The company honoured this forty-year relationship with a gala celebration 19 September 1997, on the lawn in front of the mill.

Hinton grew into a modern, prosperous, well-educated community. According to the 1996 census, the 2,227-hectare municipality had a population of 9,960. Fifty-one per cent of the residents over twenty-five years old had some post-secondary education, including 8.5 per cent with university degrees, and 66 per cent were high-school graduates. The average income of people reporting income was

continued on page 132

$29,989—nearly $4,000 higher than the Alberta average and $5,000 higher than the Canadian average. The unemployment rate in 1996 was 5.9 per cent, compared to 7.2 per cent for Alberta as a whole and 10.1 per cent across Canada.

In the municipality's 1996 labour force of 5,465, about one-fifth worked in resource industries (including forestry), one-fifth in construction and manufacturing (including pulp and lumber production), and three-fifths in service industries. Several hundred more lived in the surrounding forest management area, including the communities of Brule, Robb, and Cadomin.

The horses were kept in a barn at camp and we harnessed them up and took some hay and oats for the day. We then walked them out to our logging strip, sometimes up to an hour away. We also had to carry our own gas in two-gallon cans, and chainsaw oil. These were not supposed to be hung on the horse, because of the risk of spilling gas on the horse. Although we were not supposed to ride the horses out to the strips, many of us did.

We worked hard all day with the horses, cutting trees down, bucking them to eight-foot lengths and hand-piling them in "ricks." At the end of the day we left the singletrees [wooden harness crossbars] and skid chains in the strip, returned to camp, unharnessed the horses, and turned them back to the barn boss.

Supper was served at six and again eaten in silence. Food was good and hearty, although there were not always fresh vegetables. The "cookees" cleaned up the dishes while the cook began preparations for the next morning's breakfast. We were not allowed to linger in the dining hall, but could return for a cup of coffee at around 8 p.m.

In the evening, some men would read and others might play cards in the bunkhouse, usually poker. Some might go fishing. The company safety supervisor, Lloyd Stafford, would come to camp about once a month to check on us and talk about safety. He would usually bring a 16-millimetre projector with him to entertain us with some old Hollywood movie.

Woods operations shut down during the spring thaw, resumed on accessible dry ground during the summer, and hit top speed after the ground froze in the fall.

The earliest mechanical skidders were small crawler tractors, but they were inefficient and expensive for pulpwood operations.

Trucks, initially a mix of farm trucks and locally hired flat-decks, could travel the main roads for most of the year, but had to wait for the hard freeze to use many of the secondary roads to the logging sites. Pete Hart noted that one big advantage of Hinton was the relative absence of black flies and mosquitoes; in eastern Canada, these pests made summer operations an ordeal for the workers.

In the 1960s, as roads and vehicles improved and more of the men had families in town, many of them began commuting to work daily. When skidding was mechanized in company operations between 1966 and 1968, the camps were no longer needed to stable horses near work sites. Most of the camps shut down in 1968, and the last closed in 1975. Married men generally welcomed the change, but some bachelors missed the camaraderie of the camps.

Recruiting and Training Pulpcutters

Those were the orders: Even if he was an elevator operator, if he wants to come, send him up. So that was what happened.

—Rosaire Lacroix, 1997

After a decade of pulpcutting and union jobs that had taken him from Labrador to northern Ontario, Rosaire Lacroix drove into Hinton on 17 August 1956 to check out the new operation. The company's human resources manager, Wayne Sawyer, knew Lacroix from Ontario and thought he was just the person to help find the hundreds of workers needed for the first full season of logging in 1956–57. Five more camps were then under construction, and soon there would be fourteen camps in operation, but there were only about seventy-five loggers working in August.

Four days later, Lacroix headed east again for a four-month recruiting drive in the bush camps and union halls of Ontario and Quebec. The experienced loggers he recruited, many of them French-Canadian, formed the crucial nucleus for the woodlands labour force. By the time he returned, some 1,270 would-be pulpcutters showed up at Hinton. Stan Hart estimated that there were as many as 1,100 workers in the woods at the peak. Many of them did not stay long, and by the end of the winter the woods workforce was down to about 600. For most of the horse-logging era, the woods workforce was generally between 400 and 600. The International Woodworkers of America (IWA, now Alberta Local 1-207, Industrial, Wood and Allied Workers of Canada) began an organizing drive among woods workers in April 1956 and, after two months of negotiations, signed its first contract with the company on 24 August 1956.

Robin Huth, who was later in charge of hiring loggers, looked for reasons behind the high turnover, which he described as two armies—one coming into Hinton and one leaving. As he recalled in his memoir, *Outdoor Junkie*, Huth discovered two common factors among those who quit. One was easy to predict: The

English Lessons

When Jim Clark transferred from forestry to the woodlands department in 1960, he noted that many of the workers spoke little English. After he mentioned this at home one evening, his mother-in-law, Dorothy Scott, volunteered to give English lessons in the camps. Woodlands manager Adrien Provencher and industrial relations manager Wayne Sawyer supported the idea.

For about three years, safety supervisor Lloyd Stafford drove Mrs. Scott to two camps each week. They would arrive just before supper and join the men for the meal, after which she would teach for about two hours. Her only compensation was the free dinner, which she apparently enjoyed very much. Clark called her "the Florence Nightingale of logging camp education."

Amelia Spanach

The logging industry was a male-dominated field, and the few women, like Amelia Spanach, stood out. Amelia married Coal Branch entrepreneur Robert (Bob) Spanach in 1941 at age sixteen (he was then twenty-nine), bore two children, and helped out in her husband's businesses during the 1940s. He died on 25 October 1949, after his clothing got tangled in sawmill machinery. His businesses then included the sawmill, which produced mine props and railway ties, as well as the Mercoal theatre, the GM dealership, and a café–boarding house. He left no will and few business records, and his assets were frozen for six years until the estate was settled. The theatre burned down two weeks after his funeral. The banks would not give loans to the twenty-three-year-old widow, nor would GM let her keep the franchise. A coal company loaned her money but demanded rock-bottom lumber prices in return. She dealt with

continued on page 136

Amelia Spanach, retired sawmiller, photographed in 1999. Mrs. Spanach ran her family sawmill at Coalspur until the mid 1950s. R. E. Stevenson, Alberta Forestry Collection

men who tried to earn a living with swede saws instead of chainsaws quit after one or two days. The other factor was a bit more surprising. Most of those who quit were Albertans. They apparently expected to find the easy-going work environment of the earlier seasonal logging camps in the foothills and soon found it too hard to keep up with the disciplined pace of pulpcutters from eastern Canada and abroad.

About 60 per cent of the pulpcutters were immigrants, including newcomers from Poland, Hungary, Germany, Korea, Spain, Italy, Portugal, Sweden, Finland, Belgium, and Yugoslavia. They included a number of Germans who had first cut wood in the Alberta foothills a decade earlier as prisoners of war; after repatriation, they came back. Because of language barriers as well as noisy machinery, sign language was a vital means of communication. Many of the supervisors and managers were "from away" too, including contingents from eastern Canada, the British Isles, and the United States.

During the winter of 1956–57, Lacroix was one of four full-time instructors who provided new men with two weeks' training before they began work on their own in two-man teams. "We showed them the proper way to work, and we tried to be with them as much as possible and discourage bad habits," Lacroix said. "After thirty days, if they didn't obey the rules and listen to the instructor and break their bad habits, there was no point in keeping them." One of the most dangerous habits was trying to push over a leaning tree by hand (the tree could twist and fall on them), rather than using a push pole from a safe distance. Other serious problems were standing too close to the tree, and working too close together and too close to the horses. "We had horses killed, and we had men falling trees on their partners' head, shoulders, and back," recalled Lacroix.

Injuries were frequent among the workers in the bush. The worst year was 1958, when there were 174 lost-time accidents. Lacroix, who served as a first aid and safety instructor from 1957 to 1963, recalled that it was common to see three or four chainsaw cuts a day. Serious injuries went to the company clinic, staffed by a doctor and nurse, and if necessary to the hospital in Edson until Hinton got its own hospital in 1959.

Hardhats were mandatory from the start, and soon so were steel-toed boots and nylon kneepads. Company safety superintendent Lloyd Stafford toured the camps constantly to give lectures and demonstrations and show safety films. However, the injury rate remained high until mechanization moved most workers off the forest floor.

There were seven on-the-job woodlands fatalities (three employees, four contractors) during the horse-logging era from 1955 through 1968, and twelve during the next three decades (six employees, six contractors). Nine of the deaths were due to falling trees, six to road accidents, and four to logging or construction equipment.

Independent contractors operated the camps initially, but the company

Multiple Uses and Values
Sawmillers and the Pulpwood Agreements

The original pulpwood agreement stipulated that existing timber berths and permits on the lease area would be honoured while they remained in effect, but not renewed upon expiry. This meant that most existing sawmillers cutting timber on the lease area were gone by about 1960. The large sawmill at Brule shut down in 1957 as pulp harvesting began nearby.

A way of life ended for many local sawmillers. Some found new timber harvesting berths outside the forest management area, a few worked as contractors for the new pulp company, but most went into other occupations or left the area. The Corser family operation was one that successfully made the transition. Two Corser brothers had started their family business in 1925 with a tie-hacking contract, which led to sawmilling for ties and lumber. Richard Corser then led the firm in contracting for a NWPP company camp and in pioneering work with scarification (site preparation for reforestation) for the company. He also continued to operate the family's sawmill complex south of Edson.

The Corser sawmillers crew used a steam sled for this winter log haul near Edson in the early 1940s. CORSER COLLECTION, UNIVERSITY OF ALBERTA ARCHIVESY

More typical of the displaced operators was Amelia Spanach, who said the local operators met several times with Norman Willmore, the minister responsible for forests, to argue that NWPP could take smaller trees for pulp and still there would be plenty of sawlogs to harvest. "At one meeting in Edson," she remembered, "Willmore said if you can't make it logging, go start raising sheep. There were a couple of verbal attacks on him that time. I think a lot of people started disliking him from there on in. He lost a lot of friends with that statement." However, many other local people were excited by the economic opportunity provided by the pulp mill as coal mines closed during the 1950s. Willmore was re-elected as the area's member of the Legislative Assembly in 1959 and 1963. He died in an automobile accident in 1965 while driving west from Edmonton to speak at a riding meeting.

Fred McDougall, then an official in Alberta Lands and Forests, also recalled these concerns and noted one of the longer-term implications: "I think it may have been one of the reasons why later on there was some opposition from independent sawmillers to (later) pulp developments [elsewhere in the province]—the history of what happened at Hinton and west of Edson." After the quota system replaced timber berths in 1966, the government allowed sawmillers to maintain their quotas in subsequent forest management areas in the provinced.

Although they were offered the option to obtain quotas, two independent operators in the Hinton forest preferred co-operative agreements with the company. From 1965 to 1983, Bighorn Forest Products produced fence posts in the Gregg River area south of Hinton, harvesting stagnant stands of dense lodgepole pine there, which then allowed NWPP to regenerate a faster-growing forest. Another independent operator, Don Terris, had an agreement to take 750,000 board feet of lumber annually from the Camp 2 area west of Hinton. Terris kept his logging operation into the 1980s, although he shut down his sawmill in the 1970s and thereafter sold timber to the Hinton mill.

GM by a legal ruse—"selling" the dealership to the bookkeeper. She was doing fairly well until 1956, when fire destroyed her sawmill and much of her timber lease, and at the same time North Western Pulp & Power took over most of the other available timber in the area. She bought another sawmill, mainly to process fire-killed timber for mine props, but the closure of coal mines in the area dried up the market. In 1959 she bought a fleet of bulldozers and other equipment for strip mining at Coal Valley, but that mine closed three weeks after the contract began. She and her family moved to Edmonton and switched to construction and oilfield contracting. Her son George, a Canadian Football League player in the 1960s, continues to operate Spanach Construction Ltd. in Edmonton.

eventually took over most of them. In 1963, Lacroix was promoted to foreman of Camp 23, a large company camp just south of the Berland River, north of Hinton. During the main harvest season, from September to spring breakup in March or April, the camp housed about 110 men and up to 90 horses.

The Berland camp closed in 1968 as mechanical skidders replaced horses, and Lacroix became the foreman of about twenty-five men and a dozen skidders. He was promoted to superintendent of the Berland-Athabasca logging district in 1975 and general superintendent of woodlands production from 1987 until his retirement in 1989.

In June 1971, Lacroix also earned the unwanted distinction of being the only company worker ever attacked by a bear. He was alone while surveying a road location when he ran into a black bear sow and cub. She took a bite of his torso under the arm and clawed his face. He tried to staunch the bleeding with his hand while he walked about three hundred metres to the road. There he found Bert Guimond, who took him to camp, about five kilometres away, and they radioed Dr. Ian Reid at the company clinic. On the way to the hospital from the clinic, Lacroix stopped at home to tell his wife Ada that "a bear took a little chunk off my side." Fortunately, he added, the bear found him unappetizing and "didn't come back for a second helping."

Mechanization

Right from the beginning, the company's woodlands department recognized that machines could reduce the cost of harvest and improve both productivity and safety. Technological change eventually affected every aspect of production—felling, delimbing, skidding, loading, hauling, woodyard, and mill—but the most dramatic advances occurred in the woodlands, where daily output per worker soared from about seven cubic metres in the 1950s and 1960s to more than eighty cubic metres in the 1980s and 1990s. Meanwhile, the number of serious injuries annually plummeted almost to zero.

From the 1950s to the 1970s, tree felling was done primarily by men with power saws.

Felling and Delimbing

The chainsaw was just coming into its own as operations began at Hinton, although there had been designs and prototypes for such machines since the nineteenth century. Cost, weight, and reliability were the big drawbacks of early models, and it was not until the 1940s that chainsaws began to appear in Alberta forest operations. Post-war improvements finally produced machines that were clearly superior to the woodsman's traditional axes, crosscut saws, and "swede" bow saws. In 1956 and 1957, however, the company still supplied swede saws to new cutters until they could afford to purchase chainsaws.

Usage of chainsaws in the Canadian forest industry went from under 10 per cent in 1948 to over 90 per cent in 1958. Because fallers at Hinton—as elsewhere—had to provide their own tools, some newcomers in the early years tried to get by with handsaws and axes, but generally held out only a few days before they quit or obtained chainsaws. As the machines became more reliable and affordable, they also got lighter and safer. Important developments in the following decades included anti-kickback chains, chain brakes, more powerful engines, and better vibration suppression.

The fallers' work was unchanged for many years, but concerns about both worker safety and productivity soon led to a renewed search for a suitable felling machine. The first two feller-bunchers arrived in 1973. These were self-propelled tracked machines that cut the stems with hydraulic shears and then placed them in a "bunch" for pickup by the skidder. In cold weather, the shears tended to splinter the bottom metre or so of the stem, an effect known as "butt shatter," but this was not a serious issue because there was still an ample supply of sawlogs for the stud mill and the damaged wood could be used for pulp. However, the highest quality of lumber is usually derived from the butt log, so butt shatter in the long run would not have been supportable.

Stroke delimbers became common in the woods in the 1980s.

Developed in Scandinavia, modern feller-processors employ the latest computer technology in felling, sorting, and scaling logs at the stump.

The next challenge was how to remove the limbs and tops. For a while, workers continued to do this manually with power saws. Then the company experimented with a crude device called a "flail delimber." This was a large, rapidly spinning drum with chains welded onto it, mounted on the front of a small tractor. The chains literally beat the branches off the trees. The machine was tested at both stumpside and roadside, but it was slow and tended to knock off a lot of bark and some merchantable wood.

The problem was solved in the early 1980s with the acquisition of stroke delimbers. These are machines that pick up the tree and pull the stem through a cluster of shears that lop off the branches. The delimber also has a saw to cut off the top at a prescribed diameter.

In the 1980s, the major harvest system was comprised of feller-bunchers, cable skidders, delimbing at roadside, and wood hauling with self-loading trucks. Hand falling with power saws continued on some terrain, but was phased out wher-

The Pope Harvester

In 1957 and 1958, the company even built and tested a machine intended to do all the jobs performed by the most sophisticated harvesting machines today—the Pope Harvester. John Pope of Hay River, Northwest Territories, invented the machine, and St. Regis bought the patents and financed construction of a prototype. Mounted on the front end of a crawler tractor, the harvester attachment consisted of a hydraulically operated chainsaw and two jaws, one of which was mounted on a track for delimbing. The prototype performed impressively, cutting trees up to 55 centi-metres in diameter and almost
30 metres tall, at a rate of 2.4 cubic metres per hour, and the quality of delimbing was excellent. However, it was necessary to position the whole carrier, a D-7 Caterpillar, at each tree to be felled, and the hydraulics tended to overheat. The company made numerous unsuccessful attempts to market the idea to potential manufacturers.∞

One of the earliest known prototypes of the modern-day feller-processor, the Pope Harvester is shown during field trials in 1957–58.

ever feasible. Later machines, called feller-processors, could delimb and top trees at stumpside and if necessary cut logs to length. By the late 1990s, saw-head feller-bunchers and feller-processors accounted for more than 90 per cent of the harvest at Hinton.

Skidding and Forwarding

In the 1950s, the biggest technological puzzle for the forest industry was how to get wood from stump to truck. Horses or oxen were the traditional means of skidding logs from the bush to the nearest road, river, or railway, but the industry urgently sought safer, more economical, and less labour-intensive ways to accomplish this. Most of the work was done in winter, and the large teams of horses pulling sleighs loaded with wood on ice roads could be overtaken and crushed by their loads on downhill grades. Sometimes it was even necessary to put in winches anchored at the tops of steep grades to ease the sleighs down the hill.

In British Columbia, cable systems had long been used to "yard" logs on the ground or in the air. Cables and pulleys would be strung out across areas and anchored to fixed points such as at the tops of trees "topped" for that purpose. Workers would attach logs to lines slung from these cables, then large winch-equipped machines called "yarders" at the landings would pull the trees out and pile them. This was well suited to mountainous terrain and dense stands of large timber. Between 1957 and 1959, NWPP tested four yarding machines at several locations, but this method was not economical for foothills forests and pulpwood operations. Various tractors were also used occasionally for skidding in the early years.

Elsewhere in North America, a variety of rigid-frame wheeled vehicles—typically based on farm tractors or four-wheel-drive trucks—had begun to replace horses for skidding on easier ground, but they could not cope with the heavy bush, steep slopes, sharp turns, and sudden changes in grade often encountered in forests like those around Hinton. The forest industry also used crawler tractors occasionally for skidding, but they were expensive to buy and operate, and caused a lot of damage to soil and standing timber. As a result, the Hinton operation relied mainly on tried-and-true horse skidding for the first decade until better technology was developed.

George Garrett invented one of the first really effective, economical, and versatile skidders in the late 1950s. These four-wheel-drive, rubber-tired machines were hinged, or "articulated," in the centre. Steered by hydraulic pistons, they could manoeuvre around obstacles and keep all four tires in constant contact with the ground. Such machines began to be introduced commercially around 1958, but it took several more years to find the right combinations of weight, power, tires, and brakes for various forest types. Garrett demonstrated his machine for the company at Camp 33 in 1960. Contractor Charlie Miles subsequently bought a Garrett

Tree Farmer in 1963 and logged several blocks, but these trials did not appear to prove the real value of the equipment. The next year, the company began its own trials to determine the cost and feasibility of mechanical skidding and tree-length hauling.

The trial in 1964 involved four Tree Farmer skidders at Camp 22. Company staff were immediately impressed with the speed and ease with which these machines moved logs from the stump to the landing, and it was apparent that the horse-logging days would soon end. The experiment took on added importance when the company was only able to recruit 359 bush workers for that year's logging season, although 450 to 500 men were needed. Increasing the price offered for purchased wood narrowly averted a wood supply crisis.

Field trials with articulated frame skidders in 1964 presaged the end of horse logging in 1967–68.[

Modern skidders use high-flotation tires to reduce ground pressure and impact on the soil.

Woodlands manager Stan Hart observed that the improved availability, reliability, and efficiency of mechanical systems made them increasingly attractive. Owen Bradwell, a forest engineer who had been in charge of road development since 1957, was assigned to lead planning for mechanization. During a second trial in 1965, tree lengths were skidded to roadside where a machine bucked them into cordwood lengths for hauling to the mill.

The company acquired more skidders in 1966 and dealt with safety issues such as logs potentially catching in wheels or riding up on the driver's back by installing protective screening around the operator. The major changeover from horses to skidders occurred in 1967 when fifty-five shiny new Timberjack skidders were delivered. "It was an impressive picture to see a lineup of fifty-five red skidder machines sitting on the woodlands garage property one Monday morning," Stan Hart observed. "At the time we bought them, it was the largest single order for skidders that had ever been placed in Canada, according to Timberjack representatives."

During the transition period from a "cordwood" operation to the tree-length operation, the logs had to be bucked in the woods because the mill woodyard was set up to handle 2.4 metre cordwood lengths piled in large stacks in the woodyard.

To feed the mill, a crane plucked bunches of logs from the piles and placed them in a flume, where the flow of water carried them into the debarker and chipper units. This continued until the mill installed permanent facilities to accept tree-length wood handling in 1968. In 1969, the first off-highway trucks began to haul large loads of tree-length logs.

A water-filled flume was used to transport logs from large piles in the millyard to the woodroom for debarking and chipping.

Former horse loggers adapted fairly easily to operating the skidders, which were still doing essentially the same job as the horses. The operator manually hooked logs onto the cable, using short lengths of cable called "chokers," then winched the logs snug against the rear of the machine and drove to the landing. Later models, acquired in the late 1980s, were equipped with a hydraulic grapple for this purpose. Grapple skidders use hydraulic clamps, like small cranes, to pick up stems for skidding. The key advantage is that the operator can stay in the safety and comfort of the cab while picking up a load. However, because grapple skidders carry fewer logs at a time than cable skidders, they have a shorter effective range (generally two hundred metres or less) than cable skidders. It is not economical for an expensive machine to make long round trips with a small amount of wood.

Feller-processors leave sorted logs in piles, which are moved to roadside using self-loading forwarders.

An alternative method of moving wood from stump to roadside is the "forwarder," which carries wood on a deck or cradle and therefore avoids rutting the soil. The Pettibone-Mulliken Carry-Lift, a wheeled machine with a hydraulic grapple, was sometimes used as a forwarder in the early years at Hinton although its main function was loading trucks at roadside. In the 1990s, forwarders began to be used at Hinton for sensitive and remote sites and specialized tasks such as commercial thinning. Forwarders can operate effectively for much longer distances than skidders, up to a kilometre or more if necessary, although longer distances are generally less economical.

Road Building and Hauling

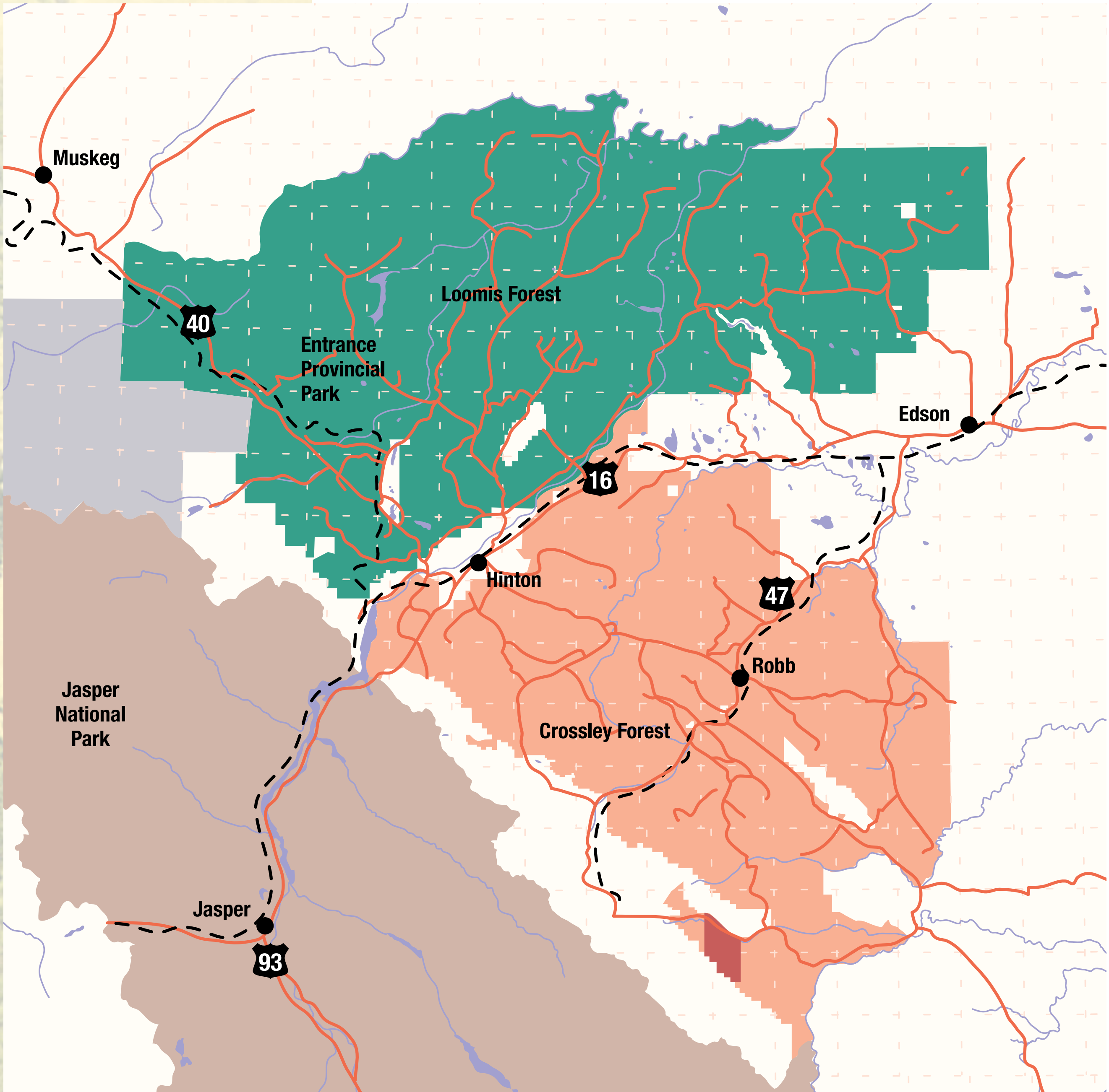
American Benjamin Holt invented the tracked crawler tractor in 1904, and the same principle was used in military tanks during the First World War. Crawler tractors were called bulldozers when equipped with a front blade. After Holt's company merged with another to form Caterpillar Inc. in 1928, crawler tractors began to gain wide usage, and the "Cat" name became almost synonymous with crawlers. Even the underpowered early models had great advantages for road building, which had previously been a slow and tedious business involving horse-drawn equipment, hand labour, dynamite, and sometimes power shovels.

In the Alberta forest industry, beginning in the 1920s, crawler tractors were used for road building and for towing trains of log sleighs. The Millar family at Whitecourt acquired their first crawler tractors in 1927, and by 1936 were hauling trains of up to sixteen log sleighs behind D-8 Caterpillars. Improvements in engines, hydraulics, and drive systems during and after the Second World War led to more powerful and versatile machines. The thousands of kilometres of roads required for the Hinton operation could hardly have been built without the bulldozer. Crawler tractors also provide the motive power for scarification (although articulated wheeled skidders later took over this task on some terrain, and specialized silvicultural equipment has now displaced scarification on many sites). Better bulldozers built better roads, which facilitated truck transport to the mill and eventually led to year-round operations.

At first the hauling to the mill woodyard was done with a motley assortment of farm trucks, most carrying fourteen cubic metres or less in a load, and larger tandem trucks carrying up to about twenty-eight cubic metres. After the switch to tree-length hauling in the late 1960s, big off-highway trucks carried more than

Self-loading trucks transport up to sixty cubic metres of tree-length logs per load from landings to the woodyard.ù fifty cubic metres in a load. After 1976, many of these trucks were equipped with self-loading grapples; otherwise, a crane or loader was required at roadside landings. Off-highway trucks currently carry up to sixty cubic metres, and highway trucks about forty cubic metres.

Figure 7.1. Major roads and railway lines in the expanded Weldwood forest management area in 2000



Effects of Mechanization

Technology and Safety

As the new technologies were introduced, the number of workers "on the forest floor" dropped dramatically. A way of life in the logging camps disappeared. Workers needed higher levels of skill and training. Mechanics moved in as blacksmiths moved out. Night shifts were introduced in 1986, as good electrical lighting systems were available on new machines.

There were two strikes by the IWA in the era of industry mechanization, one in 1968 and another in 1972. However, both disputes focussed on wages and benefits rather than mechanization. In fact, because of the high turnover among loggers, there were no layoffs due to mechanization.

The effect of mechanization on safety and productivity was dramatic. In the horse-logging era, there were typically about one hundred lost-time accidents per year. This dropped to thirty to fifty such accidents annually in the 1970s, less than ten per year after 1982, and less than one per year on average in the 1990s (see figure 7.2). Over the same four-decade period, the output per woods worker rose more than tenfold.

However, it was not just equipment that improved safety. A key decision in 1975 required each supervisor to maintain daily contact with employees and become accountable for safety. As a result of improved training, workers looked for hazards before they happened and knew how to respond quickly and effectively when unsafe conditions arose.

The emphasis on safety continues. Since the operation became part of Weldwood of Canada Limited in 1988, the Hinton forest resources department has won the company's prestigious President's Safety Award seven out of twelve years, in competition with all the other Weldwood mill and woods operations in Alberta and British Columbia.

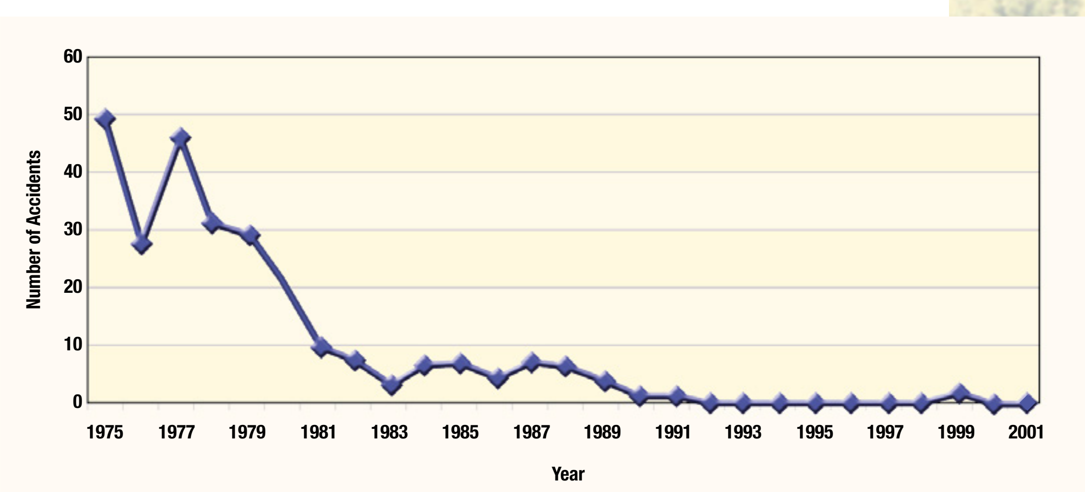


Figure 7.2. Lost-time accidents in Hinton forest operations, 1975–2001

Multiple Uses and Values
Aboriginal Peoples

The original lease area in 1955 did not include any permanent Aboriginal settlements or reserves, but there were quite a few Aboriginal people among the population. These included descendants of Métis families who settled in the Entrance area early in the twentieth century, as well as other Aboriginal people who came to work in the sawmills, railways, coal mines, and related businesses such as trucking.

In the 1996 census, 725 Hinton residents (about 7 per cent of the population) listed themselves as Aboriginal, and others lived in surrounding parts of the forest management area. These included the “Smallboy Camp,” a group from the Ermineskin First Nation who moved in the early 1970s from near Nordegg, Alberta, onto Crown land in the southern part of the forest management area.

There were always some Aboriginal people among the employees and contractors, and the company made a specific effort to recruit Aboriginal people around the time mechanical skidders replaced horses in company operations in 1968. Rosaire Lacroix said he had six or seven Aboriginal people on his crew in the Berland area at that time. One faller and two skidder operators, brothers Jerry, Fred, and Tom Beaverbone, were among the crew’s top producers.

The first formal relationship with an Aboriginal community began in the early 1970s. About a dozen families, originally from the Rocky Mountain House area, had been logging timber berths in the northwestern part of the forest management area since the 1950s. In 1972, they formed a co-operative (which later became the Fox Creek Development Association Limited) to perform contract logging for the company. Woodlands manager Jim Clark and former Alberta Forest Service ranger Sam Sinclair worked with the group to obtain funding for additional equipment, and one of the company’s staff, Norm Teskey, helped with training. Fox Creek Development started with six horses for skidding and eventually made the transition to mechanical skidders. “Their contract situation allowed them to work independent of the company’s operation,” Clark observed. “If some fellow needed time off work to hunt or attend a ceremony, he arranged his time off without a problem. Their work accommodated their traditions and ancestral way of life, while they accommodated to the work’s need. It is a Native Peoples’ success story and they are rightly proud of it.”

In the 1980s, as the company moved to newer harvest methods, the Fox Creek group—most of whom had moved into Hinton—continued to use power saws and cable skidders, which enabled them to work on steeper terrain and sensitive sites not accessible to heavy equipment. In 1994, when hand logging with power saws was largely discontinued, Fox Creek Development got out of the harvest business and became one of the company’s leading silvicultural contractors.

Fox Creek Development generally employed about fourteen or fifteen workers in logging, and this increased to about twenty workers doing silvicultural work in the late 1990s. Most of this work involves manual clearing of brush overtopping young reforestation. In addition, Fox Creek Development also performs campground maintenance for Weldwood, and supplies an eight-person firefighting crew to the forest service when needed. Including non-Weldwood projects, Fox Creek Development now provides part-time work for up to forty-five Aboriginal people in the Hinton area.

Technology and Sustainability

Each combination of technologies produced a different result in the forest. Horses could only skid efficiently for short distances, one hundred metres or less, and generally downhill, so cutblocks tended to be relatively small, but a great deal of road building was required. Rubber-tired cable skidders were efficient over distances up to about eight hundred metres, and the first generation of feller-bunchers, mounted on heavy crawler tractors, was most efficient for large clear-cuts. As a result, in the 1970s and 1980s, mechanization led to larger cutblocks and bigger roadside landings, but reduced the need for roads. New machinery designs subsequently allowed a variety of options, including tree-by-tree selective cutting (instead of clear-cutting) where appropriate, and harvest could occur up to a kilometre or more from the nearest road. This flexibility was crucial in meeting the multiple objectives of sustainable forest management.

The changing technologies had other social and environmental consequences that were initially unforeseen. Roads opened up formerly inaccessible forest areas to public access at the same time that the environmental movement was gaining momentum in Canada and internationally. The industrial "footprint" in the forest was heaviest and least pretty in the 1970s and 1980s, just as many urban Canadians were discovering both outdoor recreation and environmentalism. In the 1990s, a new wave of "softer" methods and technologies began to reduce environmental and aesthetic impacts, but a highly polarized debate continued about when, where, and how to conduct harvests.

Company foresters had a second, equally important reason to modify harvest methods in the 1990s. Surveys of regeneration on recent harvest sites showed that some aspects of forestry practice, such as heavy equipment, were reducing the effectiveness of reforestation. If continued, this could have had severe consequences—more need for planting and other costly silvicultural treatments, less growth and yield, and an annual allowable cut lower than might be achieved otherwise.

Lighter and more versatile equipment helped to reduce these impacts, but perhaps the most important change was the integration of silviculture and harvest planning. Careful evaluation of ecological conditions enables planners to choose the best combination of harvest design, equipment, time of year, and silvicultural treatment for each specific site. Yet another technology, the computerized geographic information system (GIS), plays a key role in the integration of silviculture needs, along with other values, in these sophisticated harvest designs. A GIS is an organized collection of computer hardware, software, and geographic data designed for capturing, storing, updating, manipulating, analyzing, and displaying all forms of geographically referenced information.

Strip Thinning with Modern Machinery

In March 2000, a ROCAN feller-processor, mounted on a converted farm tractor, performed two kinds of treatment: strip thinning and feathering (partial cutting), and straight strip thinning. The harvesting unit is about 2.1 metres wide, and the hydraulic boom can extend the feller-processor head nearly 6 metres. The delimbed, cut-to-length logs are taken to roadside in a ROTNE Rapid 10-tonne forwarder that is about 2.6 metres wide.

For straight strip thinning, the machine simply cuts corridors 3 metres wide through the stand. The strips are laid out in parallel rows, 11 metres between the centre lines—i.e., separated by 8 metres of undisturbed forest after thinning.

For thinning and feathering, the machine again cuts a 3-metre corridor, but also reaches up to 5 metres into the stand to thin the trees. The goal is a 1.8-metre spacing in the feathered area.

continued on page 146

Feller-processors are used for commercial thinning operations.

In this trial, the parallel corridors are 22 metres apart at the centres—i.e., separated by 10 metres of feathered stand and 9 metres of undisturbed forest.

Some of the thinned stands are also being treated with nitrogen-based fertilizer. Comparison of these trials and untreated stands will help foresters to determine the most cost-effective methods for enhanced forest management.<

Economic forces and government policies brought a third factor, wood utilization, to the fore in the 1980s and 1990s. As the Environment Council of Alberta noted in its 1979 report, nearly 50 per cent of the harvested wood was ending up in burners or landfills, and a lot of potentially merchantable timber was left on the forest floor. Companies and government recognized this waste was both economically and environmentally undesirable. By the 1990s, there was a much greater integration of Alberta's lumber, pulp, and panelboard operations, aiming toward maximum value-added from the harvest. Full use of all cut timber became a key consideration, as did the quality of wood delivered to mills. New technologies also emerged during the 1980s for producing pulp and panelboard from aspen, formerly regarded as a weed species. Managing the wood inventory, at both roadside landings and mill woodyards, became increasingly complex.

Adapting to New Requirements

As the application of knowledge and technology transformed woodlands work from predominantly "muscle" to "mind," transformations of similar magnitude occurred in the manufacturing side of the Hinton operation, requiring even more changes in the woodlands. The 1988 revision of the Forest Management Agreement brought new challenges. The agreement doubled the pulp mill cap-acity and increased the forest management area by 25 per cent, but most significantly it called for a dimension-lumber sawmill to replace the stud mill that had been producing two-by-fours since 1972. The HI-ATHA sawmill, which began production in 1993, was four times larger than the stud mill and demanded quality as well as quantity (see figure 7.3).

Even before the agreement was approved, the company was studying ways to deal with problems such as the "butt shatter" caused by the hydraulic shears on feller-bunchers. Previously, there had always been more than enough sawlogs for the stud mill, but HI-ATHA could not afford any waste. Fortunately, new cutting

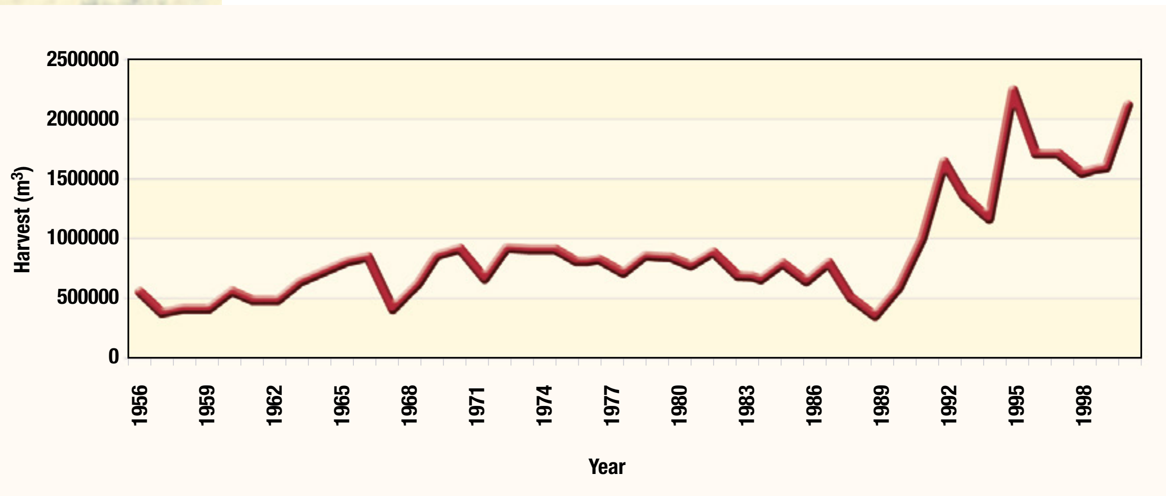


Figure 7.3. The volume of harvest per year, starting with 1955–56

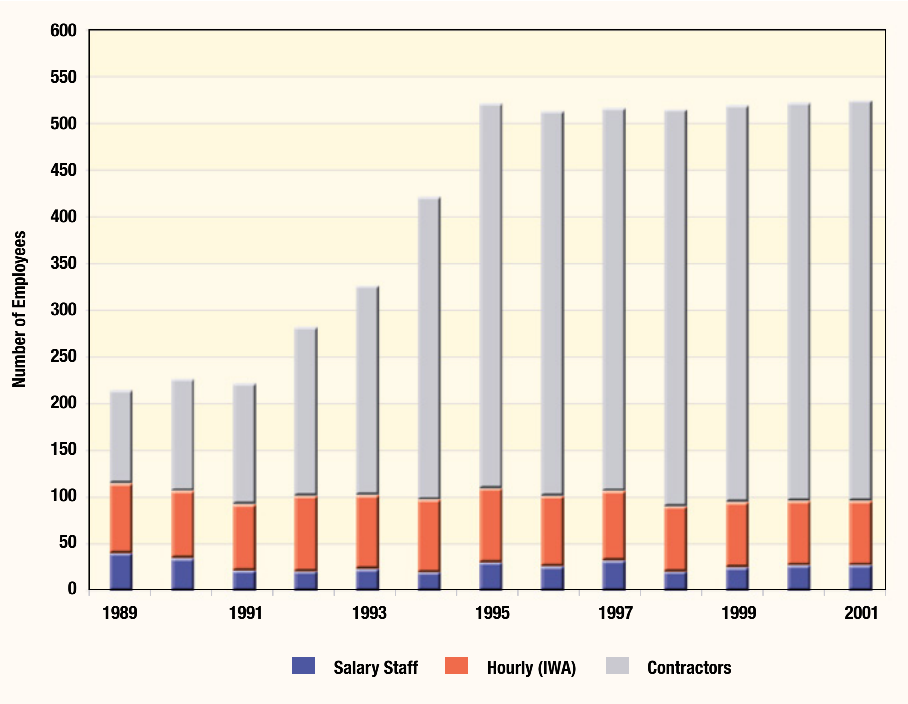


Figure 7.4. Employment in the Weldwood forest resources department, 1989–2001

heads were available that used hydraulic saws instead of shears for felling. Saw heads began to be introduced in the mid-1980s and the last shear head was replaced with a saw head in 1991.

After relying primarily on company crews for twenty years, Weldwood decided to bring in more contractors as production soared (see figure 7.4), and negotiated an agreement with the IWA to enable this change, representing about 60 per cent of the harvest. Some of these were contracted for specific tasks such as felling or trucking, while others were grouped on a "stump to dump" basis. The latter type of contract might include one feller-buncher, a couple of skidders, and two or three trucks. In a stump-to-dump contract, payment was based on tonnes delivered to the mill rather than a specific phase of the operation. Two automated weigh scales were installed at the mill to calculate the amount delivered. With the shift to contractors, however, it was important to plan exactly how the harvest would be conducted.

Slash burning is becoming less common as technology supports integrated harvest and reforestation planning.

At about the same time, company foresters identified potentially costly problems associated with roadside delimbing. For one thing, large piles of slash accumulated. The usual practice of burning slash piles was expensive and a fire risk, and it degraded the soil. On pine sites, removal of the cone-bearing slash hampered natural regeneration and meant more sites had to be planted. Needles, fine limbs, and

Feller-processors fell, delimb, and buck logs at the stump, sorting them into piles for end uses that include pulpwood, sawlogs, and veneer logs.

debris provided fewer nutrients to the soil, microsites for seedlings, and microhabitat for animals. Without slash, there was less material to hold snow and allow a slow release of moisture in the spring. In effect, the current savings in logging costs were more than offset by the future costs for silviculture and environmental damage.

During this review of logging systems in the early 1990s, it became evident that a new harvest method called stumpside processing could address a number of issues. Stumpside processing can be accomplished either by a feller-processor or by a combination of conventional feller-bunchers and a delimbing machine located in the block rather than at roadside. The slash is left on the forest floor, returning seeds, woody materials, and nutrients to the soil.

An added advantage of stumpside processing is that it creates a mat of debris to cushion the impact of heavy machinery on soil. With year-round operations, rutting and soil compaction were an increasing concern. Soil impacts were also reduced by use of "higher-flotation" machines with wider tracks or lower-pressure tires. Some of the machines were considerably lighter than early models.

In 1993 and 1994, as a wider array of tools became available, the company made important changes in the way harvests were planned and executed. The basic principle was that harvest represents "both the end of the stand of trees and the beginning of the new forest." This meant silviculture foresters worked together with harvest planners to make sure the optimum combination of systems and methods would be used on each site, depending on its specific ecological conditions (see

Table 7.1. The seven major logging systems in use at Hinton in 2000

System	Type	Approximate percentage of harvest volume (%)
Feller-buncher, grapple skidder, roadside delimbing	Tree length	10
Feller-buncher, grapple skidder, in-block delimbing	Tree length	45
Hand falling, topping, cable skidding, roadside delimbing	Tree length	4
Feller-processor, grapple skidder	Tree length	22
Feller-processor, clambunk forwarder	Tree length	6
Feller-processor, shortwood forwarder	Shortwood	4
Feller-buncher, in-block topping, grapple skidder, bush chipping	Chips	9

table 7.1). By 2000, seven different systems were in use on various parts of the forest management area.

Weldwood also recognized that many impacts depended on the minute-by-minute decisions of operators who usually worked without direct supervision. As a result, a high priority was put on developing operator awareness and skills. This was accomplished through group presentations and one-on-one contacts, backed up by post-harvest audits. A computerized CD-ROM stewardship-training program was developed in 1998. It encompassed all aspects of stewardship—including legislation, planning, ecosystems, water quality, and best management practices. Fifty-four contractors and employees completed the course in the first year, and the goal after 2000 is to have all contractors and staff complete the course once every three years. Training in safety and stewardship is also provided for employees and contractors each year during spring breakup.

The educational program was enhanced in 1999 with publication of the company's *Handbook of Forest Stewardship for 21st Century Workers*. In plain English, the eighty-five-page handbook explains the principles of sustainable forestry and practical ways to put those principles into effect. For this handbook, Weldwood was awarded a Wildlife Habitat Canada (WHC) Stewardship Award in 2000.

In 1999, Weldwood logger Glenn Davies also received the WHC Stewardship Award for his individual contribution to stewardship. Davies was operating a feller-buncher when he spotted a goshawk flying into a nearby clump of trees. It turned out the goshawk had its young in a nest there. The harvest crew left the area until the birds fledged and left the nest.

Table 7.2. Key forest technologies adopted by the Alberta forest products industry

Activity	Before 1950	1950s	1960s	1970s	1980s	1990sP
Camps	Logging camps, almost all in winter	"Modern" camps with power and water, mostly seasonal	Daily commuting, moving toward year-round operations	Year-round, commuting	Year-round, commuting, reduced woods labour	Year-round, commuting, further reduced woods labour per cubic metre harvested
Felling	Crosscut or swede saw felling, undercuts with axe	Chainsaw felling	Lighter, safer chainsaws, later anti-vibration designs	Shear head feller-buncher (tracked) or chainsaw	Saw head feller-buncher (tracked); high-intensity lighting, night shifts; reduced chain saw use	Feller-buncher or stumpside feller-processor (tracked or wheeled, some with computerized log optimizers); minimal chainsaw use
Delimbing	Axe or swede saw delimbing	Chainsaw delimbing	Chainsaw delimbing	Chainsaw or roadside delimbing	Roadside delimbing	In-block or roadside delimbing (or feller-processor)
Log lengths	50- or 100-inch pulp logs (1.25–2.5 metres); 8- or 16-foot sawlogs (2.5–5 metres)	50- or 100-inch pulp logs (1.25–2.5 metres); 8- or 16-foot sawlogs (2.5–5 metres)	Transition to tree-length skidding, hauling and woodyards	Tree length and whole-tree skidding and roadside delimbing; tree-length hauling and woodyards	Whole-tree skidding, roadside delimbing	Multiple systems including tree-length and cut-to-length (CTL)
Bucking (and chipping)	Crosscut or swede saw	Chainsaw	Chainsaw top, some chainsaw bucking	Tree-length, shear topping	Tree-length, shear topping; portable roadside chippers	Tree length, saw topping, or cut-to-length (CTL) sawing; roadside chipping
Skidding	Horses, early bulldozers	Horse, winch, or rigid-frame tractor	Horse or articulated wheeled skidder cable	Cable or grapple skidder	Cable or grapple skidder, wide tires, soft "terra" tires	Various types of skidders or forwarders, low-impact tires and tracks
Roads	Horse-drawn buckets and graders, tracked vehicles for road building, winter roads and ice-rutters	More powerful engines, earth movers, winter roads, and some all-weather roads	Winter and all-weather roads	Winter and all-weather roads, precast bridges	More all-weather roads; more bridges and culverts to reduce erosion and siltation	More all-weather roads; portable temporary bridges; low-impact installation methods
Loading	Hand loading or A-frame and horse	A-frame and winch, grapple or front-end loader	Mobile crane	Self-loading truck or mobile crane	Self-loading trucks, front-end loaders, chip blowers	Multiple systems
Bush to Mill	River drives, flumes and booms, rail, sleighs pulled by horses or tractors	Variety of light to heavy trucks hauling wood to mill	Off-highway heavy duty trucks; radio dispatch	Self-loading trucks, year-round operations	Portable chippers, chip vans	Central tire inflation, geographic positioning systems (GPS), and computer-assisted dispatching

Quality and Quantity

Once the company could no longer afford any waste of harvested trees, managing the inventory became a crucial and complex task. This involved sorting and transportation systems, "fibre trades" with other forest companies, and computer-aided control of every step from stump to end product.

In contrast to the previous studmill, the HI-ATHA sawmill used the latest technology to extract as much high-quality product as possible for premium markets in North America and abroad. As a result, the size, straightness, and soundness of sawlogs were particularly important. Initially, to ensure quality control, the company decided that final grading and bucking should all be done at the central woodyard in Hinton. By the late 1990s, with raw logs directed to a number of mills throughout Alberta, it became evident that sorting in the woods would be critical to success. Meanwhile, improvements in cut-to-length (CTL) harvest technologies made them attractive for this purpose. As a result, use of CTL systems increased in the late 1990s, and they are expected to become more common in the future. The key advantage is the reduction in the number of sorting and handling operations.

Weldwood's HI-ATHA sawmill, opened in 1993, is one of Alberta's largest high-technology dimension-lumber sawmills.

In addition, recent research indicated that the "freshness" of wood was important for both the sawmill and the pulp mill. Fresh logs sawed more easily, yielded higher grades of lumber, and facilitated kiln-drying schedules. Fresh chips yielded greater pulp strength. Oxygen delignification, a new process that reduced chemical requirements in the pulp mill, worked better with fresh chips. However, the only way to achieve freshness was to keep inventories as low as possible and maintain a nearly year-round flow of wood to the mill.

Stains in the wood were a concern if lumber was destined for the Japanese market. Yet another quality issue was the small amount of subalpine and balsam fir harvested along with pine and spruce in the forest management area. The fir tended to be older and more resinous than the pine and spruce. This variation in wood quality and its different kiln-drying characteristics made fir less desirable for HI-ATHA. As a result, fir was directed to the pulp mill. Weldwood's Sunpine mill at Sundre was also testing single-species runs of fir for specialty products.

As the new century began, new harvesting machines continued to improve tree utilization. Trading equivalent fibre with other industry partners added value for everyone's operations (see figure 7.5). For example, poplar could now go to oriented strandboard mills in exchange for conifer wood chips; sixteen-foot sawlogs of uniform diameter could be sent to other sawmills and veneer plants in exchange for wood chips and pulpwood logs; sawmill waste could be shipped to a medium-density fibreboard plant in return for wood chips. A portable debarking and chipping unit improved fibre recovery and reduced waste by producing chips from the small trees in mature, small-diameter stands. An experimental dual-purpose chip truck carried cut-to-length timber in one direction and wood chips on the way back.

The HI-ATHA mill produces high-quality lumber, which is sold primarily to Canadian and U.S. markets.

Weldwood is developing a dual-purpose truck for moving logs from the woods to customer mills, such as Sunpine's lumber mill at Sundre, and returning with wood chips for the Hinton pulp mill.

Continuous Operations

Company planners worked with contractors to find systems that could operate even during spring thaws and summer rains. For example, 80 per cent of skidders and forwarders in 2000 were equipped with high-flotation tires up to 1.3 metres wide and using very low pressures. Central tire inflation, a system that allows drivers to lower tire pressures on softer roads, was likewise becoming standard equipment on logging trucks and chip vans operating on company roads.

Bryon Muhly, Weldwood's manager of resources optimization for Alberta, said the new systems available at the start of the twenty-first century reflected a convergence of economic, operational, silvicultural, and environmental objectives:

> *There were a number of benefits from changing harvest systems to operate on a more continuous basis. We reduced the ground compaction and site*

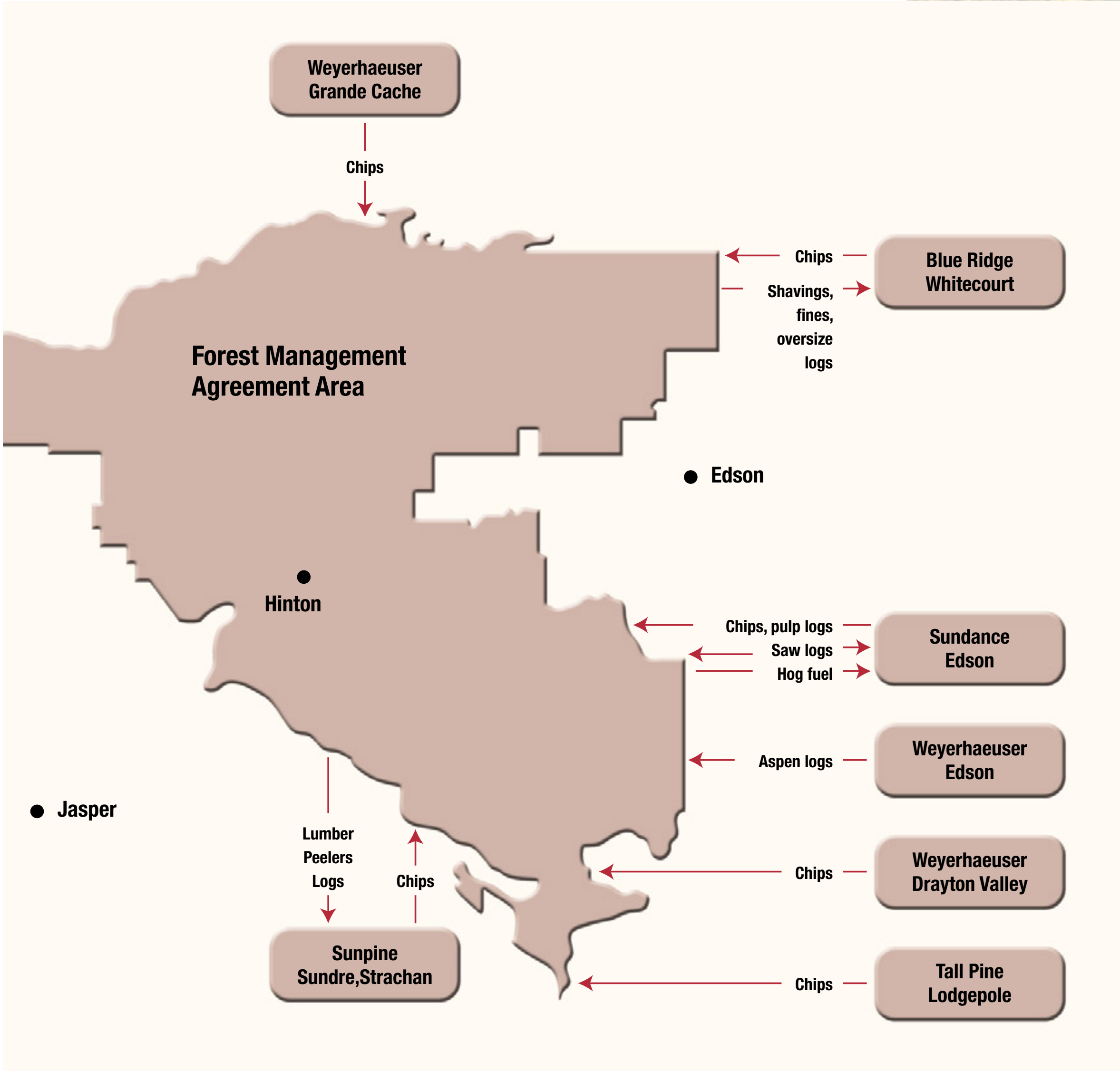


Figure 7.5. Flow of fibre transactions to and from the Hinton forest management area, 2000

impact and reduced our silviculture cost, improved log quality and fibre quality for both the sawmill and the pulp mill, reduced logging costs because contractors were able to put more volume through their equipment, and reduced to some extent our roading costs and site impacts through being able to drive over limbs and tops while skidding wood out of the block and to roadside.

Terry Nilson, the company's fibre allocation manager, noted that management encouraged company personnel to experiment as much as possible with new and potentially rewarding technologies and systems. A lean and simple project approval process helped. "We're not forced to put together complex proposals for every innovation," Nilson said. "If there's something we want to try to improve our business, to run a little longer, to protect the environment, we just do it. We have that luxury—management wants us to have that freedom, so they encourage it."

Will Horse Logging Ever Return to Hinton?

In 1990, an interesting experiment was conducted on an environmentally sensitive riverside area south of Hinton. Weldwood wanted to remove some older timber selectively while maintaining wildlife habitat, so it was decided to do part of the job with modern machinery and part with hand falling and horse skidding. "The mechanical system was much more effective," Bryon Muhly said. "The environmental impacts were the same or less, but the machinery was far safer and cheaper." In fact, the hand faller could not meet one of the environmental objectives—to leave standing, dead trees (snags) for wildlife habitat—because this is unsafe and contravenes Alberta Occupational Health and Safety regulations.

Returning to the old methods would be economically impossible in any case. Today, only about 110 person-years are required to cut, delimb, skid, and pile Weldwood Hinton's two million cubic metres of harvest (an average of 83.5 cubic metres per person-day). To cut the same amount at the old horse-loggers' productivity rate (7.2 cubic metres per day) would require 1,275 person-years of labour. Including the 435 person-years of current forest management labour not directly involved in harvest, the total forestry and woodlands workforce would have to triple, soaring from 545 person-years to 1,710 person-years.

CHAPTER EIGHT

Forest Products

APPLYING TECHNOLOGY TO ADD VALUE

The single most attractive element was the potential of the under-utilized forest resource base and the adjacent available unallocated forest land. The key to a successful forest products operation is obviously a quality forest resource well located relative to its infrastructure needs (e.g., community, water supply, and transportation) and its manufacturing facilities. North Western Pulp and Power had just such a resource well located to its manufacturing facilities and infrastructure needs.

—KEN HALL, 1997

Young spruce trees develop in the partial shade of a mature lodgepole pine stand adjacent to a fully reforested cut-over. Pine and spruce constitute over 90 per cent of the fibre supplied to the Hinton facilities. STAN NAVRATIL

Kenneth Hall, a pulp mill executive with wide experience in British Columbia and abroad, did a careful study of the Hinton operation before agreeing to become its general manager in 1977. As he recalled in an interview twenty years later, he was excited by the potential.

From the 1940s through the 1970s, the Alberta forest products industry developed relatively slowly. Until the oil slump of the mid-1980s, the provincial government saw little need to match the financial incentives offered to forest companies elsewhere in Canada and abroad. Additional deterrents were Alberta's relatively high labour costs (attributable to oil and gas industry activity) and the long, expensive haul by road or rail to major forest products markets. In fact, for many years, oil and gas companies cut more forested area annually than forest companies. However, the forest management agreement and quota systems created a progressive framework for further development. Sawmills modernized and expanded after 1966, and the second Alberta pulp mill was built at Grande Prairie in the early 1970s. Then the modern, integrated industry was shaped by a series of economic, political, and technological events in the 1980s: a severe recession, a sharp decline in crude oil and natural gas prices, changes in government policy, growing environmental awareness, and new methods for manufacturing products from "waste" wood and "weed" species. By the 1990s, the industry was effectively reborn. Hinton was affected, directly and indirectly, by all these developments.

Alberta's First Kraft Pulp Mill

Between 1951 and 1954, North Western Pulp & Power (NWPP) apparently considered several possible pulp mill configurations. Capacity between 32,000 and 64,000 tonnes per year was mentioned in early versions of the lease agreement. After St. Regis joined the project in 1954, the agreement was revised to specify annual cap-acity of at least 96,000 tonnes. By the time plans were drawn up and the mill site relocated from Edson to Hinton early in 1955, the design capacity increased to

Construction of Alberta's first pulp mill began at Hinton in 1955.
Stanton G. V. Hart"

128,000 tonnes annually. The mill actually exceeded this figure every year after 1959, and continuous fine-tuning brought the facility's output to a peak of 192,558 tonnes in 1988 before a major modernization more than doubled capacity in 1991.

The goal from the beginning was to produce a high-quality bleached kraft sulphate pulp that would appeal to papermakers on the basis of its strength and whiteness. (Kraft is the German word for "strong.") Product quality would help overcome the high start-up costs of a new venture in new territory—$42 million at the time, equivalent to more than $270 million in year 2000 dollars—and the relatively high cost of rail transportation from Hinton. One reason St. Regis rejected Frank Ruben's original plan to use coal for fuel was the risk that coal specks would affect the whiteness and brightness of the pulp.

Until after the Second World War, most pulp mills produced either "sulphite" pulp or groundwood pulp. The fibres in sulphite pulp were not as strong, and the mills were notorious for odours and pollution. Groundwood pulp was literally ground-up wood and was used mainly for newsprint and other low-value papers where the high lignin content was not a consideration. Lignin is the glue that holds cellulose wood fibres together. It has a brownish colour; papers containing lignin yellow in sunlight and deteriorate over time.

In 1954 and 1955, samples of timber were sent to St. Regis facilities for testing to determine the best process to use in the new mill, and the technology chosen was state-of-the-art for the day. Two Kamyr continuous digesters, the first in North America, would separate most of the lignin and pitch from the wood, and a series of chlorine bleach baths would remove the remaining impurities from the long, strong cellulose fibres of northern conifers.

The heart of the kraft process is the digester. Wood chips are cooked there in "white liquor," an alkaline solution of sodium hydroxide (caustic soda, NaOH) and sodium sulphide (Na_2S). These chemicals dissolve most of the lignin, but the cellulose strands remain intact. In the Kamyr digesters used at Hinton, there is a continuous flow through the vessel. Wood chips, softened first by steaming, are fed into the top, and cellulose fibres emerge at the bottom. Careful control of the temperature, pressure, and chemical composition is essential to make the process work properly. There were many problems fine-tuning the process during the first two years, which explains why production was well under capacity until 1959.

What made the kraft process economical was the invention of methods to recycle the chemicals and recover the energy from the lignin. The lignin-and-chemical mixture is known as "black liquor" when it comes out of the digester. Evaporation then concentrates the liquid and removes most of the water. This thickened black liquor becomes the main fuel for the plant's boiler. As the lignin is burned, the spent chemicals flow out the bottom of the combustion chamber. These spent chemicals are dissolved in water again to form "green liquor." Through chemical reactions with calcium oxide (lime, CaO), the green liquor is reconstituted into a new supply of white liquor.

Pulp is produced in bales for shipment to market and further processing into consumer products.

The kraft pulp from the digester is strong enough for papermaking, and it can be used to make products such as paper bags and cardboard, which have the characteristic brown colour of unbleached pulp. However, it takes further processing to get the pure white cellulose fibres required for fine papers, sanitary products, and the like. In the original Hinton mill design, and continuing until 1993, this was accomplished by a series of bleaching treatments using elemental chlorine. The bleaching removes the remaining lignin and other impurities without impairing the strength of the fibres. The pulp is then spread on a moving wire screen, dried with forced air and heat, cut into sheets, then pressed into bales.

Papermakers across North America and around the world have blended the "Hinton Hi-Brite" with other pulps to create consumer products as varied as the paper pull strips on chocolate candy, the backing on photographic paper, facial tissues, Easter egg "grass," magazine paper, wrapping tissue, flooring and wallpaper backing, coloured construction paper, shooting targets, party hats, sandwich bags, paper plates, ordinary waxed paper, and the green waxed paper used by florists.

In the early days, when pulp buyers were not familiar with the quality of lodgepole pine fibre, some purchasers insisted on pulp made solely from spruce. As a result, species were separated in the woodyard to serve these customers. "Special K" was a spruce-only pulp used by Kodak for photographic papers. In 1963, there was also a test run of poplar. The deciduous wood produced a good-quality pulp, but it could not be dried properly because the mill's dryers were not designed for a pulp with short fibres. This option was not pursued at Hinton.

For several years, the company operated an experimental digester that could process four kilograms of chips at a time, allowing technicians to examine various wood and process combinations. (This lab unit was really tiny; at the time, the mill was consuming about a million kilograms of chips per day.) Studies there showed that good pulp could be produced from fire-killed timber, but the company was reluctant to risk compromising pulp quality and did not use any fire-killed wood until after the mill expansion in 1990.

Reducing Environmental Impacts

The original Hinton pulp mill was clean and efficient by the standards of the 1950s, especially compared to the old sulphite mills. However, by today's standards, it was smelly and polluting. The quantities of nutrients, solids, and chlorinated compounds released by this one mill into the Athabasca River during the 1950s and early 1960s, although well within the licence conditions of the day, were considerably greater than the amounts released by all seven Alberta pulp mills during the 1990s. For example, figure 8.1 shows biochemical oxygen demand (BOD), an indicator of the amount of nutrients in effluents. Nutrients affect fish and other aquatic life by reducing the amount of oxygen available to them.

The Alberta government recognized that pulp mill discharges could have a significant impact on rivers. According to Pete Hart's recollection in a 1976 interview, this concern was a major reason for relocating the mill from Edson to Hinton. "The government wouldn't let us [build the mill in Edson]," he said. Because of the low water flows in the McLeod River, "the pollution would be too heavy, and it would make a sewer out of it." The Athabasca River, with more than four times the water volume, would dilute the discharges considerably. "We had plenty of water in the Athabasca," Hart noted.

The company provided water and sewage treatment for the town as well as the mill, and the treatment facilities were upgraded several times as technology improved and standards were raised. The government began monitoring water quality in the Athabasca in the early 1960s, and the licence requirements changed at least once per decade over the next forty years. The main concern was the impact on the river in mid-winter, when the surface is frozen and the water flow barely one-tenth of its summer peak.

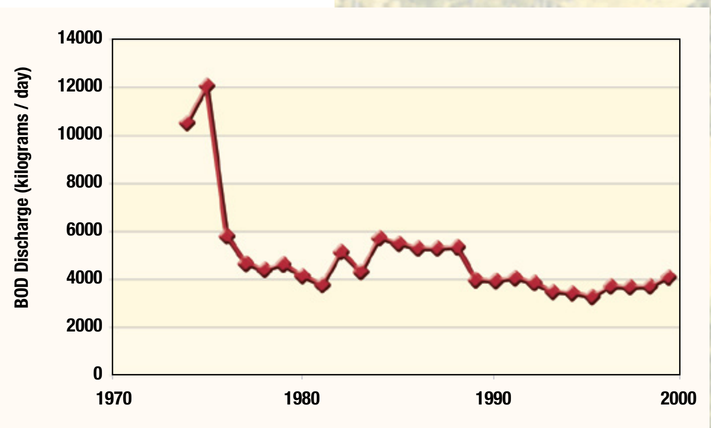


Figure 8.1. Biochemical oxygen demand (BOD) discharge to the Athabasca River, 1970–2000

As the mill became more efficient, more water was recycled and more solids and nutrients were burned in the boilers. Treatment ponds were enlarged so that there was more treatment capacity and more solids settled out before water was discharged. The solids were hydraulically dredged out periodically and disposed of in landfill. Aerating the water during treatment encouraged bacteria to digest the organic materials. By the 1980s, chlorine compounds were the principal water quality issue for bleached kraft pulp mills. The compounds, resulting from use of elemental chlorine in the bleaching process, included trace amounts of highly toxic dioxins and furans. Potentially cancer-causing dioxins and furans were a major focus of environmental concern about pulp mill effluents in the 1980s, and this was a key factor in the adoption of new technologies in the 1990s.

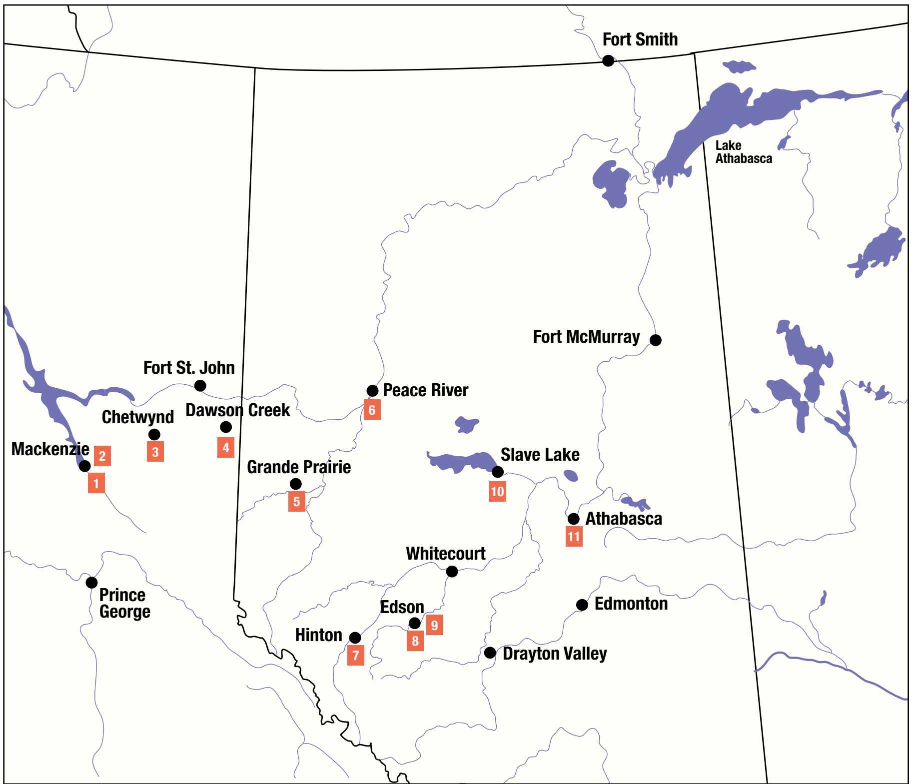
When the mill was rebuilt and expanded in 1989–90, a new process called oxygen delignification was added. This process removes a substantial amount of lignin between the pulping and bleaching stages. As a result, it was possible to use alternative bleaching agents such as oxygen and chlorine dioxide. The pulp mill stopped using elemental chlorine in 1993 and was labelled "elemental chlorine free (ECF)." After 1993, the chlorine compounds in effluent dropped sharply, and the quantities of dioxins and furans were below regulators' measurable limits. This further reduced effects on the river and made the pulp more marketable, especially in Europe.

Treatment ponds aerate effluent from the pulp mill and sewage from the Town of Hinton to reduce biochemical oxygen demand in the discharge.

Between 1991 and 1996, the Alberta and federal governments launched a major scientific study of the province's north-flowing rivers (see figure 8.2). The Northern River Basin Study included about 150 research projects on such diverse topics as river flow, hydraulics, nutrients, dissolved oxygen, contaminants, fisheries, ecosystem health, traditional knowledge, cumulative effects, modelling, drinking water, resource use, and human health. The study found that, on the whole, the condition of aquatic ecosystems in the northern basins was good. Dioxins and furans in fish were declining, and basin residents had access to good quality drinking water. The governments pledged to continue research and address problem areas.

Air-quality issues at Hinton mainly involved odours from sulphur compounds in the plant's emissions. While the total amount of sulphur was less than the releases from a medium-size natural gas plant or coal-fired generating station, the emissions included highly odorous substances such as methyl mercaptan. These emissions were reduced by improving process controls and emission treatment facilities. Directing process vent gases through the power boiler for combustion reduced odours and sulphur emissions. As with so many environmental issues, management systems and worker training were key factors in improving air quality.

Solid wastes include bark, woodyard debris, green liquor dregs, and lime mud. Some hog fuel (bark and wood wastes) have been burned in one of the mill's three power boilers since 1957, but most of the other solid wastes were disposed of in a landfill. After the mill expansion in the late 1980s, the power boilers burned more hog fuel to produce steam and electricity for the lumber and pulp mills, with excess power fed into the provincial grid. In the 1990s, a new device called a "reclaimer"



ID	Pulp Mill	Start-up Year	Product	Receiving Water
1	Fletcher Challenge	1972	bleached kraft pulp	Williston Lake
2	Finlay Forest Industries	1969	mechanical pulp, newsprint	Williston Lake
3	Louisiana-Pacific	1991	bleached chemi-thermomechanical pulp	not applicable
4	Fibreco	1988	bleached chemi-thermomechanical pulp	Peace River
5	Weyhaeuser Canada	1973	bleached kraft pulp	Wapiti River
6	Daishowa-Marubeni	1990	bleached kraft pulp	Peace River
7	Weldwood of Canada	1957	bleached kraft pulp	Athabasca River
8	Millar Western Pulp	1988	bleached chemi-thermomechanical pulp	Athabasca River
9	Alberta Newsprint Company	1990	thermomechanical pulp, de-inked paper	Athabasca River
10	Slave Lake Pulp	1991	bleached chemi-thermomechanical pulp	Lesser Slave River
11	Alberta Pacific Forest Industries	1993	bleached kraft pulp	Athabasca River

Figure 8.2. Mills and rivers: Northern River Basins Study, 1996

recovered woody materials from the woodyard and also reduced the amount of material deposited in landfills. In addition, woody wastes were used for soil remediation projects, and the company joined in research to find alternative uses for lime mud, boiler ash, and secondary-treatment sludge. Recycling efforts were stepped up throughout the operation: a new engineered landfill was built in 1992 for solid wastes; aggressive programs reduced and safely disposed of hazardous wastes; and spill prevention and response programs were upgraded throughout woodlands and mill operations.

To address environmental issues in the 1990s, the company established a Public Advisory Committee and a joint company-union environmental committee with Local 855 of the Communications, Energy and Paperworkers Union of Canada (CEP), which represents hourly employees at the pulp mill and sawmill. The company also joined the West Central Airshed Society (WCAS), a voluntary air-quality monitoring and improvement initiative involving government, industry, and non-government organizations in west-central Alberta.

The mills' environmental management systems passed demanding external audits in the 1990s for certification under the Alberta Forest Products Association's FOREST*CARE* program and in 2000 for certification under the International Standards Organization's ISO 14001 standards.

Table 8.1 shows the way in which wood processing technology improved in the last century in response to changing markets and opportunities to improve wood use and value.

Table 8.1 Alberta forest products technologies through the decades

Decade	Technology
Pre-1950	Tie-hacking, portable sawmills, central saw, re-saw, and planer mills
1950s	Portable sawmills, central sawmills, kraft pulp, plywood
1960s	Permanent sawmills, kraft pulp, plywood
1970s	Integrated lumber and pulp operation, second kraft pulp mill, large central sawmills, plywood
1980s	Use of aspen for chemi-thermomechanical pulps (CTMP) and oriented strandboard (OSB), softwood for medium-density fibreboard (MDF), kraft pulp, large central sawmills integrated with pulp and panelboard industry, laminated stressed beams, log home manufacturing, plywood
1990s	Paper production (newsprint), hardwood and softwood kraft and CTMP pulps, advanced emission- and effluent-control systems, phasing out chlorine bleach, FOREST*CARE* certification, custom sawing lumber for dimension and quality, MDF and OSB mills, central sawmills, plywood, remanufacturing by-products (e.g., finger-jointed lumber), engineered wood, log home manufacturing, energy from waste, increased integration of entire industry

Integration and Expansion

St. Regis always focussed on its main business, pulp and paper, and was not very interested in other products such as lumber or panelboard. However, a significant quantity of potential sawlogs were being cut and chipped under the "oldest first" approach to forest management. As a result, there was continuing pressure from the government to extract more value from the timber. Government officials did not forget the sharp criticism they endured from sawmillers displaced by the original Hinton pulpwood lease. In addition, producing a tonne of lumber generates more revenue and creates more jobs than producing a tonne of pulp—there is more "value added" in lumber. Since only about half of the volume of harvested wood entering a sawmill will emerge as lumber, chipping the residues can still support a healthy pulp industry. The Forest Management Agreement gave the company the right to turn all harvested wood into pulp, but the government clearly desired more integration of pulp and lumber operations. Renegotiations of the agreement for proposed expansions gave officials the opportunity to push this option.

In the early years, the sawlog issue was addressed by allowing some area sawmill operators to harvest larger timber. At least one sawmill operator, Bill Nigro, cut railway ties and sent his small-diameter logs and tops to the mill. One NWPP study in 1959 also examined the sawlog potential of the provisional reserve area, and another in the mid-1960s looked at wood quality throughout the pulpwood lease area. These studies, and the government's prompting, led to the construction, in 1971, of a sawmill—producing two-by-four "studs"—that began production early in 1972. Also in 1971, the company set up a portable sawmill in the woodyard that produced 240,000 ties under a contract with the Canadian National Railway. Jim Clark, who was woodlands manager during this period, said the latter venture was never profitable. These sawmilling initiatives partially satisfied the government's demands and also established Alberta's first integrated lumber-pulp operation, the forerunner of much greater integration across the province in the 1980s and 1990s.

Another attempt at diversification was a plant to extract "tall oil," a soapy mixture of fats and resins, from the pulp stream. The plant operated from 1967 to 1991, but was shut down after the mill expansion because of a continuing decline in demand for tall oil in the marketplace.

Ken Hall, as vice president and resident manager at Hinton from 1977 to 1987, was determined to realize the latent potential of the Alberta foothills around Hinton—an underutilized forest resource and a favourable social climate. The existing mills were too small to compete globally, and new technologies were available to improve efficiency and to reduce environmental impacts. Hall led the company through two major proposals to expand operations. The first was the company's failed project in 1978–79 to expand by acquiring a block of land north of the forest management area, advertised by the Alberta government as the "Berland Timber Development Area."

The Berland proposal, which failed when British Columbia Forest Products won government approval to develop the region, left Hall disappointed by the "politics" surrounding the government's decision (British Columbia Forest Products was partly owned by the Alberta government). For some time after this proposal, the only new development at Hinton was a 40 per cent expansion of the stud mill in 1981 to produce seventy million board feet annually. Further plans were delayed for several years by the severe recession of the early 1980s, low pulp prices, and major corporate battles for St. Regis. After fending off takeover attempts in 1983 and 1984 by Sir James Goldsmith and Rupert Murdoch, the venerable paper company announced a friendly merger in 1984 with Champion Corporation.

In 1984, the Alberta government published a major White Paper, *Proposals for an industrial and science strategy for Albertans 1985–1990,* which emphasized forest industry development as a key element in reducing the province's dependence on the oil and gas industry. Encouraged by this, Hall prepared a new strategic plan that won approval by Champion in late 1985. He and Champion president L. C. (Whitey) Heist met in April 1986 with Alberta premier Don Getty and Don Sparrow, the minister of Forestry, Lands and Wildlife, to discuss the possibilities. Hall then retired as vice president and manager in March 1987 to become expansion project leader until the new pulp mill opened in 1990.

This set off a year of intense planning and negotiations leading to the new Forest Management Agreement signed on 16 June 1988. Key considerations included railway freight rates, federal and provincial taxes, a provincial loan guarantee, utilities, roads, wood resources, forest management, and environmental standards. The three main components were a modernization to double pulp mill capacity, replacing the seventy-million-board-foot-per-year stud mill with a three-times-larger dimension lumber mill, and a 25 per cent increase in the forest management area.

The $415-million project included a new Kamyr digester, oxygen delignification, chlorine dioxide bleaching, a new recovery boiler, and advanced pollution controls. The mill's capacity doubled to 380,000 tonnes per year. Ken Hall retired on 14 March 1990, as the project was completed. The Alberta Chamber of Resources named him the 1990 Resource Person of the Year.

Sawmill construction was delayed by economic recession and the need for detailed analysis of timber supply, wood quality, mill technologies, and lumber markets. Dennis Hawksworth, who transferred to Hinton from Babine Forest Products (a Weldwood mill in British Columbia), used the time to good advantage as he led the design and construction of a state-of-the-art dimension lumber mill, specifically tailored to the timber growing on the forest management area. The $72-million HI-ATHA mill, designed to produce 215 million board feet annually, was completed in August 1993. It included the latest computerized equipment to reduce waste and obtain optimum value from each log. Because trade restrictions affected the traditional U.S. lumber market, HI-ATHA produced both U.S. and metric dimensions and was able to meet the demanding Japanese Agricultural Standard (JAS) lumber criteria. In 1997, the mill's output reached 230 million board feet, and output rose to 245 million board feet in 2000 (see figure 8.3).

Figure 8.4 shows how a planned harvest level of 2.2 million cubic metres is allocated to end uses. About 100,000 cubic metres is undersize (below regulatory utilization standards) for sawlogs and another million cubic metres would be classified as marginal sawlog—i.e., mostly pulpwood—and the rest are conventional sawlogs. Woodroom consumption (material not converted to lumber—i.e., chipped for pulp, sent to a panelboard mill, or burned in the power boiler) from that amount is around 600,000 cubic metres. HI-ATHA is using all the conventional

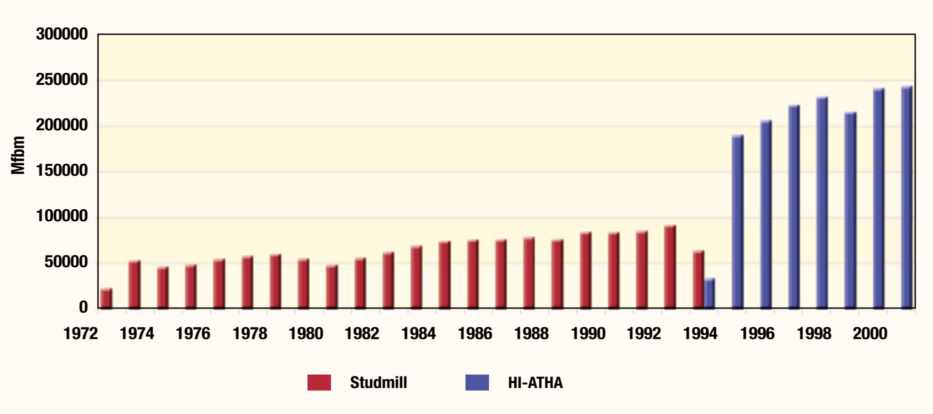


Figure 8.3. Lumber production, 1972–2000Å

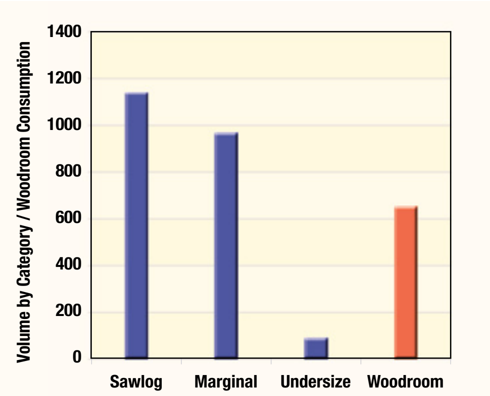


Figure 8.4. Distribution of harvest volume by log quality compared to woodroom production.

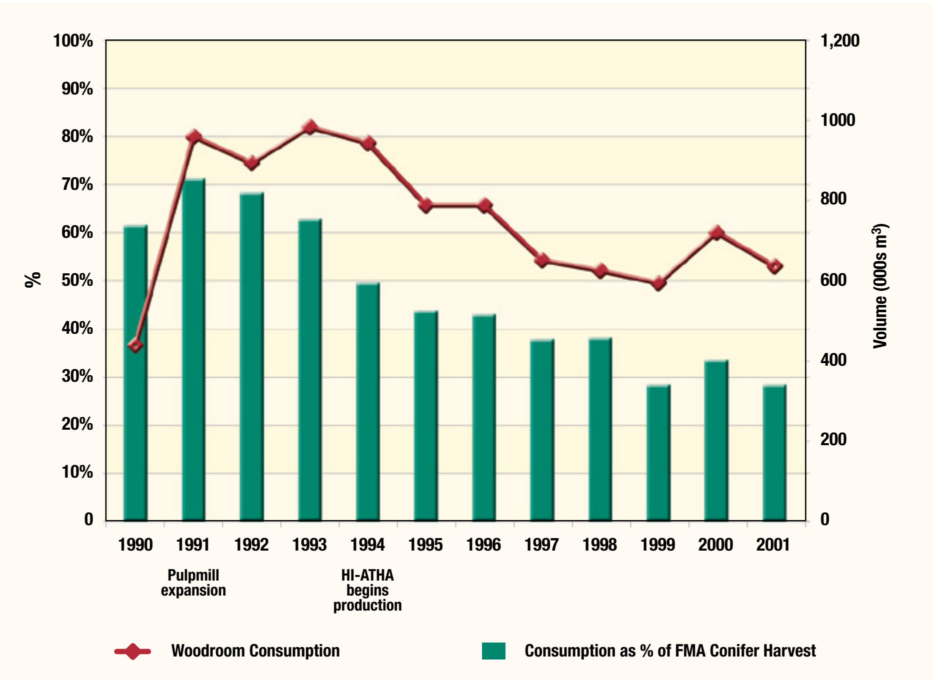
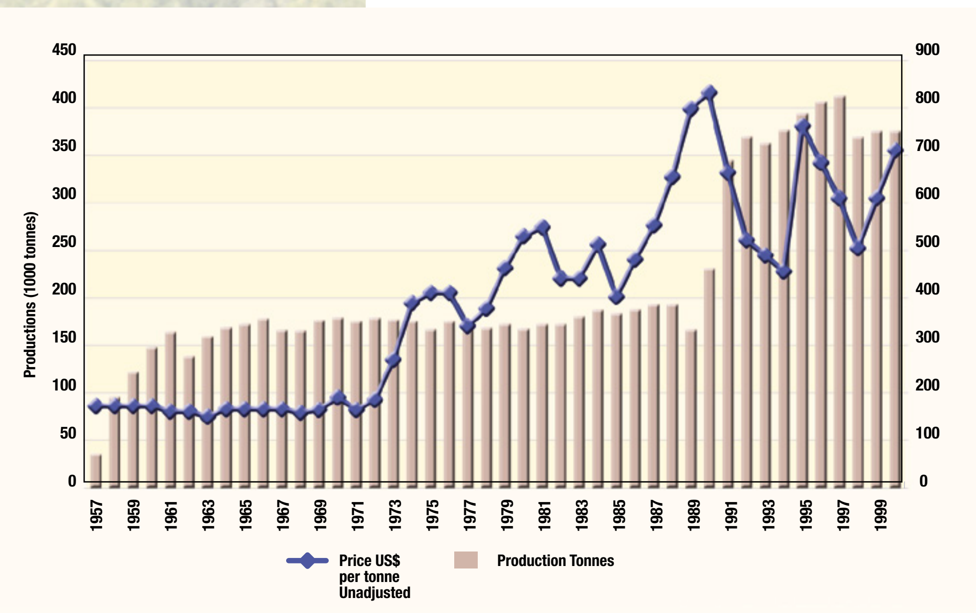


Figure 8.5. Woodroom total production and as a proportion of forest management area conifer harvest, 1990–2001

sawlogs plus about 500,000 cubic metres of marginal sawlogs. Weldwood is not running sawlogs through its woodroom to be ground up into pulp chips. As can be seen in figure 8.5, the proportion of roundwood from the forest management area being fed directly into the woodroom for chipping has been steadily declining. Conversion of roundwood to chips, as a proportion of the total volume harvested, has steadily declined from more than 60 per cent in the early 1990s to about 30 per cent in 2002. It is imperative that company operations make the best end use for each wood product.

The highest nominal price received for pulp at Hinton was $985 US per air-dried metric tonne in October 1995, equivalent to $1,112.97 US in 2000 dollars, adjusted for inflation. The lowest nominal price was $156.30 US per tonne in January 1963, but this was equivalent to $880.70 US in 2000. The price of pulp when the mill began production in 1957 was $176.40 US, equivalent to a quite respectable $1,081 US in 2000. Pulp prices are historically cyclical, rising and falling according to global supply and demand. The big difference over the years has been the sinking value of the Canadian dollar, which was worth $1.06 US in 1957 but only about 66 US cents in 2000. In Canadian dollar terms, pulp prices in the 1990s translated into relatively high historic values.

Figure 8.6. Pulp mill production (bars) and average selling price per tonne (line), 1957–2000



Betting on Trees

The 1988 Forest Management Agreement, doubling pulp production and quadrupling lumber output, represented a bold gamble by the company. The long-term viability of the venture depended crucially on foresters' ability not only to maintain but to increase the productivity of the forest management area. It was an informed risk, based on decades of successful reforestation, but until the 1990s the actual harvest was less than the annual allowable cut, so there was always a margin of error. After that point, failure to reforest successfully would lead to reductions in the annual allowable cut, with potentially disastrous consequences for the company.

CHAPTER NINE

Growing the New Forest

Alberta is the only province in which the timber licensee is obliged to conduct reforestation of cut-over lands at his own expense. This puts the responsibility for performance directly on his shoulders and it is in his own self-interest to accomplish this goal in an economically efficient manner. At the same time, he is obliged to satisfy the performance regulations devised by the Crown, with which he may not agree.

—Environment Council of Alberta, 1979

Young pine trees signal the beginnings of a new forest on a logged-over area south of Hinton.

For nearly a quarter century, from the mid-1950s to the late 1970s, Alberta stood alone in its reliance on industry to grow the new forest after harvest on public lands in Canada. The forest around Hinton was the laboratory where this approach was tested on a large scale, refined, and ultimately proved successful. The policy covered all forest management agreements and was extended to most of the province's

other forest operations after the quota system was introduced in 1966. This gave Alberta a substantial head start when reforestation became a major public concern in the 1970s and 1980s, and it set the stage for sustainable forest management in the 1990s. The evolution of forest renewal at Hinton is an excellent example of adaptive management in practice.

Until Alberta's innovative approach, reforestation in Canada was generally left to government or nature. Government efforts were sporadic, depending on the vagaries of budgets, resources, and priorities. Most harvested areas were left to nature. This produced variable results, depending on the site, species, and harvest method, but there were typically long delays between harvest and the establishment of the new forest. A few sites did not regenerate at all, some regenerated slowly, and others came back with less desirable species predominating.

The problem, for both industry and government, was easy to see but hard to remedy. In northern forests, where the tree species mature in 60 to 120 years or longer, today's decision-makers will not be around to reap the benefits of the new stands they establish. In economic terms, the "present value" of the future forest is very low. Yet it was clear, as early as the 1950s, that lack of systematic reforestation endangered the long-term viability of both the industry and the resource.

The Alberta approach gave industry four good reasons to conduct effective reforestation—two "carrots" and two "sticks":

1. Long-term tenure agreements were renewable so long as commitments, including reforestation, were fulfilled.
2. The annual allowable cut, based on the amount of forest growth, could increase if new stands grew more vigorously than the ones they replaced, and the forest management agreement holders would receive this increase.
3. There were financial penalties, so much per hectare, if new growth was not successfully established on harvest sites within ten years.
4. Companies faced the additional cost of going back to treat the not satisfac-torily restocked sites until they were deemed to be satisfactorily restocked.

The government assisted this process by providing free seedlings to industry from 1968 to 1995, or paying forest industry nurseries an equivalent amount. Smaller operators had the option of paying the government to perform reforestation for them. Federal and provincial research also helped industry identify the most effective and least costly regeneration methods. There was, and continues to be, vigorous debate about the details of stocking standards and enforcement. (Stocking is the proportion of an area occupied by trees or seedlings.) The debate among foresters in government, industry, and academe reflects different views of economics and technology as well as scientific theories and visions of the desired future forest. Companies dependent on deciduous trees, for example, often disagree with the reforestation priorities of those harvesting coniferous timber.

The Environment Council of Alberta's far-reaching 1979 recommendations supported the general concept of goal-oriented reforestation, performed largely by industry. Alberta seemed to be on the right track, thanks largely to pioneering work at Hinton. British Columbia had adopted sustained-yield forest tenure legislation in 1947, two years before Alberta, but a royal commission headed by Peter Pearse concluded in 1976 that British Columbia was falling far behind in reforestation of lands denuded by logging and fire. A 1977 report by the Canadian Forestry Association found that a substantial portion of forests harvested since the 1960s across Canada was regenerating “with difficulty or not at all.”

New requirements, similar to Alberta’s, were included in the British Columbia Forest Act of 1978. Ontario adopted new tenure legislation and reforestation requirements in 1979, and other provinces followed suit over the following decade. Thanks in part to federal-provincial Forest Resource Development Agreements in the 1980s, as well as new provincial legislation, the area receiving silvicultural treatments in Canada more than doubled between 1980 and 1992, and the area planted annually more than tripled.

In 1989, the Alberta government again asked experts to review forest management practices in Alberta. The Expert Review Panel on Forest Management in Alberta, which again included a Hinton forester, Bob Udell, issued its report in May 1990. Like the Environment Council of Alberta, this panel made recommendations for improvement but backed the general principle of goal-oriented, industry-conducted reforestation. In response to the panel’s recommendations, as well as national and international moves toward sustainable forest management, the Alberta government began a lengthy, multi-stakeholder consultation process leading to the Alberta Forest Conservation Strategy in 1997. Wayne Jacques, a member of the Legislative Assembly, also led an inquiry in 1995–96 into the forest management agreement system. Among other things, Jacques’s report emphasized the need for “intensive” management in some portion of Alberta’s forests, where maximum timber production would be the primary objective to maintain wood supply for mills and offset the loss of commercial forests to protected areas. The desirability and feasibility of this strategy were reinforced by the report of a provincial Enhanced Forest Management Task Force in 1997, co-chaired by Udell and Trevor Wakelin of Millar Western.

The government policy based in part on these reports, but primarily from the four-year, multi-stakeholder Alberta Forest Conservation Strategy report and recommendations of 1997, was the Alberta Forest Legacy announced in 1998. The key conclusion was that the province’s forests should be managed on a “triad” basis—a network of protected areas with no industrial forestry, areas managed “extensively” for multiple uses, and intensively managed areas. The latter was particularly important for the forest products industry, because the yields from intensive management would at least have to offset timber supply reductions due to protection and multiple uses.

The task of growing a new forest became increasingly complex as the need to manage other interests in, and uses of, the lands grew. The industry thus required

Above: Weldwood plants up to ten million trees per year on its harvested areas.

Above right: A 1997 commercial thinning trial along Highway 40, established to encourage lichen development for caribou habitat.

ever-increasing sophistication in applying the basic tools of silviculture:

- choosing the optimal harvest method, equipment, layout, and scheduling
- preparing the site
- planting, seeding, or ensuring adequate natural seed sources such as cones or windblown seeds
- tending the site to control competing vegetation
- thinning overly dense stands
- integrating silviculture into the overall strategy of sustainable forest management

Intensive management uses all these tools, plus additional techniques such as tree improvement, fertilization, and commercial thinning.

The other crucial task for company and government foresters was to protect both old and new stands from the ever-present threats of fire, disease, and insects. Co-operative forest protection was yet another example of adaptive management.

Silviculture

We never planted much in New Hampshire or Vermont and even in Maine. The only place in the north that we have planted extensively is Hinton. You know why? Because the government made us. In order to keep the peace with them and live up to our obligation to them, we had to do it.

—H. V. (Pete) Hart, 1976

Pete Hart was northern and Pacific woodlands manager for St. Regis Paper Co. during the early years of the Hinton operation. In a 1976 interview with the Forest History Society, he recalled that St. Regis had little previous experience with silviculture in northern forests before coming to Hinton. Plantations were common by then in the southern United States, where some species mature in twenty to forty years; but he noted that in many of the company's northern forests, recreational uses were expected to become more valuable than timber by the time a new crop matured. However, he said, St. Regis accepted that forest renewal responsibility was a fair trade-off for long-term tenure at Hinton.

The company gave Des Crossley wide latitude over silviculture because he was already an established expert in the field. As a researcher for the Canadian Forest Service, Crossley had demonstrated that post-harvest site preparation was the key to successful regeneration of cut-overs in the Alberta foothills. Before his hiring, Crossley had already prepared a report on silviculture for the new operation.

North Western Pulp & Power Ltd. built Alberta's first forest industry greenhouse in 1965.

Crossley did not initially expect to do much planting per se. Based on his research, he believed that a combination of clear-cut harvesting and site scarification would faci-li-tate natural regeneration in the foothills forest. This proved to be true for lodgepole pine on most sites. Natural regeneration was less successful for white spruce, the other principal commercial species. Spruce trees do not produce a lot of seeds in most years, and they grow more slowly than pine during the early years when other vegetation crowds around the seedlings.

The company's first greenhouse was established in 1965 to grow seedlings, mainly spruce, as cutting began to move onto "second-pass" blocks, many of which would not have an adjacent natural seed source. The planting program played a vital role later when mechanical harvesting methods reduced the effectiveness of natural regeneration at the same time that the company sought to increase the promptness and vigour of new growth. In the 1990s, however, new

A new greenhouse built in 1980 produced up to three million seedlings a year for planting.

harvest methods also improved the effectiveness of scarification and natural regeneration, which again became an important tool for silviculture.

The government's basic requirement was that regeneration be established within ten years of harvest. In practice, the cut-overs were surveyed on a systematic grid seven years after harvest, and the company then had three years to address the areas deemed not sufficiently restocked. In the early years, frugal Crossley insisted that surveyors count every seedling, no matter how small or scrawny. He believed that even if these did not survive, many others would come along to replace them. This later proved to be a false economy when marginal sites required further treatment.

Crossley's famous frugality paid off in many other ways, however. The company kept its commitment to devote up to 10 per cent of the total delivered wood costs to forestry—including inventories, research, and planning, as well as reforestation—and Crossley made sure the actual expenditures were always held within that figure. "It was not a munificent sum," he recalled later, "but the staff was aware of its restraining effect, and with imagination and innovative approaches, it was made to suffice." Over his twenty years as chief forester, he reported to a number of senior managers in the company hierarchy, and he had to convince each of them that the budget was warranted. He was therefore keenly aware that he had to satisfy two masters, the company and the government. He delighted in "win-win" solutions that benefited both.

In the early years, for example, government regulations required that loggers cut up and scatter the limbs and tops to reduce the post-harvest fire hazard. Crossley saw that the heavy crawler tractors and ploughs used for scarification would crush and redistribute the logging debris just as effectively, so he convinced the forest service to drop the "lopping" requirement for scarified areas. This increased loggers' productivity considerably, a benefit for the woodlands department, and helped him to justify the large expense for contracting three D-9 Caterpillars to scarify the sites.

Leading the Way

Our initial goal was to sustain the wood yield that the lease was naturally producing before we appeared on the scene.

—Des Crossley, 1984

Crossley personally managed the reforestation program until 1960, when Gordon Jones was hired as the first section head for silviculture, but of course the chief forester maintained a keen interest in it throughout his tenure (and beyond). The early 1960s was when regeneration surveys began to be conducted on the first harvest sites from the 1950s. Those surveys showed that three-quarters of the sites were already satisfactorily restocked, and Crossley was sure that many more would pass muster before the ten-year government deadline. He cited research, including his own, to show that "ingress" from surrounding seed sources would eventually fill in the gaps in regeneration; the question was how long this would take. He recognized that some sites certainly needed planting, and more would need it as harvest moved to "second-pass" spruce sites without an adjacent seed source.

By this time, Crossley had already developed a highly effective method of site preparation and had begun trials of various silvicultural techniques such as seeding, planting, fertilizing, and thinning. Results from the planting trials, using "bare root" seedlings from the provincial nursery, were disappointing. However, research in British Columbia and elsewhere indicated much better success rates for the then-new technique of enclosing seedlings in containers.

In 1964, Crossley recruited Bob Carman as silviculture section head, mainly because of his previous experience in growing containerized seedlings. Carman, a gold-medal-winning University of Toronto forestry graduate who had been working for the Ontario government, built Alberta's first forest industry greenhouse at Hinton and established trials to determine the best containers for growing and planting seedlings. This work put Hinton at the leading edge of the new technology.

Carman also developed a system of post-harvest "management opportunity" surveys, beginning in 1965. Initially, the purpose was just to prescribe the optimal slash disposal and regeneration treatment, but the system also established an invaluable database about the forest ecology. If a cut-over contained several signi-fi-cantly different ecological conditions, it was further divided into "ecological units." For each site or unit, the survey recorded:

◀ ▶ CONTENTS INDEX

- forest cover type before harvesting
- seed availability either from slash-borne cones or adjacent uncut stands
- soil moisture conditions and drainage
- existing or potential vegetative competition
- advance growth
- slash conditions and depth of duff
- topography and aspect

On the basis of the survey, the surveyor then prescribed the appropriate treatment for reforestation.

Over the following decades, foresters were thus able to correlate the failure or success of silvicultural treatments with the particular conditions on each site. This allowed them to refine the treatments continually, a textbook example of adaptive management. After Carman left the company in 1968, Steve Ferdinand took over the silviculture program and expanded it over the next six years.

In 1968, the company signed a new Forest Management Agreement with the province that doubled the size of the Forest Management Agreement area and committed the company to a major expansion of its production facilities. In 1970, as the company was preparing for the expected expansion, Crossley and his team prepared a report, "Wood Potential from the Pulpwood Lease through the Intensification of Management," describing how the increased productivity could be achieved. The measures recommended were:

- utilization of smaller timber and dead and fire-killed wood
- precommercial thinning in overly dense pine regeneration stands
- commercial thinning
- tree improvement programs
- forest fertilization trials.

Most of these proposals were put on the shelf when economic conditions prevented the expansion and the government withdrew the Forest Management Agreement approval in February 1972. Without the planned expansion, there was no incentive for the company to invest heavily in enhanced growth while the harvest remained less than the annual allowable cut. In fact, later studies showed that the existing programs were successful enough to increase growth and yield rates substantially. Precommercial thinning continued until 1988, however, and a tree improvement program was begun in 1976, but largely discontinued in 1981. Programs remarkably similar to the ones recommended by Crossley's team in 1970 were eventually adopted, or at least re-examined, in the late 1990s.

Crossley and Ferdinand faced another challenge in the early 1970s when an Edmonton-based environmental group questioned the effectiveness of reforestation on the forest management area. Save Tomorrow, Oppose Pollution (STOP) claimed massive forest degradation was occurring in Alberta and published pictures in major newspapers of Hinton cut-overs to back the allegations. The controversy continued until Kare Hellum, head of silviculture for the provincial government, located STOP's photo points and flagged every seedling. Hellum's photos, showing a sea of flags, refuted the accusations. Ferdinand and retired government forester Bob Stevenson revisited the same locations in 1998 and photographed healthy forest stands.

In 1976, shortly after replacing Crossley as chief forester, Jack Wright convinced the company to invest in one part of the 1970 intensive management proposal: tree improvement. He hired Peter Sziklai, a recent forestry graduate from the University of British Columbia, to run the program. Sziklai collected lodgepole pine cones from superior trees in eight zones of the forest management area and then planted seeds from all eight in each zone to test whether the superior performance was transferable. Although he left the company in 1981, Sziklai kept meticulous records, and subsequent remeasurement of the young trees every three years showed remarkable growth in some of the strains. This set the stage for the Weldwood Pine Program and other tree improvement programs launched after 1996. Sziklai also oversaw the design and construction of a new greenhouse, which began production in 1980.

Wright came up with a unique program to keep the forestry department "connected" with its ultimate goal: growing the forest. From 1976 to 1987, every member of the staff, including the chief forester, was required to conduct regeneration surveys. Before that, university forestry students had been hired to do the surveying each summer, but Wright said there was a flaw in this: "The most important thing you get from a survey is the recommendation, and the students were not around in the fall to explain their recommendations." In addition, the students' surveys were not always as thorough as they might have been. As a result, Wright noted, forestry staff often had to verify or follow up on the students' work during the 1960s and early 1970s. He decided it would benefit everyone to see results on the ground, especially with tougher restocking standards being enacted by the government in the late 1970s. The staff surveys continued until 1987, shortly after Wright's retirement,

In 1972, the controversial STOP report asserted that NWPP was degrading the environment and failing to reforest after harvest.

In 1997, the same areas presented in the STOP report were rephotographed and showed healthy stands of eight- to ten-metre tall pine and spruce.

when the company decided to contract out the work to certified surveyors. The increasing workloads of company staff, combined with expansion activities, made it impossible to continue the annual hands-on exercise.

Bill Mattes, a European-trained forester, headed the silviculture section from 1974 to 1987. During this period, the amount of planting continued to increase, and new site-preparation equipment was introduced to provide better microsites for seedlings. When Mattes retired, however, a corporate reorganization merged the forestry and woodlands departments into a single forest resources department. Bill Rugg was hired to replace Mattes and given the title of silviculture planner, but the operational responsibility for reforestation shifted to three district managers whose most pressing task was to get wood to the mill. At this time, managers were also preoccupied with issues arising from the Forest Management Agreement expansion in 1988.

The district silviculturists found it difficult to keep up with their post-harvest surveys and record keeping, and the entire program suffered from a loss of focus and direction for several years. Silviculturists' responsibilities continued to grow and the company's switch from mainframe computers to personal computers in 1992 created major challenges in maintaining silvicultural records. To make matters worse, many records and photos were then lost due to a May 1993 fire in a temporary office building used by silviculture staff and other employees.

Meanwhile, company and government foresters were becoming increasingly concerned about the backlog of harvest sites deemed not satisfactorily restocked and awaiting further treatment. In addition, the quality of silvicultural prescriptions and implementation appeared to be slipping. The 1988 Forest Management Agreement, leading to the pulp mill expansion in 1990 and the HI-ATHA sawmill in 1993, brought a renewed need for prompt and effective regeneration. The annual allowable cut was fully utilized for the first time, so any increase in growth was a direct economic benefit to the company, and any loss was a cost.

In the early 1990s, the Alberta Forest Service criticized the company for instances of excessive soil degradation and issued some penalties. Subsequently, Weldwood worked with soil scientist Dave McNabb of the Alberta Research Council to study issues such as rutting, compaction, remediation, and road decommissioning. Weldwood engaged outside experts Hamish Kimmins and Lorne Brace to review the company's forestry practices, and their 1993 report led to a series of major changes. If corrective actions were not taken, Kimmins and Brace warned, the company would not meet the assumptions of the 1991 Forest Management Plan, and this would lead to a decline in the annual allowable cut. They said the most pressing issues were the quality of planting stock, the negative effects of roadside delimbing, and vegetative competition on regeneration sites.

After a field trip with forestry staff to examine the problems identified by Kimmins and Brace, Udell and his forestry team prepared a summary report for senior management. Don Laishley, then the manager of forest resources, responded by requesting a business case detailing the proposed changes. This business case, submitted on 1 November 1993, was the *Crossroads Report*. It set out twenty-five recommendations for adaptive management, pre-harvest planning, crop protection, quality control, seedling supply, backlog reforestation, tree improvement, and forest stewardship. By 1999, all of the recommendations were put into effect.

One of the first changes resulted in a reorganization of silviculture staff. David Presslee, a forester with a rich background of silvicultural experience in British Columbia, was hired in late 1992 as a silvicultural planner. When he joined the company, silviculture staff members were dealing with many pressing issues: the forest management area expansion in 1988, the backlog of not satisfactorily restocked sites awaiting treatment, another backlog of sites needing post-harvest surveys, and the department's impending switch from mainframes to personal computers. The combination of the new Forest Management Agreement, the 1991 Forest Management Plan, and the new free-to-grow standards meant there would effectively be a sixfold increase in the staff's workload, from 8,500 hectares treated or surveyed annually to 50,500 hectares treated or surveyed annually. Presslee was named forest operations area superintendent, responsible for all silviculture operations, in February 1994. This ended the dispersal of silviculturists in the organizational chart and got them focussed on the task at hand. Presslee worked to fine-tune an ecological site classification system that would later be applied to the entire forest management area. He used this system to perform pre-harvest assessments and prescriptions so that silviculture and harvesting would be planned jointly to increase reforestation effectiveness. Presslee brought wit, innovation, passion, and professionalism to his work, and his untimely death on 29 January 2000 was a tragic loss.

Forester David Presslee championed many changes to improve the integration of harvesting and reforestation in the late 1990s.

Many of Presslee's initiatives echoed plans and proposals put forward by Crossley, Wright, and other Hinton foresters decades earlier. In 1996, for example, Diane Renaud was named tree improvement forester to resume the work begun by Sziklai in the 1970s. In the same year, the company hired Stan Navratil to identify and evaluate options for implementing the type of intensive management program first envisaged by Crossley and his team in 1970.

By 2000, the backlog of old sites awaiting treatment had been eliminated, and Weldwood foresters were reporting improved regeneration success and greatly improved seedling growth. These advances were made possible by four decades of research, data collection, analysis, innovation, and adaptation in each aspect of silviculture at Hinton (see figure 9.1).

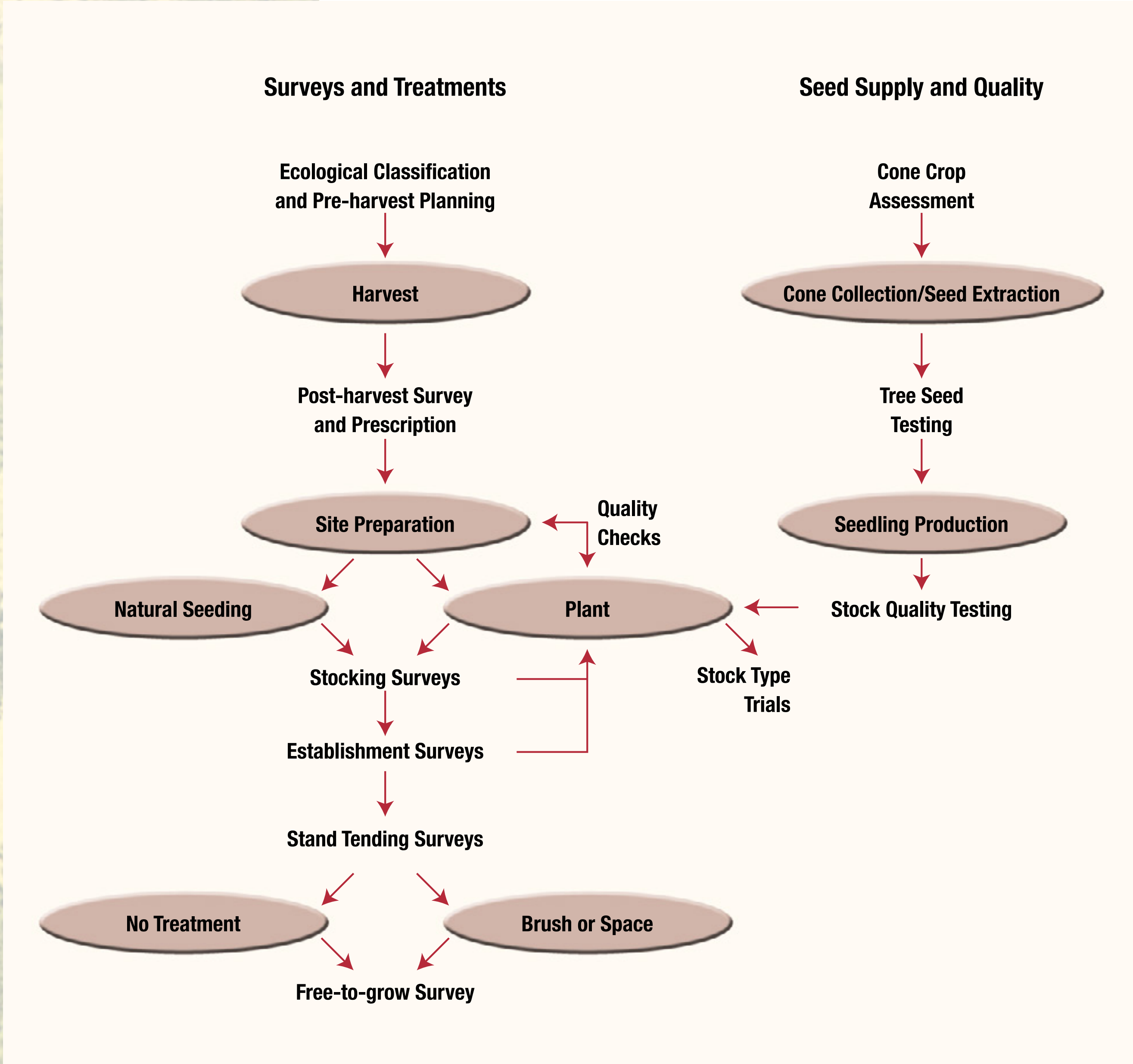


Figure 9.1. Elements of silviculture at Hinton in 2000ø

Harvesting to Enhance Regeneration

In the past, the loggers logged and the silviculturists came in later to fix it up. Silviculture was more of a rehabilitation operation.

—David Presslee, 1997

Until logging began at Hinton, the standard cutting practice in Alberta was the diameter-limit cut. This meant that loggers removed up to 50 per cent of the timber volume from a block by choosing the biggest trees and best sawlogs down to a given stump diameter, typically thirty centimetres for pine and thirty-five centimetres for spruce. Based on his experience in eastern Canada, Reg Loomis favoured changing this to a form of harvest that would remove 40 per cent of the standing volume and leave behind well-spaced trees of good quality to provide seed and shelter for the next crop. He formed a strong conviction that such a system of tree-by-tree or clump-by-clump (selection or shelterwood) cutting was the only "proper" harvest method for sustained yield. Loomis and Charlie Jackson, occupying key positions in the Alberta Forest Service, were both very skeptical of Crossley's plan for clear-cut harvests.

Crossley was equally adamant that clear-cuts were the best way to promote regeneration in the even-aged, fire-origin forests of the Alberta foothills, accounting for 94 per cent of forests in the forest management area. His research and experience in western Canada showed that the selection cut actually impeded regrowth of lodgepole pines, which need direct sunlight to promote early growth. Moreover, he asserted, selection cutting potentially removed the superior genetic stock from the forest and reduced the forest's long-term productivity. Later foresters would have additional objections: Selection cutting would replace the naturally occurring even-aged stands of pine and aspen with "unnatural" multi-aged stands and thus alter the wildlife habitat. Selection cutting would likely require more permanent roads, and there would also be worker safety issues.

This clash of views continued for years, and Loomis never fully conceded the point. However, a compromise was reached with development of the 1958 operating ground rules. In essence, Crossley would have to demonstrate that his approach worked or find an alternative.

The basic design, still widely used today, was the two-pass clear-cut in which approximately 50 per cent of an operating area is harvested in alternating patches on the first pass, and the other 50 per cent is cut when regeneration is well established on the first-pass sites. (In fact, up to 5 per cent of the old stand is usually retained for various reasons.) The original plan called for a ten-year delay between the two passes, but this was later extended in some instances due to wildlife habitat concerns. The rule adopted in the 1970s stated that growth on the first-pass sites should be at least 1.8 metres high before the second pass. This was intended mainly to give ungulates cover so they would be less visible to hunters and predators. In the

Strip cutting in white spruce forest types was intended to encourage natural regeneration in the harvested areas from seed in the adjacent uncut strips.

1990s, the two-pass system was further modified to leave clumps, single trees, and dead trees in the blocks, mainly for wildlife habitat but also for aesthetic reasons.

Crossley's research indicated that almost any clear-cut shape would result in lodgepole pine regeneration, and the blocks were therefore designed to conform to stand boundaries and landscape features. On level ground, the pine cutblocks were usually rectangular. In spruce stands, Crossley initially used relatively narrow strips at right angles to the prevailing winds, in the expectation that seeds would blow onto the cut-over from adjacent stands. This strategy was abandoned, partly due to problems with trees uprooted by wind (blowdown) and partly due to the uncertain spruce seed supply. Aesthetic, wildlife, and ecological considerations in the 1990s led to more contoured cutblock layouts and "feathered" partial cutting at the edges.

Several silvicultural benefits accrued from felling and skidding practices during the horse-logging era. Limbs and tops were removed at the stumpside. In pine stands, this left cones to provide seed sources on the site. The logging debris also reduced erosion and helped to create microsites for regeneration. Horses usually did not cause a lot of rutting and soil compaction, and they could circumvent wet areas. The increasing mechanization of harvests after 1966 whittled away at these advantages. In particular, the practice of delimbing at roadside in the late 1970s and 1980s decreased the effectiveness of natural regeneration. This trend was reversed in the 1990s when new equipment such as stumpside feller-processors became available.

After the restructuring of the company's reforestation program in 1994, silviculturists worked with the operational planning teams to design harvest strategies that would enhance, rather than impede, regeneration. This led to a much greater variety of harvest designs, methods, and equipment—modified two-pass and three-pass harvest systems, partial cuts and shelterwood cuts, many different sizes and shapes of cutblocks, with various amounts of standing timber left in the block. Equipment was selected to minimize soil impacts and achieve the optimal distri-bution of logging debris. Presslee noted that such changes might increase harvest costs but could offer big savings in silvicultural costs. One study showed that stumpside harvesting increased logging costs by $0.50 per cubic metre but reduced silvicultural costs by $3.00 per cubic metre.

In the 1990s, Weldwood foresters actually returned in some instances to the selective and shelterwood methods urged by Loomis. This was done mainly in areas such as riparian buffer zones to protect wildlife habitat, watersheds, and recreation areas.

Site Preparation

I undertook the first scarification research while at the Kananaskis Forest Experiment Station, so we were able to call on those results to assist us in applying them to a large-scale industrial operation. We fundamentally knew that if we could disturb the soil on the cut-over areas and mix it with the humus layer and the overlying slash, then we were in business.

—Des Crossley, 1984

Des Crossley believed that site preparation would play a vital role in reforestation at Hinton. Subsequent experience showed he was right.

The survival and growth of seeds and seedlings depend on the microsites that provide moisture, nutrients, light, shelter, and rooting media—the necessities of life. In the Alberta foothills, fires leave a layer of ash on the mineral soil, and the tree species have adapted to grow in this type of microsite. After logging, however, the moisture-retaining mineral soil was often covered by a thick layer of duff, which provided a poor microsite. The remedy was scarification—mechanically disturbing the forest floor to break up the organic material and expose the mineral soil.

As the first harvests got underway, the company tested a variety of ploughs, rakes, and disks that could be pulled or pushed by a crawler tractor. Most of these were designed for agricultural land clearing, and none was entirely suitable for scarification in the foothills. Crossley and his team finally came up with their own design for a toothed blade, and this evolved over several years into three plough-like devices on a modified 5.8-metre blade in front of the tractor. By 1958, the still-evolving system was achieving the goal of 60 per cent mineral soil exposure.

The key to successful scarification was the use of more powerful, wider-tracked crawler tractors. The first trials were done with D-8 Caterpillars, but these had to stop and back up frequently as they bogged down in the heavy slash, stumps, and duff. "You can't make money going backwards," observed Jack Wright. A contractor, Dick Corser, had a D-9 Caterpillar and demonstrated in 1957 that this machine could keep moving forward with the scarifier. D-9s became the standard propulsion for many years.

Des Crossley and his staff pioneered the development of site preparation equipment for natural reforestation, such as this anchor-chain drag behind a D-9 Caterpillar.

Ploughing alone would have been sufficient preparation for spruce seeds, but for pine sites the system also needed to pull cone-bearing slash into the furrows. Bob Ackerman of the Canadian Forest Service suggested dragging something behind the tractor for this purpose. The early design was a spreader bar towing a combination of steel "cat pads" and anchor chains, but this was soon changed to just spiked anchor chains. After various modifications, the final design of the plough and drag was achieved about 1965. This system, known as the "Crossley scarifier," was used for most natural regeneration sites until the late 1980s, when a variety of other tools became available. Heavy equipment was no longer needed on so many sites as operations moved into younger age classes where there was less slash and woody material, although a somewhat similar plough-and-chain combination is still used on some pine sites.

Developed in Sweden in the 1970s, the Bracke cultivator was one of the first modern machines designed to prepare sites for planting.

Experience and research led to a continual adaptation and refinement of site preparation methods. For example, foresters realized that drags were only needed where pine cones were scarce—in very old pine stands and on skid trails and landings—and could be dispensed with on other sites.

Another challenge was the very moist duff, up to sixty centimetres deep, that built up in old spruce-fir stands at higher elevations. The scarification ploughs could not penetrate this heavy material to reach the mineral soil, or, if they did, the duff fell back into the furrow. In 1965, company foresters decided to bulldoze this material into compressed windrows during the spring thaw. In essence, the duff layer was "peeled" off the still-frozen mineral soil. This method, called spring blading, was used on deep duff sites until 1980, when the company found that a rear-mounted Craig-Simpson ripper plough allowed for a longer operating season. The latter system was used in early winter when there was enough frost to support the tractor but before the snow was too deep. Exposing sufficient mineral soil continued to be a challenge on some sites, however.

The C&H plough, mounted on a small bulldozer, is used to prepare sites for planting in areas of heavy vegetative competition.

In the early 1970s, as more and more sites were planted, it became evident that planted seedlings needed better microsite preparation to survive on dry, exposed sites such as the Camp 1 area. In other locations, planters had to cut tough sod with a mattock, a laborious and inefficient task. Jack Wright found a solution to both problems in 1975 when he saw a Bracke scarifier demonstrated at Sault Ste. Marie, Ontario. This Swedish-designed machine used a pair of chain-driven mattock wheels to cut and invert "scalps" of sod. Depending on soil moisture and the amount of competing vegetation, seedlings could then be planted on the top or sides of the mound, beside it, or in the adjacent excavation. The first Bracke was acquired in 1976, and the machine paid for itself within a year. In 1979, after testing a number of tractors to pull the unit, the company purchased two Timberjack 240D skidders and a second Bracke. This system was soon used to prepare about 85 per cent of planting sites.

Adaptations of drag scarification techniques continue, such as this combination of shark-finned barrels and anchor chains.

On about 10 per cent of planting sites, the rapid growth of hardwoods (mainly aspen) created too much competition for the conifer seedlings. A Cazes and Hepner (C&H) plough was acquired in 1979 and mounted on a modified Komatsu tractor in an attempt to deal with this problem. The plough stripped away organic soil so that seedlings could be planted on the mineral soil and thus enjoy a period of reduced competition. The plan called for a follow-up herbicide application, but the government vetoed this treatment. As a result, the strategy had limited success. In the 1990s, company foresters decided the best remedy was simply to identify high-competition sites in advance and plant them immediately after logging with large, well-developed seedlings.

The 1990s brought some new types of equipment, but the big changes resulted from the integration of harvest and silviculture planning, the use of ecological site classification, and the growing body of knowledge about what prescriptions worked best for each particular combination of soil, moisture, aspect, time of year, species, and competing vegetation. By the late 1990s, silviculturists used six primary types of site preparation in the forests around Hinton, as shown in table 9.1.

Table 9.1. Site preparation methods in the Weldwood silviculture program

Drag Scarification (with barrels and chains)

- Used primarily for natural regeneration of stumpside-delimbed lodgepole pine sites.
- Creates a good area for the pine seed to regenerate by exposing mineral soil, and at the same time distributes the pine cones onto the mineral soil.

Some planting may occur on these sites, but most of the regeneration comes from pine cones left on site.

Donaren Mounding

- Used for artificial regeneration of wet and/or cold soil sites, or sites where other vegetation will compete with the planted seedlings for limited site resources (light, moisture, nutrients).
- Creates a mound—an elevated planting spot that provides warmer soil and improved drainage.

All of these sites are planted with pine and/or spruce.

Excavator Mounding

- Used for artificial regeneration of very wet sites, sensitive sites, along watercourses, sites with very significant competing vegetation, or sites with slash that limits the use of the Donaren mounder.
- Creates elevated mounds similar to the Donaren mounder.

All of these sites are planted with pine and/or spruce.

Site Excavator Screefing*

- Used primarily for artificial regeneration of steep slopes or blocks that have only winter access.
- Creates a narrow strip of exposed mineral soil, two to three metres long, for planting.
- Minimizes erosion potential on steep slopes because this is a spot treatment and there is no continuous treatment line.

All of these sites are planted with pine and/or spruce.

* *Screefing is the removal of herbaceous vegetation and soil organic matter to expose a soil surface for planting.*

Disc Trenching

- Used for both artificial and natural regeneration.
- Creates a furrow with a raised soil strip on one side for a planting spot.
- Can also be used on stumpside-delimbed blocks to expose soil and distribute slash for natural regeneration.

Many of these sites are planted with pine and/or spruce, but some are left to regenerate naturally.

CS (Craig-Simpson) Plough

- Used for both artificial and natural regeneration of blocks that are only accessible in the winter.
- Creates a planting spot similar to the disc trencher, but is used when the ground is frozen.

Many of these sites are planted with pine and/or spruce, but some are left to regenerate naturally.

Seeding and Planting

Spruce does not bear serotinous cones. Its cones open up each year as they mature, and the seeds are cast into the wind. Both cones and their contained seed are destroyed by the passage of fire. Consequently there must be some other explanation [for the presence of spruce in fire-origin forests]. Where does the seed come from? My observations through many years indicate that it comes from bordering spruce stands that escaped the fire.

—Des Crossley, 1984

Crossley's research demonstrated that the serotinous cones of lodgepole pine would provide an ample seed source for natural regeneration on most sites. The bright sunlight in clear-cuts, falling on the dark surface of scarified soil, combined with the mechanical action of scarification itself, would break the cones' resin seal and release the seed as effectively as a forest fire. This simple and inexpensive regeneration method worked extraordinarily well in the forests around Hinton. When it did not work, the problem was usually a lack of cones—due to over-mature stands, logging activities, or roadside delimbing—or some deficiency in scarification.

Regenerating white spruce was more problematic. This species releases its seeds into the wind every fall when the cones open, but in most years the cone crop is modest. At variable intervals, approximately once every seven to twelve years, a spruce will produce a superabundance of cones in a phenomenon known as masting. The reasons for this are still debated—possible explanations include stress in the previous year, climate, cone rust, weevils, sunspots, or the tree's own hormones—but in any case it makes natural regeneration much less reliable. Spruce seeds are a popular food source for birds and small mammals, so few seeds actually survive to germinate except after masting events. Crossley hoped that scarification would improve natural regeneration of spruce. However, early trials showed that some planting or seeding would be needed on first-pass harvest sites, even those located near standing seed sources. He knew much more planting or seeding would be needed after the second-pass cuts removed the seed sources.

Because planting seedlings was expensive and, at that time, unreliable, the company in 1960 began trials of seeding to supplement natural regeneration. Seeds spread with hand-operated Cyclone Seeders on scarified blocks gave variable results, apparently depending on the amount of mineral soil exposed. Later, between 1966 and 1978, helicopter-borne seeding was used on about one thousand hectares. The results of aerial seeding were generally quite good, but unpredictable. Moreover, huge amounts of seed—more than three hundred thousand seeds per hectare—were needed to offset losses to birds and rodents. (In the early 1970s, the company voluntarily stopped using seed treated with the rodent pesticide Endrin due to its toxic effects on birds and mammals.) Seeding continued to be used occasionally on some high-elevation sites until the early 1990s but was then abandoned altogether for three reasons:

◀ ▶ CONTENTS INDEX

1. The supply of high-quality seed was limited, and it was wasteful to spread so many for each successful seedling.
2. The outcomes were too variable, depending on microsite quality and losses to birds and mammals.
3. The long time span needed for germination and early growth allowed competing vegetation to invade the sites.

From the early years until 1988, seeds for both seeding and planting programs were mostly obtained from squirrel caches. Squirrels collect a great many more seeds than they can possibly eat. They are either excessively prudent or simply forget where the caches are. Research determined the squirrels did not suffer from human raids on the caches. From 1976 to the mid-1980s, seeds were also collected from specific seed production areas established in the forest management area. Since 1989, all seeds have been collected by harvesting cones, either from a helicopter or on the ground, from high-productivity wild stands. In 1995, Weldwood joined other companies in the Huallen Seed Orchard Company to produce gen-etically superior seed for future reforestation.

Planting seedlings was the other option. The first experimental plantings began in 1958, and the company planted about ninety thousand seedlings between 1961 and 1964. Most seedlings were provided by the provincial nursery, then located at Oliver on the northeastern outskirts of Edmonton. The small, flimsy "bare root" seedlings had poor survival and growth rates. In 1960, Crossley also began experimenting with the then-new technology of containerized seedlings, but the early attempts did not live up to expectations. The first container used at Hinton was called the Walters Bullet, designed by University of British Columbia forestry researcher Jack Walters. It was a bullet-shaped plastic container designed to be "shot" into the soil or even dropped from aircraft, but it turned out that the seedling roots were not strong enough to break out of the container as intended.

In 1964, discontented with the quality of the provincial nursery seedlings, Crossley negotiated a deal with the government to compensate the company for growing its own. By this time, successful trials in Ontario and British Columbia had convinced him that containerization would provide better results than bare-root planting. The company's first greenhouse produced 250 thousand seedlings in 1965, and two years later was growing more than 1 million per year. The original plastic-covered structure, 73 square metres, expanded to a 220-square-metre, fibreglass-covered growing area by 1973. Jean Bourbeau managed the greenhouse from its inception until 1979, shortly before it was replaced by a new, highly mechanized growing facility in 1980. The second greenhouse had a capacity of more than three million seedlings per year.

The first container used widely at Hinton was a split plastic cylinder about ten centimetres long, called an Ontario Tube. Planters punched a cylindrical hole in the ground with a tool called a dibble and then bent over to insert the seedling, still in its container. The theory was that the pressure from the growing roots would

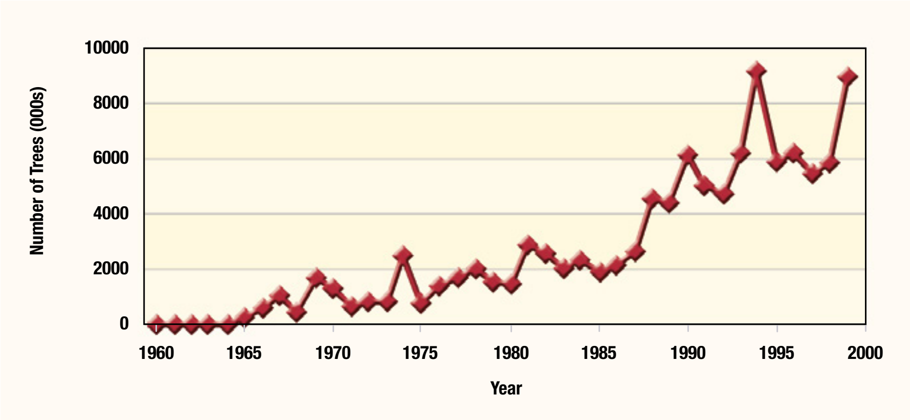
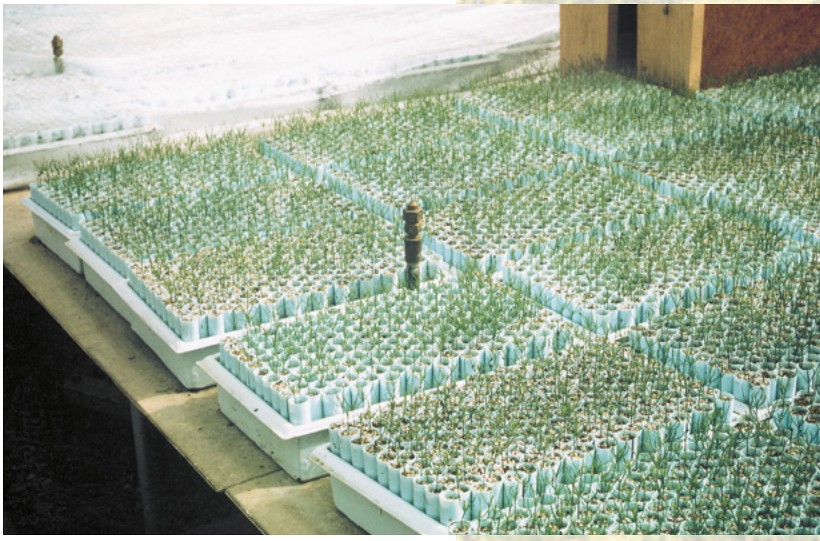


Figure 9.2. Trees planted by year, 1960–1999. Before 1960 the company relied on natural regeneration, and awaited the first regeneration survey before beginning to plant.

force open the tube and break it, allowing the roots to emerge unimpeded. Unfortunately, this seldom happened as intended, and the container restricted root development and growth. Research indicated that the plastic also prevented moisture and nutrients from reaching the plant; the best survival and growth rates were on very moist sites. When early planting sites were surveyed in 1970, only 73 per cent were adequately restocked. Seedling survival rates dropped from 70 to 80 per cent in the first year after planting to 60 per cent by the third year.

Steve Ferdinand, who directed the sil-viculture program from 1968 to 1974, worked with experts from the Canadian Forest Service (CFS) and used their recent plant physiology research to find a better method for growing and planting seed-lings. He concluded in 1971 that larger containers, longer nursery periods, low-nitrogen fertilizer, and less watering during the final weeks should lead to "relatively large, hardy and well-balanced seed-lings." Most important, however, he said it was essential to discard containers during the planting operation, so the roots could penetrate the surrounding soil immediately. (The company also asked the National Research Council to find or develop a container material that would biodegrade in the ground, or fracture in winter frosts, but none was identified.)



The first NWPP container seedlings were grown in longitudinally split Ontario Tubes.

Ferdinand then tested two disposable containers, a Styrofoam block system developed by the CFS in British Columbia and a folding container marketed by Spencer-Lemaire Industries of Edmonton. Working with Hank Spencer of Spencer-Lemaire, he came up with an adaptation of the folding container that met the Hinton operation's requirements. This adapted folding-container system came to be known as the Ferdinand Roottrainer. The larger seedlings required a larger hole, and planters now had to remove the seedling from the container, so Ferdinand also identified a better planting tool called the Pottiputki. This Finnish device had several advantages over the dibble. Seedlings are fed into a tube at the top. A foot pedal and lever mechanism at the bottom creates the planting hole and inserts the seedling. The planter then closes the hole with his or her boot. The planter no longer had to bend over to plant each tree. This was a huge ergonomic benefit for planters, mostly university students recruited each year to work from May to August.

Planters with Pottiputkis are shown planting seedlings grown in Ferdinand Roottrainers, circa 1980.P

In the 1990s, nursery workers used styroblock containers for seedlings.

The rate of planting rose from about 1 million a year in the early 1970s to 2.5 million a year in the 1980s. In 1984, chief forester Jack Wright compared the company's planting system with some mechanical systems then being developed: "Trials with mechanical tree-planting machines at Hinton have convinced us that, given good site preparation, planting production per person using a Pottiputki is almost as high as with a planting machine, while the quality of planting and site selection is vastly superior to machine planting."

In the late 1980s, the company decided to hire planting contractors instead of university students, and the planters used narrow spades instead of Pottiputkis because larger seedlings required a larger hole. The company also began to switch from roottrainers to a British Columbia system using styrofoam blocks. Greenhouse manager Larry Matwie argued in 1988 that this system would reduce costs with no loss of quality, and he linked a series of repetitive-motion injuries in the greenhouse to problems with the roottrainer system.

The changeover to styroblocks began in 1990 and was completed in 1994. It was consistent with the industry trend at the time, but was not embraced by all, most notably retired chief forester Wright. However, the problem was not so much the styroblock design—which became the industry standard in western Canada—but rather the fact that the blocks took up more space in the nursery. This raised the cost per seedling. More importantly, the number of annual seedling crops had to be increased from three to four to maintain output. However, because each seedling in the styroblock had relatively more growing space than those in the root-trainers, the seedlings were better developed, and they exhibited much better growth in planting trials.

The 1993 re-evaluation of silviculture at Hinton identified poor seedling performance as a key issue. "Our own nursery was part of the problem," commented David Presslee. "It had to be upgraded." He worked with silviculturist Diane Renaud, who joined Weldwood in 1992, to identify and correct the contributing factors. A new computerized climate control system was installed in the greenhouse. There were adjustments to nutrition and the growing methods. For example, the silviculturists noted that when trays of seedlings were stored outside on the ground, the roots started growing down into the soil and then ripped when the trays were lifted; this was addressed by putting two-by-fours under the trays. The biggest change was a drastic reduction in the number of crops, from four to two, to lengthen the growing time and ensure more robust seedlings.

The shortfall was met by purchases from high-quality private nurseries that emerged in the early 1990s to meet industry's increasing demand for good planting stock. The provincial government stopped supplying free trees to industry in 1995, and privatized its own Pine Ridge Nursery, established near Smoky Lake in 1979. Competition and technological developments led to rapid advances in the quality and efficiency of the private nursery sector.

In June 1999, Weldwood announced it was closing the Hinton nursery. Major capital investments would have been needed to bring the facility up to the latest standards, and foresters could now order seedlings from private nurseries to meet their precise specifications at lower cost. Private nurseries were already supplying 70 per cent of Weldwood's seedling requirements, using seed collected by Weldwood for the purpose. Survival and growth rates rebounded to new heights as more and more robust seedlings were planted. Renaud noted in a 2001interview that the smallest seedling size planted by the company in 2000 would have been the largest in 1996. In 1999, the company celebrated the one hundred–millionth tree planting in the forests around Hinton.

Stand Tending

It sounds simple now, but a lot of experimentation was involved before the results were considered satisfactory.

—Des Crossley, 1984

Des Crossley was referring to the company's pioneering experiments with the use of aerial photography for regeneration surveys, but he might have used the same words to describe the entire process of "minding" growth on a site from the initial silvicultural treatment until the healthy juvenile stand can be left to grow on its own. This process includes:

- surveying the sites to determine regeneration success or failure
- scarifying, planting, or seeding sites that are not satisfactorily restocked
- spacing young trees that are growing too densely
- controlling vegetation that competes for light, space, nutrients, and moisture

Soon after the company began doing its own aerial photography for mapping in 1960, Crossley thought this might also be a way to save money on regeneration surveys. In collaboration with the Canadian Forest Service, he and his team tested a method of low-altitude, helicopter-borne photography with a sensitive infrared film originally intended for detecting military camouflage. The filming was done in the fall when the herbaceous groundcover had turned brown, and the photo interpreter could identify the conifers as magenta spots on the developed film. However, the method never attained a sufficient reliability to be adopted by government or industry.

Instead, stocking surveys at Hinton have always used a person on the ground, counting seedlings in sample plots laid out in grid patterns designed to give a mathematical probability that the results will apply to the entire site. This task was done by university forestry students from 1961 to 1976, by company foresters until 1987, and since then by certified contractors. The original stocking standards were developed by the company and approved by the government. The government developed regulatory stocking standards in 1968 and made them increasingly rigorous in each succeeding decade.

Stocking surveys were initially conducted five years after harvest. However, when crews returned two years later to plant the not satisfactorily restocked (NSR) sites, many of them had become sufficiently restocked, so the government agreed that surveys should be done seven years after harvest. The NSR sites were then treated—usually by planting—and surveyed again three years later to ensure the treatment was successful.

During the first twenty years of logging, harvests focussed on the oldest stands where there was relatively little grass or understorey vegetation. Seedlings growing on such sites did not have to contend with heavy competition for moisture, nutrients, and sunlight. The usual reason for poor stocking was lack of natural seed sources, which was remedied with seeding or planting. Early tending efforts focussed instead on the other major hindrance to healthy, productive forest stands: too many trees growing too closely together. This is a common problem in lodgepole pine after fires or overly successful regeneration on harvest sites.

Culling seedlings and young trees to optimal density is known as juvenile spacing or precommercial thinning. Trials of juvenile spacing in the Gregg Burn area found the most cost-effective technique to be with brush-clearing saws—similar to heavy-duty weed-eaters, but with a circular saw blade instead of a whip—and this became the preferred method for operational tending programs. Due to the extremely high densities and heavy slash, the work was slow and costly. Thinning operations were conducted in the Gregg Burn from 1974 to 1976,

Commercial thinning was done in 2001 in this sixty-year-old pine stand south of Hinton.

but by that time only 125 hectares of the 9,325-hectare burn area had been treated.

In 1977, chief forester Jack Wright suspended the Gregg Burn thinning and moved operations to regenerated stands. Some of the stands that had regenerated after logging had densities of 10,000 to 20,000 stems per hectare, and the new program thinned these to densities of 1,800 to 2,500 stems per hectare. A student crew did this work each summer for seven years, until replaced by a full-time company crew from 1984 to 1987. Under this program, more than three thousand hectares were treated.

The program aimed to improve growing conditions and final crop yields, but Wright also intended it to "set up" the stands for subsequent commercial thinning, an element of the intensive management plan proposed in 1970. Commercial thinning is the partial removal of middle-aged trees when they are large enough for pulpwood; this allows the remaining trees to mature more rapidly and vigorously into sawlog timber. Wright later summed up the vision he had tried to implement:

> *In future, final crops on average-to-better sites should be high-quality sawlog trees. The pulp mill should be running on wood obtained from thinnings, small trees, poor sites, and by-product chips. To accomplish this, average and better sites need proper early spacing so commercial thinning can be carried out twenty years before final harvest. Without proper juvenile spacing, commercial thinning is not possible.*

There were, however, some problems evident with thinned stands, especially on good sites where other species and rodents invaded the stands and inflicted damage on the remaining trees. Wright retired in 1987, and company managers suspended the precommercial thinning program in 1989, pending a broader examination of its risks and benefits. The money was diverted to more pressing needs.

There were indeed other priorities facing Weldwood in the late 1980s. On an operational level, the priority was to control competing vegetation on regeneration sites, a task known as stand cleaning. Competing vegetation had become an increasing problem through the late 1970s and 1980s as harvests moved to lower elevations and more biologically productive sites. In 2000, small-scale precommercial thinning resumed with the intent to gather information and determine costs for its potential inclusion in an intensive management program.

In 1986, the company sought provincial government approval to use herbicide on a trial basis to control competing vegetation. The widely used agricultural herbicide Roundup, which kills only broadleaf plants and biodegrades quickly, had recently been licensed for forestry use. One permit was approved, but a local coalition mounted a strident opposition to further use.

Although other companies went ahead with successful and uncontroversial trials—and herbicide use became an increasingly common industry practice in Alberta during the 1990s—Weldwood decided to postpone its plans to avoid generating further controversy that could affect forestry herbicide acceptability across the province. Instead, crews used brush-clearing saws to remove the smaller deciduous growth. To kill the larger aspens, they cut away a ring of bark with a curved blade, called a "girdling gun" because of its pistol-shaped handle. Since 1993, workers from the Fox Creek Development Association, an Aboriginal co-operative, have performed all this work, treating about 2,500 hectares per year.

Camp 1: A Silvicultural Challenge

There was this illusion that nothing was growing there, because it's a very poor, harsh site—very slow growing. It was always a concern when the senior managers flew into the airport from Vancouver. They would always say, "You guys fix that Camp 1. It looks awful."

—David Presslee, 1997

A great irony of forestry at Hinton is that the company's first harvest occurred in one of the most challenging areas to regenerate. To make things worse, it was highly visible—just west of town in the Athabasca Valley, near the major highway—and later became popular for recreation. The original harvest plan was sound practice for its day and the forest eventually grew back, but for many years it caused a lot of embarrassment.

The term "Camp 1" refers to both the facility itself, which was located beside Wildhorse Lake, and the operating compartment around it. In the horse-logging era, a compartment was intended to provide a twenty-year wood supply for a fity-man camp (some, like Camp 1, were larger), and the timber had to be located within reasonable walking distance.

In this view of the Camp 1 area in the mid 1990s, the first-pass strips are fully regenerated (darker areas), and planted seedlings from second-pass cuts are now evident above the snowpack.

The Camp 1 forest was predominantly spruce, up to four hundred years old, that had survived the region's frequent fire cycles. Brule Lake and the mountain ramparts to the west apparently created a natural firebreak to protect the area. However, high winds whistling out of the mountains dried the timber and impregnated the bark with fine sand particles. The larger bottom logs often had cracks, separated rings, a spiral grain, and pockets of decay—which explains why earlier sawmill loggers avoided harvesting the area, known locally as the "Green Timbers Area," although it had been designated as a potential timber berth as early as 1909.

The poor sawlog quality was not a problem for making pulp. Under Crossley's oldest-first approach to forest management, the readily accessible stands were an obvious choice for early harvest. He envisioned vigorous young trees replacing the "decadent" old growth.

A two-pass harvest was laid out in alternating strips, about one hundred to two hundred metres wide and up to eight hundred metres long, at right angles to the prevailing west wind. Trials with various strip widths in the early years determined that the wind could carry seeds from the residual strips across the width of the cut strips. As the first-pass strips were horse-logged between 1956 and 1966, the crews also preserved "advanced growth" (young trees in clearings or understorey) wherever possible. Shortly after harvest, the strips were scarified to prepare a bed for seeds blown from the uncut strips. Lacking a natural seed source, the second-pass strips cut after 1966 were scarified and planted with seedlings from the company's greenhouse. On the second pass, mechanical skidders were used, and there was no effort to preserve advanced growth.

Regeneration surveys of the first-pass strips began in the early 1960s and showed that stocking standards were being met, although growth was very slow.

Skeptics were invariably impressed when they were shown the numerous small seedlings, but often a person had to get down on hands and knees to see the baby trees. It should be noted that these harvests occurred before the rules were changed to require growth 1.8 metres high on first-pass sites before the second-pass cuts—and long before aesthetic considerations and public consultation entered into the planning process.

Because new growth on the first-pass blocks was barely visible as the second-pass cuts proceeded, casual observers thought they were looking at vast clearcuts—hardly a good impression to give local residents and visitors. Until it was relocated further south, the main highway to Jasper passed through the Camp 1 cutblocks, which were also visible while driving south on Highway 40 from Switzer Provincial Park. The regional airport, built in the early 1970s, was at the eastern end of the compartment, providing air passengers with an unobstructed view. Moreover, the area's stocked lakes became popular fishing spots, and campgrounds were established at Kinky Lake and Wildhorse Lake. The lack of visible regrowth became a target for critics and an ongoing challenge for silviculturists.

In retrospect, it is clear that seedlings in the first-pass cuts had benefited greatly from the shelter, shade, and moisture retention provided by trees in the adjacent strips. When those strips were removed, the entire area was fully exposed to sun, wind, and weather. The second-pass strips did not even have the partial protection provided by advanced growth left standing. In 1976, the company used a Bracke scarifier to address the exposure problem. The machine scooped out clumps of soil and deposited them upside-down next to the excavation. The soil clumps provided shelter for seedlings planted on the lee side.

Eventually, as poplar and shrubs sprang up, they provided more shelter for the spruce seedlings, but also competed for light, moisture, and nutrients. The understocked areas were replanted, sometimes more than once. Compared to other cutovers in the forest management area, growth was disappointingly slow. However, as later studies demonstrated, the post-harvest regeneration at Camp 1 was actually growing more rapidly and vigorously than the natural post-disturbance regeneration that had produced the stands being harvested.

Various techniques were tried to stimulate seedling survival and growth, including aerial fertilization trials in the late 1960s. But further research showed that the real culprit was the soil itself. It was mainly loess—glacial silt that had been carried down the Athabasca River from limestone mountains over the millennia and then redistributed by the wind. The soil was therefore calcareous (having a high calcium content), and this caused a condition called iron chlorosis in the seedlings. The condition was toxic to lodgepole pine and greatly slowed the initial growth rates for spruce.

In 1994, Weldwood commissioned a reputable independent silviculturist to survey the Camp 1 area again, and he found acceptable stocking levels on most sites. He said much of the young spruce was just reaching the height at which growth rates would take off as the trees rose above competing vegetation and roots extended deeper into the underlying mineral soil. By 1999, after more surveys, less than 3 per cent of the area was classified as not satisfactorily restocked—mainly on wet sites and higher, exposed, dry, west-facing sites where tree growth was probably always sparse and slow. Another 24 per cent was stocked, but in need of brush clearing to remove competing vegetation. The remaining 73 per cent was classified as satisfactorily restocked, growing well, and requiring no further treatment.

David Presslee, looking back on the Camp 1 experience in 1997, said it was humbling for the foresters involved. Many of the problems would have been avoided by modern methods such as pre-harvest assessment and ecological mapping, "but these terms and procedures were yet to enter the lexicon or practice of forest management." In addition, he noted that public consultation and visual quality guidelines, introduced in the 1980s and 1990s, would have averted much of the criticism and controversy about appearance. Yet the original design was state-of-the-art forestry for its time, an early example of integrated harvest and regeneration planning, and the site remains a continuing example of adaptive management in practice.

Sustainable Silviculture

As allowable cuts are allocated and utilized on agreement areas and management units, any extra supplies of wood will have to come from greater utilization of material formerly wasted, or increased growth from the areas in production. Efforts to increase yield have been modest in Alberta.

—Environment Council of Alberta, 1979

In 1979, Des Crossley and his colleagues on the Environment Council of Alberta forestry panel helped to set off a chain reaction leading to the implementation of sustainable forest management in the 1990s. The ECA panel said that the province could sustain a much larger forest products industry, and in fact such an expansion would give industry the needed incentive to reduce waste and improve forest productivity. This recommendation became government policy in the mid-1980s and led to a rapid expansion of the industry over the following decade. However, the panel also stressed that better methods were needed to evaluate the success of regeneration and improve the growth rates of the forest.

One problem stemmed from the "conifer standard" used for regeneration surveys in Alberta since the 1960s. Under this standard, a site was certified as satisfactorily restocked if surveys found a sufficient number of seedlings—pines at least two years old, spruce at least three years old—growing on the sample plots ten years after harvest. This standard had some unfortunate consequences. For one thing, it meant there could be up to eight years of lost productivity from the site. More importantly, there was no requirement to ensure the survival and growth of

These young lodgepole pine seedlings were naturally seeded following a fire; fireweed grows in the background. Donna LeLacheur

the young trees after the satisfactorily restocked certification. Remedial efforts all focussed on the not satisfactorily restocked sites.

In 1985, the provincial government conducted a study called the Juvenile Stand Survey on a sample of cutblocks harvested between 1966 and 1974 and subsequently certified satisfactorily restocked. The survey found that most of the blocks were forested, but a large percentage of them were no longer satisfactorily restocked with the desired conifer species. Many had poor growth rates and severe problems with competing vegetation. The company carried out a parallel study at Hinton and reached similar conclusions. While other research indicated that growth and yield rates for regenerated harvest sites were substantially higher than those for the standing forest and naturally regenerated sites after fires, the new surveys indicated lurking problems and a potential for far better performance.

A government-industry committee, including a Weldwood representative, was formed in 1987 to develop new stocking standards that would ensure survival and growth of the new forest. The resulting free-to-grow standard took effect in March 1991. This standard required three stocking surveys—the establishment survey at four to eight years after harvest, the growth survey at eight to fourteen years, and the final check-off at fourteen years. The young stand had to be unhindered by competing vegetation to be classified as free growing. The standard created a further incentive for industry to continue improving the success of forest renewal.

Intensive Forest Management

In order to take advantage of the inherent capacity of the lands under lease to produce raw material far in excess of what it produces in its wild state, and by so doing guarantee a perpetual supply of wood in spite of unpredictable drain to other users of land, and to realize the opportunity of paying a fixed rent rather than stumpage fees, the following recommendations are made.

—Crossley et al., 1970

The 1968 Forest Management Agreement called for a major expansion of both the lease area and the timber harvest. One clause in that short-lived Forest Management Agreement provided an option for fixed "ground rent" rather than volume-based stumpage payments once the full annual allowable cut was being harvested. This would have given the company an incentive to enhance growth and yield without incurring any financial penalty for the increased productivity. In addition, there were increasing concerns in 1970 about loss of productive forest to coal mines, oil and gas industry activities, and recreation. The 1972 cancellation of the expansion plans cancelled such incentives and shelved intensive management plans for almost a quarter century.

The company foresters' *Crossroads Report* in 1993—combined with the full utilization of annual allowable cut under the 1988 Forest Management Agreement expansion and the 1991 Forest Management Plan—set the stage for a new phase of intensive management. By the late 1990s, government policies and various aspects of the 1999 Forest Management Plan would make intensive management an essential component of sustainability. However, a directive from head office in Vancouver provided further incentive.

On 28 October 1994, the Weldwood board of directors asked company staff to evaluate the costs and benefits of a tree improvement program. The team of foresters who produced the *Crossroads Report* reconvened and produced a response in January 1995. They contended that tree improvement had the potential to increase the annual allowable cut substantially, at a cost per cubic metre less than that of purchased wood. They also emphasized that support must be continuing, not start-and-stop as previously. A year later, Weldwood foresters further elab-orated the future vision in an *Enhanced Silviculture Proposal,* which led to the 1996 appointment of Diane Renaud as tree improvement specialist, the hiring of distinguished silviculture scientist Stan Navratil, and examination of the full range of intensive forest management options. Between 1992 and 1994, Weldwood Hinton also joined regional tree-improvement co-operatives for high-elevation pine and low-elevation white spruce and black spruce.

The company's initial tree improvement strategies were developed in consultation with the provincial government and experts Jim Gent and David Todd from Champion's technical centre at Greenville, North Carolina. Diane Renaud then began writing and implementing the plan, which has two main aspects:

1. tree breeding, testing, and verification, and
2. seed orchards.

In the breeding program, carefully selected superior trees are bred to produce a large number of offspring, from which the best candidates will be selected for the next generation. The breeding population is managed to maintain broad diversity while improving traits such as growth rate and disease resistance. Each generation's breeding population is carefully screened to identify the best trees to form the seed orchard for that generation. New material is periodically introduced to ensure a continued broad genetic base to each of the programs.

Seed orchard trees, like most other orchard trees, are produced by grafting or from seedlings. In grafted orchards, twigs from the very best trees in the breeding population—the "orchard populations"—are clipped off in late winter and grafted onto seedling rootstocks in spring. As the grafted portion grows, the rootstock is trimmed back to leave only the grafted material to continue to grow. This new "ramet" is a genetically identical copy of the original selected tree. Several copies of each ramet are established in the orchard to interbreed with other superior trees. Orchards with seedlings or grafted material are designed to maintain a certain distance between related trees to avoid inbreeding. This breeding program is conducted at the company's David Presslee Seed Orchard near Edson

In seed orchards, pollen from male flowers is trapped by plastic bags over the male flower buds. Donna LeLacheur Z and is known as the Weldwood Pine Population Program. It results ultimately in genetically superior seed for use in reforestation.

Renaud ensured that genetic diversity was maintained by using up to 600 "parents" in each of the tree breeding programs, and 36 to 150 in each of the orchard populations. She also stockpiled pollen from the breeding population for future use in the Weldwood Pine Population Program. In one innovative field trial, Renaud experimented with grafts of lodgepole pine in the forest management area as well as in pots to see if they might grow better in the field. The trial showed that the same material grafted in the field had 70 per cent better survival after two years than the material grown in pots.

None of the trials or projects involves any gene transfers or modification—that is, there are no genetically modified organisms, or GMOs, in the programs.

The Huallen Seed Orchard is operated by a consortium of five forest product companies: Weyerhaeuser Company, Canadian Forest Products, Weldwood of Canada, Millar Western Forest Products, and ANC Timber. Other partners initiated orchard establishment in 1986, and Weldwood joined the consortium in 1995. Ongoing operational research trials address issues such as seed production potential, flower stimulation, cone crop periodicity, pests and diseases, and pollen and crown management.

Young grafts grow in the David Presslee Seed Orchard near Edson.

Tree improvement was only one facet of intensive forest management, and by 1996 it was clear that other components such as juvenile spacing, commercial thinning, and fertilization also would have to be considered. Like Des Crossley forty-one years earlier, Stan Navratil was a researcher with the Canadian Forest Service when he was invited to Hinton in 1996 to evaluate the prospects for such initiatives. Based on the scientific literature and various experimental plots established in Alberta since 1941, Navratil concluded that there was substantial potential to improve yields. The challenge was to select the most cost-effective combinations to produce the desired result. Navratil subsequently left the government service and moved to Hinton to continue his research and oversee establishment of the various trials.

In 1997, Presslee and Navratil collaborated in a study that showed the complexities in choosing which sites would benefit most from intensive management and what prescriptions to apply. To justify the investment, the sites would not only have to be biologically productive but also secure from possible loss due to recreational or industrial activities. The treatments could range from "light" and inexpensive ones—aerial fertilizer application, for example—to very expensive options such as repeated visits for vegetation control, juvenile spacing, fertilization, and commercial thinning.

Soon after, with the support of Foothills Model Forest, the Foothills Growth and Yield Association was established to pursue collaborative research in the establishment and growth of lodgepole pine. Dick Dempster was hired as director and scientific authority for the co-operative program, and nine member companies began installing trials in 1999.

The 1996 operating ground rules, the 1999 Forest Management Plan, and the company's ecological site classification program helped to create a framework for decision-making about how, where, and when to apply intensive forest management. Numerous trials underway in 2000 and 2001 were expected to provide vital information in coming years about the cost-effectiveness and potential allowable-cut contribution of the various options.

Protecting the Forest

I stayed with my crew at the [Gregg] cabin to protect it and to keep the fire on this side of the river. It was too far from the river, so we dug out the spring and pumped out of it. We knocked the fire out of the crowns with the hose, and the crew shovelled like hornets, throwing dirt on the fire to put it out. It was plenty hot in there. The fire was roaring like a freight train, and the smoke was heavy and thick, but we held the line.

—Vern Truxler, 2000

Vernon Truxler was born in Jasper, grew up in the Hinton area, and was among the first employees hired in 1955 by North Western Pulp & Power (NWPP). During eighteen years with the company, he worked on timber inventories and later in maintenance for the first mechanical skidders. He was subsequently employed by Switzer Provincial Park, the Forest Technology School, and the Town of Hinton.

In May 1956, Truxler was cruising timber when fire broke out near the Gregg River south of Hinton. There was no road into the Gregg Valley at the time, so he and his crew drove up the Robb Road as far as they could and then hauled a gasoline-powered pump on a Bombardier tracked vehicle to the old Dominion Forestry Branch ranger cabin. They fought the fire for twenty-eight days.

The Gregg fire left 9,325 hectares of "dead black snags on a black landscape," as Truxler put it. The burned area was horseshoe shaped, with two arms about eighteen kilometres long. Fire investigators believed that it started from a debris fire at a seismic crew's camp on Antler Creek, although this was never proven conclusively. The seismic crew enlisted help from a nearby sawmill and fought the fire for a day, but it blew out of control due to strong winds on the second day. As the flames spread, there were concerns the fire could continue right into Hinton. That was why Truxler and other company employees worked flat out to create a fire line along the Gregg River.

Two other major fires broke out on the lease area that summer. The Pine Creek fire near Edson roared across 6,060 hectares, and another blaze in the Berland area north of Hinton affected 3,424 hectares. Along with the Gregg Burn, the fires destroyed timber on 2.4 per cent of the NWPP lease area before it had even been inventoried.

Chief forester Des Crossley was shocked by the apparent ineffectiveness of the Alberta Forest Service (AFS) in dealing with the fires. The AFS was responsible for fire protection under the lease agreement, but it had been perennially short of funding, staff, and equipment since the 1930s. "Everybody, including our New York office, was upset over this unexpected situation," Crossley said, "and the Alberta minister was made aware of our concern, which he apparently shared." The minister, Norman Willmore, represented Jasper-Edson in the Legislative Assembly, and he was keenly aware of the fires' impact on his constituents. At Willmore's request, Crossley asked all the employees involved in fighting the fires to write down their observations, and these formed the basis for a highly critical brief submitted to the government. Unfortunately, the minister did not inform his staff about his earlier discussion with the company, and the report took the AFS by surprise. Crossley described the report as "devastating" in its indictment of government support for forest protection.

Although the Alberta Forest Service defended its actions, director of forestry Eric Huestis said he appreciated the company intervention since it supported his often-stated concerns about the human resources and equipment available for forest protection. Fred McDougall, a subsequent director of forestry, later observed that the critique played an important role in getting more funding for the service's protection efforts. The government established a future target of annual fire losses, averaged over twenty years, no more than 0.1 per cent annually on the lease area. The forest service continued to play the lead role in forest protection, but the company also became much more actively involved.

The result was a major improvement in fire prevention and suppression. Although the rest of the province's forests experienced much more extensive fires—notably in 1968, 1980–1982, and 1998—the Gregg Burn remained the largest on the lease area, and 1956 stands as the worst single year for fire losses on the forest management area since the first lease was signed.

The 1956 fires actually came at a pivotal time for Alberta. For the first time, the means were at hand for a major advance in fire protection. Oil and timber revenues meant the province could afford to train and recruit rangers and firefighters. The just-completed Forestry Trunk Road along the foothills, combined with a growing network of roads built for logging and oil and gas industry operations, made it possible to get heavy equipment to fire sites much more quickly. Powerful bulldozers could clear fire lines. Helicopters and fixed-wing aircraft assisted lookouts in spotting fires, ferried personnel, helped to co-ordinate the attack, and doused the flames. Better radios and an expanding telephone network aided detection and control efforts. Forest fires would still rage, but not as often or over such large areas.

The Government's Role in Fire Protection

It is pointless to commence a forest management program until adequate protection of the timber can be provided. The system must be good enough to justify spending subsequent time, energy, and money on meaningful forest management.

—Des Crossley, 1984

Fire protection had been a primary government goal since the first Dominion Forestry Branch rangers and foresters arrived in western Canada at the beginning of the twentieth century. The Alberta Forest Service inherited this task when the foothills forest reserves and northern forests were transferred to the province in 1930, but lack of funds severely limited the capabilities of the AFS during the Great Depression of the 1930s, as did labour shortages during the Second World War. It was only after the war, assisted by government revenues from the oil industry, that the service could finally begin to address its responsibility.

In the late 1940s, Alberta sawmills were producing more lumber than ever before, about 490 million board feet annually, and AFS director Eric Huestis expressed concern that the industry was overcutting the province's sustainable timber supply. The severe fire losses of 1931, 1937, 1938, and 1941 gave him legitimate cause for concern. If the forests mature in about a hundred years, and an average of 1 per cent burns annually, then simple math indicates there is not much "sustained yield" to support an industry. Better inventories and much-improved utilization improved the outlook, but reduced fire losses also played a vital role in the industry's subsequent expansion. (In 1999, Alberta produced 3.1 billion board feet of lumber—more than six times as much as in the 1940s—and a wide variety of other wood products.)

In addition to better roads and equipment, the other key elements in protection were personnel and training. The AFS began to hire more foresters and rangers after the war. The first formal fire training in Alberta was a four-month course for returning veterans given at Calgary and Kananaskis in 1946, and the next was a five-week course for rangers and national park wardens at the Banff School of Fine Arts in 1950. A year later, the AFS began conducting a ten-week "forestry training school" annually at the Kananaskis Forest Experiment Station, a former prisoner-of-war camp west of Calgary. The program was offered only to AFS staff, and the primary emphasis was on fire prevention and control.

Peter Murphy was given responsibility for the training program in 1956, and in 1960 it was moved to a permanent facility in Hinton—originally called the Forest Technology School, later renamed the Environmental Training Centre and now

(2003) the Hinton Training Centre—and it became a centre of fire-management expertise. Fire-control training was extended to people outside the forest service in 1962, and a certification program for firefighters was established the following year. Many Aboriginals were among the more than thirteen hundred firefighters certified during the 1960s. In co-operation with the Northern Alberta Institute of Technology, the Hinton school also began to offer a two-year diploma program for rangers and forest technicians beginning in 1965. In 1967, the school acquired its first simulator to train supervisors to manage fire-control operations. In February 2001, the new Forest Engineering Research Institute of Canada fire research centre was established in Hinton, also located in the training centre.

Although aircraft had been used for fire spotting since the 1920s, their use in support of firefighting was hindered until the late 1950s by lack of landing strips in forested areas. The AFS acquired its first airplane in 1957 and thereafter both fixed-wing aircraft and helicopters played an increasingly important role. Most importantly, it became possible to get "initial attack" crews to fires while they were still small enough to contain.

Aerial water bombing was added to the arsenal of tactics available for fire control in the late 1950s. The first use at Hinton was in 1959 when four Grumman Avenger water bombers dropped "wet water" on a fire along Maskuta Creek. (A pink-dyed drilling mud ingredient is added to the water so that it will adhere to surfaces it hits, and the colour then shows where it landed.) The fire affected 347 hectares, and the effort to control it eventually involved four hundred men, sixteen bulldozers, six Bombardier tracked vehicles, the four fixed-wing water bombers, two fixed-wing spotter aircraft, and a helicopter. This fire also demonstrated the

A B-26 water bomber applies Firetrol fire retardant.
Alberta Sustainable Resource Development

value of radio communications to marshal and co-ordinate company and AFS resources, and it prompted a major expansion of the company's radio network.

The propane stove in a logger's trailer, parked on the road in a cutblock, started the Maskuta Creek fire. The company insisted thereafter that "shackers" locate their accommodations adjacent to the main camps.

As recreation became more popular in forest areas, the Alberta Forest Service began providing safe camping areas and educating the public about fire hazards. In 1958, Walt Disney Studios designed Bertie the Beaver as a fire-prevention mascot for the AFS, similar to the U.S. Forest Service's Smokey the Bear. The Alberta government also worked with the oil and gas industry, and other commercial forest users, to reduce fire risks.

These efforts were generally quite successful. In the 1990s, although human activities caused about 40 per cent of the forest fires in Alberta, the human-caused fires accounted for only about 10 per cent of the area burned. Lightning continued to cause the largest number of forest fires, and by far the largest area burned. A provincial lightning-detection system, one of the most advanced in North America, aided considerably in the early detection and control of forest fires. Fire lookout towers also continued to be an essential part of fire detection.

The Company's Involvement in Fire Protection

The 1952 version of the pulpwood agreement contained a provision whereby the company would be responsible for "safeguarding of timber from fire" and pay *all* the government's costs of firefighting on the lease area—a potentially staggering liability—but the 1954 agreement, like all subsequent ones, restored the government's primary role in fire protection and established an area-based annual charge for this service. North Western Pulp & Power's main duties were to prevent and suppress fires in the immediate vicinity of its own operations.

However, the experience in 1956 showed that the company could, and should, play a more active part in providing people and equipment for firefighting. The company agreed to procure firefighting equipment and keep the AFS informed about the location of equipment in the field. The forest service agreed in turn to provide training and certification for company staff.

In 1959, after the Maskuta Creek fire was attributed to operations at Camp 2 (the propane stove in a trailer), the AFS sent the company a sizeable bill for suppression costs. This prompted another round of vigorous discussions about respective obligations, leading eventually to a formal fire control agreement in 1967. The agreement established mutual responsibilities and set out a sliding scale of compensation to be paid for fires caused by company operations. These provisions continued in the most recent version of the fire control agreement, adopted in 1989, although the company's commitment of equipment and trained personnel expanded considerably over the years.

In the mid-1970s, the company established its own "initial attack crew" to fight

A crew mops up after a fire. Fire-line workers continue to play an important role in fire suppression.

fires on the lease area. The crew was initially university students working under a company employee, but later became a full-time, year-round team of four company employees. They work closely with counterparts in the forest service and also provide primary response for fuel or chemical spills in the forest management area. The crew has pioneered new techniques such as the use of foam on forest fires and adapting skidders and all-terrain vehicles to carry water tanks.

The company–government agreement also spells out the details to be covered in the company's fire-control plan, the minimum inventory of firefighting equipment to be maintained, the minimum numbers and training requirements for company fire crews, initial attack responsibilities, and arrangements for communications and co-ordination with the forest service.

The forest industry today is still the only non-government contributor to direct fire-guarding charges, although protection of the commercial forest from fire is fourth in provincial priority after protection of (in order): life, communities, and watersheds.

A Continuing Threat

Despite continued advances in fire-control methods and company–government co-operation, weather and fuels can still conspire to create conditions in which fires "blow up" and become virtually uncontrollable almost from the moment of ignition.

A recent example occurred in the early morning hours of 14 December 1997. A dry autumn and lack of snowfall combined with unremitting chinook winds to create tinder-dry conditions in the forest. Then wind snapped a spruce tree near Mountainview Estates just outside Hinton, casting it against a power line. Sparks ignited a firestorm that cascaded across the land and consumed much in its path, including a large ranch house whose occupant narrowly escaped.

At the same time south of town, sparks from a highway clearing project ignited two fires that quickly joined and consumed about three thousand hectares of the Gregg River drainage, including various ages of reforestation, old forest stands, and younger lodgepole pine regrowth from the 1956 fire.

Company crews, contractors, and forest service firefighters—almost two hundred people with an array of heavy equipment—battled both blazes for almost a week. High winds and frozen conditions prevented the use of water bombers. Even helicopter use was severely limited by the gale force winds.

"The sky north and south of Highway 16 was lit up by the fires, and at first I thought the town itself might be hit," said Dennis Quintilio, former fire researcher and later director of the province's integrated resource management division, who was summoned to Hinton in the early morning darkness. "Thankfully, this was not the case, although had the ignition point been elsewhere it could have been a more serious situation."

These fires brought home to many the need for awareness and readiness to protect forest-based communities. It reinforced for many residents the timeliness of a new Alberta government initiative. In 1997, the province began a new study of ways to anticipate and reduce the potential risks of forest fires to communities, and Hinton was chosen for one of the pilot studies, the Hinton Wildland Urban Fire Interface Initiative. The program includes risk definition, fuel modification, and educational components. This program, now known as FireSmart, has been adopted by a number of communities, including the Town of Jasper, where Parks Canada introduced it in 2001 as a Foothills Model Forest project.

In 1998, a dry spring and high winds combined to spread devastating fires across many Alberta forests. The government's fire protection spending soared to $149 million, compared to a ten-year annual average of about $30 million. This led to a re-examination of protection options. One possibility was reducing the continuity of fuels by changing the design and placement of forest harvests. On sites that are scarified after harvest, the fire hazard is reduced because the slash is broken up and mixed with soil. Foresters are studying ways to improve the effectiveness of these and other treatments. "Cooling the forest"—reducing the risk of fire and/or implementing measures that will, if fire does happen, limit its spread—is becoming yet another goal of forest management.

Insects and Disease

Frequent fires in the past left much of the Hinton forest area in relatively young stands. As a result, the forests have been better able to withstand attacks from insects and diseases. However, potentially harmful insects and diseases live throughout the forest as part of its biological diversity, and they could become a more serious threat as fire prevention becomes more effective.

The major potential threat in the forest management area is the mountain pine beetle, which has killed extensive tracts of lodgepole pine in the southern interior of British Columbia and, from 1979 to 1981, in the Crowsnest Pass area of southern Alberta. This small beetle bores a hole through the bark to lay its eggs in the cambium layer. As the larvae feed on this growing layer, they effectively stop tree growth and impair the tree's ability to move nutrients to the roots. The beetle can also transmit bluestain fungi, which further weakens the tree by clogging the water-carrying cells in the sapwood. The natural defence of the trees is to flood the insects' feeding galleries with pitch. However, during an epidemic, the numbers of beetles are so great that these defences are overwhelmed.

The mountain pine beetle recently spread to the upper Fraser River area in British Columbia, and an increased infestation was noted in Banff National Park, along with some scattered "hits" in Jasper National Park during 2000. In 2002, the beetle infestation had spread in the Banff area and pockets of infestation were found near Canmore. Alberta's cold winters normally kill off the beetles, but forests are monitored for any signs of outbreak. Many foresters believe that the only effective control is to cut the affected trees, peel the bark, and burn the slash. In the 1930s and 1940s, about twenty-five thousand trees were cut and burned in a four-thousand-hectare area of Banff National Park to control mountain pine beetle. Under current Parks Canada policies, controlled burning would be the preferred method for controlling the beetle. Parks Canada, Alberta Community Development, Alberta Sustainable Resource Development, and the forest industry are developing strategies to deal with potential beetle outbreaks in the mountain parks as well as adjacent Crown lands all along the eastern slopes.

Other naturally occurring insect threats include spruce beetle, spruce and pine terminal weevil, and forest tent caterpillar in aspen. Tree diseases occurring in the forest management area include armillaria root rot, atropellis canker, dwarf mistletoe, western gall rust, and a number of other rusts. Healthy trees can usually withstand the effects of such insects and diseases, but succumb when weakened by old age or stresses such as drought.

Blowdown

Strong winds in the foothills can often blow down natural forest stands as well as residual trees (those left exposed after an adjacent harvest). The downed trees are tangled and broken and, unless salvaged, soon begin to rot away. In laying out harvests, foresters try to use wind-firm boundaries of well-rooted, wind-resistant trees, such as those along natural openings and muskegs. "Feathering" the edges of cuts—thinning out the trees to reduce the density but still retaining some trees to disperse the wind—also appears to reduce the amount of blowdown.

Some of the early cutting at Camp 2, west of Hinton and south of Highway 16, was so severely exposed to wind that many of the residual trees blew down. The company was able to salvage the timber as these events occurred, but the result was a large clear-cut on a highly visible hillside. The site, which has since regenerated, provided some valuable lessons in harvest design.

One of the advantages of the extensive road system in the forest management area is that it provides an opportunity to salvage trees killed by blowdown, fire, and other disturbances. This is important, because all this wood must be accounted for as part of the annual allowable cut.

Completing the Cycle

The themes of chapters three to nine represent the sequence of sustainable forest management activities as they would be implemented in a single stand:

1. Determining the objectives of management (chapter three)—intervention in nature is literally pointless unless it has goals; the goals give rise to the framework of policies, laws, and regulations governing management.
2. Integrating multiple uses and values (chapter four)—a key provision of forest management in Alberta, as in most of Canada, is that Crown lands should support multiple uses and values; when practised properly, integrated management maximizes the benefits that society obtains from the forest landscape without impairing its value for future generations.
4. Gathering knowledge about the forest ecosystem (chapter five)—the quality of decision-making depends on the knowledge available to managers; in forestry, the necessary information includes the timber inventory, the forest's growth and yield characteristics, the ecological processes, and the social, cultural, and economic values and trends affecting the forest landscape.
5. Planning (chapter six)—management plans translate goals and knowledge into strategies and tactics; the plans describe, step by step, how the desired future forest will be attained, and how contingencies will be addressed.
5. Harvest (chapter seven)—safe, efficient, and economical harvest is essential for successful forest management, but harvest methods are also a key element of silviculture; harvest is not just the death of an old stand but the birth of a new one.
6. Manufacturing (chapter eight)—the products extracted from the harvest pay the bills for forest management, support the jobs of forest and mill workers, and underpin the economies of forest communities; mills have to operate efficiently, with minimum environmental impact, and manufacture maximum value-added products to meet society's needs and fully utilize the forest resource.
7. Silviculture and forest protection (chapter nine)—growing and nurturing the new stand fulfills the foresters' commitment to future generations; a healthy young stand assures society that the forest ecosystem will remain intact as older stands are cut.

This sequence of activities—which seems so stately and elegant as it proceeds for the better part of a century on a single stand—becomes vastly more complex

◀ ▶ CONTENTS INDEX

when there are thousands of stands to be managed on a million-hectare landscape. However, if only a small percentage of the stands are directly affected by human interventions at any given time, the lessons from past interventions can be applied to improve future success.

The final stages of the management cycle are monitoring and assessment, which have been integral parts of forest planning and operations at Hinton since 1955. This integration can be seen in the evolution of each of the activities described in the chapters above. The development of the operating ground rules is a notable example, but there are dozens of others such as the changes in inventory methods, harvest equipment, mill processes, containerized seedlings, and site-preparation methods.

Monitoring and assessment occur on many levels and time frames, from day-to-day operational decisions to the decade-by-decade iteration of forest management plans and the measures (indicators) used to track progress and conformity to plan assumptions. Formal monitoring and assessment results are presented annually in the company's forest stewardship report and reviewed frequently through external audits, regulatory procedures, public consultations, and proceedings of the Forest Resources Advisory Group. Chapter ten offers instead a more qualitative and impressionistic set of reflections on the lessons from the Hinton forest enterprise and the directions it might take in the twenty-first century.

CHAPTER TEN

Sustaining the Hinton Legacy in the Twenty-first Century

In the early years, the main focus was avoiding the mistakes that had been made elsewhere. Then it moved to creating a science-based forest management, which became known as sustainable forest management in the 1990s. I think we are now moving into a new phase where we focus more on the needs and demands of the end user.

—JIM LELACHEUR, 2001

New pine reforestation is tangible evidence of a renewable resource that will continue to provide jobs, biodiversity, and cultural and spiritual values for generations to come. STAN NAVRATIL

Jim LeLacheur, general manager of forest resources and lumber, offered the above observation during a wide-ranging "think-tank" discussion among senior managers at Hinton in January 2001. LeLacheur referred specifically to the customers for pulp, lumber, and panelboard, who can now choose among a vast array of options from around the world to meet their needs for construction materials and print media. With a relatively slow-growing northern forest resource, located one thousand kilometres from ocean ports, foresters and mill managers at Hinton will certainly need continued cleverness to remain competitive in terms of cost and quality. This is the bottom line. The revenues from the products are the mainstay of the regional economy and pay the bills for forest management.

LeLacheur's remark also reflects a deeper truth. Forest managers today are making an unprecedented effort to understand the end users of the living forest as well as the end users of the products extracted from it. Socio-economic research by the Foothills Model Forest has already identified a challenging dichotomy among the values of users. People who live and work in forest areas tend to have a "utilitarian" view of the landscape—as a source of goods and services, which can be as varied as wood, jobs, wildlife, recreation, clean air and water, scenery, or solitude. On the other hand, the urban population seems to have a more "biocentric" view of the forest ecosystem as a living entity to be nurtured and protected for its inherent qualities.

Both of these visions were already well developed in the period between 1985 and 1995 when politicians, bureaucrats, industry foresters, academic scientists, environmental activists, and members of the public debated what would constitute "sustainable forest management." The definition that was adopted, in Canada and internationally, embraces both of the popular concepts: multiple benefits (utilitarian) and biological integrity (biocentric). In addition, the definition of sustainability includes closely related concepts such as maintaining forest productivity, conserving soil and water resources, contributing to global ecological systems, and fulfilling social responsibilities. It is a complex, interconnected definition for a complex, interconnected task. Communicating this goal, and charting progress toward it, has been a difficult challenge. Yet it is essential that "end users" understand the framework if they are going to support sustainable forest management and make wise decisions affecting our future forests.

Hugh Lougheed, forestry manager for Weldwood at Hinton, was the lead author of the 1999 Forest Management Plan, the first to be based explicitly on the sustainable forest management framework, and one of the first anywhere to quantify the conceptual framework and apply it to a large "working forest." He noted that there is one significant flaw in the way the framework has been presented to the public. Virtually all the documents, including the Forest Management Plan, start with biological diversity as the first criterion and end with social responsibility as the last one. "It gives the impression that there is a hierarchy, but in fact all of them are equally important and none can be achieved unless they all are," he commented. "Sometimes I think we should present them in a different order each time."

In July 2000, the million-hectare Hinton forest management area received singular recognition when it became the largest in Canada to be certified for sustainability under demanding standards established by the Canadian Standards Association (CSA). It remained the largest until December 2001 when

Weyerhaeuser's 1.36-million-hectare Grande Prairie–Grande Cache forest management area received CSA certification. Weldwood's 580,000-hectare Sunpine Forest Products operation, in the foothills south of Hinton, was also certified in December 2000.

The Hinton certification was the culmination of three years' preparation and analysis by the company to ensure its systems and performance could meet the CSA criteria. However, this did not mean Hinton foresters and managers could settle back and rest on their laurels. The achievements of 2000 were the direct result of adaptive management over the previous forty-five years, and the future would depend on continuing that commitment to ongoing adaptation. The company's sustainable Forest Management Plan identifies forty-eight indicators that will be monitored to ensure that the goals of management continue to be met.

Learning from the Past

I am impressed by the Weldwood performance. I noticed numerous occasions where Weldwood had exceeded the standards of practice, had taken the first initiative to address concerns of the environment, adopted more than adequate responses to wildlife, and took aggressive actions in reforestation, safety, and silviculture. I appreciate that Weldwood has an open attitude of learning and presents itself as willing to try innovative responses to problems that arise. I believe that Weldwood should "toot its horn" a little more. The general public has little or no understanding of the work, effort, time, and money that is invested to be responsible stewards of the environment.

—BILL BULGER, 1996

Lutheran minister Bill Bulger, a long-time Hinton resident and member of the Forest Resources Advisory Group, wrote this comment in 1996 after participating in an external audit of Weldwood's Hinton operation for certification under the Alberta Forest Products Association's FOREST*CARE* Codes of Practice. The need for dialogue with stakeholders is one of the enduring lessons of the Hinton story. Equally important is the need for continual adaptation to new circumstances.

Looking back, one can see many forks in the road where different decisions or actions could have resulted in very different outcomes. At various points, for example, the federal and provincial governments could have sold the foothills forest lands to private owners, but they decided to retain public ownership—to protect watersheds and to reap the benefits of renewable and nonrenewable resources for present and future generations. In establishing forest management agreements, however, Alberta decided to give private companies the responsibility for inven-tories, planning, and reforestation. In the early 1970s, some public opinion in Alberta favoured turning the mountains and foothills of the eastern slopes region into parks, like Jasper and Banff, but the government opted instead for multiple use and integrated land management.

Hinton "Firsts"

1951 First successfully initiated sustained-yield forest management agreement in Alberta.

1954 First company in Alberta to accept full responsibility for all aspects of forest management.

1956 Pioneering efforts in scarification for natural regeneration.

1957 First pulp mill to rely primarily on lodgepole pine (in Alberta or elsewhere).

1958 First operating ground rules incorporating principles of adaptive forest management. First planned network of permanent sample plots in Alberta (3,200 plots still maintained for growth and yield studies).

1960 First detailed forest management plan written in Alberta.

1965 First forest industry nursery in Alberta. First use of containerized seedlings in Alberta.

1970 First forest industry recreation initiatives in Alberta.

1972 First integrated forest products operation in Alberta (sawmill added to pulp mill).

1982 First integrated wildlife/forestry program in Alberta.

1988 First forest industry wildlife biologist hired in Alberta.

1989 First public advisory committee for forest management.

1992 Sponsoring partner in first (and still only) model forest in Alberta.

1999 First company to plant one hundred million trees in Alberta.

1999 First forest management plan in Alberta to include an explicit quantitative analysis of forest, wildlife, and hydrological interdependencies.

2000 Sustainable forest management system certified under demanding standards established by the Canadian Standards Association. Largest forest management area in Canada to receive such certification at that time (and until December 2001).

These "firsts" kept Hinton at the forefront of industry advances, and they are significant not only individually, but also collectively, as they were sustained over nearly half a century and across a broad spectrum of forestry issues.

The people of Alberta, as the owners of the land and its resources, establish the goals for its management. In the 1950s and 1960s, it was assumed that the government spoke for the people; public input was informal or indirect through the political process. The government's principal goal was economic development —Alberta was still very much a "frontier" province, and memories of desperate poverty during the 1930s were still fresh. The particulars of sustained-yield management originated largely from individuals in the Alberta Forest Service and industry rather than from popular demand or grand government policy.

The role of such individuals in this story cannot be underestimated. Reg Loomis and Eric Huestis shaped the government's approach on the basis of their knowledge, experience, and beliefs. Likewise, Des Crossley set the company on the progressive course and science-based management ethic that continued over the decades. Jack Wright, a keen outdoorsman himself, recognized in 1970 that recreation opportunities on publicly owned forest lands would play an increasingly important part in the company's future sustainability by respecting and conserving other values people hold dear. Jim Clark saw the benefits of working with Aboriginal people in the 1970s and of developing a new approach to wildlife in the 1980s. Bob Udell, serving on the province's expert panel on forest management in 1990, recognized the need for new levels of stewardship to meet demands of public, government, and customers. David Presslee enthusiastically revitalized the silviculture program between 1994 and 2000. Hugh Lougheed was one of the architects of the linked planning process and lead author of the company's first sustainable forest management plan. These are a few examples of the scores of committed individuals who made unique contributions based on their experience, professionalism, and commitment.

By the late 1980s, it was no longer sufficient to receive public input indirectly through the government. Hinton matured into a modern community, and roads opened up access to the forest management area for both the public and for other industrial and commercial users. The company created a mechanism for direct dialogue with stakeholders through the Forest Resources Advisory Group (FRAG) and its predecessor. This led to remarkable innovations in the 1996 Operating Ground Rules and the 1999 Forest Management Plan. The FRAG helped the company address controversial issues such as the harvest plan for Athabasca 4, an operating compartment near Brule Lake, located near a guest ranch in the forest management area that had developed much of its client base by advertising a wilderness experience. Foresters gained new insights into their work when they had to explain it to nonprofessionals, and interested members of the public gained new insights into forestry. The final plan for Athabasca 4, incorporating the results of consultation, was significantly different from the original one.

Exponential increases in knowledge about this particular landscape and about forestry in general made it possible to meet ever-increasing demands for sustainability and multiple use. It was fortuitous that the first mainframe computers became available at the same time the first inventories were conducted, and equally fortuitous that even more powerful personal computers emerged in the 1990s to meet the information-handling needs of sustainable forest management. Basic knowledge, including John Stelfox's wildlife studies and Bob Carman's silvicultural planning systems, allowed later generations of biologists and foresters to understand the basic processes of the ecosystem. Des Crossley's commitment to research, and his close relationship with researchers in the federal and provincial forest services, laid the groundwork for the advanced research at the Foothills Model Forest in the 1990s. The concrete result of this knowledge, and its application, was an agreed-upon increase in the annual allowable cut from 1.1 cubic metres per hectare per year in 1960 to 2.7 cubic metres per hectare per year in 2000.

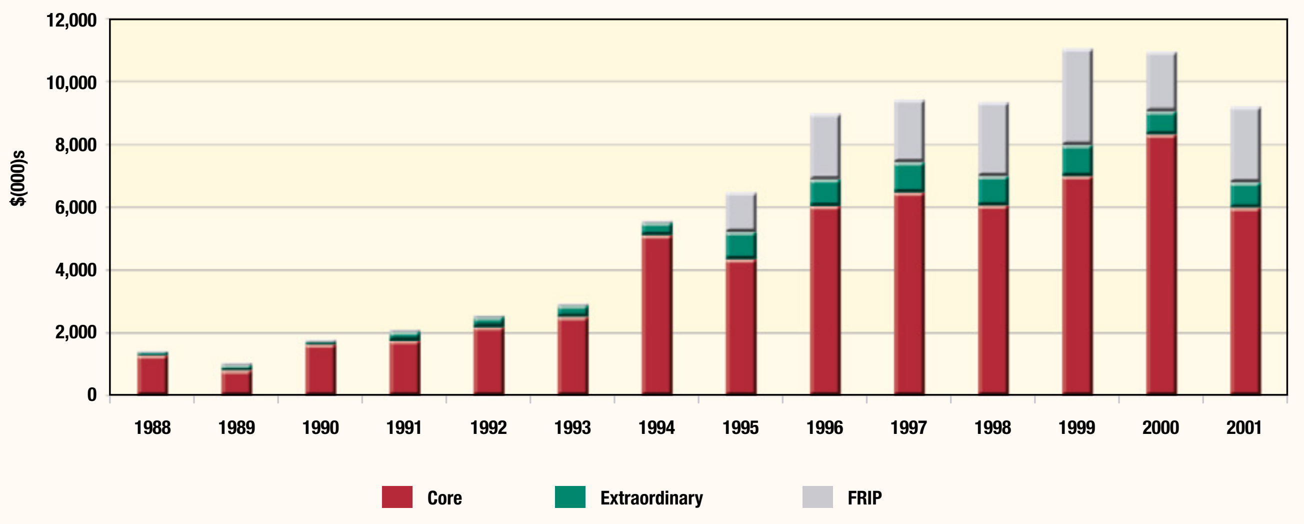
In addition to computers, other technologies utterly transformed both forestry and production. Aerial photography largely eliminated the tedium of on-the-ground timber cruising. The danger and drudgery of logging were reduced dramatically by the introduction of mechanical skidders and feller-bunchers. Today, the technology of stumpside harvesters and forwarders combined with the demands of site-specific planning have made logging an intellectually challenging assignment in forest stewardship and wood utilization. Mills now produce higher quality product, with less pollution, than could be imagined even twenty years ago.

One enduring legacy of forestry at Hinton is the commitment to silviculture. No aspect of the operation better exemplifies the principles of adaptive forest management. Crossley's basic research led to one of the first and best corporate reforestation programs in Canada. Even his earliest efforts had a 75 per cent success in restocking within seven years, and the resulting stands had much better growth rates than those resulting from natural disturbance. Subsequent refinement brought continual improvement in stocking, survival, and growth. The "regeneration delay" between harvest and establishment of the new stand has been reduced almost to zero (when year-old seedlings are planted in the same year as harvest).

However, silviculture is not the only defining legacy of forestry at Hinton. Company foresters have also been pioneers in the development and testing of forest policy and forest management systems. The forest management system developed at Hinton and the inventory and growth and yield systems that provide the foundation for it are unparalleled in North America, perhaps in the world. These systems provide the framework to link forest growth to economic, social, and ecosystem values—the underpinnings of sustainability. Ultimately the legacy is the culmination of many achievements rather than any single achievement.

None of this could happen, of course, if it was not economically viable. By setting royalty and tax rates that allowed a competitive return on capital, the

Figure 10.1. Forest management spending at Hinton. The total expenditures include those that are necessary to fulfill the company's obligations under various acts, regulations, and agreements, including the Forest Management Agreement (core funding). They also include projects that are not part of the company's regulatory obligations. These are either funded directly (extraordinary) or through the Forest Resource Improvement Program of Alberta (FRIP). The big-ticket items in 1999 were inventory, growth, and yield studies ($1.2 million) and the normal silviculture program ($5.1 million) plus a smaller amount for management and planning ($100,000).



A Walk in the Woods, a Walk Through Time

The core team that prepared this book met in January 2001 to review our work and get up to speed on the latest developments at Hinton. We saw technological marvels in the mills and woodlands, and we heard managers describe sophisticated strategies to meet the new century's myriad challenges. But what brought us together in the first place was a keen interest in both human and natural history, so we were especially thrilled by Peter Murphy's discovery of two lodgepole pine snags on the edge of a cutblock near the hamlet of Robb.

The harvest contractor, using the latest cut-to-length stumpside processing system, obligingly cut cookies (cross-sections of the dead trees, about thirty centimetres above ground) so Murphy could study the rings. We already knew that the mature pine stand being harvested had originated from regrowth after a fire in 1896, and Murphy expected the rings on the snags would tell the story of the site during the preceding century or two. He was right about one of the snags, but the other one turned out to be much, much older—most likely dating from the late fourteenth century. The older snag apparently survived the fire, around 1686, that cleared the ground for the second tree to begin growing about two years later. Both trees died much later, but remained standing to the present.

Murphy pieced together a fascinating history of these few hectares. The big events were the fires that swept through in 1387, 1595, 1686, 1708, 1740, and 1896. In between, there were years of lush growth, and times when drought or long winters resulted in just the tiniest increments. There are scars, perhaps indicating another tree fell against the more wind-firm survivors. A charred ring on the stump of a harvested tree nearby indicates that yet another low-intensity fire occurred in 1908.

It was a wonderful reminder that despite the seeming vastness of the foothills forest, and the apparent uniformity of many stands, each tree is a unique individual and each site a unique ecosystem.

The snags also reinforced that the forest and the landscape operate on different time scales than humans. In 1387, for example, Chaucer had just begun writing the *Canterbury Tales,* and the Ming Dynasty was consolidating its power in China after overthrowing the Mongol Empire. Even in 1896, the most recent "big year" in this site's history, Alberta was still part of the North-West Territories, and the Robb area was known only to a few Aboriginal people and government surveyors.

government made it possible for the company to continue investing in the mills and forest, including developing benefits and opportunities for the public. The transition to sustainable forest management in the 1990s saw a major increase in the cost of forest management, and the government set aside a portion of stumpage revenues in a special fund (Forest Resource Improvement Program) to assist in resource management initiatives beyond the regulatory requirements. In 1999, spending on "discretionary" items (beyond regulatory requirements) totalled $3.9 million, including more than $2 million for enhanced silviculture trials and the tree improvement program. During the 1990s, the company's total forest management spending at Hinton soared from less than $2 million annually in 1991 and 1992 to more than $10 million in 1999 (see figure 10.1).

Sustainable Forest Management

The traditional concept of "old growth" bears little ecological relevance to the boreal forest. In fact, most of the "natural" boreal landscape historically had very young trees on it due to active fires. Mature trees were, and always have been, in the minority. There were probably times in history when, under perfectly "virgin" conditions, there was virtually no forest older than one hundred years on the entire forest management area. The same can be argued for complexity, structure, and diversity. Many virgin areas of the boreal forest are highly homogeneous structurally and compositionally. If there is any irresponsibility, it is that we force on these landscapes artificially high levels of complexity and structure. In my opinion, the single most influential cultural impact on the boreal forest in the past century has been fire control—not cutting. We have been good at fire control for about forty years, yet it is seldom mentioned as a "human activity." If we assume fire control **is** *a human activity, then one could argue the only virgin forests are in the far north.... Given the fuel buildup on the current landscapes (indicated by the large amount of older forest), to cease harvesting of the forest management area but to continue controlling forest fires could lead to both ecological and social disasters.*

—David Andison, 2001

Fire researcher David Andison is one of the Foothills Model Forest scientists who are contributing basic scientific knowledge about the natural processes of the forest ecosystem. This knowledge enables foresters to emulate natural disturbance patterns and thereby maintain the biological diversity and wildlife habitat that existed on the landscape before human intervention.

However, as Andison pointed out, it is not logging but rather fire prevention that constitutes the most significant human intervention in our forests. This raises profound questions for the managers of parks and protected areas where fire control is creating "unnatural" old stands that lack the previous landscape's diversity and habitat qualities. It raises equally profound concerns for industrial forest managers who fear that the protected areas will become increasingly vulnerable to fire and insect or disease outbreaks that will then spread to commercial timberlands. Protected areas could also become less desirable habitats for both human visitors and naturally occurring animal and plant species. Communicating this dilemma to the public and environmental interest groups is one of the pending challenges of sustainable forest management. Beyond mere communications, it will be necessary for foresters to engage external stakeholders in the search for mutually acceptable solutions. Unfortunately, lingering distrust from past confrontations impedes dialogue on both sides. It may require a dramatic event, like the Yellowstone fire of 1988, caused by the accumulation of fuels on the "protected" landscape, to spark a change in the tenor of discussions.

As Des Crossley pointed out in a 1975 article, "we have been haunted by the historical image of the ruthless timber exploiter who was allowed to tie up too much land, pollute the air and water, erode the land, and fail to regenerate harvested areas." The Environment Council of Alberta inquiry, on which Crossley served a few years later, dealt with each of these concerns and pushed the province along the road to sustainable forest management. Yet many people, especially from urban areas, remain unconvinced. The aesthetics of clear-cuts, particularly when laid out in obvious rectangles, are a big part of the problem. The "footprints" of past practices remain visible for a long time—typically at least ten or twenty years—before the regenerated stands start to blend in with their neighbours. One Alberta study indicated, however, that there were few ecological differences between post-harvest and post-fire boreal forest sites twenty-eight years after disturbance. Casual visitors see the forest in terms of snapshots, not as a living entity that grows, ages, dies, and renews itself. It is easy for them to believe a critic who shows the outline of a timber lease on a map and says it will be "destroyed." Thus far, the success of sustainable forest management is most evident to local residents and professionals who have watched it unfold.

Donald Mackay, in his 1985 book *Heritage Lost: The Crisis in Canada's Forests,* listed a series of crises afflicting forestry across Canada: overcutting, poor reforestation, inadequate forest protection, inaccurate inventories, dubious planning, loss of valuable species and biological diversity, and so on. Mackay cited Hinton as a notable exception to this gloomy portrait and cited Alberta's "enlightened" policy as one of the nation's few forestry successes. However, the company and its foresters recognized that they could not simply hold themselves apart from the rest of the industry, for all are tarred with the same brush in the public's mind. As the company showed through its active participation in developing the Alberta Forest Products Association's FOREST*CARE* Codes of Practice (an industry initiative for self-monitoring and self-improvement), Weldwood accepted an obligation to help raise the standards for the entire industry. Company foresters knew they could not be complacent in any case. The 1988 Forest Management Agreement, the subsequent expansion of pulp and lumber production, and Alberta's free-to-grow

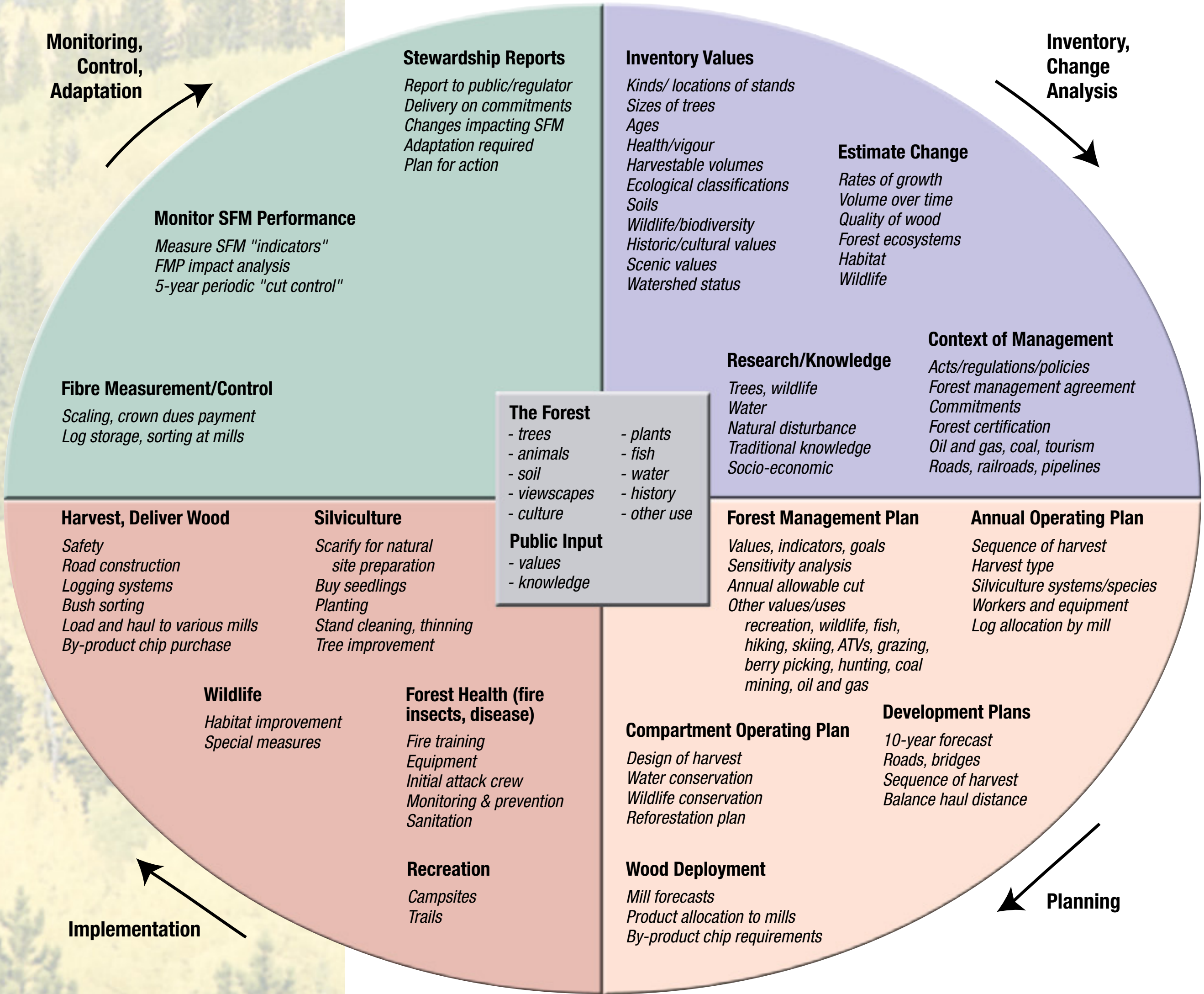


Figure 10.2. The cycle of sustainable forest management (SFM) in 2000

reforestation standards, all meant that practices—however good they had been in the past—would need to be raised to a new level.

Not only are society's demands increasing, but the possibility of global climate change also raises both opportunities and challenges. On one hand, there is the opportunity to realize the value—economically and politically—of vigorous forest growth as a way to remove carbon from the atmosphere. It is even possible that increased carbon dioxide in the atmosphere and warmer temperatures might enhance forest growth. On the other hand, however, there is also the danger that climate change could stress species and genotypes that have adapted to a particular climate regime. The forests could become more vulnerable to fire, disease, and insects. Because of these uncertainties, Weldwood has actively supported the federal government's Voluntary Challenge program and reduced the Hinton mill's emissions of carbon dioxide (and the carbon dioxide–equivalent amounts of greenhouse gases such as methane and nitrogen oxides) by 38.5 per cent between 1990 and 1999.

To address this multiplicity of goals and objectives, the cycle of forest management activities (described in chapter one) has become increasingly complex. Figure 10.2 provides a more complete listing of the cycle's components as we enter the twenty-first century.

Preparing for the Future

Should we be seeking maximization of wood production? Or is it not more realistic to aim for optimization of yield for each of the wild-land resources?

—Des Crossley, 1975

The new approach to forest management includes both the options suggested by Crossley, who was, as usual, thinking far ahead of his contemporaries. However, forest management now extends much further, beyond growing wood and husbanding wilderness. Foresters must meet new standards of social responsibility and accountability, not only to government and other stakeholders, but also to employees and investors. Competitiveness, communication, and consultation are as important as science and technology in today's forestry. "Forestry isn't rocket science," observed Fred Bunnell, professor of forest science at the University of British Columbia, in a 1999 article. "It's much more complex."

Alberta's basic strategy to address complex and overlapping objectives is the "triad" approach under which some land will be managed for non-timber values, some for multiple use, and some for maximum timber yield. At Hinton, where key elements of the triad were already in place when the official strategy was adopted, Weldwood expects the annual allowable cut will rise from 2.7 cubic metres per hectare per year to 3.1 cubic metres per hectare per year as early as 2010, and intensive management could produce even more dramatic increases in future decades. A crucial question, though, is whether the contributing land base will be maintained or whether it will continue to be whittled away by industrial uses and protected areas. One suggestion is that there should also be a "protected" status for intensively managed areas to make sure that they remain in timber production.

The company's relationship with the Alberta government, for so long a mutually beneficial partnership based on negotiation and consensus, is another critical consideration. With seventeen forest management agreements now in effect, and sizes ranging from 56,000 hectares to 5.8 million hectares, there is a concern that the province could adopt a cookie-cutter approach to ground rules and regulations. However, adaptive management depends crucially on innovation and flexibility. The past approach led to remarkable achievements such as the 1996 Hinton ground rules, which fully incorporated ecosystem stewardship, provided specific guidance for forestry workers, and were developed in close consultation with the Forest Resources Advisory Group.

Thanks to adaptive approaches in the past, Hinton foresters were among the first to develop and apply the natural disturbance model as a means to conserve biodiversity, but there are challenges in this realm too. As more is learned about natural disturbance, for example, it might suggest a need for much larger clearcuts, or more harvest in riparian zones, than citizens would ever tolerate on aesthetic grounds. Multiple use of the forest management area can also undermine the natural disturbance model. The numerous linear disturbances for oil and gas industry activity—roads, pipeline corridors, power lines, and seismic cutlines—are already a serious concern. Renewed coal-mining activity, or development of other mineral resources, would pose further complications. Meanwhile, several environmental interest groups are seeking to create a broad wildlife corridor along the eastern slopes of the Rockies—ultimately from Yellowstone to Yukon—yet it is not clear how their objective could be achieved, or indeed how it would differ from properly practised, properly understood sustainable forest management.

Perhaps the greatest challenge in the coming years will be reaching a consensus definition of sustainable forest management, and then assuring all stakeholders that it is actually being practised on the land. One of the first attempts at this was the FOREST*CARE* Codes of Practice developed in the early 1990s by the Alberta Forest Products Association and a stakeholder advisory committee. Hinton foresters were actively involved in developing FOREST*CARE* and then in achieving FOREST*CARE* certification for the company's operations. Broader definitions of sustainable forest management emerged in the mid-1990s through the Alberta Forest Conservation Strategy and the government policy based on it, the Alberta Forest Legacy. At the national level, the Canadian Council of Forest Ministers cri-teria and indicators have been applied directly by governments and by companies such as Weldwood, and they have also provided the conceptual framework for the Canadian Standards Association (CSA) sustainable forest management standard under which Weldwood Hinton was certified in 2000. The CSA standard also incorporates the International Standards Organization standard for environmental management systems (ISO 14001).

Backed by the World Wildlife Fund, the Forest Stewardship Council (FSC) has developed yet another sustainable forest management standard, and some companies have announced their intention to seek FSC certification in addition to, or in place of, other standards. As of early 2003, however, the FSC had not yet agreed on a regional "boreal standard" for the publicly owned, multiple-use forests of western Canada. Several other sustainability standards have also been developed and applied in Canada, the United States, Europe, and Australia. In 2002, the Forest Products Association of Canada announced that all member companies would be required to be certified by 2006 under a standard requiring third-party forest audits. This certification could be based on CSA, FSC, or the U.S. standard known as the Sustainable Forestry Initiative. The national industry association did not specify which of these standards must be applied, but emphasized that the audits would have to certify actual forest practices as well as management systems.

The delay in developing a single, widely accepted certification system for sustainable forestry is certainly unfortunate, but perhaps the result will ultimately be a sounder synthesis of the various approaches. The social sciences and natural sciences that underpin sustainable forestry are moving ahead rapidly, at Foothills Model Forest and around the world, and social values change over time too, so convergence among definitions and certifications could indeed happen more easily and quickly than now seems possible. However, a great deal of energy could be wasted in head-butting and name-calling if opposing positions become entrenched.

Knowledge, technology, social values, and the ecosystem itself will, of course, continue to evolve, often in unpredictable ways. What if, for example, the natural disturbance model—based on historical ranges of variability in species and habitat—is no longer applicable because of climate change? What if pulp or building materials can be manufactured more cheaply from genetically engineered crops than from wood fibre? What if electronics and alternative materials eventually make paper and lumber as obsolete as buggy whips? Thus far adaptive management has enabled Hinton foresters to meet each challenge as it has arisen.

As this book was being published, Alberta and the other provinces in Canada were contemplating changes in forest management systems, wood allocation, and tenure that could have profound impacts on the nature and competitiveness of Canada's forest industry. Tired of the endless battle with the United States over trade and tariffs on softwood lumber, the provincial governments were working toward a long-term solution that would meet the needs of all parties and allow this important industry to survive and continue its contribution to Canada's future. The implications of the so-called "changed circumstance" for mills, forests, and forestry at Hinton were uncertain. The resiliency, innovation, adaptation, and dedication that sustained the Hinton forest management legacy thus far would certainly be called upon again to respond to this new challenge.

By continually learning from past experience, testing the current hypotheses, and projecting possible futures, an adaptive approach offers the best way to map the way through the thicket of uncertainties. As René Dubos observed: “In human affairs the logical future, determined by past and present conditions, is less important than the willed future, which is largely brought about by deliberate choices.” In other words, we can know the past, but cannot change it; and although we cannot know the future, we *can* change it.

Interviews for the Hinton History Project

The primary sources for this volume were the interviews listed below, public documents such as the company's forest management plans, and some internal documents such as the 1970 Intensive Management Proposal.

Interview subjects were offered the opportunity to review and revise the interview transcripts, and many of them did so. Interview transcripts and documents have been deposited in an archive at the Weldwood offices in Hinton, where they are accessible to the interviewees and—with their permission—others seeking access to them.

The Notes in the next section provide additional information about the sources for each chapter and elaborate on some points in the text. Most conventional print sources are listed in the Bibliography and Internet Resources, which follows the Notes.

Name	Position	Date	With	Interview location
Bonar, Rick	Chief Biologist	1997-07-10	PJM	Hinton
Bowersock, Jim	Vice-President St. Regis (ret.)	1999-06-29	PJM	Kamloops, BC (phone)
Callihoo, George	Fox Creek Development (ret.)	2000-06-13	PJM-RDB	Hinton
Clark, Jim	Woodlands Manager (ret.)	1997-06-12	PJM-RES	Hinton
Crossley, Desmond I.	Chief Forester (ret.)	1984	PJM	Hinton, Edmonton, and Sidney, BC
Curry, Sean	Growth and Yield Forester	1997-07-09	PJM	Hinton
Folkmann, Paul	Land Use Coordinator (resigned)	1997-07-09	PJM	Edmonton
Groat, Judd	Guide and Outfitter	1998-08-12	PJM-RES	Brule
Hall, Ken	Vice President & Resident Manager (ret.)	1997-05-25	PJM	Vancouver, BC
Hart, H.V. (Pete)	Vice-President Northern Woodlands, St. Regis (ret.)	1976	ERM	Ft. Meyers Beach, Florida
Hawksworth, Dennis	Vice President, Hinton Forest and Wood Products	1997-11-14 1997-11-15	PJM	Hinton
Hostin, Paul	Resources Planning Co-ordinator	2000-06-13	PJM-RDB	Hinton
Kehr, Warren	Purchase Fibre Manager	2000-06-13	PJM-RES-RDB	Hinton
Lacroix, Rosaire	Forest Operations Manager (ret.)	1997-10-27	PJM-RDB	Edmonton
Laishley, Don	Director of Environment and Forestry (ret.)	1997-05-29 1998-04-09 1998-07-29	PJM	Vancouver, BC Edmonton Edmonton
Loomis, Reginald D.	Director of Forest Management (ret.)	1987-1989	PJM	Edmonton
Lougheed, Hugh	Management Forester	1997-07-09	PJM	Hinton
MacKellar, Bob	Woodland Production Manager (ret.)	1997-05-24	PJM	Vancouver, BC
Matwie, Larry	Manager Fox Creek Development Corp.	2000-06-13	PJM-RDB	Hinton
McDougall, Fred	Deputy Minister (ret.)	1998-11-09	PJM	Edmonton
Muhly, Bryon	Manager, Resources Optimization	1997-07-11 2000-05-03	PJM	Hinton Edmonton
Navratil, Stan	Silvicultural Consultant	2000-11-25 2001-02-28	PJM	Edmonton

Presslee, David	Forestry Manager	1997-07-10	PJM	Hinton
Ranger, Raymond	Forest Lands Manager (ret.)	1998-05-20	PJM-RES	Marshall, Saskatchewan
Reid, Dr. Ian	Medical Doctor, MLA, Hinton	1999-04-21	PJM	Edmonton
Renaud, Diane	Silviculture Forester	1997-11-14	PJM	Hinton
Sommerfeld, Bill	Logger, IWA negotiator	2002-05-14	PJM	Edmonton
Spanach, Amelia	Sawmill Operator, Coal Branch (ret.)	1999-01-25	PJM-RES	Edmonton
Stauffer, Rob	Forest Operations Manager	2000-06-13	PJM-RDB-RES	Hinton
Steele, Robert G.	Deputy Minister Lands and Forests (ret.)	1997-08-07	PJM	Qualicum Beach, BC
Udell, Bob	Forest Policy/Government Affairs Manager	1997-08-01 1998-05-15	PJM	Hinton
Van Zalingen, Hank	Logger	1997-11-14	PJM	Hinton
Walker, H. Douglas	Management Forester	2001-11-14	PJM	Edmonton (phone)
Welechuk, Stan	Woodlands Safety Coordinator	1997-11-14	PJM	Hinton
Wright, Jack	Chief Forester (ret.)	1997-06-11 1998-05-08	 PJM-RES	 Hinton

Abbreviations:

PJM—Peter J. Murphy;

RES—Robert E. Stevenson;

RDB—Robert D. Bott;

ERM—Elwood R. Maunder, executive director, Forest History Society, Duke University.

E-mail, phone interviews with:	**Regarding:**
Appleby, Frank	Leitch proposal
Ayrton, Bill	Hinton area geology
Bowersock, Jim	Leitch proposal
Crossley family	Bob and Lynn
Hall, Ken	Leitch proposal
Hart, Stanton G. V.	photos and history
McDougall, Fred	policy-influencing events
Alberta Mining	references and photo
Ruben, Robert	North Western Pulp & Paper
Truxler, Vern	Gregg Burn
Warrack, Allan	1972 Forest Management Agreement cancellation

Notes on Sources

This book is a summary of the complete, multi-volume *Case Study of Policies and Practices Leading to Adaptive Forest Management* published by the Foothills Model Forest. Peter Murphy was the lead author of the case study. In addition to this volume, the case study comprises:

- *A Hard Road to Travel* (history and ecology of the unmanaged "state of nature" in the Hinton-Jasper area prior to 1955)
- *The Hinton Forest 1955–2001: A Case Study in Adaptive Forest Management* (a detailed account of the evolution of the Hinton forest management area)
- *Evolution of the Forest Management Agreements* (the forest management agreement as a policy instrument in Alberta)
- *Development of Adaptive Management in Protected Areas of the Foothills Model Forest* (management evolution in Jasper National Park, Switzer Provincial Park, and Willmore Wilderness Park).

Sections of the case study can be found at the model forest web site, www.fmf.ab.ca. A shorter summary was also published by Weldwood in a brochure, "Living Legacy," written by the co-authors of this volume, as part of celebrations in 1997 marking the fortieth anniversary of pulp production at the Hinton mill.

Introduction

Peter J. Murphy and James M. Parker of the University of Alberta conducted a series of interviews with Desmond I. Crossley in 1983 and 1984, two years before his death. The edited transcripts were collected in a volume called *We Did It Our Way,* and a limited number of copies were made. A copy can be found in the University of Alberta Archives in Edmonton.

Chapter One

The Leopold quotations are from Meine 1988. Canadian Standards Association 1996. A new edition of the CSA sustainable forest management standard was printed in December 2002.

Forests: A Shared Resource

Environment Canada 2001 provides an up-to-date overview of Canadian forests and the forest products industry. A new edition of this excellent reference is published annually. Check for updates on the Canadian Forest Service web page at: www.nrcan-rncan.gc.ca/cfs-scf.

What Does "Management" Mean in Forestry?

Baskerville 1997 is posted on the Internet journal *Conservation Ecology* at: www.consecol.org/vol1/iss1/art9. There is a commentary on it at: http://139.142.203.66/pub/www/Journal/vol1/iss1/art15.

Adaptive Management

Alberta Forest Management Science Council 1997 is posted on the Internet at: www.borealcentre.ca/reports/sfm.html.

The Cycle of Sustainable Forest Management

The illustration was prepared in 2001 by Bob Udell of the Weldwood Hinton Forest Resources Department. The illustration and text elaborate on a discussion written originally by Peter Murphy for a section of the Hinton history project, based on Professor Gordon Baskerville's work.

Evolution of Forest Management at Hinton

The Canadian Sustainable Forestry Certification Coalition web site at www.sfms.com provides up-to-date information about the status of forest certification across Canada.

Chapter Two

Opening quotation from Dubos. According to the web site of Joy Grillon at Washington University in St. Louis, http://capita.wustl.edu/ME567_Informatics/concepts/global.html:

> Think Globally, Act Locally refers to the argument that global environmental problems can turn into action only by considering ecological, economic, and cultural differences of our local surroundings. This phrase was originated by René Dubos as an advisor to the United Nations Conference on the Human Environment in1972. In 1979, Dubos suggested that ecological consciousness should begin at home. He believed that there needed to be a creation of a World Order in which "natural and social units maintain or recapture their identity, yet interplay with each other through a rich system of communications." In the 1980s, Dubos held to his thoughts on acting locally, and felt that issues involving the enviroment must be dealt with in their "unique physical, climatic, and cultural contexts."
> (Eblen and Eblen, 1994, p. 702)

The Landscape

The Alberta Natural Region Land Classification System, as updated 20 December 1999, is posted on the Alberta Natural Heritage Information Centre web site at: www.cd.gov.ab.ca/preserving/parks/anhic/landclas.asp.

A description of the forest types and species in the Foothills Model Forest is posted on the Natural Resources Canada web site at: www.cfl.forestry.ca/ECOLEAP/Pilot-regions/pilotalberta.html#alb_description.

Genesis

The geology discussion is based on Bott 1999, with additional input from Calgary consulting geologist Bill Ayrton. Another reference is the Geological Highway Map published in 2000 by the Canadian Society of Petroleum Geologists, Calgary. The *Encyclopedia Britannica* (www.britannica.com) provides additional information about geological eras.

Climate and Hydrology

Environment Canada climatological data are posted at: www.msc-smc.ec.gc.ca/climate/climate_normals. Biologist Rick Bonar of Weldwood Hinton provided additional input for this discussion.

Fire

Murphy 1985 is a basic reference on fire history in Alberta. David W. Andison, a fire researcher with the Foothills Model Forest, summarizes current fire research in a series of bulletins ("Quicknotes" 1–13 as of April 2002) posted on the Foothills Model Forest web page at: www.fmf.ab.ca (Publications).
See also Andison 1997.

Black Cat

Peter Murphy compiled the fire history of the Black Cat based on photographs and Weldwood's age-class maps for the area.

Forest Dynamics

A description of typical forest succession can be found in "Plant Succession: How a Field Becomes a Forest" on the Duke Forest web page at: www.env.duke.edu/forest/sucession.htm. Weldwood Hinton biologist Rick Bonar revised the classic definitions of forest dynamics to reflect their application to the Alberta foothills. McRae 2001 elaborates on the distinction between fire (chemical and thermal disturbance) and logging (mechanical disturbance).

The Human Presence

Dickason 1997 and Beaudoin 1996 are primary references on precontact Aboriginal societies. Charles Mann's article, "1491," in *The Atlantic Monthly* (March 2002) raises the intriguing possibility that Aboriginal populations in the precontact Americas may have been much denser and had much greater effect on the ecology than previously believed. The article is posted on the *Atlantic Online* web page at: www.theatlantic.com/issues/2002/03/mann.htm.

Trappers, Traders, and Travellers

A Hard Road to Travel, a forthcoming volume that is part of the Hinton history project, discusses the early history of the area in considerably greater detail. Sources include Pickard 1986, Beaudoin 1996, Franchere 1969, Willson 1900, Spry 1965, Milton 2001, Grant 2000, Blaise 2000, Hart 1980, Gadd 1995, MacGregor 1962, MacGregor 1977, MacGregor 1981, Johnson 1999, Murphy 1999, Dunford 1999, and various articles in *The Canadian Encyclopedia* (published originally by Hurtig in 1985 with subsequent editions published by McClelland and Stewart).

Railways and Highways

Conan Doyle's poem appeared originally in the *Canadian National Railways Magazine*, IX, 7 (July 1923). It is also in Bridgland, M. P. and R. Douglas. 1917. Description of & Guide to Jasper Park. Edited by E. Deville. Canada Department of the Interior, Ottawa.

The Forest Resource

Murphy 1985, Murphy 2001.

Forest Protection

Doucet 1914, Murphy 1985, and Murphy 2001.

The Use of the Forest

Murphy 1985, Murphy 1999, Hart 1980, Kyba 2001, and Alberta Forest Products Association 1992.

CHAPTER THREE

This chapter summarizes a companion volume of the Hinton history project, *Evolution of the Forest Management Agreements*, by Peter J. Murphy and Martin K. Luckert, to be published by the Foothills Model Forest. Drushka 1996, pp. 79–80, cites the October 1914 memo from MacMillan to University of British Columbia president Wesbrook regarding budget for a forestry school. See also "A Fortuitous International Meeting of Two Yale Foresters in 1908: H. R. MacMillan and W. N. Millar" by Peter J. Murphy and Robert E. Stevenson in *Forest History Today* (spring 1999), pp. 17–20.

Loomis and Crossley

Transcripts of Peter Murphy's three interviews with Reg Loomis (29 April 1987, 12 May 1988, and 20 October 1989, at the Loomis home in Lac Ste. Anne County, Alberta) were edited and compiled into a volume, *Natural Management of the Forest: The Pursuit of Nature's Way,* in February 1990. A copy can be found in the University of Alberta Archives, Edmonton.

Tenure, Policy, and Regulation

Fernow 1907, Darby 1956, and Pyne 1997 are among the many references available on the evolution of forests and forestry in Europe. Peter Murphy is a source of information on European forest history. Murphy 1985 describes the role of watershed protection in early Canadian management in the Alberta foothills. The papers of R. O. (Bob) Sweezey are deposited in the Queens University archives in Kingston, Ontario, and his various agreements with the Alberta government are found in the *Alberta Gazette.*

The First Successful Agreement

The chronology of agreements is based on cabinet documents published in the *Alberta Gazette,* as well as the Loomis interviews. Former woodlands manager Stanton G. V. (Stan) Hart provided input through numerous personal communications (e-mails, letters, telephone conversations, and comments on drafts) between 1997 and 2002.

Expanding the Forest Management Agreement

In addition to the agreements themselves, sources include Peter Murphy's 1997 interviews with former general manager Ken Hall and retired deputy minister Fred McDougall, and Elwood Maunder's 1976 Forest History Society interview with H. V. (Pete) Hart.

Building an Industry

The various types of tenure in Alberta are described in *Management of Alberta's Forest Resource,* Alberta Environment, 1996, which is posted at: www3.gov.ab.ca/srd/forests/fmd/pubs/Forest-Resource-Ftsht.pdf. Alberta Sustainable Resource Development and the Alberta Forest Products Association jointly published *Alberta Forest Products Industries: Overview and Economic Impact* (2001), posted at: www3.gov.ab.ca/srd/forests/managing/business/pubs/Alberta ForestProductsIndustries.pdf.

CHAPTER FOUR

See Crossley 1951 and Knechtel 1910. Knechtel (1859–1915) was inspector of forest reserves in the Dominion Forestry Branch and then in 1913 was appointed chief forester, Dominion Parks Branch, Department of the Interior, Ottawa. According to Fensom 1972, "[Knechtel] was one of the pioneers of scientific forestry on the North American continent, a notable reforestation expert and a brilliant lecturer both in the United States and Canada where he gave many well-publicized lectures in all provinces."

Integrated Planning and Consultation

The Eastern Slopes Policy is described in Alberta Government 1984. Weldwood Hinton consultation mechanisms are described on the Forest Resources Department web site at: www.weldwood.com/hinfr01/internet/hinnet.nsf.

Land Base: Not Quite a Million Hectares

Weldwood Hinton forester Sharon Meredith calculated the breakdown of land uses and dispositions in the forest management area.

Nonrenewable Resources

Patriquin 1998 describes mineral development in the Hinton area. Alberta regulations specify that "land capability" must be restored after nonrenewable resource activities cease. The operator may be held liable for any conservation and reclamation issues that may become apparent at the site for a five-year period following reclamation certification. The operator is held liable in perpetuity for all contamination issues related to the activity.

Coal Mining

Kyba 2001, Patriquin 1998, and Ross 1974 cover coal development and reclamation in the Hinton forest management area. Further information and updates on mining and reclamation can be found on the Coal Association of Canada web site at: www.coal.ca.

Crude Oil and Natural Gas

Alberta Energy Information Letter 92-13, "Energy Activity on FMAs," issued on 5 May 1992, describes the background for current regulations governing oil and gas industry activity on forest management areas. It is posted on the Alberta Energy and Utilities Board web site at: www.eub.gov.ab.ca. Interviews with Crossley, Ranger, Wright, et al., and the forest management plans for the Hinton forest management area provided descriptions of oil and gas industry activity during each of the eras in the company's evolution. The Weldwood Hinton Forest Resources Department provided statistical information on oil and gas industry activity in the forest management area.

Renewable Resources and Recreation

Stan Hart, in personal communications based on his journals, provided information about early consultations.

Livestock Grazing

Barry Irving, manager of the University of Alberta Rangeland and Wildlife Research Unit, led the horse grazing study in 1996 for the Foothills Model Forest. Each forest management plan includes a discussion of grazing issues.

Parks and Camping

This discussion is based primarily on forest management plans and interviews. Other sources include recreation studies by the Foothills Model Forest and Weldwood.

Emerson Lakes

A fact sheet on Sundance Provincial Park is posted at: www3.gov.ab.ca/env/regions/nes/pdfs/sundance_fact_sheet.pdf.

Hiking Trails

Jack Wright addressed the Rocky Mountain Section of the Canadian Institute of Forestry on 1 February 1975. Other sources include forest management plans and recreation studies by the Foothills Model Forest and Weldwood. Current recreation information is posted on the Weldwood Hinton web site at: www.hintonforestry.weldwood.com.

Skiing

This account is based largely on the records and recollections of Jack Wright and Bob Udell, who were actively involved in skiing developments in the forest management area. The company has produced a brochure on the Spruce Management Trails, which is posted on the Internet at: www.hintonforestry.weldwood.com. Farnham 1997 is an additional reference.

Canoe Routes

The Hinton Strokers web site is http://members.shaw.ca/hintonstrokers. The Blue Lake Centre is now known as the Blue Lake Adventure Lodge: see www.bluelakelodge.com.

Wildlife

Crossley discussed wildlife issues in Mackay 1985 as well as in the Murphy interviews. The six-to-eight foot rule was a major topic of discussion at Environment Council of Alberta forestry hearings in the late 1970s; see Environment Council of Alberta 1979. The changes in cutting patterns are reflected in the forest management plans and operating ground rules.

Integrated Management of Timber and Wildlife

Jack Ward Thomas retired in 1996 after a three-year term as the thirteenth chief of the U.S. Forest Service. He described his philosophy in "Forest Management Approaches on the Public's Lands: Turmoil and Transition," the Horace M. Albright Conservation Lectureship to the University of California Department of Forestry and Resource Management at Berkeley, 14 April 1992; the lecture is posted on the Internet at www.cnr.berkeley.edu/forestry/thomas.html. Primary sources for this section are the Clark, Laishley, and Bonar interviews.

Habitat Preservation

The Foothills Model Forest web site includes a description of the study "Habitat Suitability Index Models for the Foothills Model Forest" (at www.fmf.ab.ca/hsi.html). Other sources include the Bonar and Stauffer interviews.

Trapping

Weldwood Hinton wildlife biologist Chris Spytz compiled statistics on traplines in the forest management area.

Special Places Programs

Alberta Community Development describes the Special Places 2000 program on its web site at: www.cd.gov.ab.ca/preserving/parks/sp_places. Weldwood Hinton describes its Special Places in the Forest program at: www.hintonforestry.weldwood.com.Bob Udell, David Presslee, and Aaron Jones of the Weldwood Hinton Forest Resources Department provided information for this section.

Chapter Five

The quotation and introductory information are from the Crossley 1984 and H. V. (Pete) Hart 1976 interviews.

Des Crossley: A Commitment to Science

Crossley 1984 interview and Mackay 1985 are primary sources for this section. The Sunpine Forest Products web site has a description of the Des Crossley Demonstration Forest at: www.sunpine.com/report/issuej.html. FEESA, an Alberta educational foundation, has additional information about the demonstration forest at: www.feesa.ab.ca/cts/des.html.

Forest Inventories

The introductory quotation by Reg Loomis is from a memo to Eric Huestis. The Ontario Woodlot Association provides a simplified description of inventory terms and methods in "The Art of Timber Cruising" posted on the Internet at: www.ont-woodlot-assoc.org/

Timber Cruising

This section is based mainly on Murphy's Loomis interviews and drafts prepared between 1997 and 2001 for the Hinton history project by Bob Udell and consultant Lorne Brace.

Getting Started

Crossley's semiannual reports to senior management (internal company documents) provided some of the detail about initial operations in 1955 and 1956.

Management Inventories

The Crossley 1959 and Wright 1971 articles, Jack Wright's interview, and subsequent personal communications with him are key sources for this section.

Operational Inventories

"Working in the Woods: A Guide for California's Forest Landowners," an undated series of Internet publications by John W. LeBlanc of the University of California Co-operative Extension Service, includes an excellent introduction to inventory methods, including wedge-prism cruising. "What Do We Own: Understanding Forest Inventory" is posted at: www.cnr.berkeley.edu/departments/espm/extension/ inventor.htm.
The Wright 1971 article and the forest management plans provide details about inventory developments at Hinton.

Enhanced Inventories for Sustainable Forest Management

Bonar, Curry, Lougheed, Udell, and Wright interviews were primary sources for this discussion. See also the 1991 and 1999 Forest Management Plans and the Weldwood 2000 Sustainable Forest Management Plan.

Aesthetics

Mackay 1985 and the Crossley 1984 interview cite Crossley's views on aesthetics. See also Environment Council of Alberta 1979, and the 1991 and 1999 Forest Management Plans.

Measuring Growth and Yield

The introductory quotation is from Donald Mackay in *Heritage Lost.* This section summarizes a draft prepared by Bob Udell for the Hinton history project. Loomis described early issues in his interviews with Peter Murphy and cited a letter from Loomis to Eric Huestis dated 11 August 1952. The evolution of growth and yield methods and results can be seen in the Hinton forest management plans. See also the Lougheed interview and the Udell 1987 paper.

Forest Research: Science, Ecosystems, and People

Cornell University has digitized Fernow's entire book as a part of the Core Historical Literature of Agriculture project. It is available at: cdl.library.cornell.edu/chla/. Other sources for this section include Peter Murphy's 1996 Forestry 401 course notes and the "International Forestry" course notes posted on the Internet by Douglas Piirto of the California Polytechnic State University at San Luis Obispo: www.calpoly.edu/~-disteduc/FNR201/Lectures/Week10/Chpt21.html#2.0. The origins of European forestry and forestry schools are authoritatively reviewed in a publication of the European Parliament, *Europe and the Forest*, in section

I.3.3.1—"Germany and France: tradition of European silviculture," which is posted on the Europarl web page at: www.europarl.eu.int/working-papers/forest/eurfo103_en.htm. The evolution of U.S. forestry can be seen in "A Brief History of the American Forest Congresses" by Arthur V. Smyth, posted on the Yale University Seventh Forest Congress web page at: www.yale.edu/forest_congress/history.html. Peter Murphy compiled the founding dates of Canadian forestry faculties.

Forest Research at Hinton

The Crossley 1984 interview discusses his approach to research and co-operation, and the Bonar interview addresses later research initiatives at Hinton. This section is based on a draft that Bob Udell prepared initially for the history project in 1998, and the subsequent revisions suggested by Wright, Bonar, and other colleagues in the Weldwood Hinton Forest Resources Department. See also Corns 1986.

A Strange Experiment

Jack Wright provided details of the 1966 nuclear simulation.

Collaborative Studies

Additional information is posted by the Foothills Growth and Yield Association on the Foothills Model Forest web site at: www.fmf.ab.ca/growth/pdf/Report.pdf. Other sources include the Laishley and Navratil interviews.

Understanding the Ecosystem

The Stelfox report, "Long-term (1956–1996) effects of clearcut logging and scarification on forest structure and biota in spruce, mixedwood, and pine communities of west-central Alberta," is posted on the Alberta Centre for Boreal Studies web page at: www.borealcentre.ca/reports/stelfox/stelfox.html. Swanson 1977 describes the Tri-Creeks watershed research.

Foothills Model Forest

Sources include the Bonar interview and the Foothills Model Forest web site at: www.fmf.ab.ca. See also Bonar 2001 regarding the pileated woodpecker.

People in the Forest

An abstract of the camping study is posted on the Foothills Model Forest web site at: www.fmf.ab.ca/p2.html.

Chapter six

The six Hinton forest management plans are the primary references for this chapter. Authors of each of the plans—Wright, Walker, Udell, and Lougheed—were interviewed for the history project. The chapter summarizes a draft Bob Udell wrote for the history project. The Crossley 1984 and Wright interviews were primary sources for the chapter introduction, and Jack Wright also reviewed drafts of the text. An undated World Conservation Union paper, "Aspects of the Implementation of the National Ecological Network–Slovakia," chapter 2, cites Johann Judeich's contribution to forestry; the text is posted at: www.fns.uniba.sk/zp/iucn/eng/projekty/nnp/2.htm.

Crucial First Decisions

See forest management plans and Crossley 1984 interview.

Planning and Review Processes; Types of Plans and Approvals

See Environment Council of Alberta 1979 and the 1988 Forest Management Agreement. The planning and review process is also described in the Weldwood Hinton 1996 Operating Ground Rules booklet and on the Hinton Forest Resources web site at: www.hintonforestry.weldwood.com.

Operating Ground Rules

Peter Murphy saw the "rules and regulations" quote in Loomis's office in the 1950s. An Internet search indicates that it may have originated with or been popularized by Douglas Bader (1910–1982), a Royal Air Force pilot during the Second World War. The summary of the evolution of the ground rules was prepared by Bob Udell based on original documents on file in the Weldwood Hinton Forest Resources Department.

Watersheds and Fisheries

Sources include the Crossley 1984 interview and Swanson 1977, as well as the Bonar interview and Bonar's revisions of draft text. See also the 1999 Forest Management Plan.

Ecosystem Integrity

The introductory quotation is from Aldo Leopold's *A Sand County Almanac*. Additional background and references are provided in a Foothills Model Forest paper, "Rationale for Monitoring Forest Biodiversity in Alberta," posted on the Foothills Model Forest web page at: www.fmf.ab.ca/bm/detail.htm. The current provincial government approach is described in Alberta Environmental Protection 1998 ("The Alberta Forest Legacy") which is also posted at: www3.gov.ab.ca/srd/forests/fmd/legacy/legacy.pdf.

Environment Council of Alberta

The Environment Council of Alberta 1979 report, including the transcripts of its public hearings, is a primary reference for this sidebar.

The Hinton Forest Management Plans

Bob Udell prepared summaries of the Forest Management Plans, with additional input from Jack Wright and Hugh Lougheed. The 1999 Forest Management Plan in its entirety can be found at the Hinton Forest Resources web site at: www.hintonforestry.weldwood.com.

Chapter seven

On 31 January 1972, Eric Huestis addressed an orientation course for new staff at the Forest Technology School in Hinton. Peter Murphy taped the talk, which reviewed the evolution of Alberta forestry and the forest products industry since 1930. In 1986, Murphy distributed a 38-page transcript of the talk under the title "Early Days in Alberta Forestry." A copy is available in the Alberta Sustainable Resource Development Library in Edmonton.

The Horse-logging Era

Personal communications from Jack Wright and Stan Hart contributed considerably to this discussion. Other sources included internal company documents, the forest management plans for the era, and the Clark, Wright, Lacroix, and van Zalingen interviews.

Camp Life

Sources for this section are Stan Hart personal communications and the van Zalingen interview.

A Transformed Community

Hart 1980 is a primary reference on the early years. Other sources include personal communications with Stan Hart, the Wright, Ranger, and Lacroix interviews, 1996 Census of Canada data, and the company's "Treebune" newsletters. Some census data for Edson and Hinton are posted at: www.alberta-first.com/regional_images/4855.pdf. Additional community data can be found at the Town of Hinton web site at: www.town.hinton.ab.ca/.

Recruiting and Training Pulpcutters

The primary sources are the Lacroix interview and the Alberta Local 1-207, Industrial, Wood and Allied Workers of Canada web site at: www.iwa207.ab.ca. See also Huth 2000.

English Lessons

Sources for the sidebar are Jim Clark and Stan Hart personal communications.

Amelia Spanach

Peter Murphy and Bob Stevenson interviewed Amelia Spanach (1926–) in Edmonton in 1999, and Kyba 2001 has additional detail about her remarkable career.

Sawmillers and the Pulpwood Agreements

Sources include the Wright, Clark, and McDougall interviews, and personal communications with Wright and Stan Hart.

Mechanization

Silversides 1997 provides much of the background on harvest technologies for this chapter. Another reference is Alberta Forest Products Association 1992. Bott and Murphy prepared the key technologies table on the basis of these sources, and the information was reviewed by staff of the Weldwood Hinton Forest Resources Department. A short history of Caterpillar tractors is posted on the Caterpillar web page at: www.caterpillar.com/about_cat/company_information/04_history/history.html. A history of the rubber-tired skidder is posted on the VanNatta Forestry and Logging web page at: www.vannattabros.com/skidder1.html. Personal communications from Jack Wright and Stan Hart contributed considerably to this discussion. Stan Hart, Jim Clark, and Jack Wright provided additional details in personal communications about mechanization. Other sources included the Lacroix interview and internal company records.

Effects of Mechanization

The Weldwood Hinton Human Resources Department provided statistics on workplace injuries.

Aboriginal Peoples

Sources include the Lacroix, Callihoo, Matwie, and Clark interviews, and personal communications with Jack Wright and Jim Clark.

Strip Thinning with Modern Machinery

Information from Thomas Braun notes and e-mail.

Adapting to New Requirements

Sources include the Hostin, Kehr, Muhly, Stauffer, Udell, and Welechuk interviews, and personal communications with Terry Nilson.

Will Horse Logging Ever Return to Hinton?

Information is from the Muhly interview and personal communications with Rob Stauffer.

CHAPTER EIGHT

Peter Murphy interviewed Ken Hall in Vancouver in 1997, and Hall provided additional information in subsequent personal communications. Bob Bott drafted the chapter on the basis of his experience with mill operations and issues as writer and researcher for *Our Growing Resource* (Alberta Forest Products Association 1992) and other forest products industry publications. Murphy and Bott compiled the table of mill technologies. Chemical engineer JoAnne Volk, manager of the Hinton pulp mill's environmental and technical services, reviewed the chapter and suggested revisions.

Alberta's First Kraft Pulp Mill

H. V. (Pete) Hart's interview with the Forest History Society provided some of the background on the early mill development. Other sources included the early agreements between the company and the Alberta government, annual reports to senior management (internal company documents), and the St. Regis company history (Amigo 1980). For more background on pulp mill technologies, see the web sites of the Forest Products Association of Canada (www.open.doors.cppa.ca/english/wood/mill.htm) and the Alberta Forest Products Association (www.abforestprod.org/toc.html).

Reducing Environmental Impacts

Sources include the H. V. (Pete) Hart interview, Alberta Forest Products Association 1992, the Northern River Basin Study (www3.gov.ab.ca/env/water/nrbs/), and the Weldwood Canada Environmental Performance Review. Citizen involvement in environmental monitoring at Hinton was cited in the "New Ideas" section of the 2000–2001 edition of State of Canada's Forests at: www.nrcan.gc.ca/cfsscf/national/

whatquoi/sof/sof01/ideas_e.html. Additional information is contained in Weldwood's Environmental Performance Review, published every two years, available at: www.weldwood.com/wwinet/internet/weldwood.nsf.

Integration and Expansion

Sources include Amigo 1980, interviews with H. V. (Pete) Hart 1976, Jim Clark, Ken Hall, and Dennis Hawksworth, and personal communications with Brennan 1989.

Betting on Trees

Bob Udell compiled the wood utilization graphs and captions on the basis of mill data.

CHAPTER NINE

The introductory quotation is from Pete Hart's interview with the Forest History Society. This chapter summarizes more detailed drafts prepared for the Hinton history project. Bob Udell, David Presslee, and Lorne Brace contributed to the early versions, with significant input later from Jack Wright, Peter Murphy, Stan Navratil, and Diane Renaud, among others. Mackay 1985 provides some background about developments in other provinces, as do the articles by Richard A. Rajala ("The Forest Industry of Eastern Canada": Postscript) and Peter Murphy (Afterword) included in Silversides 1997. Environment Council of Alberta 1979, Mackay 1985, Expert Panel 1990, and the Crossley 1984 interview are key references. Kryzanowski 1997 describes the Jacques report, which was also reflected in Enhanced Forest Management Task Force 1997. The Canadian Forest Service glossary is posted at: www.nrcan-rncan.gc.ca/cfs-scf/science/prodserv/glossary_e.html.

Silviculture

The H. V. (Pete) Hart 1976 interview described St. Regis's previous planting experience. The Crossley 1984 interview describes his hiring and his approach to silviculture.

Leading the Way

The Crossley, Presslee, Wright, Renaud, Navratil, and Udell interviews were the primary sources for this section. Jack Wright provided a great deal of additional detail and commentary in subsequent personal communications and draft revisions. The Kimmins memo and *Crossroads Report* are internal company documents.

Harvesting to Enhance Regeneration

The Crossley and Loomis interviews describe their clash of views. The Udell and Presslee interviews describe subsequent developments.

Site Preparation

Crossley, Wright, and Presslee interviews; Wright personal communications. Bob Udell prepared the table of current site preparation methods.

Seeding and Planting

In addition to the Wright, Presslee, and Renaud interviews, sources include the forest management plans for the eras, the Ferdinand 1971 paper, and personal communications with Steve Ferdinand, now with the Land and Forest Division of Alberta Sustainable Development.

Stand Tending

Jack Wright's interview and subsequent personal communications were invaluable in preparing this section. Other sources include the Crossley and Udell interviews and the various forest management plans.

Camp 1: A Silvicultural Challenge

Presslee, Wright, Udell, and Renaud interviews, and Wright personal communications.

Sustainable Silviculture

Sources include Environment Council of Alberta 1979, Alberta Government 1984 White Paper, Wright interview and personal communications, Udell and Presslee interviews and drafts.

Intensive Forest Management

The papers cited are internal company documents. Other sources include the Udell, Presslee, Navratil, and Renaud interviews and personal communications. Sally John, president of Isabella Point Forestry Ltd., Salt Spring Island, British Columbia, contributed to the tree improvement discussion.

Protecting the Forest

Peter Murphy interviewed Vern Truxler by telephone in 1995 while researching the Gregg Burn. Murphy 1985, 1999, and 2001 are key references. Other sources include the Crossley, McDougall, Clark, Wright, and Udell interviews and personal communications. Each forest management plan includes a discussion of fire and protection issues.

The Government's Role in Fire Protection

See Murphy citations and Crossley interview.

The Company's Involvement in Fire Protection

See Murphy citations. Other sources include Jack Wright, Jim Clark, and Bob Udell personal communications.

A Continuing Threat

Dennis Quintilio, who commented on the 1997 fires in personal communications with the authors, was witness to many key events in the Hinton forest story and has been a keen supporter of the history project. Current Alberta fire protection information is posted on the Internet at: envweb.env.gov.ab.ca/env/forests/fpd/. Other sources include Murphy 1999 and 2001.

Insects and Disease

Alan Westhaver of Jasper National Park contributed information about mountain pine beetle in an exchange of e-mails in March 2001. The Alberta Sustainable Resource Development web site has up-to-date information about forest health at: www3.gov.ab.ca/srd/forests/health/.

Blowdown

Jack Wright and Jim Clark interviews and personal communications.

Chapter ten

Jim LeLacheur's quotation was from Bob Bott's notes on the "think-tank" session involving the authors and about a dozen senior forestry, woodlands, and mill managers at Hinton on 22 January 2001. The general themes of this chapter all arose during the session, although the authors accept responsibility for the interpretation. The contrast between utilitarian and biocentric views of the landscape is the subject of ongoing socio-economic research by the Foothills Model Forest and the Northern Forestry Centre, including McFarlane 2000. Other references include Shindler 1999 and McNeely 1993. The biocentric view is typified by Elizabeth May in her 1998 book, *At the Cutting Edge*. Hugh Lougheed elaborated on his think-tank remarks in subsequent personal communications with the authors. See also the web site of the Canadian Sustainable Forestry Certification Coalition at: www.certificationcanada.org and the Weldwood Hinton Sustainable Forest Management Stewardship Report at: www.hintonforestry.weldwood.com.

Learning from the Past

The Alberta Forest Products Association publishes the comments of the independent observers such as Bulger who participate in FOREST*CARE* audits; see: www.abforestprod.org/forestcare/ar96/involving.htm. A brochure on the Forest Resources Advisory Group is posted on the Weldwood Hinton web site at: www.hintonforestry.weldwood.com. Otherwise, this section summarizes information from earlier chapters. The research spending information was compiled by the Weldwood Hinton Forest Resources Department.

A Walk in the Woods, a Walk through Time

Peter Murphy analyzed the dendrochronology of the Robb snags.

Sustainable Forest Management

David Andison refined his quotation about "old growth" in a series of e-mails in November 2001. See also his "Quicknotes" on the Foothills Model Forest web site (www.fmf.ab.ca), Andison 1997, and Murphy 2001. Crossley 1975 describes the issues in the early years at Hinton. Alberta Environment 1999 describes the long-term forest and harvest residual research project. See Mackay 1985 regarding past challenges and Hauer 2001 regarding the possible future challenge of climate change. The Weldwood Canada greenhouse gas reduction plans and results are filed under "companies" at the web site of the Voluntary Challenge and Registry: www.vcr-mvr.ca/registry. Bob Udell prepared the illustration of the cycle of forest management activities in 2000, which can be contrasted with the simplified illustration in chapter one.

Preparing for the Future

See the Crossley 1975 and Baskerville 1997 articles. Alberta Sustainable Resource Development staff prepared a table of statistics on Alberta forest management agreements in February 2001, which served as background for the discussion in this section. In addition to Bunnell 1999 (on the Registered Professional Forester [of British Columbia] *Forum* at: www.rpfbc.org/forum/viewpointsjf99.html#4), more information about Fred Bunnell's background and publications can be found at: www.forestry.ubc.ca/people/bunnell.htm. The Yellowstone to Yukon Conservation Initiative is described at: www.rockies.ca/y2y. The home page of the Forest Stewardship Council is at: www.fscoax.org. A British Columbia government web site (www.for.gov.bc.ca/het/certification) provides links to many useful reports, publications, and web sites on sustainable forestry certification. The final Dubos quote, which Bott recalled from his research on Dubos in the early 1980s, may be a paraphrase of another Dubos statement: "In human affairs the logical future, determined by past and present conditions, is less important than the willed future, which is largely brought about by deliberate choices." The latter is cited in the Report of the Commission on the Future of Minnesota Post-Secondary Education, 1984 (see lrs.stcloudstate.edu/future/scherer.html). Information on the Forestry Products Association of Canada's forest management standard initiative is from an article in the "ForestryWorks" newsletter, 3 March 2002, "Canadian industry becomes first to require forest audits by 3rd-party" (www.fpac.ca/cgi-bin/view_pdf.cgi/newletter-en.pdf).

Metric Conversion Table

Available on the Internet at www.advancedforestry.com/refpages/nerefbook/p26.doc

Multiply	By	Or Divide	By	To Obtain
Acres	0.405	Acres	2.471	Hectares
Centimetres	0.394	Centimetres	2.540	Inches
Chains	20.12	Chains	0.050	Metres
Feet	0.305	Feet	3.281	Metres
Feet^2/acre	0.230	Feet^2/acre	4.356	Metres^2/hectare
Feet^3	0.0283	Feet^3	35.311	Metres^3
Gallons	3.785	Gallons	0.264	Litres
Hectares	2.471	Hectares	0.405	Acres
Inches	2.540	Inches	0.394	Centimetres
Inches^3	0.0164	Inches^3	61.013	Litres
Kilometres	0.621	Kilometres	1.609	Miles
Litres	61.013	Litres	0.0164	Inches^3
Litres	0.264	Litres	3.785	Gallons
Metres	0.199	Metres	5.03	Rods
Metres	0.050	Metres	20.12	Chains
Metres	3.281	Metres	0.305	Feet
Metres^2/hectare	4.356	Metres^2/hectare	0.230	Feet^2/acre
Metres^3	35.311	Metres^3	0.0283	Feet^3
Miles	1.609	Miles	0.621	Kilometres
No./acre	2.471	No./acre	0.405	No./hectare
No./hectare	0.405	No./hectare	2.471	No./acre
Rods	5.03	Rods	0.199	Metres

From: *Reference Handbook for Foresters,* USDA Forest Service,
Northeastern Area. NA-FR-15 Jan. 1980. p. 26.

Additional conversion factors from *Metric Conversion Factors for Timber Management,*
Alberta Forest Service, undated; and *Metric Conversions for Foresters*, United States Forest Service, undated.

Board foot lumber = 0.00236 cubic metre lumber

Cord = 3.625 cubic metre stacked wood (*i.e.*, 128 cubic feet stacked wood = 1 m^3 stacked wood)

Cord = 2.407 cubic metre roundwood solid (at 66 per cent solid wood in stacked roundwood)

Cubic metre roundwood = 233 board feet lumber (at 55 per cent conversion roundwood to lumber)

Thousand board feet (Mfbm) lumber = 2.360 cubic metres solid wood

Bibliography and Internet Resources

Alberta Environment. 1996. *Northern River Basin Study,* www3.gov.ab.ca/env/water/nrbs/misc/toc.html.

———. 1999. The impact of wildfire and harvest residuals on forest structure and biodiversity in aspen-dominated boreal forests of Alberta. Fire and Harvest Residual (FAHR) Project final summary report.

Alberta Environmental Protection. 1998. The Alberta forest legacy: Implementation framework for sustainable forest management.

Alberta Forest Conservation Strategy Steering Committee. 1997. Alberta Forest Conservation Strategy. Edmonton: Alberta Department of Environmental Protection.

Alberta Forest Management Science Council. 1997. Sustainable forest management and its major elements. Discussion paper, 10 September.

Alberta Forest Products Association. 1992. Our growing resource: Alberta's forest industry. Meeting global challenges. Edmonton.

Alberta Forestry, Lands and Wildlife. 1991. Integrated resource planning in Alberta. Edmonton: Resource Planning Branch, Alberta Environmental Protection.

Alberta Government. 1977. A policy for resource management of the Eastern Slopes. Edmonton.

———. 1984. A policy for resource management of the Eastern Slopes, rev. Edmonton.

———. 1984. Proposals for an industrial and science strategy for Albertans, 1985 to 1990. White Paper. Edmonton.

———. 1995. Special Places 2000: Alberta's natural heritage: Policy and implementation plan. Edmonton.

Amigo, E., and M. Neuffer. 1980. *Beyond the Adirondacks: The story of St. Regis Paper Company.* Westport, CT: Forest History Society, Greenwood Press.

Andison, D. W. 1997. Landscape fire behaviour patterns in the Foothills Model Forest. Report to Foothills Model Forest, Hinton, Alberta. Coal Creek Canyon, CO: Bandaloop Landscape-Ecosystem Services.

Baskerville, G. L. 1997. Advocacy, science, policy, and life in the real world. *Conservation Biology* 1(1):9.

Beaudoin, A. B., M. Wright, and B. Ronaghan. 1996. Late Quaternary landscape history and archaeology in the "Ice-free corridor": Some recent results from Alberta. *Quaternary International* 32.

Blaise, C. 2000. *Time lord: The remarkable Canadian who missed his train, and changed the world.* Canada: Alfred A. Knopf.

———. 1995. Biodiversity indicators for forest managers: An example. Unpublished discussion paper, provided by the author.

Bonar, R. L. 2001. Pileated woodpecker habitat ecology in the Alberta foothills. Doctoral thesis, University of Alberta.

Bott, R. 1999. *Our petroleum challenge: Exploring Canada's oil and gas industry.* 6th ed. Calgary, AB: Petroleum Communication Foundation.

Brennan, A. 1989. Stimulating investment: A government perspective. Paper presented at an investment forum, From Woodchips to Blue Chips, Canadian Council of Forest Ministers.

Bunnell, F. 1999. Forestry isn't rocket science—it's much more complex. *Forum* 6(1):7. Publication of the Association of British Columbia Professional Foresters, www.rpf-bc.org/forum/viewpointsjf99.html#4.

Canadian Association of Petroleum Producers. 2001. Review of revegetation practices for oil and gas disturbances in Western Canada. Research Report 2001-0014.

Canadian Council of Forest Ministers. 1995. Defining sustainable forest management: A Canadian approach to criteria and indicators. Ottawa: Canadian Forest Service.

———. 1997. Criteria and indicators of sustainable forest management in Canada: Technical report. Ottawa: Canadian Forest Service.

———. 1998. Sustainable forests: A Canadian commitment. Ottawa: Canadian Forest Service.

Canadian Standards Association. 1996. A sustainable forest management system: Guidance document Z808-96. Toronto.

———. 1996. A sustainable forest management system: Specifications document Z809-96. Toronto.

Christensen, N. L., et al. 1996. The report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management. *Ecol. Applic.* 6:665–91.

Clark, J. D. 1987. Forester. Internal Report. Hinton, AB: Weldwood of Canada Limited.

Corns, I. G. W., and R. M. Annas. 1986. *Field guide to forest ecosystems of west-central Alberta.* Edmonton: Northern Forestry Centre, Canadian Forestry Service.

Crossley, D. I. 1951. Annual meeting of the Canadian Institute of Forestry, Banff, Alberta, 11–13 October, *Forestry Chronicle.*

———. 1959. Continuous forest inventory and its relation to forest management at North Western Pulp and Power Ltd. Canadian Pulp and Paper Association, Woodlands Section. Montreal, Quebec. 24–26 March. *Pulp and Paper Magazine of Canada.*

———. 1970. Wood potential from the pulpwood lease through the intensification of management. Hinton, AB: North Western Pulp and Power Ltd.

———. 1975. Case history in forest management: First 20-year cycle at North Western. *Pulp and Paper Canada* 76:5.

———. 1976. The case for industrial management of Canada's forest lands. H. R. MacMillan Lectureship in Forestry. University of British Columbia, Vancouver, 25 March.

———. 1985. Toward a vitalization of Canadian forests. Alberta Forestry Association.

Darby, H. C. 1956. The clearing of the woodland in Europe. In *Man's role in changing the face of the earth,* edited by L.T. Thomas. University of Chicago Press.

Dickason, O. P. 1997. *Canada's First Nations: A history of founding peoples from earliest times.* Don Mills, ON: Oxford University Press.

Doucet, J. A. 1914. Timber conditions in Little Smoky River, Alberta and adjacent territory. Forest Branch Bulletin No. 41. Ottawa: Department of the Interior.

Drushka, K. 1996. *H.R.: A biography of H. R. MacMillan.* Madeira Park, BC: Harbour Publishing.

Dubos, R. 1959. *The mirage of health: Utopias, progress and biological change.* Harper.

———. 1961. *The dreams of reason: Science and utopias.* Columbia University Press.

———. 1965. *Man adapting.* Yale.

———. 1970. The genius of the place. University of California School of Forestry and Conservation, 26 February, Horace M. Albright Conservation Lectureship series, www.cnr.berkeley.edu/forestry/dubos.html.

Dunford, M. P. 1999. *North river: The story of B.C.'s North Thompson Valley and Yellowhead Highway Five.* Merritt, BC: Sonotek Publishing.

Eblen, R. A., and E. W. Eblen. 1994. *The encyclopedia of the environment.* Boston: Houghton Mifflin Company.

Enhanced Forest Management Task Force. 1997. Policy requirements for implementation. Edmonton: Alberta Environmental Protection.

Environment Canada. 2001. The state of Canada's forests 2001: Profiles across a nation. Ottawa. Available on the Internet at: http://www.nrcanrncan.gc.ca/cfs-scf.

Environment Council of Alberta. 1979. The environmental effects of forestry operations in Alberta: Report and recommendations.

Expert Panel on Forest Management in Alberta. 1990. Forest management in Alberta: Report of the Expert Review Panel (the Dancik Report). Edmonton: University of Alberta.

Farnham, K. 1997. Skiing on the Alberta Coal Branch. *Alberta History,* Summer 1997.

Fensom, K. G. 1972. *Expanding forestry horizons.* Canadian Institute of Forestry.

Ferdinand, I. S. 1971. Reforestation of cutover lands at North Western Pulp & Power Ltd. 3 March.

Fernow, B. E. 1907. *A brief history of forestry in Europe, the United States and other countries.* University of Toronto Press. Subsequent editions (1911, 1913) are revised, enlarged, and contain indexes.

Foothills Model Forest. 1997. Leading the way: Foothills Model Forest phase II proposal. 6 January .

Franchere, G. 1969. *Journal of a voyage on the north west coast of North America during the years 1811, 1812, 1813 and 1814.* Toronto: The Champlain Society.

Gadd, B. 1995. *Handbook of the Canadian Rockies.* Jasper, AB: Corax Press.

Grant, Rev. G. M. 2000. *Ocean to ocean: Sanford Fleming's expedition through Canada in 1872.* Prospero Books (from the 1873 James Campbell and Son edition).

Hart, H. 1980. *History of Hinton.* Edmonton: Friesen Printers.

Hauer, G., T. Williamson, and M. Renner. 2001. Socioeconomic impacts and adaptive responses to climate change: A Canadian forest sector perspective. Edmonton: Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre. Inf. Rep. NOR-X-373.

Howlett, M., J. Wilson, B. Cashore, G. Hoberg, and J. Rayner. 2000. *In search of sustainability: British Columbia forest policy in the 1990s.* Vancouver: University of British Columbia Press.

Huth, R. 2000. *Outdoor junkie.* Victoria, BC: Trafford.

Johnson, G. A. 1999. Koo Koo Sint. In *Lac La Biche chronicles: The early years* by G. A. Johnson. Portage College and Town of Lac La Biche (Alberta).

Kimmins, H. 1992. *Balancing act: Environmental issues in forestry.* Vancouver: University of British Columbia Press.

Knechtel, A. 1910. The dominion forest reserves. Bulletin 3. Ottawa: Department of the Interior.

Kryzanowski, T. 1997. Alberta to take tougher stance with stakeholders. *Logging and Sawmilling Journal,* www.forestnet.com/archives/mar97/alberta.html.

Kyba, D., and J. Ross. 2001. *Exploring the historic Coal Branch: A guide to Jasper's front ranges.* Calgary, AB: Rocky Mountain Books.

Lee, P., and S. Hanus. 1998. Criteria and indicators for monitoring biodiversity in Alberta's forests: Part I: Review of legislation, policies, external agreements, and programs. A progress completion report. Prepared for Alberta Environmental Protection by the Alberta Research Council, Vegreville, AB.

Leopold, A. 1949. *A Sand County almanac and sketches here and there.* Oxford, UK: Oxford University Press.

MacGregor, J. G. 1962. *Pack saddles to Tete Jaune Cache.* Hurtig.

———. 1977. *A history of Alberta: Historical highlights.* Hurtig.

———. 1981. *Vision of an ordered land: The story of the Dominion Land Survey.* Saskatoon, SK: Western Producer Books.

Mackay, D. 1985. *Heritage lost: The crisis in Canada's forests.* Toronto: Macmillan of Canada.

May, E. 1998. *At the cutting edge: The crisis in Canada's forests.* Toronto: Key Porter Books.

McFarlane, B. L., and P. C. Boxall. 2000. Factors influencing forest values and attitudes of two stakeholder groups: The case of the Foothills Model Forest, Alberta. *Canada. Soc. Nat. Resour.* 13:649–61.

———. 2000. Forest values and attitudes of the public, environmentalists, professional foresters, and members of public advisory groups in Alberta. Northern Forestry Centre, Information Report NOR-X-374, Edmonton, AB.

McNeely, J. A. 1993. Lessons from the past: Forests and biodiversity. Presented to Global Forest Conference, Bandung, Indonesia, 17–20 February.

McRae, D. J., L. C. Duchesne, B. Freedman, T. J. Lynham, and S. Woodley. 2001. Comparisons between wildfire and forest harvesting and their implications in forest management. National Research Council, *Environ. Rev.* 9:223–60, www.nrc.ca/cisti/journals/rp/rppdf/a01-010.pdf.

Meine, C. 1988. *Aldo Leopold: His life and work.* University of Wisconsin Press.

Milton, Viscount, and W. B. Cheadle. 2001. *The North-West Passage by land.* 6th ed. Prospero Books (originally published 1865 by Cassell, Petter and Gilpin, London).

Minister of Supply and Services Canada. 1994. Parks Canada guiding principles and operational policies. Cat. No. R62-275/1994E.

———. 1995. Canadian biodiversity strategy: Canada's response to the Convention on Biological Diversity. Cat. No. En21-134/1995E.

Miyata, E. S. et al. Undated. Metric conversions for foresters. United States Forest Service, North Central Forest Experiment Station.

Murphy, P. J. 1985. History of forest and prairie fire control policy in Alberta. Edmonton: Alberta Energy and Natural Resources.

———. 1999. Alberta's first water powered sawmill. In *Lac La Biche Chronicles: The early years* by G. A. Johnson. Portage College and Town of Lac La Biche (Alberta).

———. 2001. Wildfire in Alberta. Natural Disturbance and Forest Management Symposium, Edmonton, 5 March.

Noss, R. 1990. Indicators for monitoring biodiversity: A hierarchial approach. *Conservation Biology* 4:355–63.

Parks Canada. 1974. The wild rivers survey.

Patriquin, M., A. Wellstead, J. Alavalapati, and W. White. 1998. Economic overview of the mineral sector in Alberta and the Foothills Model Forest. Foothills Model Forest Socio-Economic Research Network, Canadian Forest Service, 30 March.

Perlin, J. 1989. A forest journey: The role of wood in the development of civilization. Cambridge, MA: Harvard University Press.

Pickard, R. 1986. An archaeological assessment of the Patricia lakes site in Jasper National Park. In *Eastern Slopes prehistory: Selected papers,* edited by B. Ronaghan. Archaeological Survey of Alberta, Occasional Paper No. 30. Edmonton: Alberta Culture, Historical Resources.

Presslee, D. J., and S. Navratil. 1997. Stand density management of lodgepole pine: A dilemma and options. In *Stand density management and implementation,* edited by C. R. Bamsey. Edmonton: Clear Lake Ltd.

Pyne, S. J. 1997. *Vestal fire: An environmental history, told through fire, of Europe and Europe's encounter with the world.* Seattle: University of Washington Press.

Rennie, P. J. 1967. Measure for measure. Forestry Branch, Canada Department of Forestry and Rural Development Departmental Publication No. 1195.

Ross, T. 1974. *Oh! The Coal Branch: A chronicle of the Alberta Coal Branch.* D. W. Friesen and Sons.

Schneider, R. 1997. Ecological diversity monitoring framework (draft). Unpublished discussion paper prepared for the Biodiversity Monitoring Working Group.

Shindler, B., and L. A. Cramer. 1999. Shifting public values for forest management: Making sense of wicked problems. U.S. Forest Service, Eco-Watch Dialogues, 6/7/99, www.fs.fed.us/eco/eco-watch/wickedpr.html). A version of this paper appeared in *Western Journal of Applied Forestry* 14(1):28–34.

Silversides, C. R. 1997. Broadaxe to flying shear: The mechanization of forest harvesting east of the Rockies. Ottawa: National Museum of Science and Technology.

Spry, I. M. 1995. *The Palliser expedition: The dramatic story of western Canadian exploration 1857–1860.* Fifth House.

Stedman, R. C. 1999. Sense of place as an indicator of community sustainability. *The Forestry Chronicle* 75:5.

Stelfox, J. G., et al. 2000. Long-term (1956–1996) effects of clearcut logging and scarification on forest structure and biota in spruce, mixed-wood, and pine communities of west-central Alberta, www.boreal-centre.ca/reports/stelfox/stelfox.html.

Swanson, F. J., J. A. Jones, D. O. Wallin, and J. H. Cissel. 1993. Natural variability: Implications for ecosystem management. In M. E. Jensen, and P. S. Bourgeron (eds.), *Forest ecosystem health assessment, Volume II: Ecosystem management, principles and applications,* edited by M. E. Jensen and P. S. Bourgeron, 89–103. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Swanson, R. H., and G. R. Hillman. 1977. Predicted increased water yield after clear-cutting verified in west-central Alberta. Information Report NOR-X-198. Edmonton: Northern Forest Research Centre.

Udell, R. W., and W. R. Dempster. 1987. Predicting the growth and yield of regenerating lodgepole pine. *Canadian Forest Industry* 107(2): 48–60.

United Nations. 2001. *The world at six billion.* New York: Department of Economic and Social Affairs, Population Division, www.un.org/esa/population/publications/sixbillion/sixbillion.htm.

Urquhart, I. (ed.). 1998. *Assault on the Rockies: Environmental controversies in Alberta.* Edmonton: Rowan Books.

Valtanen, H. 1996. German consumers set high environmental standards. *Timberjack News* 2:96.

Walker, M. A. (ed.). 1984. *On Alberta's industrial and science strategy proposals.* Vancouver: Fraser Institute.

Walters, C., and C. Holling. 1990. Large-scale management experiments and learning by doing. *Ecology* 71: 2060–68.

Ward, Dame B., and R. Dubos. 1972. *Only one earth: The care and maintenance of a small planet.* New York: Ballantine Books.

Weldwood of Canada Limited, Hinton Division. 1999. A handbook of forest stewardship for 21st century workers.

———. 2000. Sustainable forest management plan.

Wellstead, A. M., C. R. Olsen, and W. A. White. 2001. Measuring the economic value of the visitor sector of a regional economy: A case study of the Foothills Model Forest. Edmonton: Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre. Inf. Rep. NOR-X-378.

Wild Earth. 1999. Celebrating Leopold's legacy. Richmond, VT: *The Wildlands Project* 9:3.

Willson, B. 1891. *The great company: Being a history of the honourable company of merchants-adventurers trading into Hudson's Bay.* Toronto: Copp, Clark.

Wilson, B., T. Takahashi, and L. Vertinsky. 2001. The Canadian commercial forestry perspective on certification: National survey results. *For. Chron.* 77(2):309–13.

Woodley, S. J. 1993. Monitoring and measuring ecosystem integrity in Canada's national parks. In *Ecological integrity and the management of ecosystems,* edited by S. J. Woodley, J. Kay, and G. Francis, 155–76. USA: St. Lucie Press.

Wright, J. C. 1971. Photo-point sampling for forest inventory. *Pulp and Paper Magazine of Canada,* February.

———. 1975. Remarks to Canadian Institute of Forestry, Rocky Mountain Section Meeting 1 Feb., Hinton, AB.

Web sites

The web sites of Weldwood Canada and the Foothills Model Forest contain up-to-date information about many of the topics addressed in this book. They also provide links to other forestry sites, including the Canadian Forest Service and the Alberta Forest Products Association. The annual CFS publication, *State of Canada's Forests,* provides a particularly valuable general overview of forestry trends in Canada; it can be viewed on-line or ordered from the web site.

Foothills Model Forest: www.fmf.ab.ca.

Weldwood, Hinton: www.hintonforestry.weldwood.com

Glossary

The initial source of the definitions was the glossary included in the 1996 Hinton operating ground rules booklet. Other sources included the Alberta Sustainable Resource Development glossary on the Internet at: www3.gov.ab.ca/srd/forests/fmd/timber/Glossary.html and the Canadian Forest Service glossary at www.nrcan-rncan.gc.ca/cfs-scf/science/prodserv/glossary_e.html.

Adaptive forest management: Forest management based on the assumption that scientific knowledge is provisional; focuses on management as a learning process or continuous experiment, where incorporating the results of previous actions allows managers to remain flexible and adapt to uncertainty.

Age-class distribution: Intervals into which the age range of trees, forests, stands, or forest types is divided for classification and use.

Annual allowable cut (AAC): The amount of timber that may be harvested in a year as stipulated in the pertinent Forest Management Plan approved by the minister under sustained-yield management; the basis for regulating harvest levels to ensure a sustainable supply of timber.

Biochemical oxygen demand (BOD): A method of determining the effect of organic material in effluent on receiving waters, by measuring the consumption of oxygen.

Biodiversity: The variability among living organisms from all sources including, but not limited to, terrestrial and aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems.

Blowdown: Tree or trees that have been uprooted or broken off by the wind. Also known as windfall.

Board feet: A unit of wood measuring 144 cubic inches. A 1-inch by 12-inch board one foot long is equal to one board foot. Historic measure of estimated lumber volume in a log or contents of a pile of lumber. One thousand board feet (Mfbm) lumber contains the equivalent of 2.36 cubic metres of wood.

Boreal forest: One of three main forest zones in the world, along with the tropical and temperate forests; it is located in northern regions and characterized by the predominance of conifers.

Buck: To cut a felled tree into specified log lengths.

Buffer: A strip of vegetated land protected from disturbance during operations beside watercourses, mineral licks, or other important features.

Clear-cut: A harvest method where all merchantable trees are harvested from a cutblock. Clear-cutting may be done in blocks, strips, or patches.

Crown land: Public land that is managed by the national, provincial, or territorial government.

Cutblock: The primary administrative subdivision for management, consisting of a contiguous area of merchantable timber designated for removal in one cutting operation.

Cut-over: Area of trees that have been cut or felled as in a logging operation.

Duff: The living and dead organic material and litter commonly found on the forest floor. It may consist of twigs, needles, leaves, bark, mosses, peat, herbs, forbs, and grasses.

Ecosystem: A functional unit consisting of all the living organisms (plants, animals, and microbes) in a given area, and all the non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow.

Edge habitat: A loosely defined type of habitat that occurs at the boundary between two different habitat types. Typically, edge habitats share characteristics with both adjacent habitat types and have particular transitional characteristics that are important to wildlife.

Even-aged stand: A stand where the ages of most trees are within twenty years of each other.

Feller-buncher: A self-propelled machine used to fell trees by shearing them off near the ground using a hydraulic apparatus. Some models also strip limbs and bunch the logs for later pickup.

First-pass harvest: Timber that will be cut during the initial harvest operation of the cutting cycle.

Forest: A complex community of plants and animals in which trees are the most conspicuous members. A mixed forest includes both coniferous and deciduous trees.

Forest connectivity: A measure of how well different areas (patches) of a landscape are connected by linkages such as habitat patches or corridors of like vegetation.

Forest health: The vigour or physiological condition of the forest.

Forest Management Agreement: The title used since 1968 for the area-based timber lease agreement between the company and the provincial government, most recently the 1988 Hinton Forest Management Agreement (O.C. 290/88) and subsequent amendments.

Forest Management Area: The area of forest land designated by the Forest Management Agreement for the purpose of establishing, growing, and harvesting timber crops in a manner to promote a sustained yield of timber.

Forest Management Plan: A requirement of the Forest Management Agreement that establishes a sustainable annual allowable cut, as well as the forest management strategies and methods to be used on the Forest Management Area.

Forests Act: The legislative statute that authorizes the responsible minister, currently the minister of Sustainable Resource Development, to administer and manage Alberta's forested lands.

Forwarder: A self-propelled machine, usually self-loading, that transports trees or logs by carrying them completely off the ground.

Free-to-grow: A state in which coniferous crop trees are free from competition from deciduous trees.

Geographic information system (GIS): An organized collection of computer hardware, software, and geographic data designed for capturing, storing, updating, manipulating, analyzing, and displaying all forms of geographically referenced information.

Global positioning system (GPS): A system of satellites and receiving devices used to compute positions on earth.

Grapple: A clamp mounted on the end of the skidding boom, consisting of a downward-turned clamp that is opened to pick up the stems or logs and then closed to lift and deposit them elsewhere.

Greenhouse gases: A number of gases, including carbon dioxide, methane, and nitrous oxide, which affect global climate by trapping heat in the atmosphere.

Green-up: The minimum height and stocking levels which trees on a cutblock must achieve to meet water, wildlife, visual, protection, or other forest management objectives before an adjacent stand is removed.

Herbicide: A chemical used to reduce the growth of weeds or competing vegetation.

Integrated resource management: A comprehensive approach to land and resource management. Encourages multiple use, yet recognizes that not all uses can be provided on the same area at the same time.

Inventory (forest): A survey of a forest area to determine such data as area, condition, timber, volume, and species, for a specific purpose, such as planning, purchase, evaluation, management, or harvesting.

Landings: Any bared areas where logs are gathered for processing or for further transport to a mill.

Lignin: The adhesive material binding wood fibres together, removed during the pulping process at kraft pulp mills and burned to produce energy.

Mature: A tree that has reached the age where the growth rate has begun to decline. For aspen this is generally 60 to 80 years; for pine, 80 to 100; and for spruce, 100 to 120.

Merchantable: Trees deemed available for commercial harvest.

Natural regeneration: The renewal of a forest stand by natural seeding, sprouting, suckering, or layering.

Not satisfactorily restocked (NSR): Productive forest land that has been denuded and has not been regenerated to specified standards.

Old growth: Forest dominated by mature or overmature trees, not influenced by human activity. The stand may contain trees of different ages and various species of vegetation.

Operating ground rules: A set of agreed-upon rules or standards governing how forestry operations should be conducted. Ground rules are revised within five-year intervals, or more often as needed, by joint review and negotiation between the provincial government and the company through a standing committee.

Over-mature: The age class where a timber stand is declining in vigour, health, and volume because of age, decay, or other factors.

Permanent growth sample plot: A permanent sample plot (PSP) selected for detailed growth studies.

Permanent sample plot (PSP): A plot established for long-term growth-and-yield, silviculture, or scientific study.

Pesticides: Compounds used to control competing vegetation (herbicides) or insect infestations (insecticides).

Pulpwood lease agreement: The predecessor to forest management agreements, containing most of the same rights and responsibilities inherent in present-day forest management agreements.

Reforestation: Re-establishment of a tree crop on forest land following harvest or other disturbance (*e.g.*, fire, wind damage).

Regeneration: The renewal of a tree crop, either by natural or artificial means. Regeneration may also refer to the young crop itself.

Reserve (or reserve stand): The area of timber that has been exempted from harvest.

Residual stands: Standing coniferous or deciduous trees that are left on a cutblock after harvesting.

Right-of-way: A strip of land over which a power line, railway line, road, or other linear development extends.

Riparian zone: The land adjacent to the normal high-water mark in a stream, river, or lake, extending to the portion of land that is influenced by the presence of the adjacent ponded or channelled water. Riparian areas typically exemplify a rich and diverse vegetation mosaic reflecting the influence of available surface water

Road deactivation: Returning a road to its previous productive state, which may include any of the following techniques: a) scarifying or contouring the road area to a stable form, b) removing all watercourse crossing structures and back-sloping approaches to a stable slope, c) cross-ditching to disperse run-off and suspended sediment into undisturbed areas, d) rolling back available topsoil, stripping, and re-vegetating bared surface areas, where required, to stabilize the soils and restore site productivity, e) reforesting the disturbed areas for roads within cutblocks.

Rotation: The planned number of years between the harvest of one stand and the next harvest of a new stand established on the site, which occurs at a "rotation age" or specified stage of maturity. The rotation age includes a regeneration establishment period. Traditionally, the rotation age has been specified as the point at which mean growth rates peak and begin to decline.

Roundwood: A length of cut tree generally having a round cross-section, such as a log or bolt.

Salvage logging: Designed logging operations that are often carried out to remove damaged timber following a fire, insect attack, or windthrow.

Satisfactorily restocked (SR): Term for forest land that has been regenerated to a specified standard.

Scarification: Treatment given to a site involving the breaking up of the forest floor to prepare it for reforestation by direct seeding, natural regeneration, or planting.

Screefing: The removal of herbaceous vegetation and soil organic matter to expose a soil surface for planting.

Seed bed: The soil or forest floor on which seeds fall and germinate.

Seed source: Trees or stands of trees of seed-bearing age; also cone-bearing tops and limbs of pine that will provide seed for reforestation.

Selection harvest: An uneven-aged silvicultural system in which selected trees are harvested individually or in small groups at periodic intervals throughout the life of a stand. The objective is to improve the timber condition, structure, and value or meet other resource objectives.

Selective cutting: A harvest practice that removes only trees of a certain species with a prescribed diameter and/or value.

Shelterwood cutting: A method of harvesting that involves two cuts, the first of which leaves trees at intervals to provide the canopy and species required for natural regeneration.

Silviculture: The theory and practice of controlling the establishment, composition, structure, and growth of forests.

Site: An area described or defined by its biotic, climatic, and soil conditions in relation to its capacity to produce vegetation; also, the smallest planning unit.

Site preparation: Treatments applied to the soil to prepare an area for regeneration by direct seeding, natural regeneration, or planting.

Skid trail: An unimproved temporary forest trail used by equipment such as bulldozers and skidders to bring trees or logs to a landing or a road.

Slash: The tree residue left on the ground as a result of forest and other vegetation being altered by forest practices. Slash includes material such as logs, splinters, chips, tree branches, and tops.

Snag: A dead standing tree that may provide roosting or cavity nesting/denning opportunities for wildlife.

Stand: A community of trees sufficiently uniform in species, age, arrangement, or condition, and distinguishable as a group in the forest or other growth in the area.

Standards: Legislated, regulated requirements, or other agreed-upon commitments (*e.g.*, Forest Management Plan, Ground Rules). Standards define auditable performance targets.

Stand structure: The distribution of trees in a stand which can be described by vertical or horizontal spatial patterns, size of trees or tree parts, age, or a combination of these.

Stand tending: Any silvicultural treatment carried out for the benefit of a forest crop at any stage of its life; covers both treatments on the crop itself (*e.g.*, spacing, fertilization, pruning, or commercial thinning) and on competing vegetation (*e.g.*, brushing, weeding, and cleaning).

Stem analysis: Cutting trees in short sections, then counting and measuring growth rings by section.

Stocking: A measure of the proportion of an area actually occupied by trees/seedlings, expressed in terms of a percentage of occupied fixed area sample plots.

Stripping: The layers of topsoil and fine debris above mineral soil.

Sustained-yield forest management: Managing the net forest land base in a defined area for continuous timber production where the aim is to achieve, at the earliest practicable time, a balance between net growth and harvest.

Tenure agreement: Generic term for lease arrangements such as the Forest Management Agreement.

Three-pass harvest: A harvest pattern in which all the merchantable timber in a harvest area is harvested in three passes. The percentage removed in each pass may or may not be approximately equal in area and volume.

Two-pass harvest: A harvest pattern in which all the merchantable timber in a harvest area is harvested in two passes, normally in approximately equal areas and volumes.

Understorey: Trees growing under the main forest canopy.

Uneven-aged stand: A stand where the trees have an age variance greater than twenty years.

Ungulates: Hoofed mammals, including in this region such wild species as mule and whitetail deer, elk, moose, woodland caribou, bighorn sheep, and mountain goat.

Utilization standard: Standards establishing which stands and trees will be considered merchantable.

Wildlife tree: A dead, decaying, deteriorating, or other designated tree that provides present or future habitat for the maintenance and enhancement of wildlife.

Windfall. Tree or trees that have been uprooted or broken off by the wind. Also known as blowdown.

Wind-firm boundaries: Cutblock boundaries established using features that are relatively stable and which minimize the potential for timber damage and losses from wind.

Working circles: Sustained-yield subdivisions of the Forest Management Area for the purpose of forest management and cut control.

Yield table: A summary table showing, for stands (usually even-aged) of one or more species on different sites, characteristics at different ages of the stand.

Subject Index

Index of Personal Names

People from around the world have visited the foothills near Hinton in northwestern Alberta to absorb the land ethic of the company that took on stewardship of the area's publicly owned forests in 1954. *Learning from the Forest* is part history of the company (now called Weldwood of Canada, Hinton Division), part forestry survey, and part proposal for the future of silviculture—the art and science of growing trees. From the outset, the managers of the Hinton forest recognized the challenges of managing forests whose life cycles are measured in centuries. *Learning from the Forest* describes the evolution of the forward thinking necessary to successful forest management—from the 1950s ideal of ensuring a perpetual timber supply to today's goal of maintaining a forest that sustains multiple uses and values. In Hinton this includes the extraction of other natural resources; recreation, including public parks, camping, hiking, skiing, and canoeing; and the protection of wildlife habitat and Aboriginal cultural sites.

Most important, *Learning from the Forest* tells of a work in progress and the continuous process of learning from the forest itself. Here is the story of the first fifty years of the journey.

"This is an important account of a large forest area that has had continuous management by one organization—the company—for nearly half a century or half one forest rotation. It is a first in Canada and is a major illustration of what can be accomplished by professional forest managers when provided with continuous support for their endeavours. Such commitment over decades, together with the constant documentation and continual analysis of results on the forest from activities, is surely the only way in which a vision of the future forest can be realistically portrayed."

—KENNETH A. ARMSON, R.P.F., AUTHOR OF *ONTARIO FORESTS: A HISTORICAL PERSPECTIVE*

FIFTH HOUSE

FIFTH HOUSE LTD.
A Fitzhenry & Whiteside Company
1-800-387-9776

COVER PHOTOGRAPHS WELDWOOD OF CANADA LTD.
COVER AND INTERIOR DESIGN BY JOHN LUCKHURST/GDL
PROUDLY PRINTED IN CANADA ON ACID-FREE PAPER,
10 PERCENT POST-CONSUMER WASTE