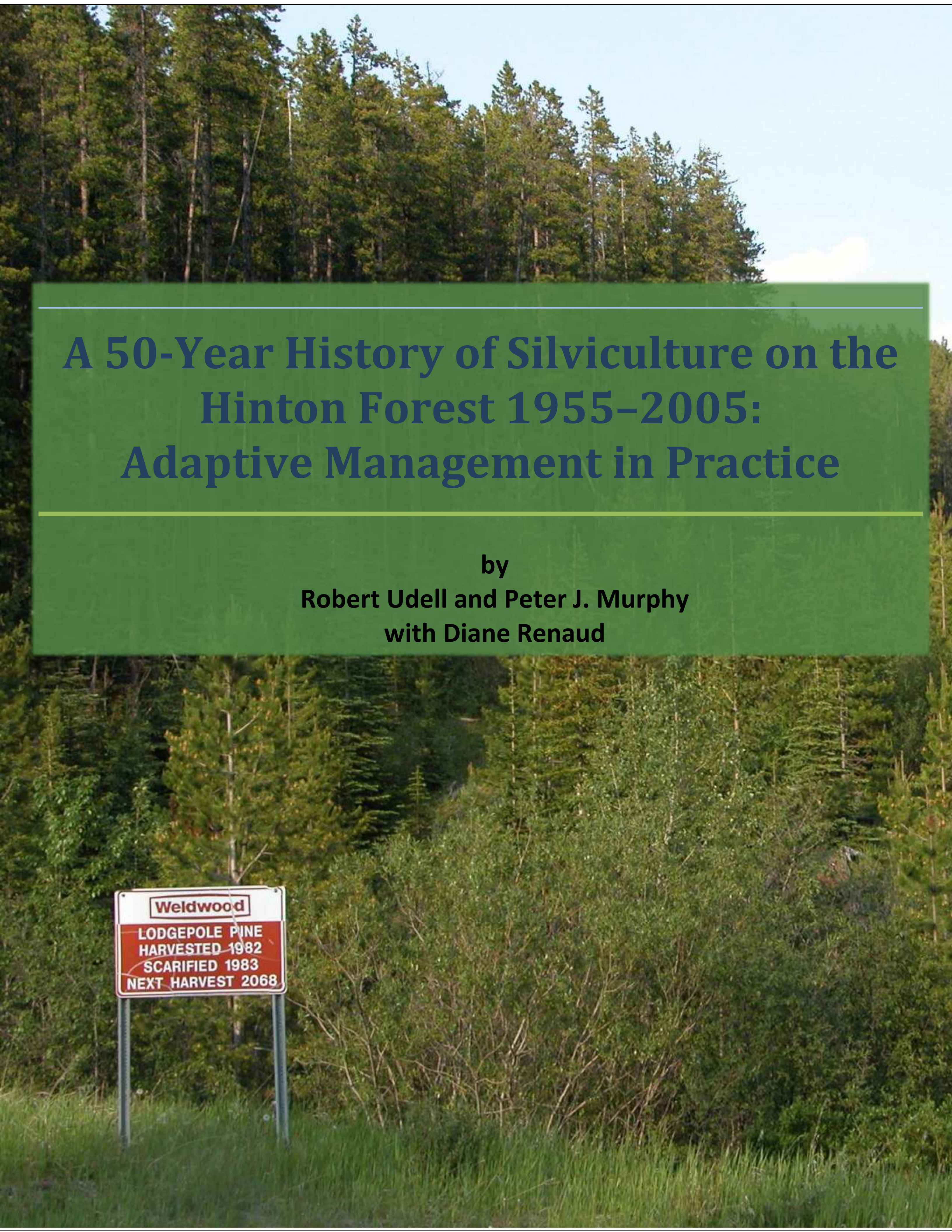
A 50-Year History of Silviculture on the Hinton Forest 1955–2005: Adaptive Management in Practice

by

Robert Udell and Peter J. Murphy

with Diane Renaud



The Forest History Program of the Foothills Research Institute
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Dedicated to the memories of Hinton foresters:

Chief Forester Desmond I. Crossley (1910–1986)

and

Forestry Manager David J. Presslee (1952-2000)

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Table of Contents

Foreword by Dr. Peter J. Murphy

"If a tree falls in a forest . . ."

Silviculture . . . its very name is rich in meaning. The first part is derived from Sylvanus, a Roman deity who was believed to be a guardian or protector of the woods; the second part, *culture*, has to do with growing and caring. Silviculture is now defined simply as "the growing of trees." It lies at the heart of forestry as practised by forestry professionals, or foresters. Although the concept is similar to that of agriculture—the growing of food crops—there are additional challenges in silviculture. As one of Murphy's Laws suggests, "nothing is as simple as it looks." Silviculture and its application to forestry differ from agriculture in two important ways.

The first major difference is that the forests are complex ecosystems. Trees are an important part of the forested ecosystem but this ecosystem supports a host of other plants and animals that must also be considered while culturing. Besides growing trees, forests provide a lot of "ecological services" such as protecting the soil, intercepting and storing rain and snow within their watersheds, slowing the speed of winds, providing shade and shelter, storing carbon, releasing oxygen, and moderating air temperatures. Forests are also enjoyable places for people to visit. As a result, people have strong feelings about forests, giving them social values in addition to environmental.

The second major difference is the length of time it takes for trees to grow and for the complex plant and animal communities to develop their interconnected relationships. Plans for managing forests in Alberta typically span 80-year periods between harvests. Changes within the forest take place slowly and are hardly noticeable from year to year. Therefore people are not usually aware of the growth and changes taking place and may become concerned about the apparent recovery of managed forests. This is quite different, for example, from seeing a field of wheat greening up in the spring and maturing to harvestable grain in the fall.

Applying silviculture takes a lot of thought to properly design the new forests after harvest, and patience to look after them as they grow. Foresters learn through years of study and are continually gaining more knowledge through observation and research. As new knowledge is gained, it is put into practice through a process called adaptive management to try to ensure continual improvement in the way forests are managed.

In forestry practice, when larger trees are harvested, new trees are established in their place. So the simple act of planting trees is often seen as the start of a new forest. But, as important as tree planting is, there is much more to it than that. Foresters actually begin the process by designing how and when the mature trees should be harvested so that the new forest can be more readily established and the many other forest values are not lost. Once the new forest starts growing, the process of looking after it continues. Young trees may need weeding until they grow tall enough to rise above competing plants; some in-fill planting may be required where seedlings are too far apart; others may need thinning if they are too crowded. And throughout their 80-year growing span, all need protection from such threats as fire, insects, and disease.

Because forests are part of more complex ecosystems and because people care about them, the knowledge and research findings of related disciplines contribute to the planning and management teams. These typically include such specialists as wildlife and fisheries biologists, watershed hydrologists, recreational planners, and ecologists. Their combined knowledge is applied to influence, for example, the size, shape, pattern, species selection, and harvesting methods to maintain or improve habitat conditions for a variety of species and values. This means, in other words, working with nature as a team to sustain the integrity of the forest ecosystem.

This first Forest Management Area of 1955 for the Hinton project was selected for the quality of its natural forests that lay along the foothills east of the Rocky Mountains of Jasper National Park. Virtually all of the trees had begun to grow following extensive forest fires that had occurred over the previous two centuries. Almost 40 per cent of the forests started to grow after extensive fires in the late 1880s and early 1890s. The pines in these forests grew from seed stored in the fire-resistant cones of their parents; the spruce grew from seed that was blown in later in from trees that had escaped the fires.

Forests of different ages support different plant communities, and birds and mammals also have preferences so a mix of ages and of species in important to encourage a diversity of biological communities or, as it is called, bio-diversity.

Foresters try to learn from these natural disturbances, especially fire, to determine cutting patterns that are best suited to support biodiversity and the vigorous growth of new trees. They also learn to avoid some of the undesirable effects of high-intensity fires that may cause soil damage and kill well-established younger stands.

This story is about how silviculture started in this first large-scale forest harvesting area in Alberta. It started with a focus on finding ways to regenerate the initial cutover areas. The focus then quickly evolved to increasing the health and vigour of the forest and to incorporating the great range of ecological, environmental, and social values into the new forest.

"If a tree falls in a forest . . . ," the forester will care, will determine why, and see to it that a new tree grows in its place.

A new forest springs from the old
FOOTHILLS RESEARCH INSTITUTE – BRIAN CARNELL PHOTO

Acknowledgements

The practice of silviculture lies at the heart of any sustained-yield forest management system. As well, silvicultural regeneration methods have a profound impact on other forest values, including that of biodiversity that has been an important consideration for the Hinton Forest from the very start of the operation.

Many people contributed to the preparation of this story of silviculture and forest renewal, and many others have contributed to its content. The Adaptive Forest Management (AFM) and History Program of the Foothills Research Institute has produced a number of books and reports in the series since 1996. The material for this report comes from these sources and others including the following:

- Lorne Brace, *A History of Silviculture on the Weldwood-Hinton Forest FMA [Forest Management Area]* (unpublished, 1999)
- Peter J. Murphy, with Robert Bott, Robert Udell, and Robert Stevenson, *The Hinton Forest 1955–2000: A Case Study in Adaptive Forest Management,* Foothills Model Forest History Series, Report #2 (Hinton: Foothills Research Institute, 2002)
- Peter J. Murphy and Martin K. Luckert, *The Evolution of Forest Management Agreements on the Weldwood Hinton Forest*, Foothills Model Forest History Series, Report #3 (Hinton: Foothills Research Institute, 2002)
- Robert Bott, Peter Murphy, and Robert Udell, *Learning from the Forest: A Fifty-Year Journey Towards Sustainable Forest Management* (Hinton, AB: Fifth House Publishing and Foothills Model Forest, 2003)
- Robert Udell, *50 Years of Harvest and Reforestation – A Historical Photo Review of the Hinton Forest Management Agreement Area,* Foothills Model Forest History Series, Report #7 (Hinton: Foothills Research Institute, 2007)
- Robert Stevenson, Steve Ferdinand, and Robert Udell, *The Resilient Forest: Looking Beyond the Stumps,* Foothills Model Forest History Series, Report #6 (Hinton: Foothills Research Institute, 2007)

The story also draws on two early interviews by Peter Murphy with Des Crossley (first chief forester at Hinton) and Reg Loomis (Director of Forest Management, Alberta Forest Service) as well as a number of interviews conducted for the Adaptive Forest Management/History Program. Those interviewed include Jack Wright, who replaced Des Crossley as chief forester in 1975 and who was author of the first two detailed forest management plans; Robert Udell, author of the next two management plans and the program lead for the Foothills Research Institute's Adaptive Forest Management and History Program; Hugh Lougheed, author of two groundbreaking management plans for the Hinton Forest; David Presslee, a visionary silviculture manager; and Diane Renaud, silviculture manager and tree improvement specialist.

Photos for the project came from various sources but mainly from the historical photo collections of Alberta Sustainable Resource Development and Hinton Wood Products, from the Foothills Research Institute collection and from various books and reports in the Adaptive Forest Management/History series.

We appreciate the assistance of Sharon Meredith in the preparation and formatting of charts and graphs used in this book.

Introduction

On September 14, 1954, the Province of Alberta signed a Forest Management Agreement with a newly formed North Western Pulp & Power Limited. This gave the Company the right to harvest trees on the defined lease area of some 7,800 square kilometers with an additional area of the same size held as a provisional reserve. The Company accepted full responsibility for forest management, including reforestation of its logged areas to ensure a “perpetual sustained yield” of wood. This meant that the Company would have to conduct a comprehensive forest inventory and a detailed forest management plan that included a silviculture program. This was the first such agreement in Alberta and the first formal commitment to perpetual sustained yield. It presented a steep learning curve to both parties, but both the Government of Alberta and North Western Pulp & Power Limited were resolved to live up to their commitments.

This story elaborates on the application of silviculture, the essential ingredient needed to meet the objective of sustained yield.

The Canadian Forest Service defines silviculture as “the theory and practice of controlling the establishment, growth and quality of forest stands to achieve the objectives of management.” The objective at Hinton was initially quite straightforward: to ensure that conifer stands come back to replace the harvested ones. The task became vastly more complex as additional objectives were added: to protect other values, ranging from watersheds to wildlife habitat; to enhance the growth and yield rates of the new forest; to manage deciduous as well as coniferous species; and to maintain biological diversity. Growing the new forest thus required 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;
- tending the site to control competing vegetation; and
- thinning overly dense stands.

The concept of sustained yield proved to be a moving target as the Company planners moved beyond their initial focus on wood supply to incorporate the unfolding needs of other forest values, including wildlife, water, fisheries, recreation, and biodiversity.

The chapters are divided into chronological periods that reflect major policies and programs and the problems, changes, and achievements that were occurring during those periods. The first chapter presents a historical backdrop to put the significance of the 1954 Agreement into context, and an overview of the approach to silviculture as described by author Robert Bott in *Learning from the Forest*.

Details about the silviculture story follow in the ensuing chapters. Chapter 2 looks at the early days in forestry, 1955–1964. Chapter 3 continues the story with advances in planning and reforestation over the period 1965–1973. Expansion and maturation of the silviculture program during the years 1974–1986 is the topic of Chapter 4. Chapter 5 deals with silviculture’s decline in the years 1987–1992. The revitalization of silviculture from 1993 to 2005 is the subject of Chapter 6 and the extensive Appendix 1 gives the timeline for silviculture and logging for the entire period covered by the book, 1954 to 2005.

1 Silviculture: Overview and Historical Backdrop

1. A Brief Overview of the Hinton Silvicultural Program

In 2003, the Foothills Model Forest and Fifth House Publishing produced *Learning from the Forest*, an overview of the forest management program at the Hinton Forest.[1] In the book, Robert Bott gave a brief overview of the Hinton silviculture program, which we reproduce in this section. The ensuing chapters will flesh out the details of this overview.

> 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[2])

Howard V. (Pete) Hart was Northern and Pacific woodlands manager for St. Regis Paper Co. during the early years of the Hinton operation in the 1950s. In a 1976 interview with the Forest History Society, he recalled that St. Regis had had little previous experience with silviculture in northern forests before coming to Alberta in 1954. St. Regis did, however, have considerable experience in plantation management in the Southern states where tree plantations mature in 20 to 40 years. Hart noted in the interview that St. Regis recognized that accepting responsibility for forest renewal was a fair trade-off for long-term tenure at Hinton.

Des Crossley, CFS Researcher ca. 1952
ALBERTA FOREST PROTECTION COLLECTION

St. Regis first offered the position of chief forester to Reg Loomis of the Alberta Forest Service (AFS), who had conducted a preliminary inventory of the new Pulpwood Lease Area. When he decided to stay with the AFS, the Company offered the position in 1955 to Des Crossley, who accepted the challenge. Crossley was already an established expert in the silviculture field. As a researcher for the Canadian Forest Service, he had demonstrated that post-harvest site preparation was the key to successful regeneration of cutovers in the Alberta foothills. Before he joined St. Regis, Crossley had been commissioned to prepare a report on silviculture for the new operation. Given his demonstrated expertise and commitment, combined with St. Regis' own shortcomings in Canadian forestry, he was given wide latitude over forest management by his new bosses.

Crossley initially did not expect to do much planting per se. Based on his research, he believed that a combination of clear-cut harvesting and site scarification would facilitate natural regeneration in the foothills forest. This proved to be true for lodgepole pine on most sites. However, 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 as the Company was seeking to increase the promptness and vigour of new growth. In the 1990s, however, new harvesting 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 10 years of harvest. In practice, the cutovers were surveyed on a systematic grid 7 years after harvest, and the Company then had 3 years to address the areas deemed not sufficiently restocked. In the early years, Crossley (who was very frugal) 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.

Crossley's famous frugality paid off in many other ways. The Company made and honoured a commitment to devote up to 10 per cent of the Company's total delivered wood costs to forestry—including inventories, research, planning, and 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 20 years as chief forester, he reported to a number of senior managers in the Company hierarchy and 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.

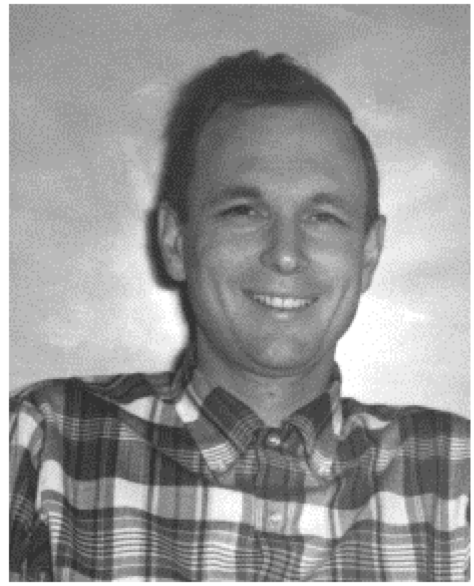
In the early years, for example, government regulations required loggers to cut up and scatter the limbs and tops of trees to reduce the post-harvest fire hazard. Crossley saw that the heavy crawler tractors and ploughs used for scarification would crush and redistribute the logging debris just as effectively, 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 of contracting three D-9 Caterpillars to scarify the sites.

> 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 managed the reforestation program personally until 1960 when Gordon Jones was hired as the first section head for silviculture, but the chief forester of course maintained a keen interest in silviculture throughout his tenure (and beyond). It was in the early 1960s that 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 certain that many more would pass muster before the 10-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 the early 1960s, 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.



Bob Carman – Staff Photo 1967
HINTON WOOD PRODUCTS COLLECTION

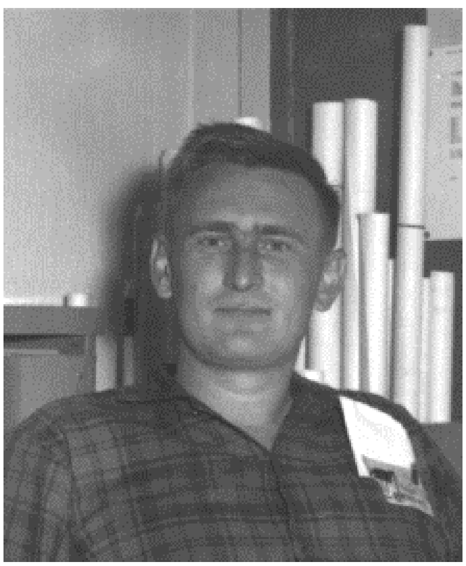
Hinton Nursery – 1965
HINTON WOOD PRODUCTS COLLECTION

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 cutover contained several significantly different ecological conditions, it was further divided into "ecological units." For each site or unit, the survey recorded the following:

- forest cover type before harvesting;
- seed availability from either slash-borne cones or adjacent uncut stands;
- soil moisture conditions and drainage;
- existing or potential vegetative competition;
- advance growth; and
- 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 continually refine the treatments, 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.



Steve Ferdinand Staff Photo, 1967

HINTON WOOD PRODUCTS COLLECTION

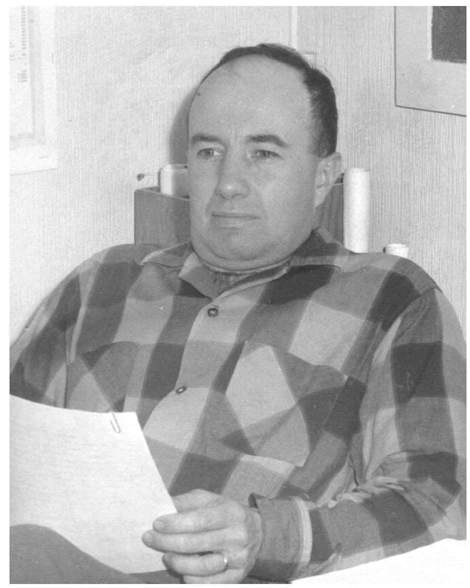
In 1968, the Company signed a new Forest Management Agreement with the province that doubled the size of the Forest Management Agreement area and committed the Company to a major expansion of its production facilities. In 1970, as the Company was preparing for the expected expansion, Crossley and his team prepared a report, "Wood Potential from the Pulpwood Lease through the Intensification of Management," that described how the increased productivity could be achieved. The measures recommended were:

- utilization of smaller timber and dead and fire-killed wood;
- pre-commercial thinning in overly dense pine regeneration stands;
- commercial thinning;
- tree improvement programs; and
- 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. Pre-commercial 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 (S.T.O.P.) claimed massive forest degradation was occurring in Alberta and published pictures in major newspapers of Hinton cutovers to back up the allegations. The controversy continued until Kare Hellum, head of silviculture for the provincial government, located S.T.O.P.'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.

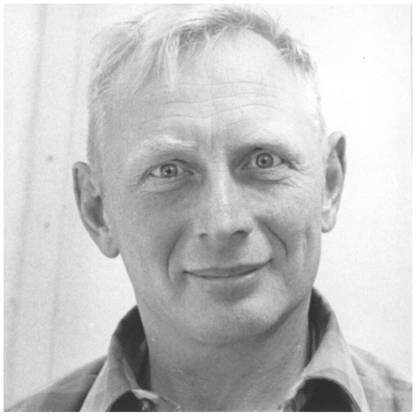


Jack Wright, 1967 Staff Photo
HINTON WOOD PRODUCTS STAFF PHOTO

Peter Sziklai, 1976 Staff Photo
HINTON WOOD PRODUCTS COLLECTION

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 re-measurement 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, 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.



Ullrich (Bill) Mattes, 1969 Staff Photo
HINTON WOOD PRODUCTS COLLECTION

Bill Mattes, a European-trained (University of Freiburg) 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 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.

David Presslee, a forester with a rich background of silvicultural experience in British Columbia, had been 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 and the associated rapid increase in harvest and reforestation required to support the new pulp mill and sawmill, 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, greatly increased pulp and lumber production, the 1991 Forest Management Plan, and the new free-to-grow standards meant there would effectively be a six-fold increase in the staff's workload, from 8,500 hectares treated or surveyed annually to 50,500 hectares treated or surveyed annually.

In the early 1990s, the Alberta Forest Service criticized the Company for instances of excessive soil degradation and issued some penalties. Subsequently, the Company worked with soil scientist Dave McNabb of the Alberta Research Council to study issues such as rutting, compaction, remediation, and road decommissioning. The Company also 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 and woodlands staff to examine the problems identified by Kimmins and Brace, the forestry staff 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 25 recommendations for adaptive management, pre-harvest planning, crop protection, quality control, seedling supply, backlog reforestation, tree improvement, and forest stewardship. By 1999, all the recommendations had been put into effect.

One of the first changes was a reorganization of silviculture staff. In February 1994, Presslee was named forest operations area superintendent, responsible for all silviculture operations. This ended the dispersal of silviculturists in the organizational chart and got them focused 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.

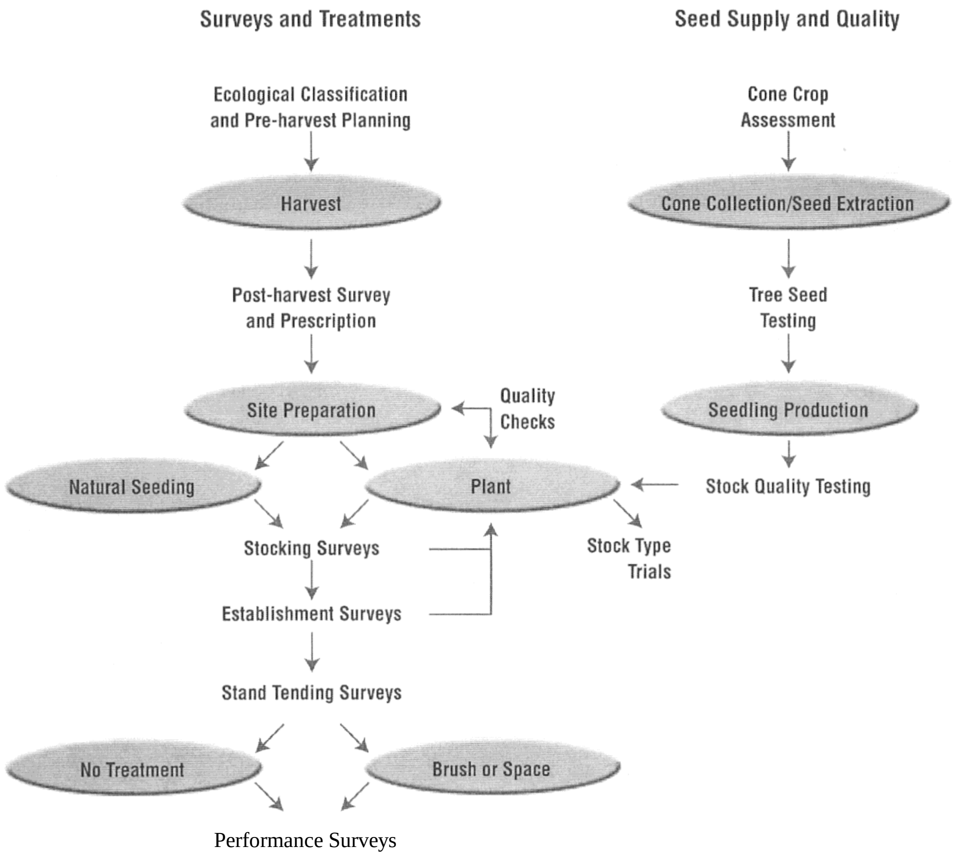
Many of Presslee's initiatives echoed plans and proposals put forward by Crossley, Wright, and other Hinton foresters decades earlier. In 1996, for example, Diane Renaud was named tree improvement forester to resume the work begun by Sziklai in the 1970s. In the same year, the Company hired Stan Navratil to identify and evaluate options for implementing the type of intensive management program first envisaged by Crossley and his team in 1970.

David Presslee brought wit, innovation, passion, and professionalism to his work, and his untimely death on 29 January 2000 was a tragic loss to his family, his friends, and the forestry community of Alberta.

His two most enduring legacies are the development of an ecological classification system used to map the entire forest estate, completed in 2002; and the development of a guiding document of ecologically based “management interpretations” of the spectrum of operating working groups on the Hinton Forest. This document continues to be maintained and updated and remains the handbook for silvicultural prescriptions on the Hinton Forest into the 21st century.

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 1.1.)

Figure 1.1 Elements of silviculture in Hinton in 2000



2. Historical Backdrop

Alberta's resources were controlled by the Dominion of Canada (see Map 1.1) until the *Transfer of Resources Act* in 1930. The Dominion Forestry Branch (DFB) was established in 1899. Dominion regulations on timber berths stipulated a diameter limit, a stump diameter below which trees could not be felled. The intent was that the residual trees would grow faster in the full sunlight and also provide seed to regenerate the stand. Too often the residuals were damaged and many blew down. The result was typically a very slow regeneration of trees. This problem was recognized by Dominion foresters such as H.R. MacMillan and T.W. Dwight , but changes were a long time coming for many reasons. However, research in silviculture and forest renewal was carried out in Alberta by the DFB in the late 1930s and through the 1940s, largely out of the Kananaskis Research Station.

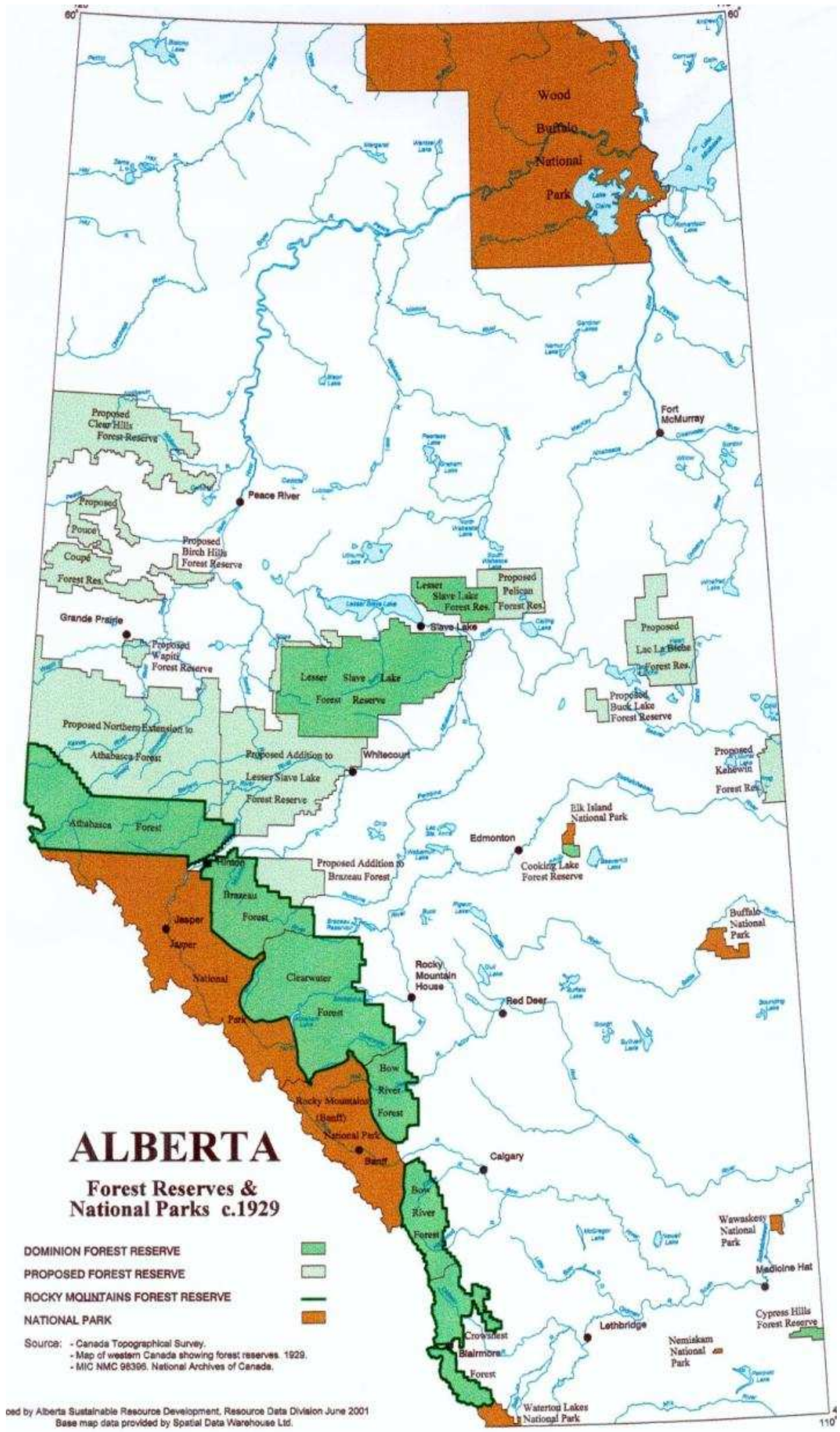
After Alberta took ownership of its resources in 1930, the province continued the existing permit and timber berth system, with timber dues now paid to the provincial government and no requirements for reforestation or ongoing stewardship. The government assumed reforestation and management planning liability but, with extremely limited budgets, neither was generally done.

Until the early 1950s, reforestation in Alberta and elsewhere in Canada was generally left to government or nature. Forest harvesting was designed to try to encourage natural regeneration, and fire control attempted to protect what grew. 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. Some sites did not regenerate at all, and others came back with less desirable species predominating. Government reforestation efforts were sporadic, depending on the vagaries of budgets, resources, and priorities.

Waste and damage in early timber berth operations in the Rocky Mountain foothills around 1921
DOMINION FORESTRY BRANCH, ALBERTA FOREST PROTECTION COLLECTION DFB14178

The problem, for both industry and government, was easy to see but hard to remedy. In northern forests, the tree species mature in 60 to 120 years or more, and 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 late 1940s that lack of systematic reforestation endangered the long-term viability of both the industry and the resource and action was urgently needed to remedy the situation.

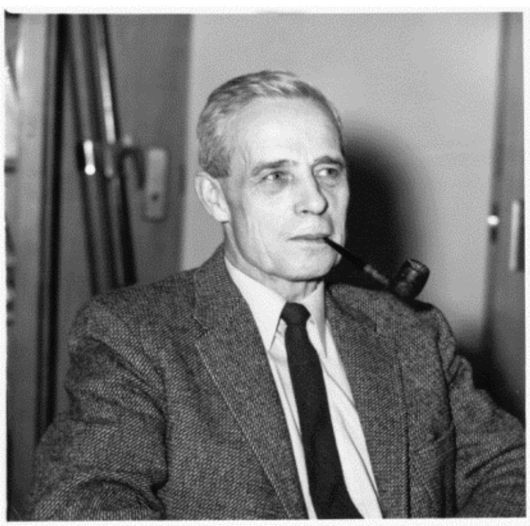
Map 1.1 Dominion Forest Reserves and National Parks in Alberta, 1929



Before the 1950s, all logging operations were by permit or timber berths; there was normally a sawlog "diameter limit" cut with timber dues paid to the provincial government, and there were no requirements for reforestation or ongoing stewardship. The government assumed reforestation and management planning liability but, as mentioned above, neither was usually done due to extremely limited budgets. A better way was needed and the Alberta Forest Service's Director of Forestry Eric Huestis set out to design it. First, he developed an Order-in-Council that in 1948 rationalized the areas available for settlement (the "Yellow Area") and those to be retained for forestry (the "Green Area"). The "White Areas" in the resulting map were areas already committed to agriculture and settlement. (See Map 1.2)

In 1949, the new *Forests Act* for Alberta was enacted on 29 March and included a new clause authorizing agreements with industry for "growing continuously and perpetually successive crops of forest products." In 1949, Huestis also hired Reg Loomis to spearhead the province-wide inventory of the Green Area, within which the future Hinton Forest was situated.

Entrepreneur Frank Ruben signed a preliminary agreement with the province in 1951 to develop a pulp mill and forestry program. Ruben retained Reg Loomis to prepare a forest-type map from photo interpretation for a forest estate to feed a proposed pulp mill at Edson. Later in 1954, he again hired Loomis to do the same for a redefined land base to support the same pulp mill. There was no detailed provincial inventory in that area at the time. Loomis' work was impressive enough that Ruben offered him the position of chief forester, but Loomis was not yet ready to abandon his commitments with the Alberta Forest Service and he declined the offer.

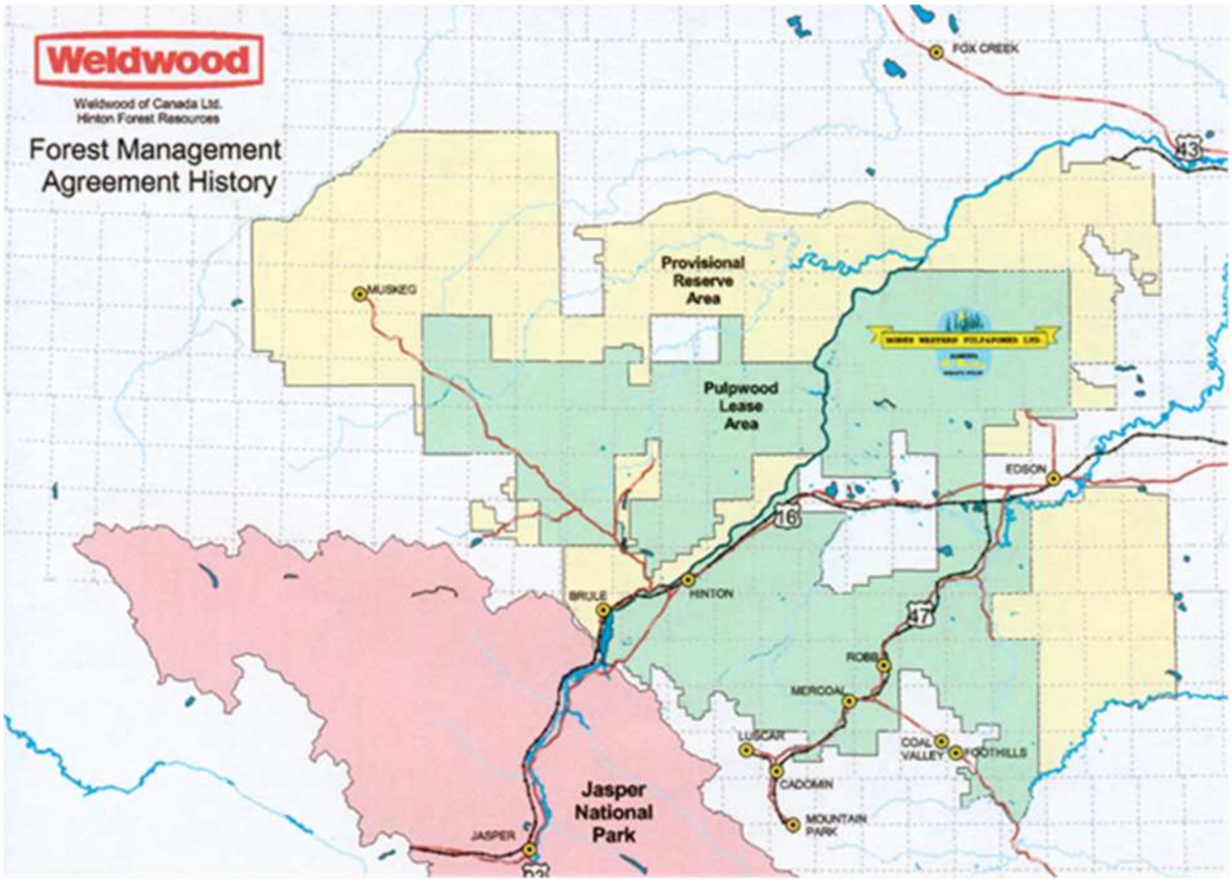


Reg Loomis, 1961
ALBERTA FOREST PROTECTION HISTORY COLLECTION

The forest management agreement signed by Frank Ruben included a mandatory sustained yield management (SYM) clause, consistent with provisions in the 1949 *Forests Act*. North Western Pulp & Power Ltd. was the first western Canadian industry to accept this obligation and honour it with a full program of forest management anchored on a progressive reforestation program. Full reforestation of all areas harvested was required within 10 years. The Agreement also signalled a change in commitment to silviculture by the Alberta government. Construction of the new mill at Hinton began in 1955, supported by a redefined forest land base with a reserve area for future expansion. (See Map 1.3.)

Map 1.2 Green, Yellow, and White Areas, 1948
(Alberta Sustainable Resource Development, 2001)

Map 1.3 Pulpwood Lease Area and Reserve 1955 (North Western Pulp and Power Ltd.)



Given the assurance that forests could, and would, be renewed and forest productivity sustained, the Company then invested intellect and funds to undertake the other prerequisites for good forest management, i.e., improved inventories, growth and yield studies, integrated land use planning, and sustainable forest management for a broader range of values and products. These were built on the foundation of forest continuity that successful silviculture was able to provide.

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 rest of the province's forest industry when the quota system was introduced in 1966. This gave the province 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.

> Alberta is the only province in which the timber licensee is obliged to conduct reforestation of cutover 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)

The Alberta approach gave industry four encouragements to conduct effective reforestation, two carrots and two sticks:

- Long-term tenure agreements were renewable so long as commitments, including reforestation, were fulfilled.
- The annual allowable cut, based on the amount of forest growth, could increase if new stands grew more vigorously than the ones they replaced.
- There were financial penalties, so much per hectare, if new growth was not successfully established on harvest sites within 10 years.
- Companies faced the additional cost of going back to treat the "not satisfactorily restocked" (NSR) sites until they were deemed to be "satisfactorily restocked" (SR).

The government assisted this process by providing free seedlings to industry for many years, and 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 methods. There was, and continues to be, vigorous debate about the details of stocking standards and enforcement. However, there was general agreement that Alberta's goal-oriented, industry-managed system worked better than the rules-based, government-managed systems in other jurisdictions.

The development of the practice of silviculture by the Company on the Hinton Forest was a profound and lasting contribution to forestry in Alberta.

Techniques pioneered at Hinton drew on historic practices in Europe and eastern North America. But the development of the Hinton program reflected innovative approaches to managing local species under Alberta conditions, not only adapting other practices but also contributing to the scientific base of silviculture in Canada. This is the story of the first 50 years of silviculture development and practice at the Hinton Forest.

3. What's in a Name?

In this report, we will generally refer to the 1-million-hectare industrial forestland supporting the Hinton operation of Hinton Wood Products as "the Hinton Forest," and the leaseholder of the Forest Management Agreement (FMA) as "the Company" because this simplifies the description of the forest and avoids confusion about the various names the enterprise has borne.

Entrepreneur Frank Ruben signed an agreement with the province in 1951 to develop a pulp mill and forest management program in Alberta. He then set out to find a joint venture partner and identify an appropriate forestland. Through a number of name changes, there was a 50-year continuity of corporate parentage from 1954, when Ruben recruited St. Regis Paper Company of New York as his partner in North Western Pulp & Power Limited (NWP&P) and they signed a new agreement with the province that set things in motion. In 1978 St. Regis changed the name of the operation to St. Regis

(Alberta) Ltd. Frank Ruben had previously (in 1969) sold his shares, held by North Canadian Oils Ltd. of Calgary, to St. Regis.

Champion International Corporation of Stamford, Connecticut, then took over St. Regis Paper in a friendly merger (following two unsuccessful but costly hostile takeover attempts), and the Hinton operation was renamed Champion Forest Products (Alberta) Ltd. in 1985. The 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.

Frank Ruben, 1980
COURTESY OF THE RUBEN FAMILY

International Paper Co. Ltd. purchased Champion International Corporation, including Weldwood of Canada, in a friendly takeover on 19 June 2000. Then, on 31 December 2004, West Fraser Timber Company Ltd. (West Fraser) purchased Weldwood of Canada Limited, from International Paper Company Limited, and all operations were enfolded into the West Fraser operation and philosophy of forest management.

2 Early Days in Forestry: 1955–1964

1. Historical Context

When operations began on the Hinton Forest, there was a modest body of scientific knowledge on which to draw, but the Company had to develop its own working practices to encourage regeneration and to ensure that the seedlings survived and grew to create the new forest. There was a legal requirement to do this but success would depend on commitment to the long time-scales involved.

Des Crossley, after demobilization from the RCAF in 1945, worked out of the Calgary office of the Canadian Forest Service as a forest research officer where, for the next 10 years, he engaged in a highly productive silvicultural research program on lodgepole pine and white spruce, the predominant coniferous species in Alberta. This research clearly demonstrated that post-harvest site preparation was the key to successful regeneration of cutovers in the Alberta foothills.

Desmond I. Crossley, NWP&P Chief Forester 1955–75
HINTON WOOD PRODUCTS COLLECTION

During this time, he wrote a report for North Western Pulp & Power on silvicultural considerations for the management of forests in the proposed development area. Then, Pete Hart hired him in 1955 as chief forester for the new operation at Hinton. Crossley saw this as the opportunity to apply to a real working forest what had been learned from his and others' research.

Gordon McNabb, former manager of the Rhinelander/St. Regis operation in Hornepayne, Ontario, was brought in as the first Woodlands Manager. He set about to locate and inventory 300,000 cords of wood for the first year's operation. Camps 1 & 2 (McLeod 1) and Camp 5 (McLeod 9) were chosen for this purpose, and camp and road construction began. In 1957, McNabb was replaced by Adrien Provencher, who came to Hinton from a St. Regis affiliate in Hearst, Ontario.

2. Forest Policy and Planning

When Des Crossley was hired as chief forester in 1955, he was given wide license to design and implement the forest management program on the Hinton Forest. The only restriction was that the cost of this program could not exceed 10 per cent of the all other costs associated with harvest and delivery of wood to the mill site. The forest management leadership assumed by the Company from the outset in 1955 is described in Des Crossley's interview "We did it our way."[3] In 1975, he wrote a case history of the first 20 years' of forest management in which he emphasized his conviction that the worst thing that could happen to a Company forester was "the creeping takeover of responsibilities for forest management . . . by the public sector and the relegation of the industrial forester from a challenging and responsible position to a simple hewer and hauler of wood."[4] In 1985 he contributed a voluntary paper - Towards a Vitalization of Canadian Forests - for the National Forest Congress of 1986. This thought-provoking document, setting forward his vision of how the forest management program at Hinton could serve as a model for other parts of Canada in designing and implementing effective forest management systems was printed as a background reference by the Alberta Forestry Association.

NWP&P senior forestry managers, McLeod River Campsite, ca. 1961. L-R back row: Steve Ferdinand, Bill Hanington, Ray Ranger, Jack Wright, Des Crossley. L-R front row: Eric Marison, Phil Appleby, Hank Somers

HINTON WOOD PRODUCTS COLLECTION

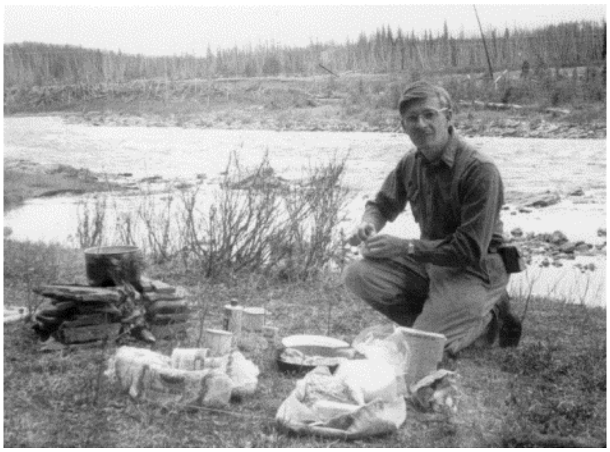
Based on his work in pine and spruce silviculture, Crossley had many ideas about how a sustainable forestry program could be designed and implemented and he welcomed the opportunity to put them into practice on this large forest estate. He immediately set out to hire a strong team of experienced foresters and technicians to help him build his vision and legacy.

The Alberta Forest Service, particularly at the instigation of Reg Loomis and Charlie Jackson, was also undertaking regeneration trials and advocating a higher profile for silviculture. The province directed increasing attention to reforestation and silviculture, creating a silviculture section in 1960, and starting programs of seed collection, scarification, and planting. Silvicultural practices grew in parallel within the Company and in the province as a whole.

2.1 Inventories

The Alberta Forest Service had started its forest inventory program in 1949. The first province-wide field surveys and interpretation of aerial photographs had essentially been completed by 1956.

In 1955–56, St. Regis brought in two staff members from the United States to help the Canadian staff develop inventories, John Miller for management inventories and Frank Laduc for operational inventories.



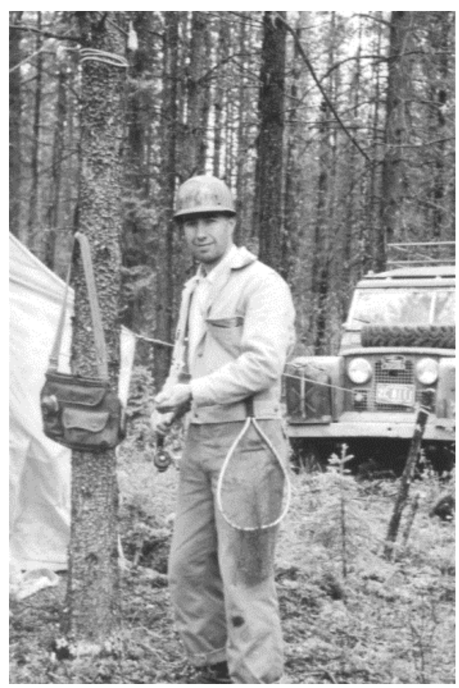
John Miller – Shore Lunch
HINTON WOOD PRODUCTS COLLECTION

John Miller designed the first management inventory for the Pulpwood Lease Area, choosing a Continuous Forest Inventory (CFI) system. Between 1956 and 1961, 3,000 CFI plots were established with three main objectives, described in the 1961 forest management plan:

1. provide a growing stock inventory for management planning;
2. provide increment data for yield tables; and
3. establish trends in forest conditions, health, age, etc.

The plots provided the core inventory for the first detailed management plan in 1961 and again for the 1966 revision of the management plan.

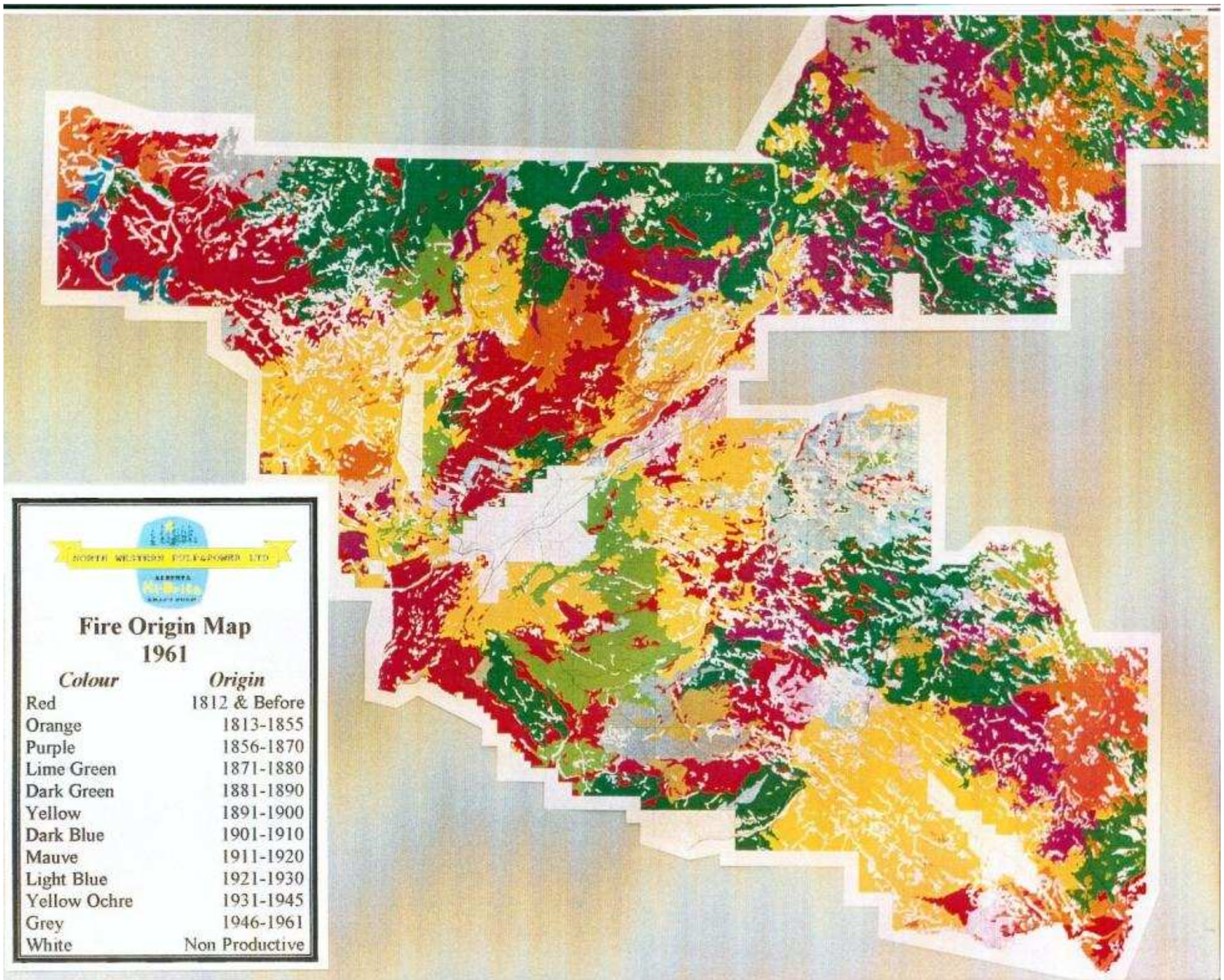
Jack Wright was hired in 1956, spending much of his first two years in operational inventory work. He succeeded Miller in 1958 when Miller returned to the United States. Jack Wright's experience with the use of aerial photography in inventory had a major impact on the design and efficiency of both management and operational inventories of the FMA. He also introduced many innovations into the CFI programme, including the use of tape recorders for field recording of plot measures, with the date subsequently transferred to punch cards for electronic processing.



Jack Wright in Field Camp, 1961. When Jack was not working, he loved to go fishing
COURTESTY JACK WRIGHT

Between 1958 and 1961, a special one-time fire boundary survey was conducted on the new FMA to establish the age of origin of the stands that were to be put under management. The survey was conducted by identifying fire boundaries on aerial photographs, then going to the field and cutting into fire scars on fire-damaged old survivors to determine the age of origin of adjacent younger stands (see Map 2.1).

Map 2.1
Fire-origin map, 1961



By 1963, a new age-class map and management inventory for the entire FMA was completed. CFI plot data were combined with aerial photo interpretation of the plots to produce Aerial Stand Volume Tables (ASVT) reflecting cover type, density, and height. The methodology for ASVTs was developed by Wright when he worked for the Canadian Forest Service in Ottawa from 1953 to 1956.

2.2 Management Planning

Crossley and Loomis had seen too many operations where cutting started at the back doors of the mills and spread out in concentric circles until the enterprise often became uneconomic. They wanted to avoid this with the Hinton operation. Crossley met with Adrien Provencher, the woodlands manager from Ontario who replaced Gordon McNabb in 1957. They agreed[5] that it would be prudent to schedule harvest operations to maintain a more or less constant average hauling distance from the cutting operations to the mill to even out wood costs over time.

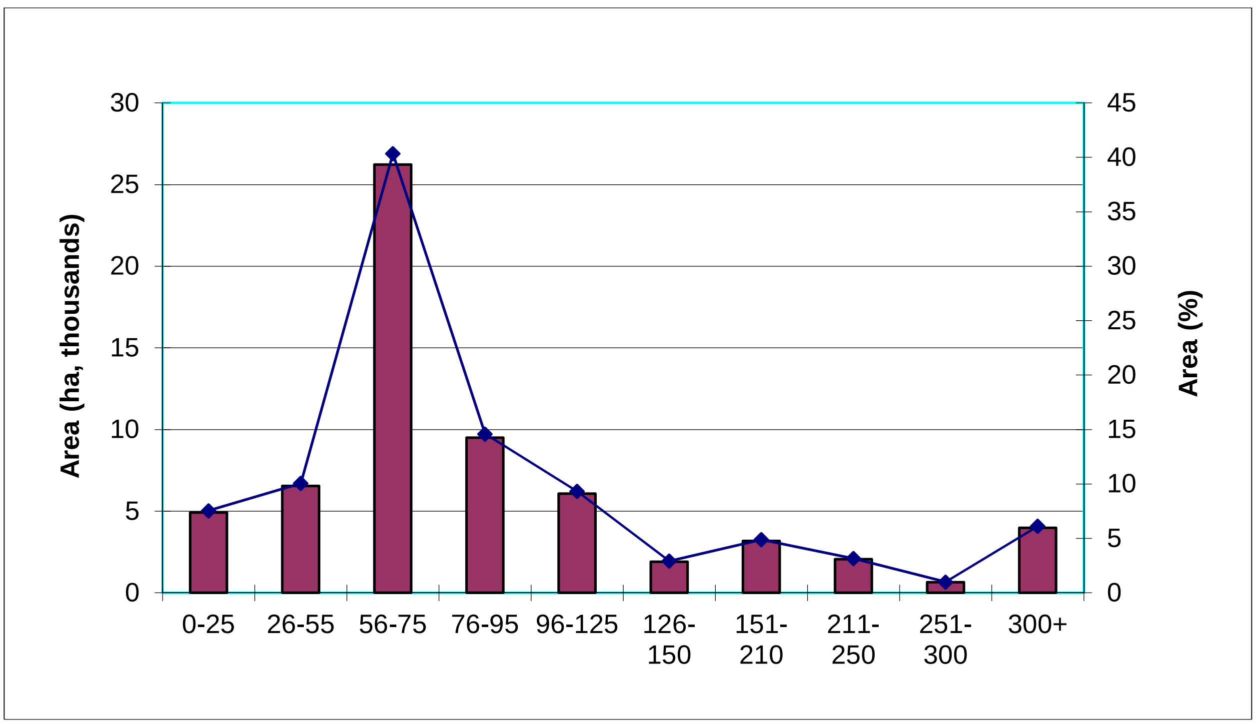
The management plans included a related policy with significant forest health and silvicultural implications, i.e., to seek out and eliminate high-risk, over-mature and climax stands, and to harvest throughout the rotation using the principle “oldest first.” The main reasons for the policy were to reduce the risks of fire, wind, insects, and disease outbreaks (protection) and to return old stands with slow or negative growth to productive, faster-growing young stands as soon as possible, thereby increasing the allowable annual cut.

These objectives remained intact in forest management plans for the period covered by this report and none would dispute the positive impact on wood costs and the sustainability of the operation over the ensuing 50 years.

The preliminary forest management plan was submitted in 1958 and the first detailed management plan in 1961. The age survey showed that the forest had unbalanced age classes with only six classes in the range from 0 to 106 years, and a significant amount of old forest of up to 400 years (see Chart 2.1).

Chart 2.1 Age-class distribution on the Hinton Forest, 1960

The preponderance of area in age class 56–75 was the result of massive wildfires that swept the Eastern Slopes in the late 1880s. (From CFI Plot Data)



In addition, the road network necessary to achieve this "oldest first" harvest policy subsequently provided excellent access throughout the FMA. This access facilitated inventory, growth, and yield initiatives; both basic and future enhanced silviculture operations and monitoring; and protection of related investments against fire. Furthermore, the scheduling of operations to achieve this "oldest first" policy led to a general balancing of the annual haul distance from the forest to the mill over the rotation of the forest. The replacement of old forests by vigorous second-growth has had particular significance for allowable annual cut (AAC) and offered opportunities to realize an allowable cut effect (ACE) on the Hinton Forest in the future. (ACE is defined as an immediate increase in today's allowable cut of a timber management unit that is attributable to expected future increase in yields, primarily as a result of improved or enhanced silviculture.)

3. Ground Rules

Des Crossley and Reg Loomis came from very different backgrounds. Each had strong and sometimes opposing views on how the forestry program at Hinton should be designed but, in a remarkable demonstration of collaboration, they negotiated Alberta's first set of Operating Ground Rules, a three-page document dated 11 March 1958, which included this clause:

> . . . the cutting system to be adopted on a trial basis will appropriately be some pattern of clear cutting. As many modifications of such cutting systems will 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 pulpwood extraction.[6]

This process of testing and adapting management hypotheses and strategies over time was an early de facto definition of Adaptive Forest Management that predated its entry into the forestry lexicon by almost 20 years. It would be decades before such a process of continuous hypothesis testing and adaptation became conventional wisdom in the Canadian forest industry.

While the goals for these ground rules were primarily ecologic and economic—sustaining the timber supply through forest management and maintaining the viability of the enterprise—they also contained provisions for water conservation and operations. There was relatively little public interest in operations aside from obvious jobs and community support in a company town.

Content complexity was minimal. Silvicultural systems were defined as clear-cutting with removal of the least thrifty timber first, and with no more than 50 per cent removal in any pass; size and shape determined to promote natural regeneration. Scarification was specified to break up and scatter the previous winter's logging slash for natural regeneration and reduced fire hazard. Other details included a brief statement on operable slopes (erosion), streamside buffers and stream alteration and crossing rules (streamflow, quality), and roadside cleanup and slash disposal (fire). Aesthetic concerns were covered in main road and resort lake buffers.

Plans were given little mention, only that the government would approve the Annual Operating Plan within four months of receipt.

4. Forest Operations

The Woodlands Division set out with the objective of supplying the Hinton pulp mill with 175,000 cords by the time it started up in spring 1957, increasing the harvest to 300,000 cords of wood per year thereafter. (A cord is a pile of 8-foot (2.4 m) logs that is 4-feet (1.2 m) high and 4-feet wide. To put it in today's metric units of measure, the annual requirement was 720,000 cubic metres [m^3].)

Camps 1 and 2 (McLeod 1) and Camp 5 (McLeod 9) were chosen for this purpose, and camp and road construction began. These were large camps, designed to house up to 100 men and nearly as many horses. Camp 1, contractor Nick Tomkiw, and Camp 2, contractor Webb Frizzell, began operations during the fall and winter of 1955–56.

Sign and tour bus at entry to Camp 1 – Official Opening 1957
PHILIP GIMBARZEVSKY COLLECTION

Camp 1 Logging contractor Nick Tomkiw and his prized team of Belgian Horses, 1960
COURTESY OSWALD HANSON

Most of the logging was to be done in winter from permanent, 20-year camps, established in operating compartments representing 500,000 cords of wood (1.8 million m^3), to be cut at 25,000 cords/year (90,600 m^3). Conventional logging at the time was with power saws, still sometimes with Swede or crosscut saws, with horse skidding to landings where the 8-foot "ricks" of pulpwood would be piled to await hauling. Hauling was done with "bob-tail" trucks carrying small loads of 8-foot pulp to the mill yard for stacking and storage.

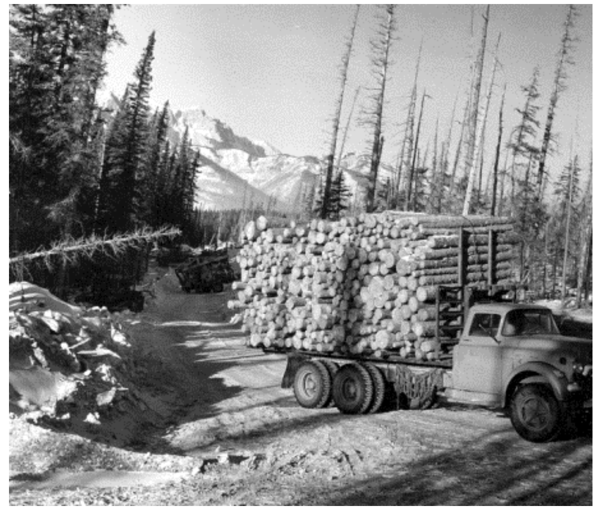
Labour was a challenge but winter operations could attract prairie farmers who wanted to supplement their income, thus bolstering the permanent workforce of Company employees. Productivity was low, averaging 8 m^3/man-day. Full-woods production began in 1956 with 600 to 700 men and as many horses working out of permanent camps spread around the forest.

A number of timber berths were still operating on the Hinton Forest at start-up and most of these were allowed to continue operations until the expiry of their 20-year licences, which were then not renewed. The last timber berth ceased operation around 1968.

Camp 33, adjacent to the Gregg River, was established in the early 1960s
HINTON WOOD PRODUCTS COLLECTION

Operations were barely underway in 1956 when three large forest fires highlighted how unprepared the province was to deal with such catastrophic fire events. Following these fires, many changes were made to the Alberta Forest Service (AFS) protection organization, including a new Fire Protection Agreement with the Company that provided strong commitments on levels of protection and mutual responsibilities.

Falling, skidding, hand piling, and hauling 8' pulp in a "bob-tail" truck were labour-intensive operations in the 1950s and 1960s



HINTON WOOD PRODUCTS COLLECTION

5. Silviculture Program: Reforesting for Sustained Yield

In all forests, trees grow, eventually die, and are renewed through a variety of mechanisms. In most of Alberta, forest fires have been the major cause of mortality and the forests have developed a variety of renewal strategies. Sometimes the natural succession after a fire, insect infestation, or logging is directly to trees. This is particularly the case with lodgepole pine and black spruce with their abundant seeds stored in fire-resistant cones. It is also the case with poplars that have the ability to re-sprout from root stocks. In other cases, seeds have to blow in from residual or adjacent trees such as white spruce and balsam fir. In these locations, the vegetation may pass through a grass phase, a brush phase, and a deciduous or mixedwood forest phase before it is again a coniferous forest.

Harvesting trees is not the same disturbance as a forest fire but there are similarities in the vegetation that grows in immediately after either disturbance. The initial task of silviculturists—those foresters charged with maintaining the cycle of establishment, growth, harvest, and re-establishment—is to create conditions to help ensure regeneration occurs and a new forest stand begins to grow soon after harvest.

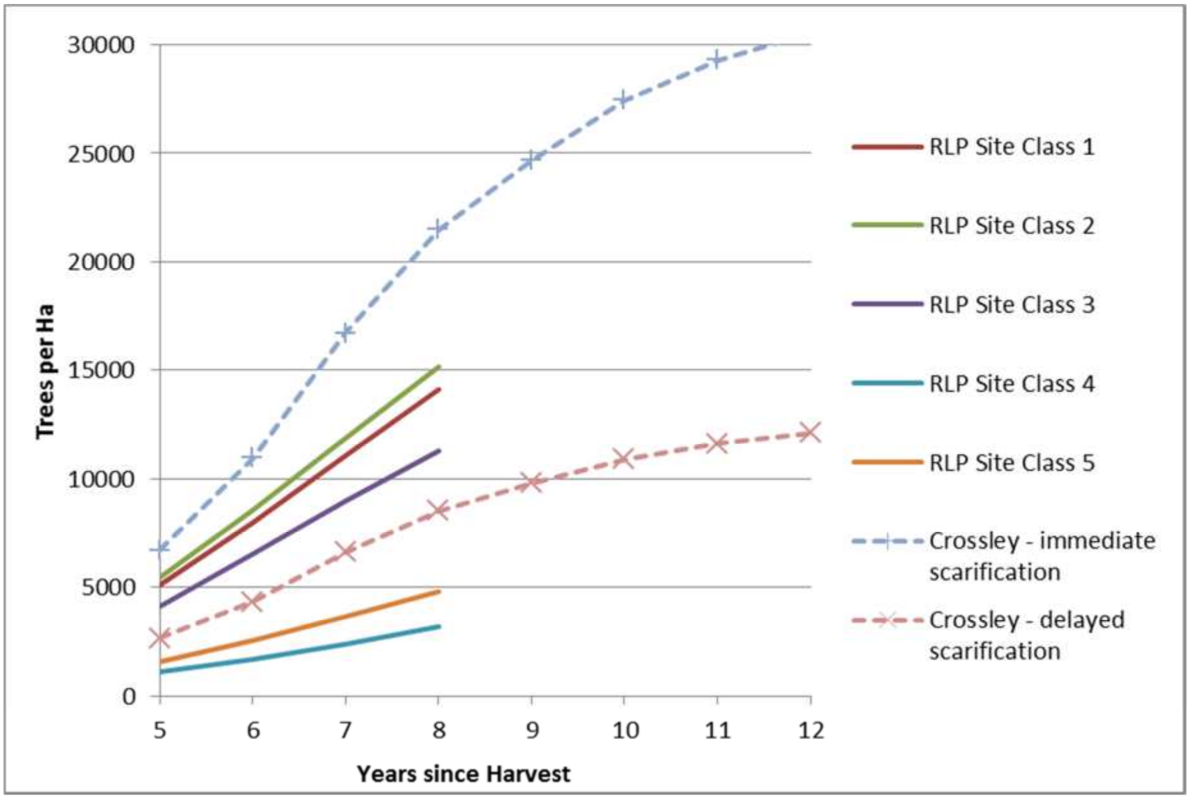
During his tenure as chief forester from 1955 to 1975, Crossley was passionate about achieving sustained yield management (SYM) through successful reforestation, preferably by natural means. Based on his research, he believed that a combination of clear-cut harvesting and site scarification would facilitate natural regeneration in the foothills forest. This proved true for lodgepole pine on most sites. Natural regeneration was less successful for white spruce, the other principal commercial species. Spruce seed crops are periodic, occurring only every six or seven years, and spruce grows more slowly than pine during the early years when other vegetation crowds around the seedlings.

Pine ingress occurs slowly for up to 15 years
COURTESY FOOTHILLS RESEARCH INSTITUTE – BRIAN CARNELL PHOTO

Crossley insisted on counting every seedling, no matter how small, during the course of the regeneration surveys. By today's standards, that seems unreasonable, but he was also convinced—and he[7] and Wayne Johnstone[8] of the CFS conducted studies that proved his point—that "ingress" of seedlings into reforested cutovers would continue for years after the surveys, replacing non-survivors.

In 2011, the Foothills Growth and Yield Association (FGYA) reported[9] that its Regenerated Lodgepole Pine trial results, after eight years of continuous measurements, were showing a remarkable consistency with the earlier work of Crossley and Wayne Johnston of the CFS (see Chart 2.2).

Chart 2.2 Natural regeneration ingress trends for lodgepole pine: two studies, similar findings
(Courtesy Foothills Growth and Yield Association)



The FGYA's Regenerated Lodgepole Pine Trial trends have not yet been measured or analyzed beyond eight years of stand age but, based on results to date (solid lines), and Crossley's earlier published study (hatched lines), it seems likely that ingress will continue beyond eight years.

5.1 Choice of Reproduction Method: Clear-cutting

Reforestation is closely tied to the harvest system used. For example, the old selective cutting based on a diameter limit created fairly cool, shady conditions for seedlings trying to get established underneath the remaining trees. This is a condition more suitable for spruce or fir regeneration than for pine. But selective cutting was primarily a harvest method of convenience, not a regeneration system. In a few cases, it resulted in increased growth as well as regeneration but, in most cases, the residual stand was left in a damaged condition, regeneration was spotty, and the seed source was typically from the less vigorous and genetically inferior trees.

Spruce, primarily due to its tolerance to shade, often forms stands with trees of varying ages (multi-aged), whereas pine loves the sunny conditions created after an intense forest fire and tends to establish an entire forest, all within a few years of the fire. Thus the whole stand consists of trees of the same age (even-aged).

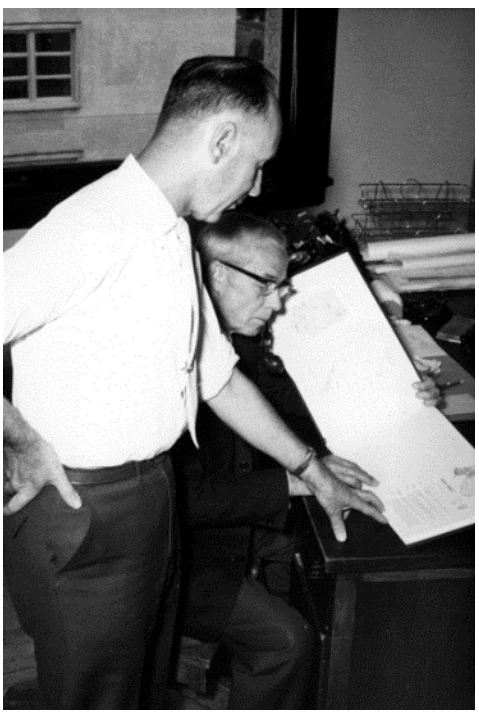
Today as then, most of the natural spruce on the Hinton Forest grows in stands of even-aged origin (94 per cent) with only 6 per cent multi-aged, mainly old spruce-fir. Converting even-aged stands of spruce to uneven-aged stands presents a real challenge. This is exemplified today, where silviculture foresters are attempting to effect this conversion in riparian areas through light partial cuts.

Reg Loomis[10] noted that, in 1955, he and Charlie Jackson from the Alberta Forest Service

> spent a lot of time out there trying to get them to cut the way we thought should be proper silviculture – good forestry. And one of the things we thought would be better, and I certainly did, was to selective cut. You know, no clear-cut at all. But it was almost impossible for Des, who didn't agree anyway.

Loomis' beliefs stemmed from observations on the family farm in the eastern townships of southern Quebec, and his experience with the many untreated clear-cuts he saw during his early career in Ontario and Nova Scotia. What impressed him most, in a positive way, was the 25-acre patch of forest on their farm that had been left as a natural forest by his great-grandfather. The forest had been logged by him selectively for sawlogs to build the original house and barn. Loomis recalled when the barn burned down when he was a young man and had to be rebuilt. He returned home to help, explaining as follows:

> We got logs out of the 25 acres that were standing. We picked the mature, mostly coniferous trees—selectively—and they were cut and hauled to a mill and sawed, and my father built a barn that was 100 feet by 40 feet. It was two stories. It was built in such a way that there were no beams in it.[11]



Charlie Jackson (standing) and Reg Loomis reviewing timber ledgers, Alberta Forest Service, 1960s
ALBERTA FOREST PROTECTION COLLECTION

Then, in the mid-1930s when the bank threatened to close the mortgage on the farm because they had been unable to pay the interest, Loomis said he went to the little forested area again:

> . . . and we cut trees—all mature, coniferous too—hauled them, sold them to the nearby sawmill. And I managed to straighten that [mortgage payment] out before I left. So that was twice that I know of that there was a heavy cut. And the last I knew, that 25 acres were just . . . like it was when my great-grandfather had it. So you could sustain an area with various ages and various species in the same area.

However, as Des Crossley[12] explained:

> . . . we had been able to convince the Forest Service that the type of timber stands in the limits were all even-aged, that clear cutting was therefore obligatory in spite of the fact that what had been used in the past in the province was a diameter-limit system with 50% volume removal, or a marked system to the same end. Such harvesting removed genetically superior trees, leaving the smaller, but inferior trees to form the next harvest.

In 1957, an attempt was made to mark out a 60 per cent removal shelterwood cut at Camp 1, as suggested by Reg Loomis. Due to the age and poor condition of the timber, it was not possible to do so, as only the smaller understory trees had a chance to remain standing with the strong prevailing winds that characterized this dry site at the outlet of Yellowhead Pass. Furthermore, the marked trees were those in the poorest condition, full of spiral grain, and the only contractor to show any interest in the project soon gave up. The suggestion to remove the overstory and preserve the understory trees was rejected because they were too scattered to form a crop. Thus the decision was taken to cut the area in strips perpendicular to prevailing winds and scarify the area to prepare the soils for natural seedfall from the uncut strips. This worked very well on the first pass. The second-pass cuts, starting in the 1970s, required planting.

In 1956–57, a large lodgepole pine clear-cut (about 300 ha) was logged (Camp 5) along Quigley Creek, south of Hinton, with about 95 per cent removal, followed by scarification for natural regeneration. This caused controversy with the Alberta Forest Service over regeneration prospects, and parts of it were planted in the late 1960s using "Ontario Tubes." Given its southern exposure and somewhat dry soils, it is likely that few of these "tubelings" survived. However, by the mid-1980s, it was fully stocked with natural regeneration. Other large blocks were harvested in the Berland Working Circle during the period, and these stands are now some of the best even-aged stands of pine on the FMA.

Block 28, McLeod Compartment 9 after harvest in 1956 (above, left); regeneration check by Russ Powell and Bob Carman in 1966 (above, right); regeneration inspection by Jack Wright in 1973 (below, right); photo mission by Bob Udell in 2006 (below, right)

HINTON WOOD PRODUCTS COLLECTION

5.2 Regeneration "Naturally"

Given that clear-cutting was the harvest system chosen for these even-aged forests, and natural regeneration was significantly cheaper than seeding or planting, the reforestation effort focused on ensuring an adequate seed supply and suitable seedbeds for germination. Natural regeneration, employing post-harvest site preparation, was adopted as the primary regeneration method for both pine and spruce, with planting or seeding as the backup regeneration method.

Seed supply came from two sources: from cones present in the logging slash after logging, and from trees in the adjacent stands of mature, seed-producing trees. Spruce cones open on the tree during the early autumn and seeds are carried by the wind into the adjacent cutover. One of the challenges of relying on naturally disseminated white spruce seed is the so-called "periodicity" of cone production. A crop of cones is grown each year, and the seed is shed in the fall. However, in most years, only a few cones are produced, not enough to effectively regenerate adjacent areas. Only at intervals of seven to nine years do spruce grow abundant crops of cones, referred to as "seed years," that will broadcast enough seed to both feed the rodents and birds with enough left over to grow seedlings.

Different cutblock sizes and shapes were tested for effectiveness in providing seed for natural regeneration and to prevent soil erosion and windthrow of the trees to be left. The system for spruce was to be 50 per cent removal in alternate strips perpendicular to the wind; for pine, 50 per cent removal in rectangular blocks on relatively flat areas and irregular patches on rougher ground. There was also provision for up to 95 per cent removal for pine, with the seed blocks that were left being one and two hectares in size.

Spruce cuts in Camp 1, as they appeared in the late 1990s- view west towards Brule Lake. The dark strips are original harvest areas, naturally regenerated to spruce. The lighter strips are mostly planted, the regeneration appearing as dots in the snowpack
HINTON WOOD PRODUCTS COLLECTION

Pine cones from harvested trees were left scattered throughout the cutblock. Unlike spruce, the seed will stay in these pine cones until high temperatures, greater than 50^0 Celsius, break the resin seal and the cones open up. These conditions generally occur in two ways: in the tree crowns during forest fires, or when the cones are lying close to the bare ground where a combination of direct and ground-reflected heat from the sun provides the necessary heat to break the resin seals and allow seeds to fall out.

Lodgepole pine cones, opened by the heat of the sun
HINTON WOOD PRODUCTS COLLECTION

Natural regeneration may also be achieved in a number of other ways. These include direct seeding, coppicing (native hardwoods sprouting shoots from the stump after harvest), suckering (native hardwoods growing shoots from the root system after disturbance), layering (black spruce growing a new tree from a live branch buried in organic matter), and by protecting existing understory. These are also planned and practised as regeneration strategies on some areas.

5.3 Site Preparation for Reforestation

The seedbed for regeneration after a fire is typically an ash-covered mineral soil, not a thick cover of dry moss and leaves (duff) as is found in a cutover area. Early attempts at natural regeneration by seeding brought out the fact that, even if sufficient seed were available, seedlings could not survive unless their roots got down to the moist mineral soil below the duff. Site preparation or "scarification" was done to break up the duff and expose mineral soil for the seed to germinate on and grow in.

A variety of equipment available at the time was tested; this includes the Flecco Rake, Brush Rakes, V-Blades, Athens Disc, etc. (The first three pieces of equipment were front-mounted, push-type rakes designed primarily for land clearing for agriculture. The Athens Disc was a pull-type large-disc plough.) In 1957, it was decided to opt for the new generation of wide-tracked, high-powered crawler tractors and a Company-designed toothed blade to break down the slash and residue, baring the mineral soil and thus preparing a more receptive seedbed.

Early scarification equipment: Flecco Rake (l), 1956 and scarification plough on D9 tractor (r) 1959 with Forester Owen Bradwell
HINTON WOOD PRODUCTS COLLECTION

Most tractors at the time did not have the power necessary for the job at hand. In an interview with Peter Murphy, Jack Wright[13] reported that the Company tried D8 Caterpillar tractors but they did not have enough power to keep moving forward in the heavy slash loads after logging. Consistent with its management objectives, the Company targeted its oldest age-classes for the first harvests. The trees were big and old, with most of the stands containing large amounts of standing dead as well as downed timber that was not utilized and remained lying on the ground after harvest. As Jack noted, “You don’t make money going backwards.” Dick Corser, who ran a sawmill and timber licence operation south of Edson, had a D9 Caterpillar that, with its greater power, could keep moving ahead despite slash and stumps.

The Company continued to work on designing a better scarification plough, eventually producing the later-named “Crossley scarifier” that consisted of three small “V-ploughs” on a T-bar at the front of the D9 tractor. By 1958, while it was still being refined in use, it was creating the desired 60 per cent mineral soil exposure for natural seeding.

Crossley Scarifiers on D9 Tractor, 1976 - Final Design
HINTON WOOD PRODUCTS COLLECTION

Scarification drag with spikes, 1966

This was fine for seed from nearby spruce trees, but the cone-bearing slash of lodgepole pine needed to be pulled into the furrows so the seed could drop directly onto the soil. Bob Ackerman from the Canadian Forest Service suggested dragging something behind the Cat for this purpose. This evolved into use of a spreader bar with a combination of anchor chains and cat pads—soon changed to just spiked anchor chains—pulled behind the tractor. Both the scarification blade and the drags underwent several modifications up until about 1965 when the final design was adopted. It became the standard scarifier for natural regeneration until it was supplemented with a variety of other tools in the late 1980s.

Jack Wright, in his 1998 interview, recalled that

> . . . regeneration techniques from the beginning involved the preparation of a proper seedbed by scarification. From a knowledge of history and research of harvesting and regeneration techniques on the East Slopes, it was abundantly clear that regeneration of white spruce and lodgepole pine . . . would depend upon the preparation of a receptive seedbed. It was our policy that every acre that supported a merchantable stand worth

harvesting at maturity in the first rotation was also worth regenerating to produce at least as valuable a crop in succeeding rotations.

He noted that the plough and drag combination gave satisfactory results on only about 70 per cent of the stands being harvested:

> We decided that the drags were only necessary in areas where pine cones were relatively scarce, such as in the very old pine stands and along skid roads and landings. In spruce stands and in pine stands closer to rotation age where there was no shortage of cones, the well-spaced furrows created more favourable microsites when the ploughs only were used and consequently the drags are no longer used in such stands.
>
> The next such condition was the very moist, deep duff, up to 24 inches in depth, which had built up in the old "Climax" spruce-fir stands of high elevations. The furrows made by the scarification ploughs frequently didn't penetrate the heavy slash and duff to reach mineral soil and where this was done, the duff layer merely fell back into the furrow behind the tractor. In 1965, we began a program of angle dozing or "blading" this material off into compressed windrows in the spring of the year as the snow was melting and when the duff layer could be peeled off to the still frozen mineral soil.

Freshly bladed "deep duff" area, Athabasca Compartment 14, 1981
HINTON WOOD PRODUCTS COLLECTION

5.4 Meeting the Reforestation Standards on All Cutovers

The annual allowable cut calculation was based on bringing all cutovers back into fully productive forests within 10 years. Over time, reforestation standards were developed, requiring cutovers to be stocked to a minimum standard with established seedlings of acceptable species by 10 years after harvest. In addition, a valid survey was required to measure stocking (the number of trees and how they are distributed) by year 7, with remedial action taken if necessary by year 10. To be considered established, a spruce seedling must have been growing on the site for three years or, in the case of pine, two years.

The intent was to scarify as much of the cutover as possible within a year of harvesting; by 1966, 40 per cent of the 30,000 ha cut since 1956 had been scarified. Sixth-year regeneration surveys of blocks cut from 1956 to 1960 showed only 27 per cent not sufficiently restocked (NSR) on scarified ground but 98 per cent NSR on unscarified areas, proving the effectiveness of scarification. Crossley knew that, to meet the policy of sustained yield management, he must address the NSR issue.

The history of planting on the FMA has two main themes: the search for suitable planting stock, which is primarily the story of the development of container planting; and the development of scarification techniques to improve planting success as well as improving success of natural seeding.

In 1957 and 1958, planting trials of both spruce and pine were initiated on the FMA using free bare-root and transplant stock supplied by the provincial nursery at Oliver, under the Pulpwood Lease Agreement. The trials failed due to poor quality stock. Also in 1958, Crossley transplanted wildling pine stock from the 1956 Gregg Burn to the Camp 1 area. These failed as well, due to high soil pH, a factor currently considered in planting programs for similar soils on the FMA.

Fill-in planting of failed (NSR) areas on cutblocks using bare-root stock from the provincial nursery at Oliver began in 1961 and developed operationally from that time, both as fill-in and as primary planting on cutblocks with no available seed source for natural regeneration. Initial planting results were not satisfactory and, by 1962, Des Crossley began searching for more suitable planting stock. This led to experiments with containers. Containerized seedlings are seedlings grown from germination to time of planting in individual containers, which may or may be removed at the time of planting. A container research program involving both field and laboratory studies was launched in 1962 in cooperation with the CFS. A variety of containers were tested, including the Walters Bullet, done in cooperation with the University of British Columbia.

By 1961, the nature and intensity of regeneration surveys had still not been decided but it was felt that, in future, “post-harvest surveys would be an annual feature of management” and that regeneration surveys would probably be done every five years, following scarification (management plan). These surveys were done from 1961 to about 1965, when they changed to every seven years. Ingress studies showed that major infilling of stocking was continuing past the five years.

Walters Bullet Test, 1963. Pine seedlings at 6 weeks. Note the very limited root excursion from the container. The heavy plastic container severely inhibited root growth and seedling survival, and it was replaced by containers that encouraged root development
HINTON WOOD PRODUCTS COLLECTION

Planting the Walters Bullet with a "dibble". The thick plastic container was split on one side to facilitate root extrusion, but did not perform well in the harsh climate and slow growth conditions of west-central Alberta.
HINTON WOOD PRODUCTS COLLECTION

5.5 The Camp 1 Challenge

The Camp 1 area west of Hinton, where harvest and reforestation began, exemplifies both the silvicultural and perceptual or social challenges presented. The stands at Camp 1 were old, even-aged white spruce that had developed over time in a harsh, dry, windblown, and loess-capped Montane forest site. Reforestation by natural means was expected from seedthrow arising from uncut residual stands in an alternating cut/leave strip pattern at right angles to the prevailing wind. Various strip widths were tested to evaluate the effectiveness of seedthrow. Reforestation was a challenge, not only because of the harsh growing conditions but also because of the periodicity of the seed crops in white spruce, typically ranging from seven to nine years. In the intervening years between crops, as harvest proceeded, the cutover strips became invaded with grass and shrubs that also challenged reforestation. But, in the end, with adequate site preparation and supplementary planting, virtually all the initial cuts were fully reforested.

First pass cutting, Camp 1. Heavy slash loads from overmature spruce forests presented challenges in reforestation
HINTON WOOD PRODUCTS COLLECTION

Second-pass cuts presented more of a challenge because of the removal of natural seed sources from standing mature timber, as well as their sheltering buffer from the unremitting winds. Because of the loss of standing seed sources, second-pass cuts were without exception planted, mainly to white spruce. Attempts to plant pine in this high pH, calcareous soil proved fruitless and were abandoned. The glacial silt (loess) is largely derived from the sedimentary limestone-based rocks of the nearby Rocky Mountains, giving the soil a high pH (a high alkalinity).

Also, the removal of the sheltering adjacent strips presented problems with seedling survival in the harsh, windy sites. The controversy over Camp 1 was to continue for a long time but ultimately had a successful outcome. The story is revisited at the end of this report.

5.6 Paying the Cost of Reforestation

Under the Agreement, the Company was responsible for the cost of reforestation, so Crossley had to negotiate within the Company to support the necessary reforestation and silvculture efforts. In 1955, he received corporate approval for a number of provisions that had significant silviculture benefits:

- Regeneration costs would not be capitalized but rather recorded as the operational costs of replacing natural stands harvested.
- The budget for the Forestry Department would be held within a maximum 10 per cent of the Woodlands Department's annual cost of supplying wood to the mill.
- Regeneration costs would be kept to a minimum by seeking cost-effective methods of surveying, site preparation, regeneration and monitoring, and the application of science and technology to minimize silviculture costs.
- Consideration of more costly intensive forests management procedures like fertilizing, thinning, and genetic improvement would be delayed until it was clearly demonstrated that sustaining the natural level of forest productivity could be achieved and there was a need for added AAC.

Crossley was keenly aware of the heavy initial expenses incurred by the Company during the development phase of both the mill and forest management program, and of the Company concerns about expenditures and cash flow. However, he also considered it fundamentally important that the Forestry department be allocated a specific budget to ensure that he could deliver on commitments in the Agreement. He successfully ran the department for the next 20 years within the 10 per cent of delivered wood costs.

This assured budget for forest management was a rarity among forest companies. The Hinton arrangement was unique in Alberta, probably in Canada. Crossley resolved to make the most of it, gaining a reputation for being frugal, some would say parsimonious. However, he encouraged the goals to be met through incentives and innovation. As Jack Wright put it:

> Crossley's negotiation of the "10 per cent" support for forestry practices was prompted in part by the fact that he reported to the woodlands manager and that, historically, woodlands managers had a primary concern to deliver adequate wood to the mill at a reasonable cost.

However, as Crossley explained:

> St. Regis hired the first woodlands manager (Gordon McNabb) from Ontario, and his experience had been confined to timber extraction. I didn't find him too difficult to work under. He admitted that he knew nothing about forest management and charged me to undertake full responsibility in this area. This was a comforting way for me to proceed. The new man (Adrien Provencher) who took his place was another Easterner whose experience was similarly confined to wood extraction. He too admitted to knowing nothing about forestry and did not wish to interfere with our program.
>
> There was a steady turnover in woodlands managers for various reasons. I therefore found myself in the position of continually having to defend it in order to prevent the loss of the ground we had already won and to satisfy our commitments to the Crown. (Managers included Gordon McNabb, 1955–57; Adrien Provencher, 1957–62; Stanton G.V. Hart, 1962–68; and James D. Clark, 1968–86.)

Crossley argued successfully that the cost of regeneration should be treated as an operational cost rather than capitalized:

> Over a rotation period of 80 years following harvesting, capital costs of (establishment planting) can go out of sight and such an eventuality could not be countenanced. Even forest economists had missed the point that, since the stand of mature timber being harvested was put in place by natural means, its harvesting must generate the source of funds to finance its replacement. We kicked the idea around amongst ourselves about expensing these regeneration costs before approaching our Comptroller. He agreed that we had a viable argument and, the next time the tax officers appeared, they agreed to it.

By the early 1960s, the silviculture program had grown to the point where full-time attention was needed. Crossley hired Gordon Jones for the position, largely to assist Crossley who retained hands-on direction over the program.

6. Research Initiatives: The Role of Science in Silviculture

The central imperative of the 1954 Agreeement—to achieve sustained yield management (SYM)—required successful reforestation, and the challenge to achieve this was understood and welcomed by Des Crossley when he arrived in 1955. In his 1983–84 interview, he reported that his initial focus was "the application of science and technology to minimize silvicultural costs." He recognized that, from the scale of the task, in the future "the shortage of labour could well defeat any silvicultural program, no matter how enlightened." This early commitment to research was stated in the 1961 Management Plan: "Every possible attempt will be made to cooperate fully with Private, Provincial and Federal agencies in matters relating to . . . research, which are of mutual interest and profit to all concerned."

6.1 Research by the Company

When operations began at Hinton, research into inventories, growth, and yield was of course fundamental to the Company's sustained-yield commitment; this got under way 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.

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 knowledge as it was gained.

Crossley encouraged Company foresters to engage in what he called "sore-thumb" research to address problems they ran into during their work. Examples of "sore-thumb" research included reforestation methods, stand development, commercial thinning, spacing of young regenerated stands, and alternative harvest systems, among others. "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 it properly and take it through to conclusion."[14]

The main research activity between 1955 and 1961 was by Company foresters who were defining operational success and research needs by surveying cutovers (harvesting began in 1956–57), developing scarification techniques, planting bare-root stock (unsuccessfully), and establishing small spacing trials. By 1961 they had identified developing regeneration problems due to heavy slash and deep duff after harvesting old spruce, the need to do density control in fire-origin pine regeneration, the need to develop a container planting program, and the need to refine scarification and natural regeneration techniques for pine. Disease and insect potential were also major concerns with erosion and siltation control as additional worries.

Chief Forester Des Crossley discusses experimental scarification drag with Charley Jackson (l) and Reg Loomis (m) of the Alberta Forest Service
HINTON WOOD PRODUCTS COLLECTION

6.2 Research by the Canadian Forest Service

Des Crossley arrived on the job with research experience in the Dominion Forest Service (DFS) where he specialized in reforestation research, becoming an authority on lodgepole pine regeneration. At that time, the DFS (later the Canadian Forest Service or CFS), was the principal player in regional forest research and had conducted silvicultural work on both pine and spruce in Alberta since 1932. The first recorded research work was in 1915 in the Cypress Hills, where Skov, Parker, and Bramhall carried out preservative treatment tests on lodgepole pine and aspen telephone poles.

It was natural that Crossley would choose to involve CFS scientists first. As he explained:

> It was obvious of course when we came here [in 1955] and started a new management program that had never been really successfully accomplished anywhere across the whole nation, that we would have to resolve many problems that would crop up as we progressed. We should be able to think ahead and decide what some of them might be.[15]

Crossley had good contacts with researchers from the federal and provincial governments and the universities of Alberta and Calgary. He could also draw on previous research in the Alberta foothills area between 1932 and 1955 and apply it to managing the FMA. Over the next few decades a wide variety of research projects were implemented on the Hinton Forest, examining a broad spectrum of issues and values that influenced good forest management – studies on (i) resources (stand productivity, site productivity, silviculture), (ii) protection (insects, disease), (iii) environment (fire, hydrology, climate) and (iv) economics. A summary of CFS research is included as one of a series of reviews in Chapter Six, and a 1988 compendium of that research prepared by Dr. John Powell is included in Appendix 2 at the end of this report.

6.3 The Stelfox Study

Clear-cut logging started on the Weldwood FMA in the winter of 1956–57 and was soon being done on a scale unprecedented in Alberta. Des Crossley recalled that "the major concern wasn't how our clear-cutting and concomitant harvesting patterns were affecting the management of our wild forest lands, but rather how they affect other users of the land—particularly in the case of those involved in Fish and Wildlife."

Eric Huestis recognized this concern and, as Director of the Alberta Forest Service as well as the Fish and Wildlife Division, he encouraged one of his biologists, John Stelfox, to initiate a study in 1956 on the effects of clear-cutting and scarification on wildlife.[16] This work continued over the ensuing decades and is discussed near the end of this report. His study focused mainly on the abundance and habitat of game species, particularly elk, moose, deer, bear, and grouse, but also included records of occurrence of other birds, including cavity nesters and small mammals. Objectives were to examine the four main seral (successional) stages of forest vegetation on regenerating cutblocks—grass and forbes (1–10 years), shrubs (11–20 years), pole-sapling (15–25 years), and the immature stand stage (25–60 years)—for their effect on the primary habitat requirements of food, shelter, and escape cover.

Plots were placed in 1956–57 cutovers of pine, spruce, and mixedwood cover types and in uncut mature adjacent forests. Des Crossley assisted in the selection of plots and provided protection for the sites, which he knew to be crucial in any long-term study. From its inception up to the present time, FMA foresters including Jack Wright, Jim Clark, and Bob Udell have cooperated in the protection and re-measurement of the plots. In 1982, when Jim Clark offered the FMA as a test site for the Jack Ward Thomas approach to forestry and wildlife management, the Stelfox study was already 26 years old, and interest was sustained and increased as integrated resource management gained momentum on the FMA into the 1980s and 1990s.

Stelfox game exclosure, 1961
HINTON WOOD PRODUCTS COLLECTION

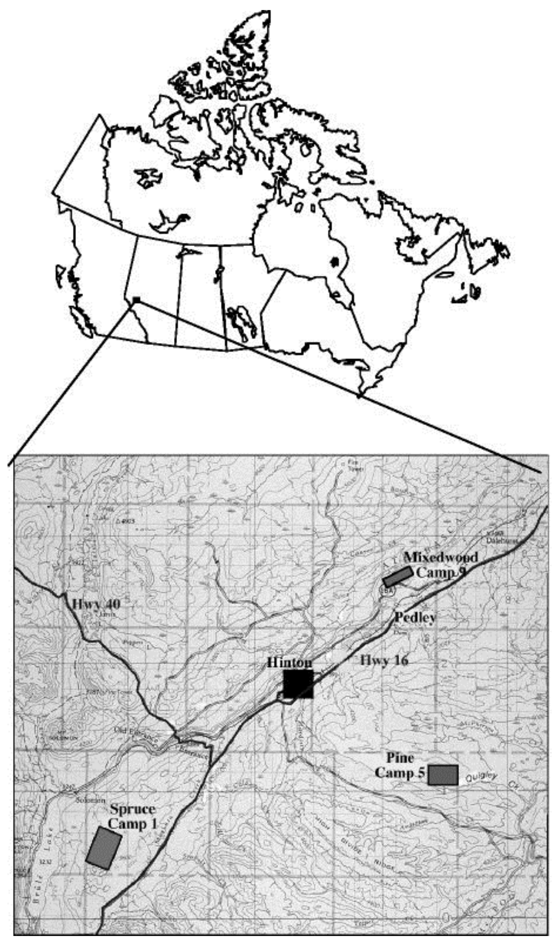
Plots have been measured four times since establishment, over a period of four decades. John (now retired) made the 1996 re-measurement[17] with the assistance of his son, Brad Stelfox.

Habitat assessments included detailed counts, heights, per cent cover, and biomass estimates of forbes, grasses and sedges, lichens and mosses, and trees and shrubs (browse species). Assessments also included population densities from pellet counts and snag densities. Statistical analyses were run on habitat factors of food, shelter, and escape cover as well as population and snag densities.

This project, which is now 55 years old, has provided a long and valuable record of the effects of clear-cutting and scarification upon wildlife abundance and habitat. There is also an excellent record of plant succession in regenerating stands that is of particular current interest to those studying plant succession in second-growth forests in the Foothills Model Forest Program on the FMA. There is also a photo record over time, which has been digitized.

Map 2.2 shows the locations of the white spruce area (Camp 1), the lodgepole pine area (Camp 5/Quigley Creek), and the mixedwood area (Camp 9/Pedley) .

Map 2.2 Stelfox study area, 1956–1996



6.4 Canadian Wildlife Service Research

The Company began aerial seeding in the early 1960s. Early results showed that the expected 300-400 trees per acre of germinants were not being achieved, and the suspected culprit was rodent predation. Researcher Dr. Andrew Radvanyi of the Canadian Wildlife Service agreed to assist in answering this conundrum and his work began in 1960. He introduced the use of radiotracing to study the fate of seeds after broadcast seeding on cutovers. Radio isotopes were placed on 2,000 seeds in 1962, and through the use of the tracking device- a portable scintillometer- he could pinpoint their locations from within 18-24 inches distance and pinpoint them to the diameter of a 25-cent coin. This study continued over several years, and he determined that rodent predation was a major issue, resulting in average losses of around 50% of the seeds, even when rodent populations were as low as 3-4 animals/acre. [18] However, higher rodent presence did not materially affect seed predation. These results led to continuing trials on coating seeds to reduce rodent predation, which continued into the late 1960s.

Further study showed that the time of the year when seed was dispersed had a major influence on seed loss and late winter seeding reduced losses to small mammals by 2/3. It was shown that this late winter seeding on the snowpack effectively stratified the seed for better germination in the spring, and this subsequently became the standard practice on the Hinton Forest.

Dr. Andrew Radvanyi in Research Plot, locating tagged seeds using the portable scintillometer, 1962
HINTON WOOD PRODUCTS COLLECTION

3 Advances in Planning and Reforestation, 1965–1973

1. Historical Context

The World Forestry Congress took place in 1966, and Chief Forester Des Crossley presented an invited paper – “Application of Scientific Discoveries and Modern Technologies in Silviculture”[19]. Within the Alberta Forest Service, Eric Huestis was promoted to Deputy Minister during this period, retiring in 1968, and Robert Steele became Director of Forestry in 1963.

On the national forestry scene, a federally sponsored National Forestry Conference was held in 1966 in Montebello, Quebec, the first national convention since 1906. There was a lot to discuss. Among the invited participants from government, industry, and associations were Des Crossley and Reg Loomis from Alberta. Intense deliberations led to a number of recommendations to further the state of Canadian forest management, centred especially on concerns about lack of forest renewal. Unfortunately, there was little follow-through at the national level.

The Hinton Forest saw strong oil and gas industry development, along with a revitalized coal industry that caused growing concern in Crossley’s mind about the integrity of the forest. This led to a major confrontation about the Company’s rights regarding the trees and lands of the FMA, which was reflected in a very important new clause negotiated for the 1968 Forest Management Agreement:

> Clause 9(2): For the purposes of interpreting *The Right of Entry Arbitration Act*, the Company is an Occupant of the lands referred to as the Forest Management Area.

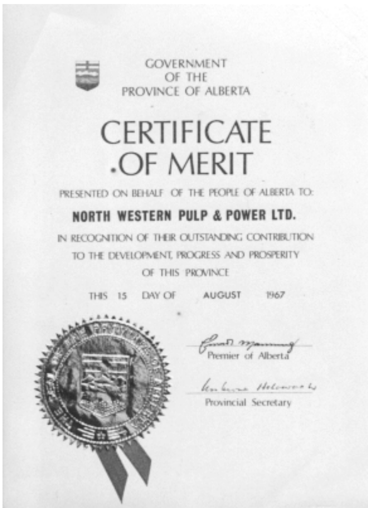
Drilling rig on the Hinton Forest NE of Hinton, 1959. Note lack of salvage of cleared timber
HINTON WOOD PRODUCTS COLLECTION

The clause meant that other commercial organizations that also needed access to the land, such as the oil and gas industry, had to deal with the Company as the “Occupant” of the land. The importance of this was later clearly demonstrated as the pace of oil and gas exploration later increased.

In 1967, Premier E.C. Manning visited the Hinton operations and presented the Company with a Certificate of Merit for its “outstanding contribution to the development, progress and prosperity” of the province.

Premier E. C. Manning (right) visits the Company greenhouse where Woods Manager Stan Hart shows him a "book" of containerized seedlings, 1967

HINTON WOOD PRODUCTS COLLECTION


GOVERNMENT
OF THE
PROVINCE OF ALBERTA

CERTIFICATE
OF MERIT

PRESENTED ON BEHALF OF THE PEOPLE OF ALBERTA TO:

NORTH WESTERN PULP & POWER LTD.

IN RECOGNITION OF THEIR OUTSTANDING CONTRIBUTION
TO THE DEVELOPMENT, PROGRESS AND PROSPERITY
OF THIS PROVINCE

THIS 15 DAY OF AUGUST 1967

Premier of Alberta

Provincial Secretary

Environmental concerns began to intensify during this time. In 1972, one of the early environmental activist groups, S.T.O.P. (Save Tomorrow, Oppose Pollution), publicized a set of photographs taken on the Hinton FMA that purported to show destructive practices and absence of regeneration. This controversy is discussed later in this chapter.

1.1 Quota System

In the early 1960s, negotiations with the Alberta Forest Products Association attempted to rationalize the distribution of forest harvesting operations and extend sustained yield forest management over the entire province. Buoyed by the success of the Hinton Forest Management Agreement* and its commitment to reforestation, the government suggested a similar sharing of rights and responsibilities with the non-pulpwood sector. The result was the 1966 "Quota System," a volume-based form of tenure in which companies received a share of the allowable annual cut (AAC) in a forest management unit. Quota holders also accepted responsibility for reforestation, either by ensuring it themselves or by paying a reforestation fee that the Alberta Forest Service (AFS) could use to reforest their cutovers.

* The term "Forest Management Agreement" was first used in the 1968 Agreement but applied retroactively to 1954.

1.2 *Revised Forests* Act

A revised *Forests Act* was passed in 1971. In it was a notable clause for FMA holders that conveyed ownership of the timber on FMAs to the holders of Forest Management Agreements. This was to have a major influence during negotiations with other industrial users on FMAs with respect to payment for damage to timber as a result of their operations.

1.3 *Environment Council of Alberta Review*

Following the controversy of the S.T.O.P. report in 1972, and the Department of Lands and Forest's successful discrediting of its findings, C.D. Schultz and Company was commissioned by the province in November 1972 to review the environmental impacts of forestry operation in the Edson-Hinton and Grande Prairie areas of Alberta.[20] As outlined in their September 1973 report,[21] the terms of reference for the review were applied to the separate fields of road systems, timber harvesting, and reforestation. The summary of conclusions contained the following statements:

> Many elements of the total environment . . . are affected in complex ways by an even larger number of identifiable activities or events associated with timber harvesting. An extremely large number of interactions thus occur. Of these, a few are considered environmentally beneficial, many are of minor importance. Some present moderate environmental threats, and a relatively small number present major environmental threats. Timber harvesting can remain as a principal and highly legitimate use of the project area.

A wide-ranging series of recommendations were addressed after extensive and vigorous discussions. The results led to better understandings and some mutually acceptable modifications to the operating ground rules. The report also led to the Environment Council of Alberta hearings on forestry, initiated in 1977, that included the entire provincial forested area.[22]

2. Forest Policy and Planning

There was a lot going on in the FMA. Wildlife management and recreation were being highlighted. Crossley presented a paper to the Canadian Society of Wildlife Biologists at Prairie Habitat Conference, 18 February 1972, describing relationships between forest management for fibre productivity and the preservation of a healthy forest environment. He referred to it as "environmental forest management."

The 1961 forest management plan was updated by Jack Wright in 1966, setting the stage for a pending expansion of the forest management area. The rotation age was reduced from 100 to 80 years, with the forest to be managed in 4- to 20-year cutting cycles.

3. Forest Operations

While horse logging continued at Hinton in the mid-1960s, many companies were replacing horses with articulated-frame wheeled skidders and the Company was also investigating the possibility of switching from 8-foot (100-inch) deliveries to a tree length system with bucking to the 8-foot lengths for chipping at the mill site. In the early 1960s, it had begun trials with a number of mechanized systems. A labour shortage in 1964 precipitated the expansion of these studies until 55 Timberjack skidders were purchased in 1967 and use of horses was phased out within three years.

Garret Tree Farmer demonstration, Camp 22, 1960
HINTON WOOD PRODUCTS COLLECTION

The last of the contractor camps was closed in 1968 as mechanization and better road systems enabled commuter operations, although Company operations continued from Camp 20 north of Edson until the camp was closed in the spring of 1975.

In the early 1970s, concerns about both worker safety and productivity led to a renewed search for a suitable felling machine. The first generation of these machines arriving in 1973 were called “feller-bunchers” because they cut the stems and piled them in a “bunch” for pickup by the skidder. With the introduction of the feller-bunchers, problems developed with power-saw delimbing, and the Company began experimenting with mechanical delimbing in the early 1970s. The first crude but somewhat effective device was a “flail delimber” that consisted of a large drum with numerous chains welded to it. Mounted on the front of a small tractor, the drum spun rapidly and the chains literally beat the branches off the trees along with a lot of bark and some merchantable wood.

4. Silviculture Program

During this period, the names of two key players—Bob Carman and Steve Ferdinand—are linked to much of the history. In 1964, Crossley recruited Carman, a gold medallist University of Toronto forestry graduate then working with the Ontario Department of Lands and Forests. Carman had experience in containerized seedling growing, and Crossley had an interest in this emerging technology.

Carman put his mark on the program during his short tenure (1964–68), including:

- designing and implementing the post-harvest silviculture planning system, the Management Opportunity Survey;
- designing and building the first containerized seedling greenhouse in Alberta; and
- installing a number of research trials to examine container seedling culture, density reduction in overstocked fire origin pine stands, and other silviculture challenges.

When Carman left in 1968 to return to Ontario, Steve Ferdinand, who at the time was section head in charge of production layout (harvest planning, inventory, and annual operating plans), replaced him and held the position until 1974 when he resigned and joined the Alberta Forest Service. Ferdinand was one of the Hungarian forestry students (Sopron University) who came to the University of British Columbia during the 1956 revolution to complete their training there.

Crossley's strategy for natural reforestation of spruce through alternate strip cuts at right angles to the prevailing winds was paying off at Camp 1, as the first-pass blocks were generally well stocked. Some challenges with grass competition and growth rates were observed, leading to some fertilization trials. (See Section 5, Research Initiatives.)

Initial harvesting began in areas that had adequate seed sources, and both the harvest layout and initial reforestation plan were geared toward utilizing this seed. Even though it was well known that scarification aided stocking success, most of the forest industry prior to 1970 had relied on natural seeding alone to restock a portion of their cutblocks, particularly the summer-logged blocks where substantial duff disturbance had occurred during skidding. They then waited for the 7-year stocking survey to see if it met the standard. Problems arose if the standard was not met, because re-treatment by seeding in the 8th year would not give them 3-year-old seedlings to count in the 10-year survey. It usually took at least two years to produce a nursery seedling to plant, and so it would have not grown on the site for the required two years prior to the 10-year survey. Obviously planning needed to be done prior to the 7-year survey.

To the delight of the Company foresters, the early regeneration surveys showed very encouraging results. Regeneration surveys had been completed on the first four years (1956–60) of cutting and were found to have 73 per cent of the 30,380 ha (75,070 acres) cut during that period satisfactorily restocked. Those that were not restocked satisfactorily were studied and, in the spirit of adaptive management, reassessed and re-treated.

4.1 A New Silviculture Planning System, 1965

The Company was ahead of the industry in developing a new approach to silviculture planning and decision-making that made reforestation success more certain. This post-logging survey, the Management Opportunity Survey (MOS), was designed and implemented by Silviculture Section Head Bob Carman in 1965. The MOS took place during the summer immediately following clear-cutting.

The MOS was to be conducted by experienced personnel immediately after harvest with the objective of assigning regeneration treatments to cutblocks or parts of cutblocks grouped on the basis of similar pre-harvest cover type, post-harvest competition potential, seed availability, residual slash, and physical soil and site characteristics. MOS details were mapped and entered on computer, and post-treatment results were added later, providing a detailed cutblock history. If significantly different ecological conditions were found to exist within the same cutover area, the strips or blocks were further stratified into "ecological units."

Significant ecological conditions relating to reforestation were recorded:[23]

- forest cover type prior to harvesting,
- seed availability either from slash-born cones or adjacent uncut stands,

- soil moisture conditions and drainage,
- existing, or potential for, vegetative competition,
- advance growth,
- slash conditions and depth of duff, and
- topography and aspect.

Now the silviculturist could begin to track which treatments worked on which sites and use the MOS data to form "prescriptions" or reforestation treatment plans for each unique cutover situation. The "plough/drag scarify for natural" tactic was soon just one choice of many.

4.2 S.T.O.P. Report, 1972: A Controversy over Reforestation Effectiveness

> This picture has been purposely chosen . . . since it very well represents the forest of the future in Alberta if we continue with present regulations under which the "pulp mill" is allowed to operate.[24]
> (excerpt from S.T.O.P. Presentation to Minister of Lands and Forests, June 1972)

During Ferdinand's tenure in the early 1970s, the Company's forest practices were publicly castigated by an environmental organization called S.T.O.P. (Save Tomorrow, Oppose Pollution). S.T.O.P. was targeting forestry practices in Alberta and chose the high-profile forestry program at Hinton as their primary focus. In 1971, Arnim Zimmer, a member of this group, visited the operation and made a pictorial record of certain harvest areas from the period 1956 to 1970 that in his mind exemplified the problem. His subsequent 1972 report/photo essay and slide show presented to the Minister of Lands and Forests (see quote above) claimed massive forest degradation and lack of reforestation.[25] It accused the Company, aided and abetted by the province, of reckless and environmentally destructive practices. This report generated considerable adverse public and media attention on the operation, much to the consternation of Crossley who took great pride in the forest management program he created.

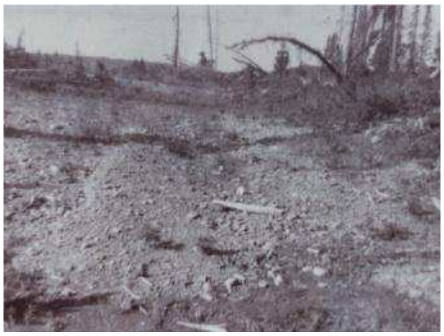
The province's Department of Lands and Forests was very concerned with the report and its negative focus on the province's stewardship of the forest resource. Fred McDougall, then Director of the Forest Management Division, dispatched Kare Hellum, then head of silviculture for the province, to locate and examine all the photo points used by Zimmer. Hellum took great pains to relocate Zimmer's original photo sites, comprising 35 photos of nine different cutblocks on the Hinton Forest. Hellum also located and staked viable seedlings in the viewscape, calculated an average stocking level, and took a new set of pictures of the same sites (see middle image, below). The photos, displaying a sea of flags, were used to effectively refute and discredit the accusations. Hellum's report[26] not only challenged Zimmer's assertions of regeneration deficits but also identified areas of overstocking in these so-called "wastelands" where he predicted that subsequent thinning would be required to maintain growth and yield. His report and the publicity it generated effectively ended the S.T.O.P. campaign.

This controversy and the subsequent reforestation and growth of the areas is well documented in a Foothills Research Institute Report, *The Resilient Forest: Looking Beyond the Stumps – A 35-year Examination of the Forecasts and Assertions of a 1970s Environmental Campaign* (2007).

This controversy and the efforts required to refute it illustrate an inherent problem of perception in forestry and forest management. The time cycles from disturbance through to seedlings and growth to maturity are much longer than in agriculture, longer than the working lives of most people.

Photo Series: STOP Report and Follow-up Photography – Block 26, Berland Compartment 8

HINTON WOOD PRODUCTS COLLECTION PHOTOS



STOP 1971: "Hardly a blade of grass grows between these windrows"

Hellum 1972: "The general area within the photo angle has ample regeneration"

2006: "…a thriving mid-rotation stand of lodgepole pine…"

Aerial view of Block 26 (on right side of road), 2006

4.3 Direct Seeding

It was recognized from the outset that it would not be possible to obtain satisfactory natural regeneration on all of the areas being harvested. Experiments began in 1960 into the development of seeding and planting techniques that would give satisfactory results on the Forest Management Area. Early trials of spot seeding were largely unsuccessful due to losses to rodents and inadequate site preparation, and broadcast seeding using hand-operated Cyclone Seeders on scarified blocks gave varied results, generally related to amount of mineral soil exposure, slope aspect, and soil moisture.

With the advent of blading in 1965 and the availability of a helicopter, the Company purchased a Brome Seeder and carried out its first aerial seeding in 1966

While this seeder was not too reliable, it showed definite possibilities as a technique. Between 1966 and 1978, several thousand acres were treated with this system using a rented aerial seeder with generally quite good—but unpredictable—results. The seed losses to rodents were compensated for by applying extra seed, up to 130,000 viable seeds per acre, rather than treating the seed with repellents. The Company voluntarily discontinued use of Endrin as a rodent repellent when it discovered a high mammalian toxicity.

Loading seed into Brome Seeder on Bell G3 Helicopter, 1973
HINTON WOOD PRODUCTS COLLECTION

Planting techniques had by this time improved to the point where very reliable results were being obtained. With the problems obtaining sufficient white spruce seed for aerial application, and the uncertainty of success, direct seeding was curtailed in 1978. Direct seeding was later attempted on specially site-prepared areas with a very high mineral soil exposure created by blading. However, once again the results were unacceptable and the practice was discontinued.

4.4 Planting and the Development of Containerized Seedling Techniques

Despite the successes with natural regeneration, staff realized that planting would become increasingly important, first, to re-treat areas not satisfactorily restocked (NSR) and, second, to regenerate second-pass cutovers in spruce stands where the residual seed sources would have been removed.

At the time, bare-root stock from the Provincial Tree Nursery at Oliver* was of questionable quality and the Company was seeking better seedlings. This nursery began growing tree seedlings for the forest industry in the late 1950s. The initial growth results for this planting stock were less than impressive. Winter kill, poor rooting, browsing by hares, and small, flimsy stock were among the problems scientists were working on at the time. The soil at Oliver was rich clay, well suited to growing grain. However, conifer seedlings did not compete well with grass and weeds in those heavy soils and it was difficult to maintain suitable seedbeds.

* This was on the site of the Alberta Hospital on the northeastern outskirts of Edmonton. The nursery was established in 1934 by the AFS to grow planting stock for windbreaks and shelterbelts. Forest seedlings were grown, starting around 1956. This nursery was replaced in 1986 by a new one at Smoky Lake.

Under the first Forest Management Agreement, the province provided free seedlings for reforestation. The Agreement also included a clause whereby, if the Company wished to grow its own trees, it would also be reimbursed for that cost. This approval cleared the way for the Company to examine other options for seedling stock, including building its own greenhouse.

In 1962, the Company began investigating the use of containerized seedlings in reforestation, starting with the "Walters Bullet" that was developed by Jack Walters, former professor of forestry at UBC. This was a radical idea at the time—to grow seedlings in a bullet-shaped plastic container that conceivably could be "shot" into the ground or dropped by aircraft. It did not live up to the expectations but did launch a long succession of trials with a great variety of containers and led to active planning for a Company container-stock greenhouse.

Bob Carman designed and built the first containerized seedling greenhouse in Alberta. It started operations in 1965, producing 250,000 seedlings the first year in "Ontario tubes"—split plastic tubes, ¾" and ½" in diameter (25 cubic centimetres volume). The first greenhouse was 73 square meters, mylar on wood frame. Subsequent additions up to 1973 added 220 square metres of space, with the covering material changed to fibreglass.

Greenhouses, 1968
HINTON WOOD PRODUCTS COLLECTION

The Ontario type of split plastic tube looked like empty cigarette tubes or giant straws cut into 10 cm lengths. As mentioned, they were either ¾" or ½" in diameter and split down one side, the theory being that pressure from the roots would force the tube to open and break it, allowing the roots to emerge unimpeded. This seldom happened. However, the tubes were readily adaptable to mechanization both in the greenhouse and in the field. Between 1965 and 1971, more than 6 million tubelings were grown in the nursery and planted in the Forest Management Area. These tubelings were planted with a dibble* on a variety of sites and seedbed conditions from untreated and deep duff areas to scarified upland sites.

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* A dibble was a planting tool for the Ontario tubes. It had a T-handle and was about 1-m in length. At the bottom end was a 10-cm solid shaft that was a bit larger than the tubeling to be planted. Above that was welded a

Greenhouse Interior, 1965. Trays were on asbestos benches, impervious to water from the sprayers
HINTON WOOD PRODUCTS COLLECTION

Comparison test – spruce (left) vs pine growth performance in Ontario tubes, 1966
HINTON WOOD PRODUCTS COLLECTION

After five years of operational planting, Ferdinand reported[27] in 1971 that:

> The present seedling production facilities have an annual capacity of 1.5 million 10 week-old seedlings in the 3/4 inch containers. The actual net production depends on the culturing success which has been around 90 percent for the last four years. The seedlings are produced in weekly batches of 100,000 to 110,000. The number of batches that can normally be produced is fourteen. With over-wintering, the productive capacity can be increased by 20 to 25 percent.

Ferdinand reported average planting production rates of 1,655 seedlings per man-day during 1970 at a 9’ by 9’ (2.74 m) spacing. The production of the best crew averaged 2,156 seedlings per man per day for a five-week period. The planters were paid piece work rates that were set between $0.014 and $0.022 per tree, depending on the planting site.

Monitoring survival and growth on the container-planted areas indicated that the average first-year survival was in the 70 to 80 per cent range for both lodgepole pine and white spruce. By the third year, survival declined to around 60 per cent on the majority of the planted areas.

Routine regeneration surveys completed in the fall of 1970 on 3,100 acres in the 1966 and 1967 plantations indicated that 73 per cent of the 3,100 acres were adequately restocked. The remaining 27 per cent required further treatment. Ferdinand observed that “while no accurate yardstick is available at present to precisely evaluate initial growth performance on the plantations, observations suggest that there is room for improvement."[28]

After five years’ experience with container planting, the optimistic expectations regarding establishment and initial growth following planting had flagged. Physical restriction on lateral root development and the small rooting volume afforded by the ¾” containers were the most important limiting factors for lodgepole pine and white spruce. This problem was made the worse by the

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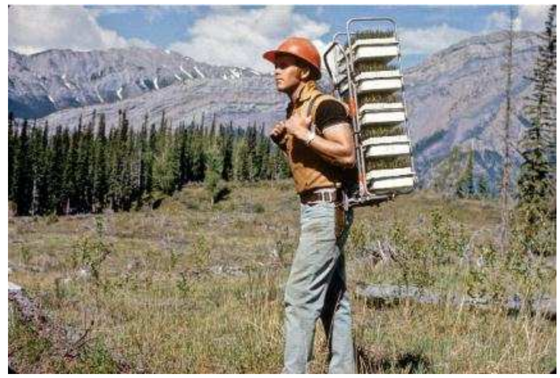
crosspiece for stepping on to drive the shaft into the ground. The tubeling was pushed into the punched hole and the planter would then “kick” the hole closed.

containers being planted in the ground with the seedling contained within them. Subsequent investigations showed that the Ontario tubelings planted in wet seepage sites (e.g., Athabasca 13) fared much better both in survival and growth rates. One hypothesis was that the container was preventing surface moisture from reaching the seedlings' roots, perhaps a more damaging impact than the restriction of lateral root development. Another concern was the soil compaction resulting from punching a hole in the ground with a solid shaft, rather than extracting a plug of soil to prepare the hole for planting.

Planting crew with Ontario tubes, Camp 1, 1969



Forestry technician Rod Rowley with rack of Ontario tubes on a converted Himilayan backpack

HINTON WOOD PRODUCTS COLLECTION

The shortcomings in the container-planting system were directly related to insufficient basic knowledge of the physiological requirements of young seedlings. The gap in basic research into the physiology of juvenile growth was gradually being closed, mostly by federal CFS research efforts. The Company, meanwhile, had acquired valuable experience in rearing and planting techniques. As a first step toward improvement, Ferdinand prepared initial specifications for greenhouse culturing, seedling quality, and field performance in cooperation with members of the Canadian Forest Service research team. The desired improvements were to be accomplished through the following modifications:

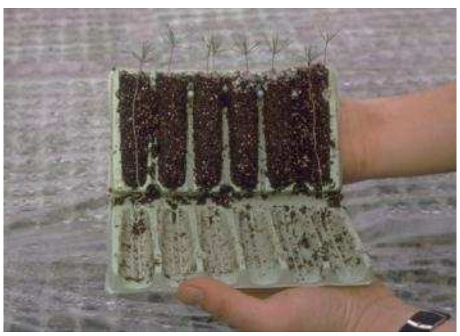
- increasing the size of container to a 1" diameter x 4" in length (estimated rooting volume 2.3 cu. in.);
- increasing the nursery period to 14 weeks for pine and longer if necessary for spruce;
- abandoning the use of high-nitrogen fertilizers and replacement with one of low nitrogen content;
- reducing the frequency of watering, especially during the last three weeks in the nursery; and
- removing containers during field planting, and planting seedlings as bare-root plugs.

These modifications were expected to produce relatively large, hardy, and well-balanced seedlings.

Perhaps the most important change proposed in 1971 was the discarding of containers during the planting operation. This would be difficult to do, but it would allow the roots to penetrate the surrounding soil immediately after planting. The Ontario tubes were not suited to this, and Ferdinand began to look for alternatives. He was aware of two systems that were designed to plant a plug without the container, the British Columbia Styro-block developed at the Canadian Forest Service Research Laboratory in Victoria, B.C., and a folding container unit marketed by Spencer-Lemaire Industries of Edmonton. Both containers offered similar environments for culturing but, for logistical reasons, he decided to adopt the "Spencer"-type container for operational use. It required only minor modifications in the existing greenhouse, planting equipment, and technique, and the expected speed of planting was to be little affected.

Working with Hank Spencer of Spencer-Lemaire Industries, Ferdinand designed what became the "Ferdinand Rootrainer" container system and began using it in 1972 at the greenhouse. Unlike the Ontario tubes, the seedlings were taken out of the rootrainers before planting. And instead of the "dibble" used for the former, the Pottiputki Finnish planting tool was used, which had both ergonomic and site advantages. The Pottiputki was a device developed and used in Scandinavia where seedlings were fed into a tube at the top and a foot pedal and lever mechanism at the bottom created a planting hole, inserted the seedling, and closed the hole. The planter did not have to bend over to plant a tree! These seedlings were also more robust than the earlier ones, each cavity providing 40 cubic centimetres of growing space, with the seedling removed from the container before planting. This was a major step forward from the Ontario tubes that generally did not perform well. The rootrainer-raised seedlings were able to begin growing soon after being planted and did not have to burst a split plastic Ontario tube to attain optimum growth performance.

Spenser-Lemaire "Ferdinand Rootrainer" showing grooves which "trained" the roots to grow down into the soil medium
HINTON WOOD PRODUCTS COLLECTION



Planter Jeanette van Zalingen with Pottiputki planting tool and seedlings. The tool is pressed into the ground to start the planting hole. A lever seen at the bottom of the tool is then stepped on, opening the jaws of the tool to open up the hole. Seedlings are then dropped into the tube and enter the planting hole.
HINTON WOOD PRODUCTS COLLECTION

A series of renovations and additions had by this time increased the capacity of the greenhouses to approximately two million seedlings per year.

4.5 Juvenile Spacing

The ability of lodgepole pine to regenerate and survive in excessively dense stands is well known. Young stands originating from wild fire with densities exceeding one million stems per hectare have been observed. These result in dense stands that survive but grow very slowly for many years regardless of site quality, as seedlings expend too much energy competing for light, moisture, and nutrients, producing a mat of regeneration with weak and spindly stems. Excessive stand densities reduce the average stand height, average stand diameter, total merchantable volume, and, in extreme cases, result in stand stagnation. Although stands originating from logging and reforestation have somewhat lower densities (1,500–20,000 stems per hectare), similar impacts can occur at the higher densities. To address this issue, the seedlings need to be thinned out.

Juvenile spacing is the first phase of thinning under these conditions since it removes very young stems. It is also called pre-commercial thinning (PCT) because the stems are too small to be sold. One of the major benefits is that it is the first chance to remove infected and defective trees. Another major advantage is that it reduces the number of stems to a reasonable number and thus prevents stagnation of growth. In addition, it also "sets up" the stand for a commercial thinning at an earlier date than would otherwise be possible.

Commercial thinning is done at a later stage in the tree's development when the trees are large enough to be utilized for a particular product. It can increase the total wood volume obtained from a stand because the trees that would naturally die can be salvaged before they fall over.

Recognizing the problem that overstocked stands presented, the Company as well as the Canadian Forest Service began juvenile spacing trials in the Gregg Burn in 1962. Techniques attempted included hand-pulling the trees, thinning them with brush axes, running light prescribed fires through them, applying herbicides to effect selective killing of the trees, using bulldozers to thin them in strips, and finally thinning with clearing saws (the last one became the preferred method of the operational tending programs). The initial objective was to prevent stand stagnation; therefore, all stands exceeding 4,900 stems per hectare (sph) were targeted and spaced down to 2,500 sph.

Mechanical thinning was ineffective, the bulldozers were incapable of moving through the heavy standing dead timber without wreaking major damage on the regeneration. Chemical thinning produced inconsistent and unacceptable results. Manual thinning was a high-risk effort as well as being prohibitively expensive.

Gregg Burn Thinning - An Operational Challenge

PHOTOS FROM HINTON WOOD PRODUCTS COLLECTION

Hank Sommers with Clearing Saw - 1963

Des Crossley examines 7-yr results 1970

Trial Thinning with 2,4-D - 1964

Bulldozer thinning trial 1974

Thinning with small power saws

Brush axe thinning

Clearing saw thinning

Manual thinning produced the best results

4.6 Early Proposal for Intensive Silviculture and Tree Improvement

In 1970, Crossley and his team produced a comprehensive report on a recommended program of intensive management on the FMA area to increase the production of wood.[29] For years, they had been installing trials and experimenting with ways to improve the productivity of regenerated stands. In addition, they had identified and catalogued a number of "plus trees" and established two seed production areas, in pine and white spruce.

With the signing of the new Agreement in 1968, which virtually doubled the size of the FMA area and promised the construction of much expanded facilities in Hinton, they believed the time was ripe for such a move. Crossley had been successful in introducing a new clause into the Forest Management Agreement that allowed the Company, at its option, to change from the current stumpage system—charges for wood harvested were based on the volume actually cut—to a "ground rent" system in which the charge would be based on the natural productivity of the land, regardless of how much volume was cut.

The summary of this report, compared with the subsequent FMA and wood supply status, is enlightening. (See Chapter 6, Section 2.5, "Enhanced Silviculture Proposal 1996.") It illustrates the vision of the authors and how their recommendations were reflected in later practices. Sadly, the promised expansion did not follow. By 1972, the expanded area had been taken back by the Crown and with it went the plans for an intensive management program on the FMA area.

Jack Wright noted that the 10-year period from around 1972 to 1982 was one of great advances in reforestation trials and accomplishments as well as a peak period in tree and stand improvement.

5. Research Initiatives

The 1966 Management Plan indicated that virtually all the research by external agencies at that time, except for the Stelfox wildlife study, was being done by the Canadian Forest Service.

Hydrology research to address concerns about soil erosion and stream siltation as well as water yield was conducted between 1970 and 1983, primarily by Bob Swanson and Rich Rothwell. Rothwell developed operational guidelines, mainly for erosion control on roads, and Bob Swanson continued to adapt a watershed model (WRENS) for the Foothills, based partly on FMA data.

5.1 Collaborative Studies

Concern about the slow growth of regeneration at McLeod Compartment 1 (Camp 1) led to a number of efforts to improve it. In 1968, Steve Ferdinand worked with Sheritt Gordon to develop a fertilizer mix designed for the dry, highly calcareous sites at Camp 1. The mixture, 27–27–0 with iron chelate added as a trace element to neutralize the calcareous effect, was later marketed by Sheritt Gordon as a popular garden fertilizer mix. In the trial, the fertilizer did little to promote conifer growth and in fact promoted competition as it was captured by grass, shrubs, and herbs in the block. It apparently produced good forage because Steve Ferdinand reports that he shot deer out of this block in the two consecutive years following the treatment. The subsequent planting to pine proved fruitless, as have all pine plantations in McLeod 1's windblown, calcareous sites. The block continued to slowly restock itself to white spruce and aspen, both of which have done well on the site.

Aerial Fertilization Experiment, block 51Y, McLeod 1, 1968. A Snow Commander spray plane applies 27-27-0 fertilizer to reforested harvest strip
HINTON WOOD PRODUCTS COLLECTION

In the early 1970s, the Company collaborated with J. Dumanski[30] to develop a site classification system for lodgepole pine, based on soil characteristics. This study contained a recommendation for further developments in site classification to include information on vegetation that would not be addressed for another decade until Ian Corns began his work on ecological classification systems for Alberta.[31]

The University of Alberta established a Department of Forest Science (now part of Renewable Resources) in 1971, the first "forestry" class having started in the fall of 1970. This department became another source of research and collaboration. Crossley played a leading role in establishing this forestry program and often lectured there. University foresters became frequent visitors to Hinton, and many of its graduates came to work for the Company.

5.2 An Explosive Experiment

Although Crossley was a strong advocate for research in the forest, a unique spacing trial north of Hinton took the concept to an entirely new level. In 1966, at the height of the Cold War, Canada as part of NATO had troops stationed in Germany, and the Department of National Defence (DND) wanted to prepare them for field conditions in a "European-style managed forest" after a nuclear explosion. DND approached the Company to request help in selecting a forest stand to be thinned and then subjected to the explosion of 50 tons of TNT placed within it. Block 107a was selected. It lay between two blocks logged in 1963 and would normally have been harvested in 1973. Alastair Fraser of the British Forestry Commission arrived in Hinton to mark the trees for thinning, but the Canadian Army had forged ahead with its own version of thinning in the chosen block. Fraser observed that the result bore little resemblance to a European forest, but the explosives were already in place and the Army was anxious to set them off. Many dignitaries, Hinton residents, and media representatives turned out to witness the dramatic blast from a distance. The site was salvaged and scarified for natural regeneration in 1967 and regenerated with no further treatment or planting. Today, as the pictures show, it supports a healthy young stand of lodgepole pine.

Blast site, thinned and ready for detonation

From afar, the blast was still an impressive sight

Des Crossley examines aftermath of the ex;losion

40 years later, the site is completely reforested

HINTON WOOD PRODUCTS COLLECTION

4 Expansion and Maturation of the Silviculture Program, 1974–1986

1. Historical Context

In Alberta, this period was characterized by great expansion in forest harvesting and policy initiatives directed both at forest industry development and forest land management. Wood harvest in Alberta almost doubled from 4.4 to 8.3 million cubic metres as a result of expansion of existing mills and construction of new mills.

Two new Timber Development Areas, Berland-Fox Creek and Brazeau, were opened to proposals and new sawmills were established as a result of their awards. As well, Pelican Mills built Alberta's first oriented strand board (OSB) mill at Edson in 1983, signalling a major expansion in hardwood utilization. A major impetus was provided in the government's 1984 White Paper on economic development in which the forest sector was identified as one of four economic pillars. A federal-provincial Forest Resource Development Agreement (FRDA) supported research in aspen utilization. In support of these initiatives, a new Forest Industry Development Division was created within the Alberta Forest Service in 1984 to promote and negotiate new forest industry agreements.

In Alberta, forest regeneration and silviculture programs were expanding. The new Pine Ridge Forest Nursery was opened in 1981 to augment seedling supply, and it also housed a genetics and tree improvement program. A seven-year Maintaining Our Forests program was launched in 1979, supported by the Heritage Savings Trust Fund that provided an augmented program of silviculture. An increased focus on forest research was signalled in 1980 with the creation of a provincial Forest Research Branch. The profession of forestry was recognized in 1985 when the legislature passed the *Profession of Forestry Act*. Three major fire years in 1980, 1981, and 1982 resulted in another major reassessment, reorganization, and more resources for forest fire management.

Consultant F.L.C. Reed & Associates was assessing strategies for forestry development across Canada in the late 1970s. Reed's report, *Forest Management in Canada,*[32] cited the Hinton operation as an example of a successful approach and suggested that other jurisdictions in Canada could incorporate similar ideas into their forest management plans and agreements.

The *Policy for Resource Management of the Eastern Slopes,*[33] released in 1977, was a first step in trying to manage land uses to reduce environmental impacts and conflicts among forest users. Part of the Hinton FMA was included, although the FMA was largely included in the "multiple use" zone in which forest harvesting was a permitted activity.

In 1978, the *Forests Act* was amended to enable designation of "Forest Land Use Zones," primarily to restrict travel by motorized vehicles and, in some instances, horses to reduce disturbance of wildlife at critical times, and to reduce conflicts with back-country visitors using non-powered means of travel.

The Environment Council of Alberta commission on environmental effects of forestry operations in Alberta, of which Des Crossley was one of four members, submitted its report in 1979.[34] One of the results was a revision of the East Slopes policy in 1984[35] that elaborated on the forest land use zoning policy as a further attempt to reduce conflicts. Another recommendation with major impact was to constrain the size of future FMA lands allocations so that the resulting allowable cuts would produce less volume than the mill requirements. This would encourage the FMA holder to pursue fuller utilization of available fibre from, and intensive management of, the FMA as well as fibre purchases from private lands and other producers.

In 1985, author Donald MacKay published “Heritage Lost: The Crisis in Canada’s Forests”[36] MacKay decried the plight of Canada's forests, which at the time represented one in every ten Canadian jobs. In McKay’s view, 150 years of forest exploitation and mismanagement by government and industry had left Canada incapable of responding to an expected sharp increase in world demand for forest products. MacKay travelled across Canada for two years researching his book, including a visit to the Hinton Forest in 1983. In MacKays view, one of the very few bright spots on the Canadian forestry scene was the operation at Hinton, and he dedicated one chapter of the book, entitled “Des Crossley’s Obsession” to this exemplary program.

Donald MacKay (l) and Des Crossley (r) in experimental Scots Pine plantation, Block 164, Athabasca Compartment 16, 1983
HINTON WOOD PRODUCTS COLLECTION

2. Forest Policy and Planning

In 1975, Bob Udell took over as Forester-in-Charge of Inventory and Management for the Company. Major management inventory changes occurred for the 1977 and 1986 Management Plans to increase the sampling intensity (and thereby the reliability) and to reduce the costs of producing a management inventory.* In the late 1960s, comparative trials were successfully completed on a new Photo Point Sample (PPS) technique of interpreting inventory information from a grid of photo points. These trials included tests against CFI-derived management inventories as well as a more intensive grid system compared with a fine type operational inventory. The PPS technique was highly efficient and freed CFI plots (now Permanent Growth Sample) for growth and yield work. PPS was used for inventory for the 1977 and 1986 Management Plans and for operational inventories until demands for more detailed stand information evolved.

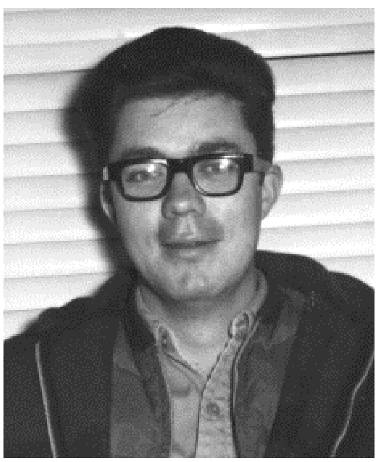
Management objectives for the two plans produced in this period were consistent with earlier plans:

* The expanded (1968) FMA was cancelled in 1972, so the 1977 and 1986 FMPs were for the original land base on which the CFI plot grid was established.

- to sustain into perpetuity, and through better management to increase the annual yield of, coniferous wood from the Forest Management Area;
- to provide a long-range, over-all cutting plan, whereby wood harvesting operations may proceed logically over the entire Forest Management Area during a single rotation;
- to remove the over-mature timber as rapidly as possible in order that these slow-growing and often decadent stands may be replaced with a more rapid-growing, regulated forest with an even distribution of ages between zero and rotation age, which will, in turn, increase the allowable annual cut on the Forest Management Area; and
- to maintain a uniform haul distance within each Working Circle, and the Forest Management Area as a whole, between cutting cycles.

One new objective was added in 1986 to reflect the new intent for integrated land use in the Hinton Forest:

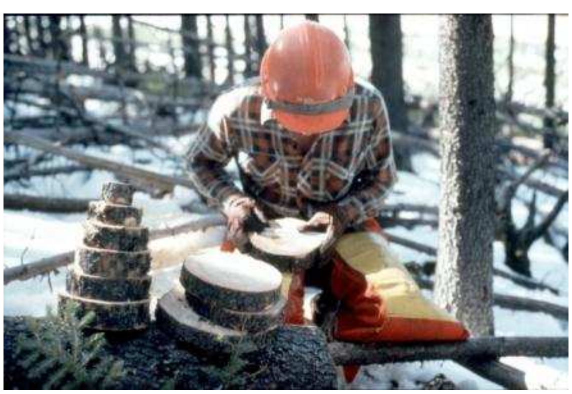
- to manage the Forest Management Area in such a manner that a variety of other uses may be accommodated. These uses may occur simultaneously or sequentially within the context of prime use for timber production, as defined in Section 10 of the Forest Management Agreement.



Bob Udell, 1967. Author of two management plans (1977, 1986)
HINTON WOOD PRODUCTS COLLECTION

In the period from 1975 to 1985, major emphasis was placed on PGS plots and the growth and yield data bank that became the largest repository of lodgepole pine growth and yield data in North America. During this time, Ken Mitchell and Jim Goudy of the B.C. Ministry of Forests, Research Branch, borrowed the Company's PGS data to develop their own lodgepole pine yield curves and, in return, they used the data to calibrate the Tree and Stand Simulator (TASS) model for the FMA. The model needed substantial further work because it did not function well for mixed stands, which characterize regenerated stands on the FMA.

In 1984, W.R. (Dick) Dempster was retained to analyze the PGS data—by this time some plots had four measurements—to develop actual growth projections to replace empirical yield curves used in timber supply analysis up to and including the 1977 Management Plan.

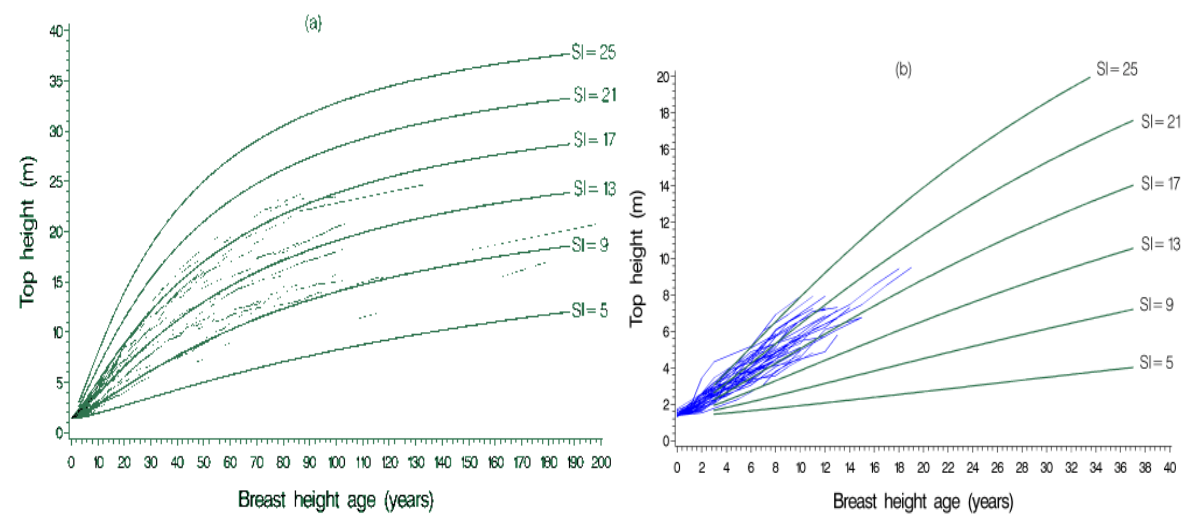


Stem analysis project 1985 – technologist Dave Wallace counting growth rings – fire origin stand McLeod compartment 2
HINTON WOOD PRODUCTS COLLECTION

In 1985, Dick Dempster and Bob Udell undertook a stem analysis project on adjacent paired fire-origin and regenerated stands. (See Chart 4.1.) By projecting current regenerated stand growth rates to maturity, the new forests were predicted to be 25 per cent taller than fire-origin stands of the same age on the same site, indicating a possible 100 per cent volume increase at maturity. They also obtained height growth data for 5- and 10-year periods ("growth intercepts") above breast height. Using this measure, they adapted pioneering work by D.G. Alban[37] at the USFS North Central Forest Experimental Station to forecast future height development of regenerated and fire-origin lodgepole pine. In 1985, Dempster also conducted a review of growth of regenerated stands using PGS plots, compared with original fire-origin stands on the same locations. This work corroborated the outcome of the preceding stem analysis work.

In the course of this work, Dempster examined height/site index relationships on existing stands in the database. He discovered that the site index appeared inversely related to the age of the stand, and that empirical yield curves appeared to be artificially depressing long-term growth and volume estimates. This was not a new discovery. Wright had already identified the relationships in the mid-1970s, but Dempster was able to better illustrate the results. No definitive reason for this was evident, but an argument was made linking the site index to initial stand density. The older stands may have had higher densities at establishment, making them less susceptible to catastrophic wildfire, but this also resulted in slower height and volume growth as trees competed for limited nutrients and moisture. Climatic warming supporting higher growth rates in younger stands was also suggested as a contributing factor.

Chart 4.1 Udell and Dempster stem analysis data from (a) fire-origin stands and (b) regenerated stands
*(*Courtesy Hinton Wood Products and Alberta Sustainable Resource Development)



The SI (site index) curves (in green) are the same on both graphs but the time frames (x axis) are much shorter for regenerated stands. SI values of 5, 9, 13, 17, 21, and 25 m were used to generate the site index curves. Note that the regenerated stands (right figure) are generally in the SI 17–25 range, which means that, at an average breast-height age of 60 years, the heights of their largest trees would be in the 17–25 m range, in comparison with fire-origin stands whose heights at the same age would range between 7 and 20 m.

The 1986 Management Plan employed a computer model called the Forest Yield Projection System (FYPS) developed by Dick Dempster. It applied improved growth estimates based on Dempster and

Udell's work, using actual rather than empirical height development over time, resulting in a dramatic AAC increase of about 25 per cent. Enhanced yield from regenerated stands (Allowable Cut Effect) was not factored into the calculation and did not contribute to the uplift.

In 1986, the Growth Intercept work of Dick Dempster and Bob Udell was published by the Canadian Pulp and Paper Association (CPPA) and won the Domtar Prize.[38] It was then used in British Columbia by Weyerhauser in consultation with Weldwood on Tree Farm License (TFL) 35 at Kamloops, where they achieved an indicated 25 per cent AAC uplift and at Prince George and Houston where similar results were obtained.

2.1 Integrating Wildlife and Forest Management

The Alberta Forest Products Association (AFPA) sponsored a forestry and wildlife symposium at Jasper Park Lodge for three days in 1982 to encourage an integration of wildlife management in the province. It was facilitated by Jack Ward Thomas (who later became chief forester of the U.S. Forest Service). Jim Clark, Hinton's Woodlands Manager, in his summary of the symposium, offered the Hinton Forest as the testing grounds for developing this type of system. An industry-government task force was struck by assistant deputy ministers Dennis Surrendi, Fish and Wildlife, and Al Brennan, Alberta Forest Service. The group was chaired by Don Fregren and included government AFS representatives Ed Gillespie and Norm Rodseth, Fish and Wildlife staff Dave Neave, Bruce Stubbs, and Gerry Thompson. The Company representatives were Jim Clark, Jack Wright, and Jim Bocking. Their positive 1986 report set the stage for the inauguration of Alberta's first Company-based wildlife program in 1988.[39]

The Forestry/Wildlife Task Force Report was followed by a subsequent 1987 report and recommendations by Rainer Ebel and Beth McCallum.[40] The task force proposed an integrated plan with guidelines that would enhance wildlife habitat through better design and timing of timber operations. The report was accepted by all parties but implementation was slow to result due to of bureaucratic issues external to the Company.

3. Ground Rules

From 1973 through 1986, there were three revisions of the ground rules. During this period, it was noted that "the objectives which drive the management system (philosophy) have remained essentially unchanged since they were originally developed."[41]

Economic goals focusing on sustained timber yield prevailed, but a gradual shift toward more explicit community goals involving integrated use began to emerge. By 1975, Des Crossley was saying "I no longer feel that we can entertain the luxury of maximum wood production. Our wildlands encompass too many other resources and public amenities to allow me to remain comfortable in the atmosphere of the ultimate in forest domestication. . . . Is it more realistic to aim for optimization of yield for each of the wild land resources?"[42]

This attitude was reinforced by the Company's forest recreation program, which had begun in 1970, when the Emerson Lakes Campground was developed. The campground expanded in 1973 when a small group of tree planters were assigned to begin construction of the Wild Sculpture Trail into the Sundance Valley. This was followed in 1976 with the development of the Pine Management Interpretive Trail for hiking and cross-country skiing. And, in 1981, work began on the Spruce Management Trail north of Hinton.

Hoodoos along the Wild Sculpture Trail
HINTON WOOD PRODUCTS COLLECTION

Key wildlife areas were designated in the 1980 Ground Rules with soft objectives for protecting wildlife resources but, by 1986, these had evolved to operating guidelines for habitat considerations for featured species (elk and caribou). Environmental goals respecting water courses and roads were increasingly emphasized in the period 1973 to 1986. These were probably linked to studies by the Eastern Rockies Forest Conservation Board in 1969;[43] a 1971 clear-cutting effects study by the CFS;[44] a 1971 CFS report by Rothwell, *Watershed Management Guidelines for Logging and Road Construction*;[45] and the Tri-Creeks Watershed Study, initiated in 1969.

Cutblock planning and design criteria likewise progressed from primarily timber-related criteria in 1973 on block size and shape with regeneration height criteria for watershed and game protection before second-pass removal, to a greater emphasis on wildlife, watershed, and aesthetics, and more detail on block size and distribution, and tree size, number, and retention criteria on regenerated cutovers by 1986.

In the period 1973 to 1986, reforestation guidelines also progressed, from basic reforestation standards covering acceptable species, stocking, survey reporting, and treatment schedule in 1973, to additional criteria for reforestation techniques to enhance growth and yield of regenerated stands by 1986. Annual Operating Plan criteria advanced from minimal mention in 1973 to a detailed appendix in 1986 that outlined plan contents and attached harvest and reforestation plans.

In the period 1975 to 1986, management philosophy had begun to change to reflect new issues such as increasing public concerns about forestry-related environmental impacts and resource scarcity due to increasing growth of the forest industry. The last pioneers of the early forestry/woodlands organization were retiring from active service (Des Crossley in 1975, Jack Wright in 1987, and Jim Clark in 1985), and a new team was emerging.

4. Forest Operations

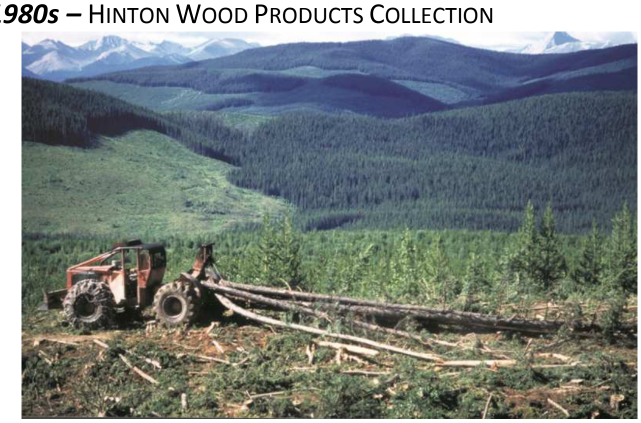
Licensed Timber Berths had disappeared from the FMA land base by the early 1970s. Two small operators remained, operating on small defined "Sale Units" as requested by the AFS and established by an agreement dated 20 June 1972. The operators were Bighorn Forest Products, producing fence posts from over-dense mature pine stands in the Warden Valley, and Terris Lumber near the park gate, operating sawlog material in very steep terrain.

Mechanization continued. In the early 1980s, the Company got its first stroke delimber. These hydraulic delimbers picked up the felled trees and stripped the branches off them by pulling the stem through a cluster of shears that adjusted to the diameter of the stem. The delimber also had a shear to cut the top off at whatever diameter was prescribed, usually 3.5 to 4 inches. The result was a much cleaner stem, critical if the tree is to be sent to the sawmill for conversion to lumber.

Self-loading trucks arrived on the scene in 1976. A hydraulic "cherry-picker" clamp on an articulated boom, permanently mounted on the truck behind the cab, was capable of loading logs and, if necessary, unloading them as well.

Woodlands Operating Systems, early 1980s – HINTON WOOD PRODUCTS COLLECTION

Feller-Buncher



Line Skidder

Stumpside Delimber

Self-loading Truck

Cutblock sizes were being reduced, primarily for wildlife habitat purposes. As a result, line skidders designed to pull large loads for long distances were becoming ineffective and grapple skidders were introduced to the system. The grapple skidders use hydraulic clamps, like small cranes, to pick up stems for skidding. Their key advantage is that the operator can stay in the safety and comfort of the cab while picking up a load. Grapple skidders became more common as more feller-bunchers came into service. For many years, combinations of feller-bunchers, line or grapple skidders, delimbing at roadside with single stem delimbers, and wood hauling with self-loading trucks were the major systems.

4.1 Progressive Clear-cutting Experiment, 1974

In 1974, a modification of the accepted clear-cutting silvicultural system, called progressive clear-cutting, was experimented with in Compartment 5 of the Berland Working Circle. The block, which reached about 2,000 ha by 1978, was co-operatively planned with the Fish and Wildlife Division and the Alberta Forest Service, particularly because of concerns about the negative impacts of strip, block, and patch clear-cutting on ungulates due to the road network and on fish due to stream siltation. The experimental harvest was set up to assess operational efficiencies of large clear-cuts, reduced environmental (siltation) impacts of roads by putting them to bed as the operation proceeded, and reduced hunting impact on ungulates due to reduced road access. Fish and Wildlife prescribed wildlife corridors and reserves and later rescinded most of them, a decision that baffled Company managers.

Progressive clearcut area in 1977, and 30 years later (2006) when the site is fully occupied with a new crop of pine and spruce
HINTON WOOD PRODUCTS COLLECTION

Records were not kept of operating efficiencies during logging and, according to chief forester Jack Wright, there was little influence on silviculture costs. Some roads had to be re-opened and about half the area required site preparation and planting. However, this may have been more a reflection of the reduced seed supply from pre-1955 “high-grading” tie operations in the area, as well as delayed germination that seems characteristic of the Berland Working Circle. Progressive clear-cutting was not practised again, and the other large-scale experimental logging proposed in 1968 for the Tri-Creek watershed was also discontinued when it came time to harvest in the late 1970s.

5. Silviculture Program

Steve Ferdinand left the Company in 1974 to join the Alberta Forest Service and Bill Mattes took his place as head of silviculture. Mattes, a graduate (1951) of Freiburg University in Germany, had been with the Company since 1970 working with Wright in inventory and management and with Ferdinand in silviculture.

5.1 Silviculture Planning

In 1976, Chief Forester Jack Wright was finally able to convince the Company to hire a tree improvement forester. Peter Sziklai, a recent UBC graduate and son of Professor Oscar Sziklai of the original Sopron faculty at UBC, was hired to fill this job. Among other things, he selected parent stock and installed a number of provenance trials on the Hinton FMA area. Eight seed zones were selected and lodgepole pine collected from the better trees in each seed zone was placed in each of the zones to test their transferability. Fortunately for his successors, he kept meticulous records of the parent stock and some of these trees were found to exhibit exceptional growth. The discovery of this record in the 1990s set the stage for the Weldwood Elite Pine Population (WEPP) breeding program. Sziklai left in 1981 amid tough financial times for the industry. Attempts to find a suitable replacement proved fruitless, and the position was left vacant until Diane Renaud took the job in 1996.

Increased mechanization and roadside delimbing in the 1980s resulted in a further decoupling of harvest and reforestation.

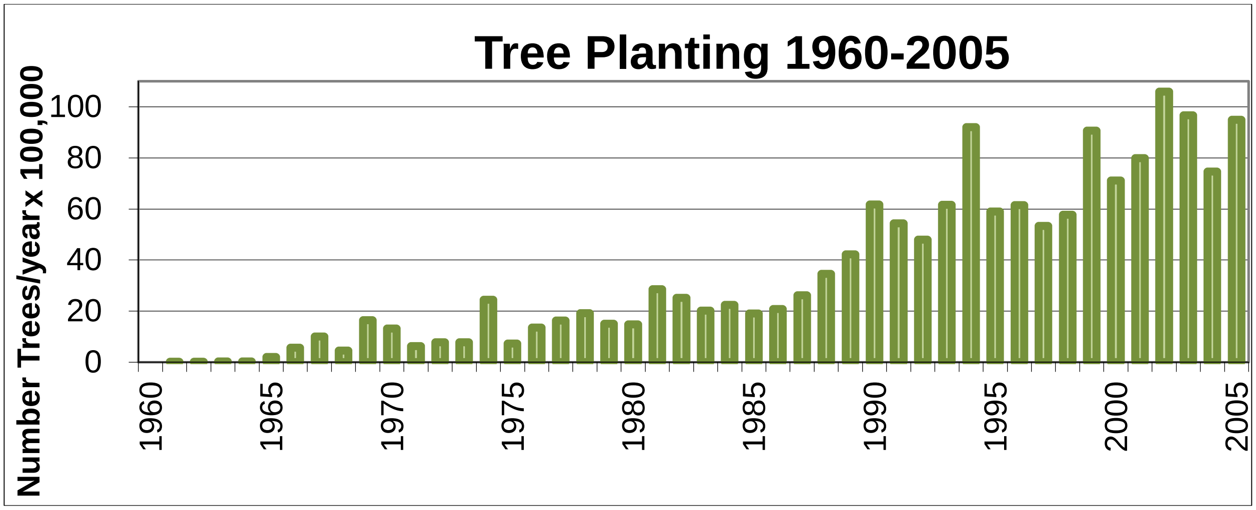
5.2 Planting and Greenhouse Expansion

By the early 1970s, records show a gradual increase in planting, from 1 million trees in 1974 to 2.5 million by the early 1980s (see Chart 4.2). It remained more or less stable at that figure until the expansion of operations late in the decade. The expanded program was a function of:

- the transition from first-pass harvest to second-pass, with reduced natural seed in spruce types;
- the fact that, after close to 20 years of operations, much of the “old growth” area, where hardwoods had long since ceased to be represented, had been harvested and operations were moving into younger areas where rapid reforestation and growth was critical to cope with competing brush and hardwood competition; and
- the use of feller/bunchers and roadside delimbing was on the rise, with a resulting loss of slash-borne seed for natural regeneration.

University students, recruited each year, planted the trees during the period May to August.

Chart 4.2 Trees planted 1960–2005, by year



In 1979, tree improvement forester Peter Sziklai was charged with constructing a new greenhouse to replace the earlier one. This came shortly after the retirement in 1979 of Jean Bourbeau who had been the greenhouse manager since it was first built in 1965. The old greenhouse had now reached the limits of what it could contribute to the planting program, growing three crops of trees, close to 2 million in total each year. The new greenhouse started production in 1980, producing 2.5 million trees, although the official opening ceremonies were delayed until 17 July 1981.

Two gutter-connected IBG Glass-Acre 300 houses were divided into four units, each able to grow 250,000 trees at a charge, or 3 million per year (three crops) in much improved growing conditions. The greenhouses were designed to take advantage of the mechanization potential associated with the container system, e.g., vacuum seeding, tray filling, vibration packing, etc. The design also allowed for the addition of a third gutter-connected greenhouse at a later date, to increase capacity to 4.5 million trees using the same production facilities. By 1984, nearly 20 million seedlings, grown in rootrainers, had been planted, for the most part with the Pottiputki planting tube.

Jack Wright stated in 1984

> 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. Since there is no shortage of high-quality tree planters when container grown seedlings are involved, a longer planting season is available than a machine could have. Thus further work on development of mechanical tree planters by Government agencies would appear to be a waste of taxpayer's money.[46]

The new Company greenhouse, 1981
HINTON WOOD PRODUCTS COLLECTION

5.3 Site Preparation for Planting and Scarification for Natural Regeneration

At the same time that improvements were being made in the culturing of planting stock, advancements in site preparation for planting were going on. While the container-grown seedlings generally performed well on most scarified and bladed areas, extremely dry and exposed scarified sites had unacceptable seedling survival rates. The other problem area was where tough sod made hand scalping with mattocks too laborious and ineffective.

In 1975, Company foresters saw a Bracke Cultivator demonstrated at Sault Ste. Marie, Ontario, and it appeared likely that this machine could provide the answer for these difficult planting sites. The Bracke scarifier is a Swedish invention. Pulled behind a wheeled skidder, the machine features a pair of chain-driven mattock wheels about 2 m apart that scoop out depressions in the soil, depositing the material as an inverted cap adjacent to the excavation. Depending on soil moisture and vegetative competition conditions, the seedlings can be placed atop or on the sides of the cap, or in the bottom of the hole.

The first Bracke was acquired in 1976. Not only did the unit pay for itself in the first year in reduced planting costs due to higher production, but survival of the planted seedlings was in excess of 90 per cent. From 1976 to 1978, a variety of towing units were tried, including the Clark 668 Skidder, Timberjack 240D, FMC Tracked Forwarder, and a Caterpillar D5 high-flotation tractor. In 1979, the Company purchased its second Bracke and two Timberjack 240D Skidders and approximately 85 per cent of planting sites were now pre-treated with these units.

At Camp 1, the Bracke was used to scoop out planting “scalps” wherein seedlings were planted on the lee side of the prevailing wind. Survival and subsequent growth was remarkable compared with previous attempts.

Bracke Scarifier working at Camp 1, 1970s
HINTON WOOD PRODUCTS COLLECTION

Areas of heavy competition from hardwoods remained a problem in terms of adequate pre-treatment. In 1979, St. Regis purchased a Cazes & Hepner (C&H) Plough to prepare approximately 10 per cent of planting sites. This unit was mounted on a modified Komatsu D65P Tractor. The C&H plough stripped away the organic soil down to the bare mineral soil, thereby eliminating all competition growing on the site. Trees were planted down this strip, usually on the transition zone between the bared soil and the undisturbed soil so they enjoyed a period of reduced competition during which they could establish and grow. That was the theory. The plan for these areas of heavy competition from hardwoods was to follow up three to five years after planting with an aerial application of herbicide to permit the planted seedlings to maintain their growth potential. The proposed use of herbicides created a major controversy, as described later. The practice now is to identify high-competition sites in advance of logging and plant them with large, fast-growing stock immediately after logging.

Cazes &Hepner Plough preparing planting sites in heavy competition area
HINTON WOOD PRODUCTS COLLECTION

In 1980, deep duff blading was replaced by the Craig-Simpson rear-mounted ripper plough. This could be operated during the early winter months as soon as there was sufficient frost to support the tractor and before the snow accumulation was too deep. This method not only extended the season but also reduced the width of the exposed path and consequently the size of the intervening windrows. Some problems remained in some deep duff sites where the ploughs did not expose sufficient mineral soil.

The standard treatment for natural regeneration continued to be the D-9 or Komatsu 355A crawler tractor equipped with the Company-owned scarification blade, the "Crossley Scarifier." However, in some situations, an overabundant seed supply would result in serious overstocking with the conventional treatment. Some optimism was evident in the results of a trial wherein a Bracke cultivator was used in place of the Crossley Scarifier in an area with an overabundant seed supply. The comparison trial resulted in 4,290 stems per ha with the Bracke in contrast to 20,730 stems per ha with the Crossley Scarifier.

The shark-fin barrel pulled by a smaller tractor was now being used in imperfectly drained sites to achieve better coverage and less environmental impact. Normal site treatment by forest type was described in the 1986 management plan as:

Lodgepole pine:
– Scarify for natural regeneration with Crossley scarifiers and anchor chain drags, or shark-fin barrels on imperfectly drained sites.

White spruce:
– Scarify with the Crossley scarifier, no drags, and wait for natural seeding. Use shark-fin barrels on imperfectly drained sites.
– Scarify deep duff and wetter areas in winter with D-9s and ripper-mounted C-S ploughs.

Where natural regeneration to lodgepole pine was the objective using the C-S ploughs, anchor chains were mounted on the hitch on either side of the plough and dragged behind to break up the slash and distribute the cones into the furrow. By using a large tractor, the Company could mount two ploughs on a "parallelogram hitch" with about 7-foot spacing between to double the productivity of the machine. Combinations of single and double ploughs could be used depending on the amount of slash and steepness of terrain. This equipment was also used to treat some upland pine sites that were inaccessible during the frost-free period.

C-S plough with chain drags for natural regeneration, 1980s
HINTON WOOD PRODUCTS COLLECTION

5.4 Aerial Seeding

Aerial seeding was described as an operational practice in the 1986 forest management plan, but it was soon abandoned due to unpredictable results and the need for large amounts of spruce seed that proved to be difficult to collect in sufficient quantities. The average annual seeding in the period 1976–1985 was 302 acres, with 80 per cent reforestation success.

5.5 Backlog Reforestation

A major effort was underway to reduce backlog reforestation liabilities on the FMA, accrued over the years as the Company continued to refine and adapt its reforestation strategies and systems. Considerable success was achieved in this initiative, reducing overall liability from 10.4 per cent of total cutover surveyed to date in 1980 to 2.4 per cent in 1985 (summarized in Table 4.1).

Table 4.1 Gross reforestation liability status, 1980–1985

Year	1980	1981	1982	1983	1984	1985
Area (ha)	6,528	5,448	3,657	2,60 4	1,497	2,002
% of cutovers surveyed to date	10.4	8.1	5.1	3.6	2.0	2.7

5.6 Juvenile Spacing Program 1975–1987

In the early 1970s, the Company began an operational spacing program in the Gregg Burn, initially using Swedish brush axes, later switching to brush saws. By the middle of the decade, it was apparent that the costs of this program (approx $1,000/ha in 1976) were prohibitive compared with any estimate of future benefit, and so the program was discontinued in 1976. Also causing increasing concern were the safety hazards from standing dead and tangled undecomposed brulé (a forestry term for burnt timber) on the forest floor.

After 1976, the juvenile spacing program switched to the stands that had regenerated following logging, where worker productivity was dramatically higher, and the impact on growth and yield per dollar expended were spread over a much larger area. Many of these areas had pre-treatment densities of 10,000 to 20,000 stems per hectare (sph) and were spaced at 1,800 to 2,500 sph. Target densities were increased by 10 per cent where western gall rust, a fungal disease of pine, was present.

Benefits expected from this program included higher final volumes at the time or harvest, and also the accelerated development of individual trees within the thinned stands that would thus be "set up" for a commercial thinning program as the trees approached maturity. As time passes, this prophecy appears to be holding true.

Operational Thinning - Marlboro Compartment 7, 1981
HINTON WOOD PRODUCTS COLLECTION

This operational thinning program continued on a small scale (200 to 300 ha/yr) using a crew of students each summer—later a full-time International Woodworkers of America (IWA) Union crew (1984–87)—and lasted until Wright's retirement in 1987. The program had three prime goals:

1. to improve growing conditions for overstocked regenerated pine;
2. to improve final crop yields; and
3. to set up the spaced areas for a future commercial thinning that might otherwise not be practical in the absence of early spacing control.

Jack Wright (personal communication) expressed his philosophy as follows:

> 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 or poor sites, and by-product chips. To accomplish this, average and better sites need proper early spacing so commercial thinning (CT) can be carried out 20 years before final harvest. Without proper juvenile spacing, CT is not possible.

Conversely, work by Ken Mitchell and Jim Goudie from the British Columbia Ministry of Forests indicated that, while some growth and yield benefits could derive from juvenile spacing of overstocked regeneration (more than 10,000 trees/ha) on low- and medium-site classes, there would be no benefits from such treatments in the richer sites. Other researchers noted risks such as pathogen attacks facilitated by stem damage during thinning, invasion of competitive species, loss of site occupancy, etc. In the late 1980s, juvenile spacing was suspended pending a more careful review of the site and stand-specific benefits and costs of such enhanced forest management treatments compared with other enhanced forest management (EFM) treatment options for the same investments.

By 1989, 2,630 hectares of regenerated cutovers had been spaced. At this time, a review was conducted of the juvenile spacing program. Mortality problems were observed on some of the earlier thinnings, particularly on rich sites where the opening of the stands allowed competing vegetation such as alder to flourish and in some cases pathogens to attack trees through incidental wounds caused in the thinning process. Meanwhile—and consistent with Mitchell and Gaudie's observations—unthinned stands on many sites appeared to be growing freely with no need for spacing. The impacts of thinning on growth and yield were poorly understood and there did not appear to be a professional consensus on the contribution of this practice to allowable cuts. Although it was clear that the treatment would increase the average diameter and volume of a stand and therefore its value for sawlogs, there was concern that overall volume production per hectare might suffer.

As can be seen later, these and other questions became part of the enhanced forest management review of the late 1990s. In addition, there was the need to redirect limited resources into cleaning hardwood competition—clearly having major impacts on softwood survival and growth—from overtopped conifer regeneration. This brushing program continued into the 2000s with about 2,500 hectares being treated annually.

As will be seen later, however, a review of intensive management options conducted for the Company by Stan Navratil in the 1990s recommended that juvenile spacing be a cornerstone of any intensive management program in lodgepole pine. Without question, this silviculture application achieves the goals identified by Wright, but it must be applied on a site-specific, not comprehensive, basis.

5.7 Failed Attempt to Introduce Herbicide Use, 1986

Deciduous trees such as poplar and aspen can establish themselves aggressively on cutovers, even in old growth stands where the hardwood component had long since disappeared. On many sites, hardwood competition arising from the deciduous component of stands became an issue. Manual cleaning of the older plantation and seeded areas was deemed prohibitively expensive and would certainly cause damage to the "crop trees" that were to be made "free to grow." Use of herbicides was a logical choice. However, Fred McDougall, then deputy minister of Forestry, Lands and Wildlife, was adamant that herbicides were not to be used without sufficient scientific knowledge and support of the public.

In 1986, the Company proposed a series of small herbicide trials testing the newly approved forestry herbicide Roundup as means of vegetation control. One permit was approved and actioned for a block up the Lynx Creek Road. However, other applications for permits ran into a firestorm of controversy when a local coalition became aware of the projects and mounted a very public action against the plans. A provincial election was underway at the time and, at a public meeting in Edson, Premier Don Getty promised that as long as the public was uncomfortable with the use of herbicides, he would not allow their use in forestry.

Bracke Herbicide Unit along Lynx Creek Road, 1986
HINTON WOOD PRODUCTS COLLECTION

Meanwhile, other companies were successfully applying for and receiving permits for both small and large-scale experiments. The Company decided that the best course of action would be to discontinue its efforts and to dampen down the controversy, which would allow the rest of the industry to prove the merit, efficacy, and environmental acceptability of these herbicides. This was done, and herbicide use was introduced elsewhere in an orderly and publicly supported fashion. Such operational use is now common on the Hinton Forest and elsewhere in Alberta.

5.8 Changing Reforestation Standards

In the 1973 to 1986 period, reforestation guidelines progressed from basic reforestation standards covering acceptable species, stocking, survey reporting, and treatment schedule in 1973 to additional criteria for reforestation techniques to enhance growth and yield of regenerated stands by 1986. Annual Operating Plan criteria progressed from minimal mention in 1973 to a detailed appendix outlining plan contents and attached harvest and reforestation plans by 1986.

In 1977, a third-year establishment survey was done after planting to preview expected regeneration survey results and to assist in planning, but it appears to have been discontinued by 1986.

In 1978 a Regeneration Survey Manual was developed, based on a review of stocking standards by Imre Bella and J.P. DeFranceschi of the Canadian Forest Service.[47] The new survey system specified a regeneration survey after seven years and employed a Sequential Sampling procedure requiring 80 per cent stocking for a block to be classified as sufficiently regenerated (SR). This satisfied the technical and statistical survey requirements of the Alberta Forest Service, with significant cost savings to the Company. A check survey was done on 10 per cent of each cutblock by a silviculture supervisor, and NSR areas were treated to meet the 10-year stocking deadline.

In 1979, the Forest Service modified the standard and the survey approach, and the Forestry Department at Hinton, which was becoming concerned about reforestation success, initiated a program whereby the regeneration surveys were apportioned to every staff member including Jack Wright (the chief forester). Wright's view was that people were spending too much time in the office and losing their connection to the field, particularly the linkages between harvest systems, regeneration treatments, and reforestation success. Despite some grumblings, most people agreed that they had a much broader understanding of field forestry as a result.

In the 1980s, regeneration success was declining as silviculturists continued their "mop-up" role following operations that were increasingly mechanized and site-impacting. This was exacerbated when silviculturists moved to the larger operating districts in 1986. During this period, concern about the adequacy of existing reforestation standards developed.

In 1985, the province conducted a Juvenile Stand Survey (JSS) on a provincial sample of cutblocks harvested from 1966 to 1974, on which there had been satisfactory stocking at year 10 under the old conifer standard. The Company conducted similar surveys on the FMA area to ensure the provincial results would also reflect local findings. They found that, although the areas had regenerated to trees, a large percentage were no longer satisfactorily stocked to desired coniferous species, and many had severe competition problems and poor growth. It was evident that the acceptance of 3-year-old spruce trees and 2-year-old pine trees 10 years after harvest was no guarantee that a productive conifer forest would result.

The 1986 Management Plan documented a continuation of a Management Opportunity Survey (MOS) but included a much more detailed Regeneration Survey Manual—reflecting the accumulation of knowledge and experience in matching treatment prescriptions to site to address NSR—and required survey notes on silvicultural recommendations and treatments by block to be entered on a Silviculture Record System.

The Survey Manual also specified a 20 per cent check survey by block, 10 per cent by the Company supervisor and 10 per cent by the Company supervisor and the Alberta Forest Service.

6. Research Initiatives

Research by other agencies on the FMA waxed and waned, the earliest being the 1956 Alberta Fish and Wildlife Division study by John Stelfox,[48] described earlier. Others involved by the time of the 1977 Management Plan included the Canadian Wildlife Service (CWS)—Andy Radvanyi's work on reducing mouse predation on seeded cutblocks; the University of Alberta's involvement in the new (1976) tree improvement program and testing soil sterilents to thin pine; the University of Calgary study of the induction of flowering in white spruce; and the Alberta Forest Service's cooperating in the tree improvement program and the Tri-Creeks watershed study. The Company was conducting 66 per cent of the silviculture research and 45 per cent of the growth and yield research, as reported in the 1977 Management Plan.

CFS research fell sharply by 1977 and continued at a low level after 1985. This was due in part to a change in CFS's focus to boreal forest research following the 1984 signing of the Canada/Alberta Forest Research Development Agreement. This was really a return to boreal forest research that was started between 1950 and 1970, primarily on alternative silvicultural systems to secure spruce regeneration, by CFS researchers such as Jack Quaite, Al Blythe, and Jock Lees.

The 1977 Forest Management Plan listed 28 research projects underway. Some of these were by the Company alone (13) while others were collaborative efforts with the Canadian Forest Service (12), University of Calgary (1), University of Alberta (1), or the Alberta Forest Service (1). Nine of these projects were in silviculture and the rest were in growth and yield (11), effects of harvesting (5), pathology (1), and wood processing (2).

Beginning in 1985, forest consultant W.R. Dempster was engaged to examine the growth performance of regenerated forests compared with the fire-origin stands, based on an analysis of PGS plots. His reports showed a substantive and statistically defensible uplift in the growth and yield of regenerated forests, which was included in the timber supply analysis. This was further advanced when Dempster and Udell embarked on paired-plot stem analysis project, discussed earlier, to examine the potential of the "growth intercept"* method of site index determination that had been originally pioneered by D.H. Alban on Red Pine at the U.S Forest Service Great Lakes Forest Experimental Station.[49] This research led to the eventual use of the growth intercept in yield forecasting not only in the Company's FMA but also in many other jurisdictions such as interior British Columbia.

The Alberta Research Council (ARC) expanded its capabilities in the forestry sector, in wood products, as well as in wildlife. This was achieved with the encouragement of the AFS and made possible, at least in part, with funding through a series of federal-provincial forest development agreements starting in 1984.

The 1986 Management Plan reflected a continuing increase in Company-applied research in silviculture—about 80 per cent of the projects—including modified mechanical scarification, monitoring establishment and growth of pine regeneration, seed production areas and provenance test

* Five- or ten-year height growth above "breast height" of top height trees in a stand.

measurements, and control of deciduous competition. The Alberta Forest Research Branch was doing mycorrhizal inoculation studies on pine and spruce (Stan Navratil); the University of Calgary was producing pine stock from selected seed; and the University of Alberta was conducting Armillaria root rot and Cronartium gall rust studies (Peter Blenis) and working with the Alberta Forest Service on the Tri-Creeks watershed study. Growth and yield work was being done mainly by the CFS (60 per cent of those projects), including a spacing and growth study on pine and spruce, re-measurement of a pine fertilization study, and growth and yield of pine. The Forest Technology School was doing a spacing and growth study on white spruce, and the Company was doing a regeneration ingress study on cutblocks.

Ingress Study, Block 5 Marlboro 7 – 1974 All stems measured and sectioned on 1/100 acre plot
HINTON WOOD PRODUCTS COLLECTION

5 Silviculture in Decline, 1987–1992

1. Historical Context

Even as the silviculture program at Hinton entered a period of decline, national and international pressures for a more sustainable approach to forest management were increasing.

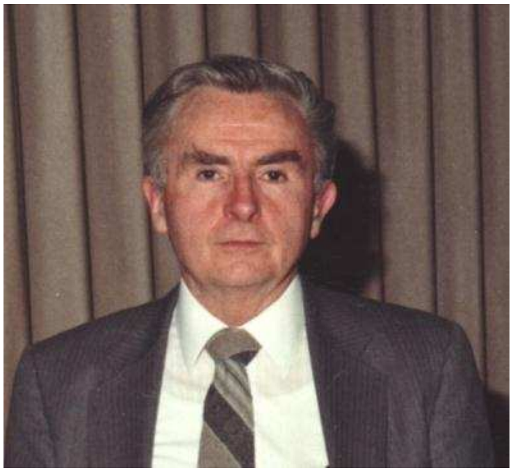
Events during this period reflected the convergence of two major forces. The first was the continuing provincial economic policy to encourage investment in the forestry sector. The second was coalescence of environmental concerns that had begun to manifest themselves in the early 1970s in response to more visible logging and petroleum developments. The United Nation's Brundtland Commission's report in 1987, *Our Common Future,* was a catalytic event. It reviewed these forces from a worldwide perspective, emphasized the need to find a balance between environment and economy, and used the concept of "sustainable development" as a philosophical objective.

The Canadian Council of Forest Ministers (CCFM) developed a Forest Sector Strategy for Canada in 1987 through consultation with selected stakeholders. Following release of the Brundtland report that same year, it became apparent that neither the scope of consultation nor the range of values addressed in the first CCFM Strategy was adequate. In 1990, CCFM launched a series of national consultations and questionnaires involving people representing a wide range of interests. These culminated in 1992 with the first National Forest Strategy (NFS)[50] and signing of Canada's National Forest Accord. Federal Green Plan initiatives included the Canadian Model Forest Program (1991)[51] and the establishment of the Foothills Model Forest (FMF) in 1992.

In Alberta, the volume of wood harvested continued to increase. The Forest Industry Development Division noted that the Millar Western pulp mill at Whitecourt in 1988 was the first new pulp mill since the Procter and Gamble mill of 1973. It then reported on five other new or expanded pulp mills along with numerous other solid wood plants utilizing both coniferous and hardwood stock, culminating in the announcement of the Alberta-Pacific Forest Industries' hardwood pulp mill at Boyle, then representing the largest single-line pulp mill in the world.

This was a catalyst for environmental movements, resulting in vigorous demonstrations and sustained criticism from groups such as the Alberta Wilderness Association (AWA), the Sierra Club, the Western Canada Wilderness Committee (WCWC), and the Canadian Parks and Wilderness Society (CPAWS).

The Alberta government responded by forming two commissions, one to review water and air concerns, and the other to review impacts on forests and forestry. The Expert Panel on Forestry was formed in 1989 and reported in 1990. The four-member panel comprised Bruce Dancik, professor of forestry, as chair; silviculture research scientist Lorne Brace; wildlife biologist John Stelfox; and forester Bob Udell of the Company's Forest Resource Department.



Resident Manager Ken Hall, 1982
HINTON WOOD PRODUCTS COLLECTION

In Hinton, new resident manager Ken Hall saw great potential for an expanded operation and resolved to make it happen. Although he was not successful in his bid for the Berland-Fox Creek Timber Development Area in 1979, he launched direct negotiations with the province in 1986 that resulted in a new Agreement in 1988. The new Agreement increased the Company's forest area from 800,000 to 1,012,000 ha, enabling expansion of the pulp mill and construction of a new sawmill.

2. Forest Policy and Planning

The forest management planning process provides an opportunity to reflect on performance, adjust the course of management practices, and set new objectives. The 1991 FMP was the first for the 1988 Agreement and included an expanded set of objectives including sustaining coniferous yield, scheduling balanced operations, improving stand vigour, and integrating renewable resources management. This was clearly a forward-looking transitional document that provided a focus for managing specific ecosystems through space and time to conserve wildlife species and to integrate other uses. In the plan's concluding statement, reference was made to the data collection and analysis that would occur and to several special studies that would be completed before the next FMP. The FMP document suggested that the 1999 plan would be even more comprehensive in the spirit of sustainable forest management.

The 1991 plan was also the first plan to include an inventory of regenerated stands in the allowable cut calculation, along with a combination of photo point samples and fine type inventories for the fire-origin stands on the Hinton Forest.

The inclusion of more and better information on the growth performance of regenerated and fire-origin stands and the use of increasingly sophisticated timber supply models, along with the success of the silviculture program and the increasing proportion of faster-growing regenerated stands in the timber supply forecasts, resulted in continuing increases in allowable annual cuts per unit of area on the Hinton Forest plan from the first Forest Management Plan in 1958.

3. Ground Rules

The 1988 and 1996 revisions of the Ground Rules reflected major changes in management philosophy, goals, content complexity (strategies), and planning linkages and feedback.

By 1988, Company foresters no longer believed that, if they just achieved sustained yield forest management, everything else would fall into place. A new direction was emerging toward integrated resource management (IRM) in a forest ecosystem context. Forest harvesting was viewed as an ecosystem disturbance and development of the regenerating forest as a process of ecological succession with particular implications for the management of timber and wildlife resources. A joint Company/Forest Service/Fish & Wildlife Service Integrated Resource Management Steering Committee (IRMSC) provided guidelines for wildlife management for the 1988 Ground Rules.

Goals within the new management philosophy evolved to include significantly more community goals, reinforcing community concern about forest health and human safety, integrated resource use coordination and conflict resolution, visual quality of the forest landscape, and protection of cultural, heritage and natural resource values. Environmental goals included, but moved beyond, the previous watershed and forest protection format to a focus on conserving ecosystem composition, structure, and function and species and genetic diversity, and on developing an international reputation for stewardship of the forest resource. Economic goals remained much the same as in the past.

Integrated resource management, primarily forestry-wildlife integration but increasingly reflecting "non-game biology," was guided by the Company/government Integrated Resource Management Steering Committee (IRMSC) from 1988 to 1992, and by Foothills Model Forest (FMF) research initiatives after 1992. A joint Ground Rules Steering Committee (GRSC) set up in 1990 reviewed and revised the ground rules as necessary. This was facilitated by a new issue-based structure in the 1996 Ground Rules.

By 1989, a Forest Management Liaison Committee (FMLC) was formed to provide public input to management planning on the FMA. By 1991, there was a two-tiered system of public input, including a yearly open house as well as the FMLC. In 1992, the FMLC was renamed the Forest Resources Advisory Group (FRAG).

FRAG provided an enhanced and more formalized public input to planning. Also, public involvement in the compartment planning process was invited through open houses where the operational plans were presented. The Linked Planning Process (LPP) between the Company and government that was developed after 1994 was included in the 1996 and 2002 Ground Rules and was also being embedded in provincial policy documents. This ensured linkages, feedback, and compatibility between Forest Management, Development, Annual Operating and Compartment Operating Plans and compliance with all relevant policies, Acts and Regulations, and the Operating Ground Rules. An annual Stewardship Report was also prescribed. Feedback became a key issue in the planning process, ensuring that management practices complied with plans and satisfied Company policies as well as Department of Environmental Protection (Forest Service) management strategies for sustainable forest management (see Section 2).

4. Forest Operations

A major mill expansion began in the late 1980s, and woodlands operations had to gear up to meet the demands of a larger pulp mill and a new state-of-the-art sawmill that came online in 1993. Operations were gearing up to increase harvest levels on the expanded forest management area from about 500,000 m^3/year to about 1,700,000 m^3 by the time the new sawmill came online in 1992.

Thus began a period of heavy focus on woods operations, with major road-building to the far reaches on an expanded forest management area, the design and layout of hundreds of cutblocks in advance of logging, a major reorganization of the Forest Resources Department to concentrate operational responsibilities within districts, a changeover from exclusively Company woods operations to one that included a preponderance of contractors with a mix of Company crews to harvest and deliver wood to the mills.

Beginning in the early 1970s, feller-bunchers began to replace hand-fallers, although delimbing continued using chainsaws at the stump.

The feller-bunchers were combined with line skidders, which pulled full trees—branches still attached—to landings along roadsides. In 1983, the Company began to use delimbing machines at the landings to remove limbs from the full trees skidded to landing, piling them for later burning. Feller-bunchers were well designed for operator safety and, by the mid-1980s, came equipped with lights that could illuminate the work area clearly, and in 1986 night shifts were introduced in woods operations to optimize machine productivity.

By 1988, all but one of the IWA logging crews had been replaced by contractors. Grapple skidders were introduced in 1989 to further increase productivity but, due to their shorter skidding distances, more internal block roads had to be constructed.

It was becoming clear to all—especially the silviculturists—that these systems had several drawbacks:

- The major drawback was delimbing. Trees had to be delimbed close to the stem, especially those portions destined for the sawmill. Chainsaw delimbing at the stump was out of the question, being both too expensive and too hazardous to the workers. The least destructive place for the mechanical delimbing systems that were developed was at the landing.
- Delimbing at roadside left great piles of slash that had to be burned, an expensive, risky, and soil-degrading treatment.
- Silviculturally, the cone-bearing pine slash was being removed so planting became more of a necessity.
- Removal of the needles and fine limbs removed nutrients from the site, along with other coarse woody debris important as microsites for seedlings and microhabitats for animals.
- The removal of slash from the site for roadside delimbing also removed a certain amount of cushioning and weight distribution for the machinery, which contributed to an increase in rutting and site degradation.
- Internal block roads to facilitate grapple skidding were constructed by using bulldozers to push soil from both sides of the road and pile it in the centre to build the grade for the road. This stripping of the topsoil and its burial under internal block roads degraded the site for reforestation. It also increased associated site degradation caused by rutting and erosion of the exposed mineral soil.

Feller Buncher and Grapple Skidder, late 1980s
HINTON WOOD PRODUCTS COLLECTION

Silviculture staff were already concerned with the decoupling of harvest and reforestation. Now government regulators were issuing fines and warnings about rutting and site degradation. Change was called for and would ensue (see Chapter 6.2.1).

5. Silviculture Program

Operational responsibility for silviculture was given over to newly formed districts under three district managers (Bryon Muhly, Dan Rollert, and Daryl Farquharson). Each district had a silviculturist responsible for planning and implementing silviculture while overall planning coordination and silviculture system development remained within Bob Udell's organization under Bill Rugg. Change was rapid, as operations began staffing up and ramping up to address the fibre needs of the new pulp mill, which began construction in 1988.

The new organization also heralded the end of the juvenile spacing program. It was indefinitely suspended until quantitative information on the benefits and threshold stocking levels leading to growth repression could be determined.*

The amalgamation of the operational silviculturists with the other operations people in the districts had many positive elements, as people working together gained a mutual understanding of each others' roles and challenges. Similarly, when there were workload "surges," people could temporarily put aside their assigned responsibilities and help others cope with the extra load. The theory was that such assistance would later be repaid in kind. Unfortunately, in the case of the silviculture program, this reciprocity seldom if ever happened, and the Company entered a period of substandard silvicultural performance. Several things contributed to this problem:

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* These benefits have yet to be quantified, and the program is still suspended as of the time of writing. The Foothills Growth and Yield Association has installed 408 plots in its Regenerated Lodgepole Pine program, and some of these will be thinned as they reach the age at which such spacing would be done.

- Because of the new imperative to ensure an increased wood supply, silviculturists found themselves at times unable to properly conduct their post-harvest planning (Management Opportunity Surveys, or MOS) surveys before treatment. Also, when silviculture field programs were dormant, the silviculturists were often called upon to assist the harvest group, sometimes at the expense of proper maintenance of the silviculture records.
- This problem became worse in 1992 when Hinton Division eliminated its mainframe computer system, along with the silviculture record management system designed for it. The replacement system had not been designed, and silviculturists faced the unfamiliar task of making paper entries of silviculture records.
- Silviculture responsibilities were divided among the central planning group and the three districts, with a resulting loss of clear direction or focus.
- The Company had always enjoyed the luxury of surplus AAC. Therefore AAC arguments for doing good silviculture were less compelling.
- Reports (e.g., the one by Udell and Dempster, discussed earlier) describing the enhanced performance of regenerated areas were masking some of the other problems that were still out there.
- Some of the silviculturists appointed by the districts lacked the experience to prescribe and execute the most appropriate treatment.
- District performance was measured by log costs and deliveries, with no performance indicators for silviculture. This is a good example of the aptness of Gordon Baskerville's observation that "what gets measured, gets managed."

5.1 Silviculture Planning

Both Jack Wright and Bill Mattes retired in 1987. This was at the same time as the restructuring of the Hinton organization that resulted in the merging of the Forestry and Woodlands departments into one Forest Resource Department under Don Laishley. Wright was replaced by Bob Udell, who headed up a new planning organization within the department, and Mattes was replaced by Bill Rugg, a University of Alberta forester who left a reforestation position with the Manitoba provincial government service to take the new position of silviculture planner.

During Rugg's tenure, many changes occurred, both within and external to the silviculture program. Free-to-grow regulations were instituted in 1991 and many companies responded with more aggressive silviculture, leading generally to an increase in planting. Rugg also developed the first Regenerated Stand Inventory for the Company, which was used in the 1991 forest management plan.

5.2 The Need for an Ecological Classification System Recognized

The de-coupling of harvest and reforestation, carried over from the previous period, continued to create problems. There was a growing sense of urgency to develop an ecological classification system and pre-harvest planning that could help determine the combination of harvesting systems and reforestation treatments that would result in the best conditions for successful reforestation and crop performance. The Management Opportunity Surveys developed by Bob Carman in the 1960s continued when possible as a final "check-off" and silviculture prescription following harvest. But, in some cases, even these were discarded due to other time pressures, and prescriptions—mainly planting—were done on the fly.

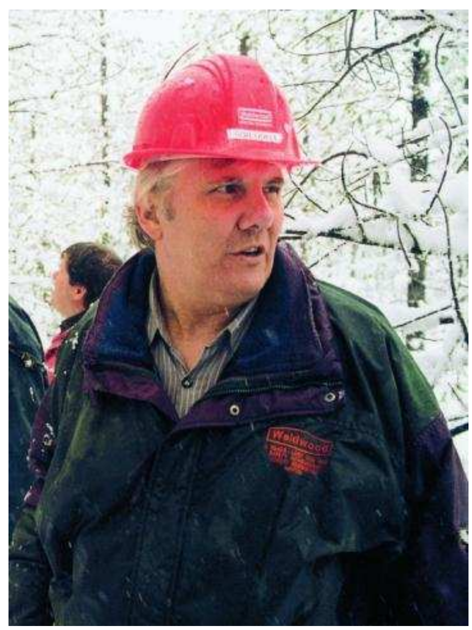
In its 1990 report, the Expert Review Panel on Forest Management in Alberta[52] emphasized the need for an ecological basis for management planning. Information was available from work undertaken in

1977 by the Canadian Forest Service (particularly by Ian Corns) to ecologically classify and estimate the relative productivity of the mature forest ecosystems of West-Central Alberta. In 1986, a field guide[53] was published, but it proved poorly suited for relating forest productivity to ecosystem associations on the Hinton FMA. This initial failure was due to a variety of factors, including a lack of trained personnel to support and pursue its application, an incomplete suite of mapped ecosites, inappropriate ecosite categories for the area, and a lack of a detailed inventory to support its application.

5.3 Planting and Greenhouse

Direct seeding had been discontinued as a regeneration technique during the early 1990s. The three main reasons were the following: (1) the supply of high-quality seed was limited and direct seeding required much greater numbers of seed; (2) results were erratic, and deficiencies occurred through a combination of microsite availability and predation by birds and small mammals; and (3) there was slow establishment and early growth of seedlings, especially as inhibited by competing vegetation. The Company could no longer afford to await the results and then plant the failed areas.

Nursery operations were reviewed in 1990 by Reid Collins Nurseries Ltd.[54] Their main suggestions were to modify cropping schedules to achieve desired seeding specifications, to match stock size to ecosite and competition status of the block, to purchase large pine stock and all spruce, to go to multiple cropping (three crops) to minimize costs, and to avoid expansion until government subsidies or user fees made it profitable to do so. The Company decided to keep the greenhouse for the time being but to increase production and reduce costs and to minimize concerns about product quality. The result was that production increased to 2 million seedlings per year by growing multiple crops with overwintering in cold frames. Unfortunately, trees often were flushing before lifting and out-planting and often demonstrated planting shock.



Silviculture Manager David Presslee
HINTON WOOD PRODUCTS COLLECTION

In 1992, when Dave Presslee was hired as silviculture manager, his opinion was that the Company greenhouse was producing very poor performing growing stock. In retrospect, the subsidized stock arrangement with the government in the 1968 Forest Management Agreement, while an apparent economic benefit, probably worked against the production of quality stock and discouraged pursuit of natural regeneration options. Poor performing stock is not a bargain. As Dave Presslee remarked in the 1993 Crossroads Project (see Chapter Six, Section 2.2) report, "A free tree is not a free tree" when you consider site preparation, planting costs, replanting costs, and failure to meet performance standards. There are significant negative growth, yield, and AAC implications.

The use of student planting crews was discontinued and planting was contracted out, with positive results in cost savings. The role of planting climbed steadily as its success became more apparent and as it seemed a fail-safe strategy in the absence of time for proper silvicultural planning. Seedling number 50 million was planted in 1991. One tree was planted at the Hinton Training Centre, and the Gregg Cabin was chosen for the second planting. A 1-hectare harvest block was cut in a mature stand close to the cabin where children and employees of the Forest Resource Department planted the area with Company President Tom Buell presiding over the planting of the 50 millionth tree.

Planting the 50-millionth tree at the Hinton Training Centre: L-R Tom Buell, MLA Peter Trynchy, unidentified Junior Forest Warden, Forest Resource Manager Don Laishley
HINTON WOOD PRODUCTS COLLECTION

Future milestones were to be similarly marked with 1-hectare clearings and ceremonial plantations.

5.4 Reforestation Standards

The original conifer regeneration standard required a single regeneration survey in the seventh year following harvest. If the area had sufficient stocking, it was deemed to have met the standard and no follow-up survey was required to determine whether or not it was free of competition and whether the seedlings were growing. If it was not satisfactorily restocked (NSR), follow-up treatment and another survey were then required.

In 1987, a joint government/industry Reforestation Technical Committee (a subcommittee of the Alberta Forest Products Association (AFPA) Forest Management Committee) was formed to recommend and track new reforestation standards. The Company was also a member. The committee formulated a new standard in 1991[55] covering conifers, hardwoods, and mixedwood stands. It was concerned not only about stocking but also about the growth rate of the tree, and its chance of growing above the competition. This standard required three check-offs over a 14-year establishment period: the establishment survey (4 to 8 years), the (growth) performance survey (8 to 14 years), and the free-to-grow check-off (at 14 years).

This new standard was a wake-up call for the industry in general to address field performance of regeneration, which implicated site preparation techniques, planting stock quality, follow-up tending practices, and the need to integrate harvest and silviculture planning. This standard remained in place up until new standards were introduced in 2000.

Because much of the regeneration that would be subject to this new standard was already in the ground, industry expressed strong concerns about its ability to meet the standard on these areas for which it had already met its regulatory obligation. The province, to encourage and support this change, agreed to accept responsibility for “free to grow” on all pre-1991 reforestation that could be considered SR under the old standard. This commitment was never fulfilled, however, as the province was soon to enter a period of budgetary restraint and manpower reduction, which continues to the present. Industry later took over many of these areas using Forest Resource Improvement Program funding to treat the pre-1991 areas for competition control.

6. Research Initiatives

The Alberta Forest Service established a short-lived Forest Research Branch that flourished from 1988 to 1994 when budget cuts and staff reductions led to its dissolution. However, the branch stimulated interest in research within the forest industry and helped to bring industry and researchers together through its role as secretariat to the Alberta Forest Research Development Trust Fund that had been set up in 1974. This latter fund was discontinued at the end of the 1996/97 funding year.

By the time the 1990 Canada/Alberta Partnership Agreement in Forestry was signed, regional CFS research policy was shifting away from applied forest management research to a "Centre of Excellence" focus on national and international programs, including fire, pest management, and climate change.

The 1991 Management Plan illustrated the relatively minor research role of the CFS compared with the past. The plan listed only one new project, pine-aspen competition (Stan Navratil), and the ongoing regenerated stand mortality study by Bill Ives and Cam Rentz. It notes a mixedwood regeneration study by WESBOGY; a University of Alberta rodent damage study on pine and another on Armillaria root rot; an aspen girdling study; a Free-to-Grow Standard study by the AFS in cooperation with the CFS and AFPA respectively; and a block road rehabilitation study by the Alberta Environment Centre. The Company continued trials on machinery and technology for harvesting, site preparation, reforestation surveying and tending.

6.1 Integrated Resource Management (IRM)

Rick Bonar
HINTON WOOD PRODUCTS COLLECTION

In 1988, Weldwood hired Rick Bonar, the first biologist staff member engaged by the forest industry in Alberta. An Alberta-wide government/Company Integrated Resource Management Steering Committee (IRMSC) was formed in 1988 to advise the Company and government on integrated resource management (IRM), and Bonar was a member from the Company. Until this time, as explained by Bonar, wildlife had been "game biology," with management concerns focused on "animals you could eat or hang on your wall." Rick Bonar observed that the emergence of "non-game biology was the early sign of emphasis on ecosystems, biodiversity, and ecological integrity that are very much part of the program today."

From 1988 onward, the approach to IRM moved from the Jack Ward Thomas' life form (species) approach, which grouped the nearly 300 vertebrates on the FMA into similar habitat classes—the "fine filter" approach—for investigation and management, to a later "coarse filter" approach based on the assumption that, if serial stages can be retained in the landscape within their historic range of occurrence, wildlife needs will be met and the species mix will be maintained.

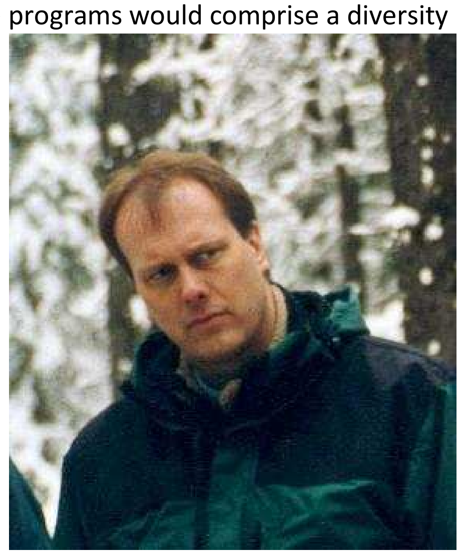
In 1990, IRMSC presented its report and, in the 1991 Forest Management Plan, the Company committed to developing an Integrated Resource Management Plan with multi-resource inventories to support strategic objections for non-timber values at the forest (landscape) level. By 1991, Rick Bonar's IRM research focus on the FMA was on habitat as a way to conserve biodiversity, viewed in terms of the dynamics of change through time, requiring habitat modelling research. This work began in 1991 but results were not available for inclusion in the 1991 expansion and management plan.

The momentum of IRM research on the FMA and the Company commitment to the ultimate integration of wildlife needs into harvest planning and operations were key factors in the successful bid to establish the Foothills Model Forest (FMF) in 1992.

By 1994, the Company employed three biologists and the FMF had two, adding impetus to IRM research through both expertise and funding. Company biologists also served on operational planning teams on the FMA.

6.2 Forest Research at the Foothills Model Forest

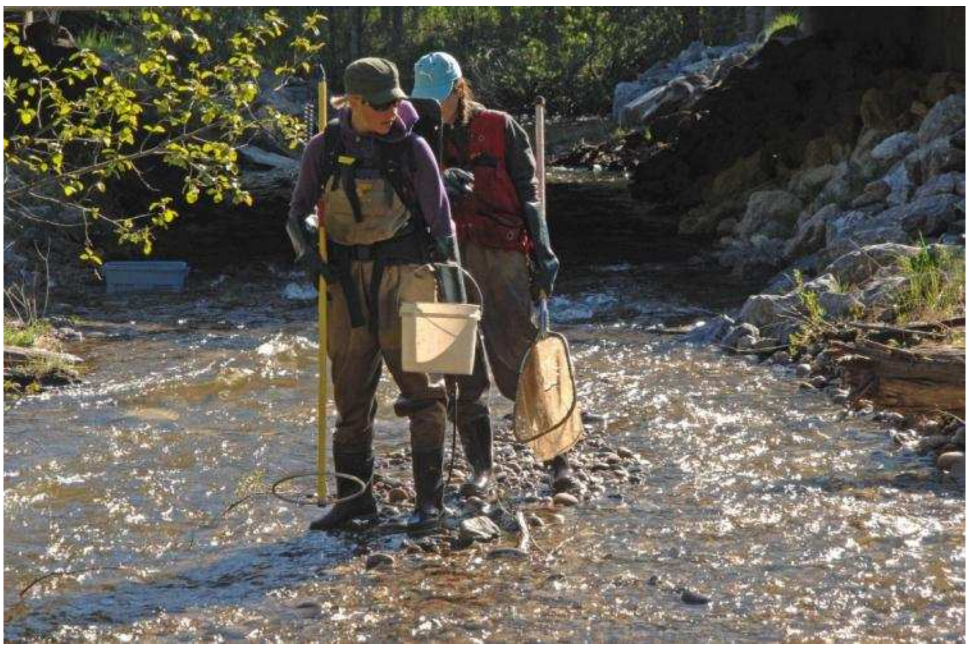
The government of Canada introduced the Model Forest Program in 1992 through the Canadian Forest Service. It was one of the federal commitments under the National Forest Strategy, and part of the government's new Green Plan in response to directions from the Canadian Council of Forest Ministers to work toward sustainable forest management practices. The plan envisaged creating 10 model forests, working models of sustainable forest management, that would be representative of the major forest regions across Canada. These forests would represent a diversity of ownerships and the partnerships involved in the programs would comprise a diversity of stakeholders. With joint funding of industry and government, each such forest board would examine various elements of sustainable forest management, conduct such inventories and studies that were necessary, and implement research to address the major gaps in knowledge about the forest and people. By 2001, the end of the 10th year of the program, there were 11 model forests and 1 adjunct model forest in the Canadian network and 18 in an international network.



Rick Blackwood was seconded from Alberta Sustainable Resource Development to become the first General Manager of the Foothills Model Forest in 1992
ROBERT UDELL PHOTO

The Company partnered with the Alberta Department of Forestry, Lands and Wildlife, and the Environmental Training Centre at Hinton (now the Hinton Training Centre) to develop a successful proposal for creation of the Foothills Model Forest (FMF) in 1992. Willmore Wilderness Park was added in 1995 and Jasper National Park joined in 1997 at the time of the five-year renewal, bringing the total core research land base to 2,750,000 hectares.

Silvicultural activities were implied in the Foothills Model Forest's definition of sustainability of forests: "to manage the forest resource without prejudice to its future productivity, ecological diversity and capacity for regeneration." A primary role of the FMF was to develop integrated resource planning models and trials to be fed into management planning and operations on the FMA area. Filling knowledge gaps in the Enhanced Silviculture (ES) initiative was to be a significant role for FMF.



Watershed research – electrofishing – at the Foothills Model Forest, 2008
COURTESY FOOTHILLS RESEARCH INSTITUTE

6 A Revitalized Silviculture Program with Enhanced Forest Management, 1993–2005

1. Historical Context

The National Forest Round Table on Sustainable Development was established in 1994. Sustainable forest management was further defined by the nationally developed Criteria and Indicators of the Canadian Council of Forest Ministers in 1995. The six criteria identified by the CCFM as broad yardsticks of sustainable forest management can be paraphrased as:

1. conserving biological diversity;
2. maintaining healthy and productive forest ecosystems;
3. conserving soil and water;
4. monitoring the forest's contribution to global ecological cycles;
5. maintaining the forest's multiple benefits to society; and
6. opportunities for society to take responsibility for sustainable development.

This was followed by the creation of third-party programs to certify forests that were being managed to achieve sustainability. The Canadian Standards Association (CSA) developed the Z809 standard for Canadian forests, while the Forest Stewardship Council (FSC) developed various systems depending on the country and its circumstances, including Canada. In the United States, the Sustainable Forestry Initiative (SFI) held sway, while in Europe the international Programme for the Endorsement of Forest Certification (PEFC) was developed. The Alberta Forest Products Associated developed its "ForestCare" program for its members, which was primarily a code of practice that related to environmental stewardship and useful for members who did not have management planning responsibilities.

1.1 The Alberta Forest Conservation Strategy, 1994–97

In the early 1990s, following a recommendation of the Expert Panel of which Udell was a member, the Alberta government began a lengthy multi-stakeholder process to help develop an Alberta Forest Conservation Strategy (AFCS). The province established an Alberta Forest Conservation Strategy Steering Committee in 1994. Its 1997 report recommended, among other things, an approach to forest landscape management that would consist of a network of protected areas; extensively managed areas; and intensively managed areas along with single-use "facility" sites for specific installations such as gas plants, mines, etc. The recommendations were considered by the government, but it deferred a response in favour of further study and additional committee work that culminated in the 1998 Forest Legacy Framework, the official response to the recommendations of the AFCS Steering Committee (see following sections).

1.2 The Jacques Report 1997

In 1996, the government of Alberta asked MLA Wayne Jacques to chair a task force to examine potential changes to the system of granting and renewing forest management agreements in Alberta. Jacques consulted widely with stakeholders, including the pulp and paper community in Alberta, which represented most of the FMA holders at the time. The final report that was accepted by the Standing

Policy Committee and the Minister included a strong recommendation that the forest industry in Alberta be encouraged to practice intensive management. As a way of encouraging this intensification, as well as stimulating fibre exchanges and purchases from other producers and private lands, Jacques included a recommendation that future forest management areas be of insufficient size to supply the full fibre needs of associated facilities.

1.3 Alberta Forest Management Science Council Report, 1997

The Alberta Forest Management Science Council was established in 1996 to report to the Minister of Environmental Protection on the science base required to change from sustained yield management to sustainable forest management. The report was to incorporate a wide range of values in the forest and inform the province on necessary steps for Alberta to meet its commitments under the Canada Forest Accord of 1992.

The Council's 1997 report and recommendations[56] adopted philosophies of the Forest Conservation Strategy and included the application of a closed-loop sustainable forest management system incorporating public participation. The report to the Minister included a new definition of sustainable forest management: "The maintenance of the ecological integrity of the forest ecosystem while providing for social and economic values such as ecosystem services, economic, social and cultural opportunities for the benefit of present and future generations."[57] It also included five important elements needed to meet the intent of the definition:

1. inherent disturbance and the conservation of ecological integrity;
2. defining a vision of a desired future forest;
3. social and economic values and public involvement;
4. balancing the spatial and temporal scales of forest management consistent with natural and inherent process in the forest; and
5. applying the principle of adaptive management.

1.4 A Policy Framework for Enhanced Forest Management in Alberta: 1997

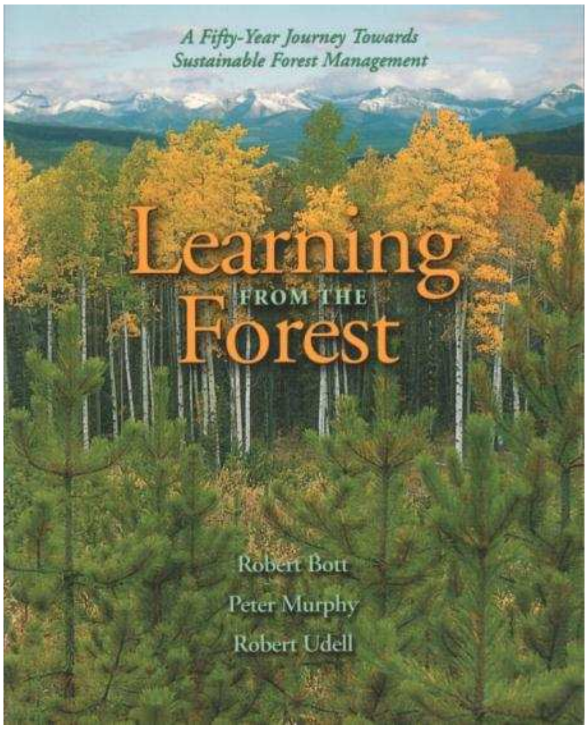
The Forest Conservation Strategy Steering Committee recommendations and the Jacques Report both cited the intensive management imperative for Alberta. But current Alberta regulation and policy, while offering no barriers to intensive management, did not provide sufficient assurance that those choosing to implement it would benefit from their choice. At the encouragement of Minister Ty Lund, a joint industry/government task force on enhanced forest management produced a report in January 1997[58] that was accepted by both Minister Lund in February and subsequently by the Standing Policy Committee.

Further work with by industry and government representatives added two reports in the fall of 1999. One described the changes to policy and regulation necessary to support the implementation of enhanced forest management (EFM) in Alberta. The second provided the technical protocols with details of how the framework principles would be addressed, including requirements for forecasting, establishing crop performance standards, monitoring and evaluation, and the allocation of benefits in the case of overlapping tenures.

1.5 Forest Legacy Framework, 1998

The Alberta Forest Legacy Framework in 1998 was the official response to the recommendations of the various committees and task forces from 1994 to 1997. It set forth, in simple terms, the province's strategy for meeting its commitments under various reports and recommendations, including the application of a closed-loop sustainable forest management system incorporating public participation.

1.6 Learning from the Forest 2003



The Adaptive Forest Management and History program was established in the Foothills Model Forest in 1996, and in 2003 published its first book – Learning from the Forest – authored by Bob Bott, Pete Murphy and Bob Udell. Gordon Baskerville, former Dean of Forestry at the University of New Brunswick and Professor Emeritus of the University of British Columbia wrote the Foreword to the book, commenting that "The Hinton story shows management must be a continuous process of learning of and from the forest, as opposed to following "rules for tools". … Learning by generations of managers has been the basis of the very real success of management in the Hinton forest." Ken Armson, former Chief Forester of the Province of Ontario described it as "…an important account of a large forest area that has had continuous management by one organization – the company – for nearly half a century or one forest rotation."

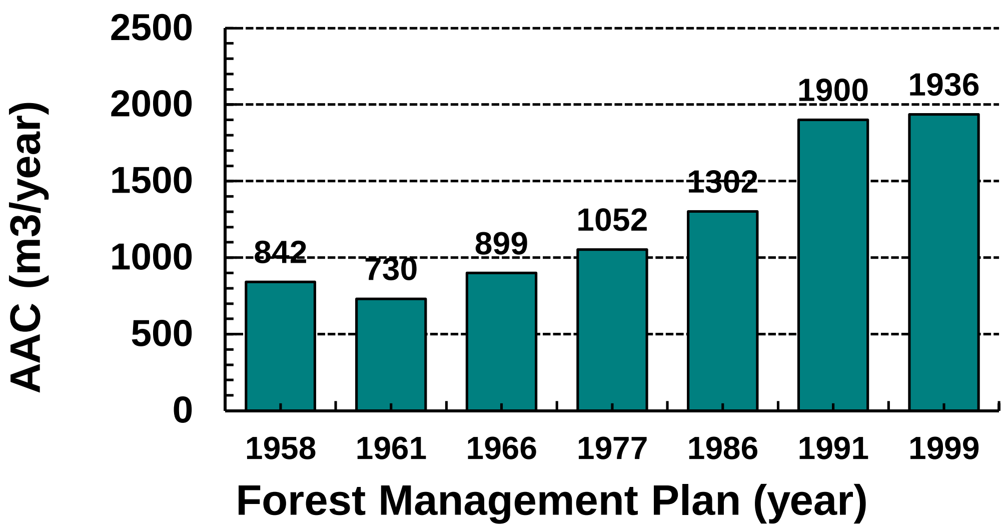
2. Forest Policy and Planning

In 1992, Doug Walker resigned and was replaced as Management Forester by Hugh Lougheed. Lougheed's 1999 Management Plan incorporated new managed-stand yield tables using an improved growth-based approach to yield determination. It did not include AAC uplift projections from the Enhanced Forest Management (EFM) Program but set the stage for detailed work to prove EFM contributions to growth and yield for use in interim planning and future management plans. It was a much more integrated resource plan than any preceding one and was the first plan where the entire enterprise was linked intimately to the relationship between assumptions—many growth- and yield-driven—and field performance based on the Linked Planning Process (see Section 2.3 below).

Hugh Lougheed (seated) with Wayne Mayan, 1995
HINTON WOOD PRODUCTS COLLECTION

Chart 6.1 shows the gradual increase in AAC between the various management plans to that date. However, the land base dedicated to timber production was a continually shifting target as expansions added land, and other initiatives such as protected area increases and stewardship set-asides took productive forestland out of the allowable annual cut calculation. The proportion of productive forest assigned to forest management declined from a high of 87.8 per cent in 1958 to 71.1 per cent in 1999. Chart 6.2 shows forest productivity expressed as mean annual increment (cubic metres growth/hectare of contributing land base/year) for the productive forests associated with each plan.

Chart 6.1 Allowable annual cuts by management plan year, 1958–1999



The gradual increase in AAC between management plans resulted from a number of factors, for example:

- The AAC in 1958 was assigned by the province and Company in the absence of an inventory.
- The 1961 AAC was calculated on, and assumed, a rotation age* of 100 years,
- The 1966 plan used an 80-year rotation during which period the full land base was to be logged and reforested.
- The 1977 plan assumed a fixed end to the first rotation. Accumulated undercuts resulted in an accelerated harvest in order to meet the deadline.
- The 1986 plan, for the first time, incorporated growth performance from permanent sample plots, as well as regenerated stand yields. The fixed end to the first rotation was eliminated and a 90-year rotation adopted.
- The 1991 plan included better information on regenerated stand performance from the new Regenerated Stand Inventory as well as permanent sample plots information. More significantly, the area of the Forest Management Area was increased from 800,000 to 1,000,000 ha.

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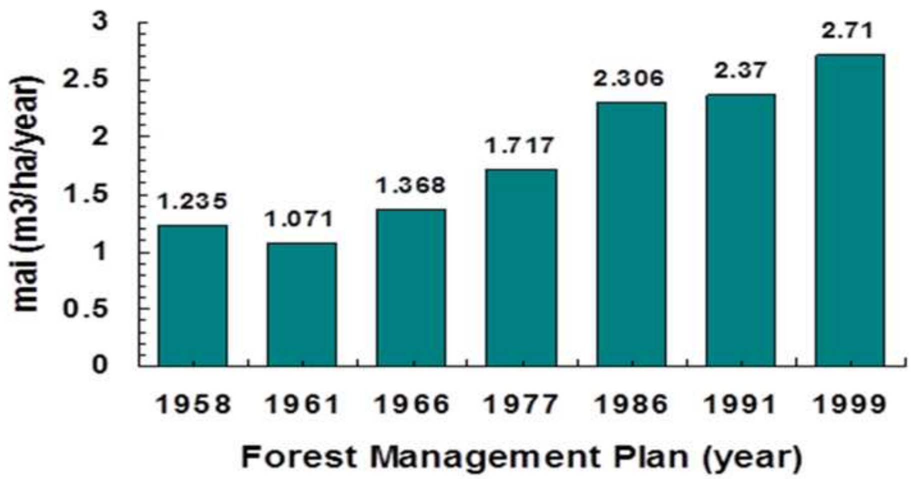
* Rotation age (R) is defined as the age when forest stands should be harvested, traditionally viewed as the culmination of Mean Annual Increment (MAI). In a fully regulated forest, there would be an equal distribution of stands between age 0 and R, and each year the stands at age R would be cut, returning to age 0. With modern computer simulation models, this system is no longer used, although the importance of reliable growth and yield information continues to be paramount in calculating allowable annual cut (AAC).

- The 1999 plan used an optimization model—Woodstock—with improved growth projections and improved fibre utilization (reduction of butt/top ratio from 13 cm/10 cm to 10 cm/8 cm).

Chart 6.2 Productivity indices (mean annual increments) by Management Plan, expressed as AAC (m3) per hectare of productive area in the FMA



2.1 The Kimmins-Brace Report, 1993

In the early 1990s, the Alberta Forest Service criticized the Company for excessive site degradation through rutting of the soil during harvesting operation and began issuing a series of penalties. Meanwhile, the AFPA and the AFS were developing guidelines to reduce site disruption by forestry operations to acceptable levels. To establish the scientific basis for the criteria, the Company worked with Dave McNabb of the Alberta Research Council to set up a number of research trials on compaction and decommissioning roads after harvest through such treatments as deep ripping through compacted soil.

The Company hired University of British Columbia professor H. P. (Hamish) Kimmins, a noted forest ecologist, to visit the operations to give his opinion on the issue. His report, based on a two-day field trip 14–15 May 1992, offered a number of suggestions for improvement, including the following:[59]

- identifying potential problem areas before harvest, including the use of certain plant species as indicators;
- better training of equipment operators;
- restricting the size of interior block roads;
- careful execution of remedial work to correct rutting;
- prompter regeneration following harvest;
- more use of planting for reforestation; and
- use of higher quality and larger planting stock.

The strong concerns he raised during his visit led to a more rigorous examination of the silviculture program by the Company. Kimmins and Lorne Brace—a member of the 1991 Expert Panel in Forestry and recently retired as a mixedwood silviculturist from the Canadian Forest Service—were hired by the Company to conduct the review. During the field trip and meetings thereafter, they advised the Company that the reforestation program was sorely lacking and not meeting the assumptions contained in the 1991 Forest Management Plan. Without corrective action, they warned that allowable annual cuts would inevitably decline as the quality of the resource base declined.

Their report,[60] submitted in February 1993, contained observations on Company operations and included 13 recommendations to improve them. Among the observations and recommendations were the following:

1. Effects of soil disturbance were speculative and needed more research.
2. Post-disturbance mitigation was often ineffective, and the disturbance should be reduced substantially in the first place.
3. The Company should formalize pre-harvest site assessments, site classification, and use of indicator plants.
4. Field training of field supervisors and equipment operators is critical.
5. “Stop Operations” guidelines should be developed and used to prevent site degradation, rather than relying on judgment calls.
6. Site preparation activities for reforestation were themselves creating problems in site disturbance.
7. Rather than burying topsoil under internal block roads, it should be removed and saved for later reclamation of the roads.
8. Managing site disturbance to the least common denominator could jeopardize long-term forest level AAC.
9. Public opinion of such site disturbance could potentially be more damaging to Company operations than any loss of productivity.

Bush Chipping Operation, McLeod Compartment 7, 1993. Full trees were chipped, the branches, bark and needles separated from the wood chips which were then blown into vans for transport to the mill. The chipped-up branches, bark and needles were loaded into a machine similar to a manure spreader, but much larger, and spread across the cutover area.
HINTON WOOD PRODUCTS COLLECTION

Although the initial purpose of the investigation was to examine the impacts of rutting on reforestation performance, the experts noted that other issues were more pressing, for instance:

1. Planting stock used in reforestation was of inadequate size and quality.
2. Roadside processing was removing the necessary seed for natural regeneration of many cutblocks.
3. Vegetative competition was impeding seedling survival and growth.

Brace and Kimmins also suggested that the Company begin operational trials to examine the impacts of chipper residue on site productivity.

2.2 The Crossroads Report, 1993

The Kimmins-Brace Report set in motion a series of decisions and events that led to a substantial leap forward in the silviculture program. An internal silviculture review generated the 1993 Crossroads Project Report[61] that reinforced the Kimmins-Brace recommendations and set out strategies and budgets necessary to put silviculture on a footing to meet the assumptions of the 1991 Forest Management Plan and ensure sustainability of the resource. This was followed by an additional $1 million per year allotted to the silviculture program by the Company to address an outstanding backlog of non-sufficiently restocked (NSR) areas and to establish a strong, effective, ongoing program.

The Kimmins-Brace wake-up call was heeded, and a task force from planning and operations set to work to recommend necessary changes to bring the forestry program up to the expectations of the Forest Management Plan. Of equal import, they wanted to set it back on the course initially charted by Crossley and his successors. The days were long gone when an excess of allowable cut over wood supply needs would compensate for any slippage in the silviculture program. Any practice that was out of line with the Forest Management Plan assumptions needed correction, and quickly.

The Crossroads Report's 25 recommendations delved into areas of silviculture management and forest management plan assumptions. The report is summarized in eight key areas:

1. *Adaptive management*: The silviculture program should be put into an adaptive management framework with explicit planning, assessment, control, and reporting procedures. In this way, any failure of the program to meet required benchmarks would be detected and could be corrected.
2. *Pre-harvest planning*: Harvest and silviculture planning should be combined in an ecologically based pre-harvest planning process.
3. *Crop protection*: A vegetation management program should be put in place, not only to meet regulatory commitments but also to preserve the softwood land base.
4. *Quality control*: A quality control program should be established to follow up on reforestation treatments to ensure continuing performance or to trigger necessary correction.
5. *Seedling supply*: The Company should take control of its own seedling supply, through discussions with the province. The Company greenhouse needed to improve its performance to, at the minimum, come up to the industry standard in Alberta.
6. *Backlog reforestation*: The Company should consider reforesting 4,000 hectares picked up as not sufficiently regenerated in the regenerated stand inventory conducted for the Forest Management Plan.
7. *Tree improvement*: The Company should immediately get back into the tree improvement program. Benefits included allowable cut at a cost per cubic metre less than purchased wood, plus a guaranteed supply of quality seed.

8. *Forest stewardship*: A local policy for stewardship with goals, objectives, and standards of performance was recommended.

The report included a five-year program with attendant costs in excess of $1 million annually. It was accepted without argument and implementation began shortly thereafter. To put the necessary rigor back into the program, the entire silviculture group was pulled out of District Operations and Forest Planning and concentrated under one manager, David Presslee, who had joined the Company in 1992 as a silviculture planner.

Presslee set about implementing the recommended changes from the Crossroads Report and did so very successfully. Virtually every recommendation was acted on with impressive results in terms of both planning and implementing a very aggressive and effective program. For example:

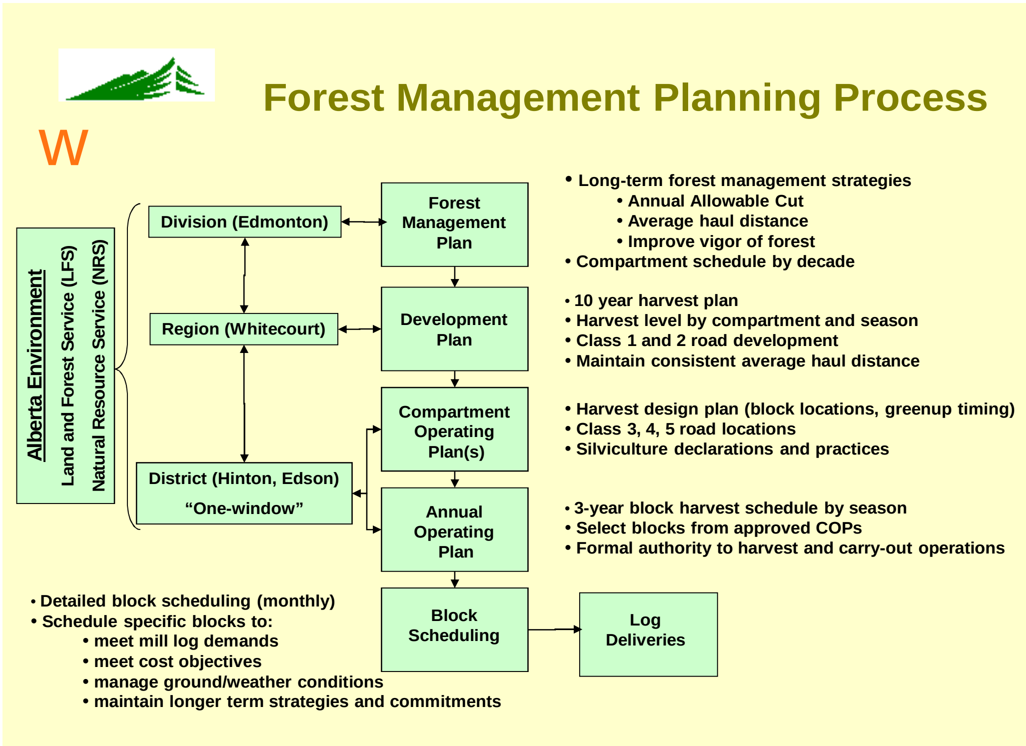
- The Foothills Model Forest developed an ecosite guide for west-central Alberta, with Weldwood's support and participation. This guide was used to begin to classify the entire FMA area by 2003.
- Silviculture and harvest planning were done together, using the ecological classification to inform the decision on harvest and reforestation systems to be used.
- The 4,000 ha backlog of NSR area was examined and, where appropriate, reforested.
- Burning of roadside slash was subsequently done only when it was prescribed for silviculture purposes, e.g., to remove slash to improve planting chance, and is now done on less than 20 per cent of the blocks harvested.
- Stumpside delimbing was re-introduced in 1994.
- Fox Creek Development worked under contract to manually clean backlog cutblocks of overtopping hardwood competition. This program kept a 20-person crew working for eight months each year.
- Following changes to the Forest Management Agreement in 1995, the Company began to supply its own nursery stock at its own cost. A rigorous quality control system was developed and applied to contract as well as Company growing stock.
- Hinton Division set forward a new stewardship policy in 1999.

2.3 Linked Planning Process, 1994

In 1993, a Linked Planning Process[62] (see Figure 6.1) was developed by a joint Company/AFS task force, co-chaired by Bob Udell (Weldwood) and Dan Wilkinson (AFS) and including Rick Bonar and Hugh Lougheed from the Company and Tony Sikora from the AFS. This was a significant turning point in management planning on the Hinton FMA and for the province as a whole. Until the early 1990s, the Company harvest was well below AAC and discrepancies between planning and performance were not a major concern, given the "cushion" of undercut. This changed with mill expansion and the ramping up to full AAC at various operations across the province.

The report on the Linked Planning Process was presented to and accepted by ADM Ken Higginbotham in January 1994 and was integrated into subsequent ground rules and management plans.

Figure 6.1 The linked planning process, 1994



2.4 Tree Improvement Proposal, 1995

Despite all the efforts to ramp up the silviculture program to meet and exceed the assumptions of the Forest Management Plan, concerns remained about the long-term timber supply available to feed the mills at Hinton. The allowable cut from the new Forest Management Area was less than the fibre needs of the facilities at Hinton, and various options to supplement this supply were under review. Purchased wood was expensive, and other means of increasing AAC were actively considered.

Weldwood's Board of Directors directed the Company (at the 28 October 1994 Board Meeting) to review the benefits and costs of tree improvement with a view to putting such a program in place.

The same players who produced the Crossroads Report reconvened to examine the issue of tree improvement at Hinton; they reported in January 1995.[63] The report reviewed the history of tree improvement at Hinton, noting that this program at Hinton had suffered in the past due to lack of a continuing commitment.

The resulting report contained 13 recommendations, strongly advising that a comprehensive tree improvement program be implemented, at an estimated cost of $400,000 per year. It suggested that such a program had the potential to increase the AAC substantially, at a lower per-metre cost than that of purchased wood. Gains would increase in the second rotation by up to 400,000 metres per year.

The need for outside help and buy-in was highlighted. First, the committee recommended that the Company cooperate with the provincial government to develop an agreement on technical and regulatory procedures to enable tree improvement programs. Partnerships with other companies of like mind were recommended. It emphasized the need for a positive and factual public information program around the program. The report also suggested bringing in forestry specialists from Champion's technical centre at Greenville, North Carolina, to help develop the program.

Tree Improvement Specialist Diane Renaud
ROBERT UDELL PHOTO

Again, the report was embraced by the Company, and immediate steps were taken to implement it. A new Tree Improvement Specialist position was established, and Diane Renaud took over the position in 1996. She moved quickly to build and implement a comprehensive tree improvement program, addressing the technical recommendations in the report.

2.5 Enhanced Silviculture Proposal, 1996

With basic silviculture and tree improvement programs beginning to build momentum, a Forest Resource Department task force turned its attention to the opportunities available from intensive forest management. The need for such a program was evident as the Company faced continuing downward pressure on the land base available for management and therefore for the AAC. The loss of land base to other uses, increasing stewardship initiatives, fears of protected areas strategies, and the impact of pending endangered-species legislation all contributed to growing unease about the sustainability of the AAC with status quo management.

With the assistance of domain specialists David Todd (Tree Improvement) and Jim Gent (Soils and Nutrition) of Champion, the committee reported back with nine recommendations for intensive management.[64] In presenting its recommendations, the committee used a table to illustrate the three levels of silviculture practice related to impacts on allowable annual cuts and the Alberta Forest Products Associations ForestCare certification standards, established in 1993. (See Table 6.1.)

In 1999, Champion specialists joined Company foresters and other industry representatives on an pivotal tour of historic pine research trials in Alberta. This photo includes the Champion and Company representatives. Standing – Diane Renaud; Back Row L-R. Dr. Jim Gent (Champion), Thomas Bruan, Rod Beaumont (Weldwood Chief Forester), Bob Udell, Jack Wright (retired Hinton Chief Forester), David Todd (Champion); Front Row L-R. David Presslee, Shannon Fagnan, Leo Fagnan, Dr. Bob Kellison (Champion)

BOB UDELL PHOTO

The committee again noted the need to ensure a policy framework was developed in Alberta to make sure investments in intensive silviculture would reap benefits for the Company. Issues of land use zoning, security of investment, and how the yield gains of intensive silviculture could be captured in the allowable cut calculation were noted. Long-term commitment in funds and manpower was stressed, along with the need to develop technically defensible yield estimates for allowable cut determination. It recommended the use of qualified consultants to help develop the program, along with the research and monitoring necessary to define the benefits. Preliminary estimates of yield increases associated with various types of treatment were offered.

Table 6.1 Levels of silviculture practice based on impact on allowable annual cut and the criteria for ForestCare certification

Level	Purpose and AAC Impact	Treatment
Regulatory	1. ForestCare Level 1 Certification (currently accepted practice) 2. To meet legislated minimums 3. Likely will not sustain AAC	- Post-harvest assessments (MOS) - Site preparation within two years - Planting or natural regeneration to achieve minimum stocking - Weeding to minimum "free to grow" standard
Basic	1. To ForestCare Level 2 Certification (forestcare level) 2. To meet 1991 FMP assumptions 3. Ensure AAC is sustained	- Pre-harvest planning - Prompt regeneration - Full stocking - Backlog reforestation - Early brushing and weeding
Intensive	1. ForestCare Level 3 Certification (Alberta state of the art) 2. To increase AAC on FMA area 3. Significant increase in AAC	- Tree improvement - Juvenile spacing - Innovative silviculture systems - Commercial thinning - Fertilization - Fertilization and thinning - Plantations of exotic species

Interestingly, although the report was developed by an independent process and used different staffs, its recommendations were remarkably consistent with those in Crossley's initial 1970 report[65] as shown in Table 6.2 below. The reason this report was embraced and Crossley's was rejected can largely be attributed to the different environments surrounding wood supply. Until the Environment Council of Alberta's report of 1979[66] on the environmental impacts of forestry operations, government policy supported full allocation of sufficient wood supplies to feed all FMA area-dependent manufacturing facilities. But that report recommended that more efficient use of wood processing by-products would be gained, and better environmental stewardship would result, if industry were granted less than its full needs. The 1988 FMA was negotiated in that context, with only approximately two-thirds of the required wood supply as the outcome.

The report was accepted, and plans began to implement the proposals. Stan Navratil, then a senior research scientist at the Canadian Forest Service's Northern Forestry Centre, agreed to serve the Company in an advisory capacity to define the appropriate intensive management program. Next, he was to design and oversee the installation of a system of research trials to provide the necessary definition and validation of the forecasts of yield improvement.

Stan Navrital
HINTON WOOD PRODUCTS COLLECTION

Table 6.2
1970 Intensification of management proposal summary and 2005 FMA status

“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:” D.I. Crossley, 1970	
Crossley’s 1970 Report recommendations	**2000 Status**
1. Minimize outside wood purchase to reach AAC earlier, thereby moving to fixed ground rent.	FMA area at full AAC, supplying approximately two-thirds of needed fibre; remainder purchased. Intensive management program in development.
2. Investigate the use of dead and down material from harvest and fire-killed stands.	Dead wood and fire-killed wood now used in mill production.
3. Investigate use of smaller size classes in harvesting systems.	Utilization now to a 10/8 standard;* bush chipping of small-diameter stands.
4. Establish additional seed production areas to encompass varying land elevations.	Seed production areas abandoned. Tree improvement program to supply spruce seed.
5. Investigate practical methods of cleaning dense pine regeneration stands.	Techniques proven; program suspended in late 1980s, starting again in 2000 with ramp-up to full operational status by 2008
6. Immediately initiate genetic improvement programs.	Provenance trials in late 1970s. Full tree improvement program underway, 1996. Elite pine seed orchard established near Edson, and Company is partner in Huallen Seed Orchard near Grande Prairie.
7. Consider forest fertilization following CFS trial evaluations.	Fertilization still being studied; potential is proven and implementation is planned. Methodology for definition of suitable areas being developed.
8. When small material is usable, consider use of harvest thinnings.	Commercial thinning trials underway. Benefits of CT have been demonstrated in net yield increase, plus value of product.

* The current utilization standard at the time was 15/10, indicating that all trees on a cutting area 15 cm and larger at the stump would be cut, and all felled trees would be utilized to a 10-cm diameter top. The 10/8 standard would have improved utilization well beyond that at both a tree and stand level. No other operation in Alberta is currently at 10/8 standard.

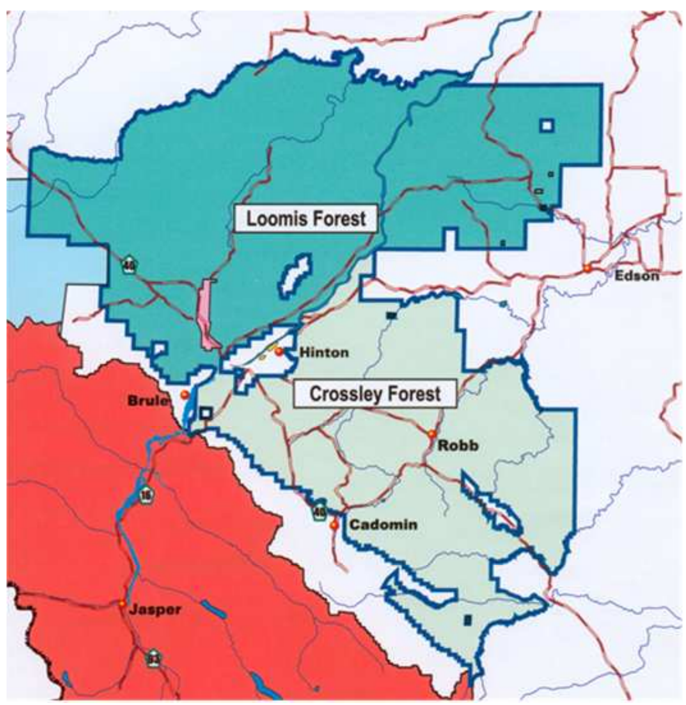
These changes resulted in silviculture planning moving rapidly into an integrated resource management framework covering the whole life of the stand, as an integral part of the Company Stewardship Policy. In just 30 years, silviculture planning had moved from a 10-year focus on conifer reforestation to full-rotation focus on integrated resource management, from a key role in maintaining the AAC to a pivotal role in sustaining and increasing the AAC.

The 1999 Management Plan emphasized increasing the AAC through more aggressive and timely reforestation, combined with monitoring and husbandry throughout the life of the stand. Although some form of clear-cutting was expected to predominate, other systems—such as shelterwood—may be adapted to sensitive areas like riparian zones and areas requiring understory protection. The system chosen had to satisfy the Company's Forest Stewardship Policy.

2.6 Renaming the Hinton Forest

In September 1997, the Company celebrated the 40th anniversary of the first bale of pulp rolling out of the mill. In conjunction with this celebration, it produced a small history of the forestry program on the Hinton Forest to date, *Living Legacy.*[67] Also, in September, members of the Crossley and Loomis families were invited to a special celebration in Hinton, where Company president George Richards announced that the contributions of Des Crossley and Reginald Loomis were being recognized officially through naming the landscape of the Hinton Forest on the south side of Highway 16, The Crossley Forest, and that on the north side, The Loomis Forest. (See Map 6.1.)

Map 6.1 The Crossley and Loomis forests, named in 1997



2.7 Forest Certification

In 2000, the Company was successful in certifying the Hinton forest to the demanding standard of the Canadian Standards Association Z809 Forest Certification Standard. This registration of the FMA area attested to its status as a sustainably managed forest under the CSA standard.

3. Ground Rules

The 1993 Crossroads Report reviewed the efficiency and effectiveness of the silviculture program and recommended a new approach to planning, monitoring, and evaluation, specifying ecologically based pre-harvest planning. This resulted in the first major change since 1955 in the way silvicultural systems were defined and applied.

By 1996, there was a three-tiered program of public input, adding public notification of initiation of Compartment planning with the Forest Resources Advisory Group providing advice on Operating Ground Rules. This move to public participation is a major change in the view taken by Company foresters of the role of the public in integrated resource management.

The 1996 Ground Rules were a collaborative exercise involving Weldwood, Alberta Environmental Protection, and Weldwood's Forest Resources Advisory Group (FRAG), a multi-stakeholder advisory committee. Content complexity and the need for frequent revision characterized these Ground Rules, which developed in response to an array of fast-moving events between 1988 and 1996. These events included the expansion of the FMA area in 1988 and the subsequent expansion of mill facilities and the need to consider intensification of silviculture (Section 6.5) and enhanced silviculture; the development of ecological land classification methods and documentation after 1993 to 1996 and its adaptation to ecosystem management; and increased localized public concern about the environmental effects of forestry in the 1980s and its globalization in the early 1990s.

A major operational change in silviculture in the 1996 Ground Rules ("Renewal and Stand Maintenance") was the focus on the ecosystem and a move back to the "guiding principles" approach of 1958 and 1968. The approach at that time had operations guided by the need to ensure that scarification, reforestation, and tending operations were ecologically suitable and environmentally responsible. Pre-harvest and pre-treatment silvicultural assessments were required to ensure site-specific treatments, facilitating the integration of harvest and silviculture planning and operations that developed in the period 1992 to 1995.

The 1996 Harvest Planning and Operating Ground Rules stated that "the silviculture system employed must be ecologically suited to the tree species and forest site being managed and likely to result in prompt, healthy regeneration." Systems for each block were to be "based on the ecological characteristics of the site, the current health, the structure and species composition of the stand, the ecological characteristics of the species to be regenerated, and the operational feasibility and economic viability of the proposed regime throughout the whole life of the stand."

The last Ground Rules update covered by this report was in 2002. They lasted until 2009 when the Company moved to the Provincial Ground Rules format. The 2002 update again emphasized the Linked Planning process. These 2002 Ground Rules were restructured to increase clarity and facilitate revisions as necessary and were subdivided into three major sectors, i.e., "Intent," "Standards," and "Operating Practices."

4. Forest Operations

4.1 Mill Expansions and Logging Systems Review

In an overall review of logging systems in the early 1990s as a result of the mill expansions under way, staff recognized that the efficiencies in logging were being more than offset by increased silvicultural costs along with environmental problems noted in the Kimmins-Brace report of 1993. Further, it was becoming evident that silvicultural considerations should be an integral part of logging planning. A decision was made to introduce new or revised logging systems that would enable a return to stumpside processing. Dave Presslee later commented on the issue of the full-tree logging system with roadside delimbing:[68]

> It got to the point where, if we didn't do something, we were going to have to plant everything, so the choice was, do we plant everything, or do we do something different. Stumpside processing, which leaves the cones scattered through the cutblock, would obviously give us the seed source for natural regeneration, along with other silviculture benefits.

Stumpside processing: the falling head saws the tree off at the stump and it is then fed through rollers which strip the branches, while the saw cuts the tree into lengths for delivery to the sawmill

HINTON WOOD PRODUCTS COLLECTION

Brian Balkwill, then area operations superintendent added further comment:[69]

> There are many other benefits like the elimination of slash burning, better nutrient recycling, a more favourable environment for seedling establishment through less disturbance, areas for small animals to hide in, which the trappers like, slash to hold more snow for a burst of moisture in the spring etc. . . . but the big one is the seed source for natural regeneration. If you take all the factors together, it has proven to make more sense than roadside processing and full planting.

Bryon Muhly, forest operations manager, explained that this ballooning harvest program, along with the brand-new contractors who would have to be hired to cut it, presented an opportunity for the Hinton Division to take a fresh look at its whole harvesting operation, and at how it would best serve the two mills:

> The pulp mill and sawmill expansions, and the introduction of contractors in 1989, gave us some opportunities that a lot of operations don't get. We've gone from 500,000 m^3 to about 1.7 million m^3, and that scale of expansion is almost like starting a harvesting operation from scratch, in terms of system selection. And we also saw some of the current issues coming down the road, like the need to reduce site disturbance and to move to a more natural silviculture. It seemed like a good time to begin addressing a variety of issues.[70]

4.2 Integrating Logging and Silviculture Systems

Several important points emerged from the in-depth review of logging operations and exploration of options in order to treble the harvest. One was the realization that silvicultural considerations must be made an integral part of logging planning—logging must be viewed as both the end of the stand of trees and the beginning of the new forest. This principle was clearly articulated in the Crossroads Report[71] of 1993 and the Linked Planning Process[72] of 1994, both of which became basic tenets of the forest resources department.

Another related point concerned incidents of site deterioration through such skidder-related factors of rutting and soil compaction. This concern was highlighted by the fact that operations had to be conducted year-round and that the utmost of flexibility in operations was needed. These problems could be alleviated through a combination of low-impact, higher-floatation machines (wider tracks, lower-pressure tires), judicious use of slash as mats to protect the soil, and developing operator awareness and skills. An outstanding example of this last point was the 1999 *Handbook of Forest Stewardship for 21st Century Workers*[73] and related training programs, introduced in 1998.

Grapple Skidder with high-flotation tires, 1990s. Note the mat of branches on the cutover, which also assists flotation.
HINTON WOOD PRODUCTS COLLECTION

4.3 Diversification of Logging Systems

In the early 2000s, about 90 per cent of wood production was from fully mechanized logging systems. Hand-falling, with an average man-day productivity of 35 m^3, was restricted to areas where terrain or tree size prohibited the use of mechanized systems. As new technologies emerged, the role of hand-falling continued to decline. It simply cannot match the productivity (and safety) of fully mechanized systems where production approaches 120 m^3 per man-day.[74]

Each harvest area was assessed and a harvest plan that matched the site and silvicultural objectives was made. In 2000, the Company deployed seven major systems as outlined in Table 6.3.

Table 6.3

The seven major logging systems in use in 2000	**System Type**	**% of volume (approx.)**
Feller-buncher, grapple skidder, roadside delimbing	Tree length	10
Feller-buncher, grapple skidder, in-block delimbing	Tree length	45
Hand-falling, topping, line 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

Eighty per cent of all skidders and forwarders were equipped with flotation tires to minimize soil disturbance. The use of forwarders, typically multi-wheeled and multi-axled with tracks, minimized site disturbance and soil compaction. Because they also carried bigger loads over longer distances, the need for roads was also reduced.[75]

Timberjack harvester and shortwood forwarder in Southern Pine plantation. The abundant lighting enables both day and night operations. With the high cost of equipment, double-shifting is often a necessity.
HINTON WOOD PRODUCTS COLLECTION

A network of permanent roads was essential. The diversity of wood needs along with harvest patterns designed for watershed, wildlife, and wood quality required multiple entries into the forest to effect smaller-scale impacts. Other reasons include access for silvicultural stand treatments, forest protection, salvage of timber from other forest-based industries, and public recreational use.

Transportation also became much more specialized. For off-highway hauling (Company roads), there were 22 self-loading trucks and 30 conventional trucks that require a loader. These hauled an average of 50 tonnes in summer and 55 tonnes in winter. For hauling on public highways, both load- and axle-weights needed to be lower. Tree-length hauling used 20 tandem-axle trucks with seven axles. Shortwood for logs or bolts used a variety of specialized trucks and trailers that carry loads of 37 to 39 tonnes. There were also 5 chip trailers with 30-tonne capacity.[76]

One chip trailer was modified to carry a message of stewardship
BOB UDELL PHOTO

Central tire inflation (CTI) was becoming a standard fixture on logging and chip vans operating on woods roads. CTI allows a vehicle operator to remotely raise or lower tire pressure according to road conditions, reducing environmental impacts and permitting more year-round operations. Bryon Muhly noted that he expected to see more such systems on logging equipment as well as on trucks.

5. Silviculture Program

5.1 Silviculture Planning

Planners in the late 1990s began preparing detailed harvest plans for complete operating compartments before operations commenced. A team consisting of a planner, a silviculturist, and a biologist took into account a wide range of factors—including public input arising from public notices—in preparing detailed and coordinated plans. These encompassed block design, road systems, watercourse crossings and stream protection, wildlife conservation, harvest systems, and reforestation strategies. They were prepared within the context of detailed information gathered for the compartment including, and of particular importance, the ecological classification.

In a 1997 interview, Dave Presslee reflected on the impact of these changes to effective planning and overall costs of harvest and silviculture:

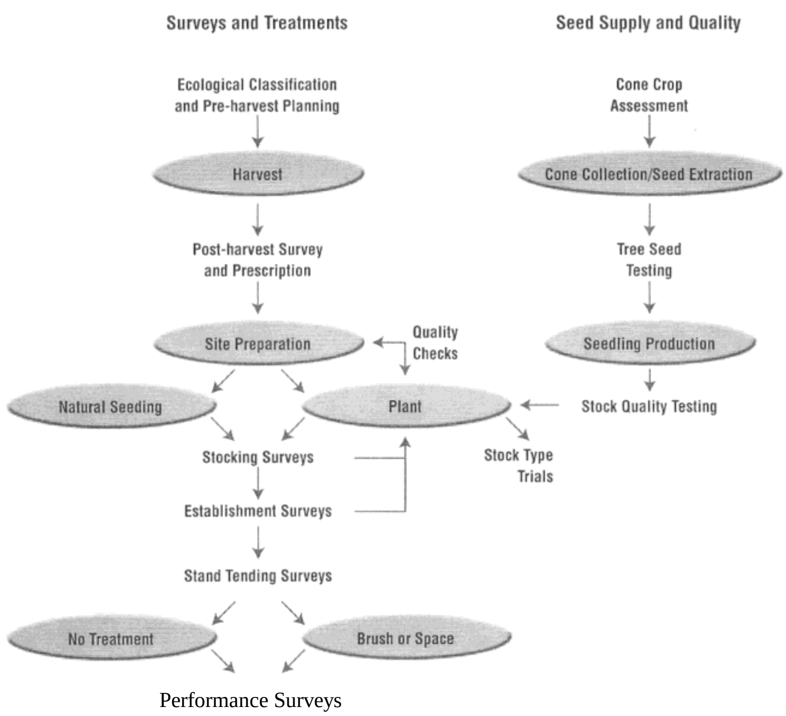
> One of the key problems identified in the Crossroads Report was that Forest Resources staff performance was being judged on minimizing costs in their own respective areas, for example, in harvesting to minimize logging and hauling costs to the mill, and in reforestation to growing and planting seedlings cheaply. Nobody was being evaluated on the performance of this entire cost to the maintenance of the AAC. Our performance should be judged on cost but also the overall performance on how it delivers and maintains the AAC. You could have a very, very efficient harvesting system that was transferring costs to silviculture.
>
> We found that, by spending $0.50 a cubic metre more for wood from trees cut by stumpside processing, we could save $3 on the silviculture side. Now, silviculture Pre-Harvest Prescriptions decide if we're going to stumpside or do roadside processing, whether we're going to clear-cut or partial cut, retain understory or not, to use short wood, tree length or full tree—all those things are decided pre-harvest. The silvicultural plan and the harvesting plan are prepared together.

Following the 1996 Ground Rules update, the main silvicultural components reflected the new holistic approach to planning, from surveys through tending. This is illustrated in Figure 6.2 (a repeat of Figure 1.1). Considerations in planning and treatment included the following:

1. Pre-harvest silviculture planning:
   - must be based on site-specific silviculture declarations developed before harvest ;
   - must integrate both harvest and silviculture planning; and
   - must consider plant biology, economic, climatic, and environmental issues (watershed, wildlife, recreation, aesthetics) as well as harvesting conditions at all times.
2. Silvicultural systems:
   - must be ecologically suited to the species and site and consistent with integrated management objectives;
   - must include modifications of clear-cutting to address understory protection or other factors; and
   - must be operationally feasible and economically viable throughout the life of the stand.
3. Post-harvest/pre-treatment silviculture assessment to ensure planned silvicultural treatments are appropriate, the cutover will be inspected, and treatments modified if necessary.

4. Site preparation:
   - must be ecologically suited to the species and ecosystem to be scarified; and
   - must be done within two years of harvest in an environmentally responsible manner, recognizing site disturbance criteria, watershed buffers, and watercourse management zones.
5. Tree planting:
   - tree species, stock type, and seed lot origin must be matched to the site and properly inspected, shipped, and handled.
6. Evaluation of regeneration success:
   - carrying out of regeneration surveys to ensure that free-to-grow standards are met, using procedures in the Alberta Regeneration Survey Manual (1992); and
   - assessment of stocking, density, height, and free-to-grow status as basis for further planning.
7. Stand maintenance (tending):
   - monitoring of regenerated areas during free-to-grow period to meet reforestation standards and management strategies;
   - recognition of non-timber values like watercourse buffers and snags and other wildlife considerations;
   - monitoring of high-competition hazard sites throughout pre-harvest planning, post-harvest assessments, and regeneration surveys to ensure maintenance of high hazard stands; and
   - retention of non-crop species and other vegetation not competing with the crop.

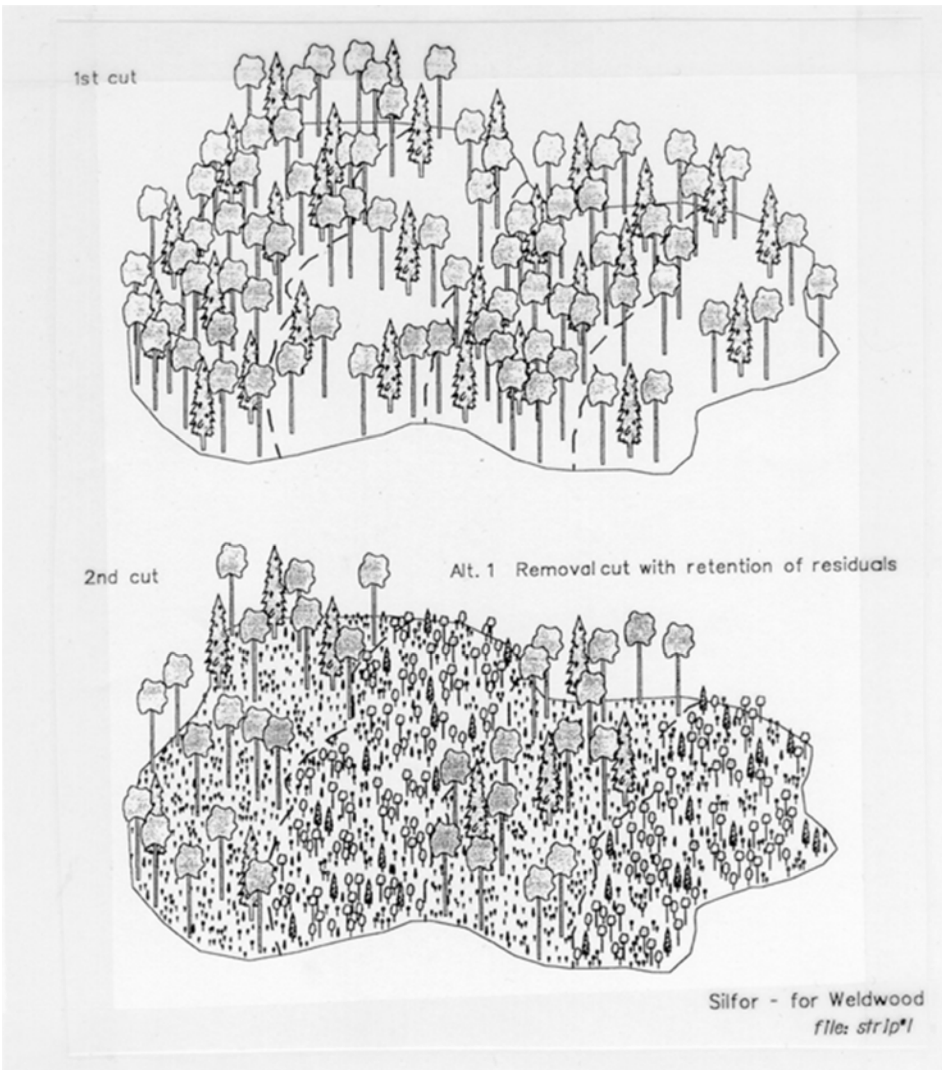
Figure 6.2 Elements of Silviculture planning at Hinton, 2000



An impressive range of silvicultural harvesting systems were developed and considered, including a number of variations of shelterwood, thinning, and clear-cutting systems, among others. These were to be selected or modified according the Pre-Harvest Prescription (PHP) for each site and in consideration of what kind of future forest was desired to meet management objectives. Stan Navratil described examples of future forest projections;[77] one such site-specific option example is illustrated in Figure 6.3.

Figure 6.3 Alternative Silviculture System Schematic

Example of alternative silviculture: application of two-cut strip shelterwood with retention of residuals after removal cut in aspen-leading mixedwoods



Source: S. Navratil, "Applicability and Designs of Alternative Ssilvicultural Systems for the Selected Areas of the Athabasca 4 Compartment, Phase 1" (Hinton: Silfor, 1999)

In practice, however, most forest types still lend themselves to clear-cutting and most of the alternative systems have been used infrequently. They were generally to be applied in circumstances where (i) the clear-cutting system does not work (e.g., many riparian stands), or (ii) where other values preclude clear-cutting (e.g., wildlife, aesthetics, etc.) but where the alternative system could still foster successful reforestation to at least the minimum Alberta standard.

As a follow-up to the Pre-Harvest Prescription done for each block, a post-harvest Management Opportunity Survey continued to be done by the responsible silviculturist to fine-tune the silvicultural prescription and reforestation strategy. All harvested blocks were being treated for reforestation within two years of harvest, but most were completed within the first year.

By the late 1990s, the level of harvest had gradually increased as the two mills worked through their growing pains and achieved a more consistent level of performance, which included some enhancements. This resulted in an increased workload on the silviculture planners and program supervisors.

The Company continued to consider its direction in enhanced forest management through this period and had not made a final commitment by 2005. The future of the silviculture program will be identified and described in the next management plan revision. If an enhanced forest management program is deemed important, the result could be an increase in the number of hectares treated or surveyed on an annual basis from 67,700 to 82,300 with no increase in the actual area harvested annually. Dave Presslee prepared a scenario reflecting this type of increase (see Table 6.4).

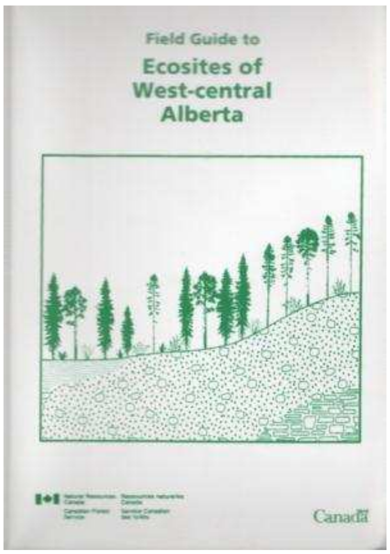
Table 6.4 Annual silviculture program, 1999 to 2005, future options

1999–2005			Future with EFM		
Year	**Treatment**	**Area**	**Year**	**Treatment**	**Area**
-3	Pre-harvest plan	8,100	-3	Pre-harvest plan	8,100
0	Harvest	8,100	0	Harvest	8,100
0	MOS[1]	8,100	0	MOS	8,100
1	Site preparation	8,100	1	Site preparation	8,100
2	Planting	4,000	2	Planting	4,000
5	Stocking surveys	8,100	5	Stocking surveys	8,100
5	Pre-stand cleaning survey[2]	3,000	5	Pre-stand cleaning survey[3]	8,100
6	Stand cleaning	3,000	6	Stand cleaning	3,000
8	Establishment survey	8,100	8	Establishment survey	8,100
14	Performance survey	8,100	15	Performance survey	8,100
16	Pre-commercial thinning	1,000	16	Pre-commercial thinning	3,000
			45	Pre-thinning survey	2,500
			50	Commercial thinning	2,500
			52	Fertilization	2,500
	Annual program	67,700		Annual program	82,300

1 MOS = Management Opportunity Survey, a post-harvest survey to determine the final silviculture treatment prescription.
2 Stand cleaning = removal of competing vegetation overtopping or restricting coniferous reforestation performance; current efforts are focused on backlog elimination.
3 After 2008, stand-cleaning backlog will be eliminated; program ongoing.

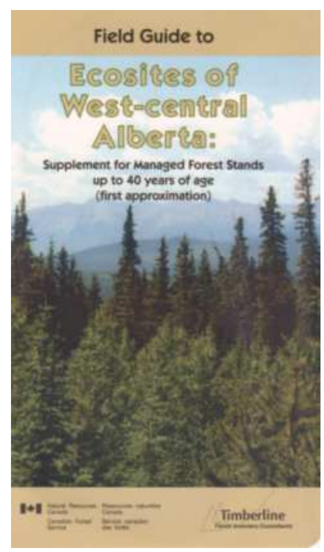
5.2 Ecological Classification

Dave Presslee joined Weldwood in 1992 as a silviculture forester and in 1993 was promoted to silviculture manager. A dedicated and innovative forester in the tradition of Des Crossley, he recognized early on the need for an ecological map of the landscape of the FMA so that planning could consider all resources in an ecological framework. He retained John Beckingham who worked with Ian Corns of the CFS—with input from Dave Presslee and Harry Archibald of the Alberta Forest Service—to further delineate and refine the 1986 field guide and publish the revised guide in 1996.[78]



Meanwhile, an operational classification program had begun in 1994 with a 74,000 ha trial mapping project. With the publication of the new guide in 1996, a full-blown mapping project for the FMA was launched and completed in 2003. Each "ecosite" and "ecosite phase" in the new guide now included vegetation composition, site properties, and measured site productivity. The information was incorporated into a new ecosystem approach to forest management. It was used to plan the most effective harvest and reforestation system for each area, to guide site selection for intensive management investments, to provide management information relevant to integrated resource management—such as wildlife habitat information—and to develop the relationship between ecological classification and site quality for timber production.

Research then began on the Foothills Model Forest (FMF) and on lands of cooperating Alberta companies outside the FMF area to extend ecosystem classification to regenerated (second-growth) stands. The 1998 Forest Chronosequence Project was begun under Ian Corns of the CFS to address management information needs on second-growth forests at different stage of succession. The intent of the research was to forecast the development of juvenile ecosystems over time to their final classification at maturity. This would facilitate timber inventory growth forecasting on managed stands/ecosites, as well as habitat forecasting for a variety of wildlife species.[79] Information would also prove useful for monitoring and conserving biological diversity and to compare natural and altered ecosystems. The hypothesis was that successional development in regenerated stands would be the same as in fire-origin stands and that growth rates of regenerated stands could be predicted from their current ecological classification. The resulting 2005 report,[80] posthumously dedicated to Ian Corns and David Presslee, has proven valuable for ecosite trajectory forecasting. However, the linkages to fibre production are not yet quantified.



The 1999 Forest Management Plan adapted and applied ecological site classification information to address the new challenges of Sustainable Forest Management. In a 1996 presentation to the Alberta Forest Management Science Council, Company representatives noted that this approach was seen as a:

1. basis for biologically, socially, and environmentally acceptable and economically reasonable management;
2. means of avoiding potential resource management problems rather than creating and correcting them; and
3. framework for understanding ecosystem function, predicting the outcome of different management strategies, and communicating knowledge to others.

5.3 Tree Planting and Greenhouse

In the spirit of "adaptive management," the Company reassessed its forest nursery operation in 1993. Despite the state-of-the-art practices put into place when the new Company nursery was opened in 1981, problems had begun to emerge. David Presslee deduced there were some problems with the performance of some of the planting stock. As he explained, "when I first got here, I looked at a number of the pine plantations, and I thought there was something wrong—these trees weren't all growing well." He also found areas where spruce was performing really well, and others not so well. His evaluation of the differences in performance, conducted with Diane Renaud, convinced them that it stemmed largely from problems in growing the seedlings in the nursery. As Presslee[81] commented in the 1993 Crossroads Report, "our own nursery was part of the problem; it had to be upgraded and the cultural regime had to become more modern and more effective."

Pine Seedlings, Hinton Nursery 1982
HINTON WOOD PRODUCTS COLLECTION

In his view, there had been two major factors. First, when Jack Wright and Bill Mattes retired, their knowledge had not been passed on to the next generation of silviculturists, and perhaps a concurrent reorganization within the Company had contributed to this. Second, there were related pressures to increase seedling production to meet the growing requests for planting stock. As Presslee explained:[82]

> We had to change the cultural regimes. The year before (1992), they had produced four crops. This was really disturbing because of the poor quality of the fourth crop. We had to make a choice on what type of regime we would have. We decided that we'd do just two

crops—a one-year crop that would be over-wintered in freezer storage, and a spring crop that we'd hot lift and put out in the summertime. In addition, we also made changes to the nutritional and cultural regimes, but the biggest need was reduce the number of crops.

> First, we worked on computerization of the nursery. The vents and the heating systems and lights and everything would be controlled by computers. Second, we looked at how we were storing trees outside on the ground. We had been just placing the trays on the ground and seedlings were actually growing into the ground. So, when we lifted the containers, we were ripping the roots out. As an interim measure, we put 2" x 4"s under them, to air prune the roots. Third, we wanted to extend the growing life of the second crop that was seeded in May. We wanted to move it ahead a couple of weeks. This was risky as it could be killed by frost. To address this concern, we built new shelter houses and linked them to the computerization as well. That was to extend the growing season and take the risk out of it.

> Finally, the biggest change in the nursery: it began producing a product that was being ordered by silviculturists, producing a product that was linked into the whole system, not just producing seedlings that someone else plants. We were trying to produce something that would perform as part of our entire system.

As a result, the nursery began to produce robust seedlings that were ready to grow when planted. However, the reduction in production capacity to two crops per year left a supply shortfall that could be met by the commercial forest nurseries that had become established in the meantime. At the same time, planting stock-rearing technology had progressed by leaps and bounds since the early 1990s. Quality seedling requirements could be readily obtained from outside nurseries, and Company foresters are able to order and use a variety of seedling types best suited to the various planting site conditions.

In 1993, the province decided to end the provision of "free seedlings" to the industry, thereby also giving up its authority to direct industry's purchases to particular nurseries. This was reflected in a 1995 amendment to the Forest Management Agreement. The Company found that it could obtain its full seedling requirements in the private sector with equal or better quality to that produced in its own nursery and at a lower cost. In June 1999, it announced the closure of its precedent-setting nursery. By this time, Company foresters had developed the seedling specifications clearly needed to ensure survival and growth. In the 35 years since operations began, over 60 million trees had been grown in the Company's own nurseries. A history of nursery production is illustrated in Table 6.5. The Company press release provides a fitting epitaph:[83]

> Weldwood of Canada announced today that it will cease the production of tree seedlings at its Hinton Reforestation Centre following the completion of the current crop. While demand for seedlings remains high, the facility can no longer supply high-quality seedlings at a cost that is competitive with private nurseries elsewhere in Alberta. No jobs will be lost as a result of this closure, as IWA staff currently employed at the nursery will be offered positions elsewhere in the Company.

> Weldwood's first nursery at Hinton was constructed in 1965, when Company foresters were unable to acquire quality seedlings from established nurseries in Alberta. As the first, and currently only remaining, forest industry greenhouse in Alberta, it pioneered the development of containerized seedlings for forest plantations. The present nursery, built in 1982, is now nearing the end of its functional life without a substantial infusion of capital.

In the mid 1990s, the Alberta Government privatized nursery production in Alberta and sold its nursery at Smoky Lake. The resulting expansion of the private nursery industry in the province led to intense competition in both quality and costs for seedlings. This has removed the need for a Company nursery facility. Purchases from private nurseries already represent over 70% of current seedling requirements.

Weldwood's commitment to sustainable forest management remains firm, and the planting program integral to this commitment will continue. In 1999, Weldwood Hinton Division plans to plant approximately 9 million seedlings, including its 100 millionth tree.

5.4 Planting and Stand Tending

As the silviculture program reached the end of the first 50 years, a multifaceted silviculture program characterized the Hinton operation. Silviculturists determined whether sites would be planted or site prepared for planting, based on a number of factors considered both at the pre-harvest prescription and post-harvest MOS stages of planning. These included such factors as

- the availability of natural seed in the stand (white spruce), or the logging residue (lodgepole pine);
- potential problems with vegetative competition; if this was believed to be a risk, sites were planted;
- species of origin of the stand; natural regeneration of white spruce was no longer considered due to the periodicity of the crop; and
- access or other limitations that influence the choice of type of strategy.

The planting program rose and fell annually based on these factors but averaged over 7 million seedlings per year during the period (see Table 6.6).

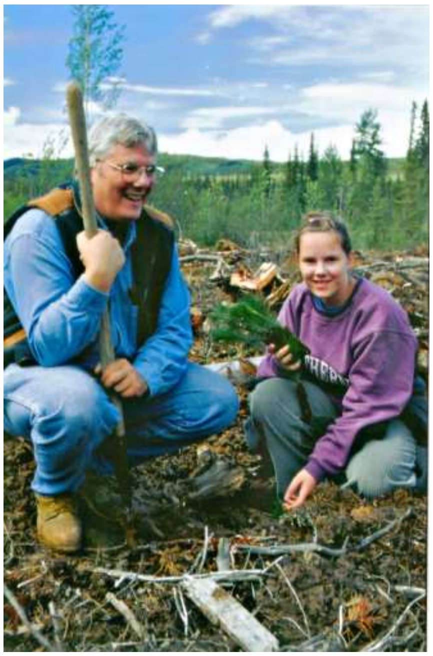
In June, 1999, ceremonies surrounding the planting of the 100-millionth tree were held at Hinton and at the Gregg Cabin where another 1-hectare children's tree plantation was established. The Honourable Mike Cardinal, MLA Ivan Strang, VP Sandy Gray, and VP Dennis Hawksworth cooperated in the tree planting. Director General Boyd Case of the CFS also unveiled a plaque at the Gregg Cabin celebrating the 100th anniversary of the Canadian Forest Service.

100 millionth tree logo, designed by Hinton Artist Norma Bonar

Table 6.5 History of nursery production for the Hinton Forest, 1955–2000

Year	Trees planted (000s)	Grown by Company	Grown by province	Grown by Company contractors	Logging/site preparation method	Other notes
1955–1964	96		96		- Horse logging. - Scarify for natural regeneration. - Fill in plant.	- All seedlings provided free by province. - Company builds greenhouse 1965. - If Company grows its own trees, province pays for seedlings at a cost equivalent to government costs. - Des Crossley retires in 1975. - Jack Wright retires in 1987.
1965	198	198				
1966	570	570				
1967	1,011	1,011				
1968	455	455				
1969	1,638	1,638			- Hand felling. - Mechanical skidding. - Scarify for natural regeneration. - Survey in 7 years; plant NSR before year 10.	
1970	1,312	1,312				
1971	624	624				
1972	774	774				
1973	784	784				
1974	2,441	2,441				
1975	728	728				
1976	1,357	1,357				
1977	1,634	1,634				
1978	1,923	1,923				
1979	1,502	1,502				
1980	1,481	1,481				
1981	2,854	2,854	New greenhouse			
1982	2,525	2,525				
1983	2,018	1,485	533		- Mechanical falling, roadside delimbing begins. - Gradual increase of planting right after harvest and site preparation (SIP).	
1984	2,251	2,251				
1984	1,906	1,602	304			
1986	2,084	1,915	169			
1987	2,620	2,375	245			
1988	3,456	1,490	1,966		- Major emphasis on feller bunchers, roadside delimbing. - Removal of seed from blocks forces major increase in planting. - Problems with site and planting stock quality.	- Operations increase for new mill. - Government pays $0.095 per tree for first 3 million grown by Company; remainder provided free of charge from government-selected nurseries.
1989	4,221	2,903	992	326		
1990	6,178	2,205	1,688	2,285		
1991	5,440	3,085	819	1,536		
1992	4,794	347	4,447			
1993	6,161	3,390	2,771			
1994	9,201	3,866		5,335	- Multiple harvest systems, multiple silviculture systems. - Planning now included pre-harvest prescriptions. - Emphasis on quality seedlings and site-specific treatments.	
1995	5,895	3,633		2,262		- All costs of seedlings to be borne by the Company. - 10,000 sq. ft. shelterhouse built 1996. - Company greenhouse closed, 1999.
1996	6,151	2,651		3,500		
1997	5,341	1,000		4,341		
1998	5,772	1,107		4,665		
1999	9,073	1,078		7,995		
2000	7,117			7,117		
2001	7,991			7,991		
2002	10,599			10,599		
2003	9,673			9,673		
2004	7,461			7,461		
2005	9,499			9,499		
Total	**158,808**	**60,193**	**14,030**	**84,585**		

The silviculture did not stop when a stand of free-growing trees was established. The new forest was monitored and, if necessary, tended to shape its development. There are two main treatments carried out in the juvenile stands: brushing, or cleaning; and juvenile spacing, or pre-commercial thinning (PCT). Each treatment follows a set of objectives that will lead to a future forest that is healthy and productive both from the standpoint of the forest products that can be produced and of the wildlife habitat and other resource values it provides. Pre-commercial thinning was not used during this period, but there was an active program of stand cleaning.



Dave Presslee and daughter Carey at 100 millionth tree plant, 1999
PHOTO BY STAN NAVRATIL

Table 6.6 Tree planting by era, 1955–2005

Silviculture Era	Trees planted	Area harvested	Average # of trees planted per year	Description
1955–64, 10 years	95,792	22,688	23,950 (4 years)	Early days in forestry; heavy reliance on natural regeneration following scarification; no planting the first six years.
1965–73, 9 years	7,366,049	34,975	818,450	First greenhouse; major advances in planning and reforestation; full-time silviculture manager.
1974–86, 13 years	24,702,671	41,895	1,900,205	New greenhouse; program expands and matures.
1987–92, 6 years	26,709,140	21,010	4,451,525	Program suffered from loss of direction and disconnect between logging and reforestation; major increase in area harvested/year.
1994–2005, 13 years	99,935,023	87,927	7,687,310	Major program review; ecological site classification a platform for joint harvest/silviculture planning; beginnings of intensive management program.
Total	**158,808,675**	**208,495**	**3,113,896**	

The rapid advancement of silviculture planning, the linkages between site characteristics and treatment, and the significant improvement of planting stock resulted in fewer areas that needed follow-up treatment. The very rich sites tend to support a wide variety of plant species besides trees, and these will always need some extra help in the early stages to give trees the competitive advantage.

> Tending was an example. We didn't have a tending program and yet it was assumed that all stands were regenerated to conifer post-1981. It was assumed that it would come back conifer on an improved growth curve. While they were doing a little bit of tending with Fox Creek, there was no concerted effort to make sure that land base stayed in the conifer land base. (David Presslee's 1997 Interview with Peter Murphy)

Brushing gets trees off to a better start by removing plants that compete with seedlings for light, water, and nutrients. During this period, it was done with power brush saws, or by girdling. Herbicide use, although widely used elsewhere in Alberta, was not yet implemented on the forest area.

The work itself was done primarily by a native self-help co-operative, Fox Creek Development Association, which the Company helped set up in 1972 and has used continuously since, initially for logging and, more recently, silviculture. The co-op employs status and non-status natives and Métis people from the local area. Under contract, a 20-person crew manually cleaned competing hardwood species encroaching on young softwood regeneration on the Company's reforestation areas. With this experience, the co-op expanded its business to several other companies in the area, as well as working on the Company's recreation program.

George Callihoo, who first served on the Fox Creek board of directors in 1974 and was still on the board in the 1990s, had this to say about the co-operative:[84]

> We started this co-operative so that as many of our people as possible would have an opportunity for work to support themselves and their families. This is still our goal and, for that reason, we have tried to build a business in jobs that require manpower, rather than high technology machinery. Our people take pride in the quality of the work they do, and they are respected for it. We have always had a very good relationship with the Company, no matter who was in charge. No matter what happened over the years, we have always been able to meet and talk and sort things out.

5.5 Site Preparation

Reforestation, whether from natural seeding or from planting, almost without exception requires site preparation as a precursor to crop establishment. There is no single piece of equipment that is the answer for all of the varied conditions that are encountered in the forest; each species, stand condition, soil type, regional climate, and variation in slash and duff condition provides a new challenge. Today there is a range of site preparation tools available to the forestry team (see Table 6.7).

Modern site preparation equipment – Barrel and chain scarifier (left) and Disc trencher (right). Better utilization, including dead wood, leaves less debris and deadwood on the cutover areas, and lighter equipment such as that shown can be used effectively to prepare sites for natural seeding or planting
HINTON WOOD PRODUCTS COLLECTION

5.6 Reforestation Standards

The 1993 Crossroads Project had identified— through 1992 and 1993 regeneration surveys—that actual free-to-grow performance for height and density was often below FMP and legislated expectations. It identified possible AAC reductions by 1998. Suggested remedies included joint harvesting and silviculture plans, pre-harvest prescriptions, high-quality planting stock, and crop tending.

In 1992, the ForestCare program was adopted and the Enhanced Silviculture review in 1995 showed that the Company was still operating a Level 1 (regulatory) reforestation program, meeting only minimum free-to-grow standards for stocking and growth.

By 1996, the Enhanced Silviculture Project Proposal was being initiated that included plans to “notch up” reforestation efforts to Forest Care Level 2 (Basic), with a planned move to Level 3 (Intensive) where existing free-to-grow standards would be met or exceeded in support of an AAC uplift. The 1996 Ground Rules stated that “standards specified in the Timber Management Regulation and the Alberta Regeneration Survey Manual (1992) and strategies specified in the Forest Management Plan will be achieved.” This included linking stocking standards and performance standards to ecological units in the 1999 Management Plan.

By 1999, initial reforestation success based on effective pre-harvest assessment has risen to over 90 per cent. With increased focus on stock quality, plantations were growing as never before.

The 1991 provincial reforestation standards were reviewed in 1995 and refined in 2000.

Table 6.7 Summary of site preparation types and their primary use in the Hinton silviculture program

Site preparation type	Primary use in Hinton silviculture program, 2000
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 (e.g., light, moisture, nutrients). – This treatment 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. – Also 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 are accessible only in the winter. – Creates a 2- to 3-metre narrow strip of exposed mineral soil for a planting spot. – Because this is a spot treatment, erosion potential on steep slopes is minimized because there is no continuous treatment line. – All of these sites are planted with pine and/or spruce.
Disc trenching	– Used for both artificial and natural regeneration; creates a furrow with a raised soil berm on one side for a planting spot. – This treatment 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.
C&H plough	– Used for both artificial and natural regeneration of blocks that are accessible only in the winter. – Creates a planting spot similar to the disc trencher but is completed when the ground is frozen. – Many of these sites are planted with pine and/or spruce but some are left to regenerate naturally.

5.7 Intensification of Management

In 1997, the Company struck a task force to investigate ways to prioritize, quantify, and advance the implementation of the intensive management program as recommended by the three pivotal reports cited earlier. The Company needed to enhance the allowable cut of the Forest Management Area to guard against a possible fibre shortage in the next century, to offset the gradual erosion of the contributing land base, and to accommodate gradually increasing mill demands arising from improvements in productivity and capacity. Past Company studies had shown strong evidence that the future yield of regenerated stands would surpass that of natural stands of lodgepole pine. It was predicted that average sites of well-stocked regenerated stands at 80 years would yield 75 to 100 per cent greater merchantable volume per hectare than fire-origin stands (Table 6.8). Much of this improved growth performance was attributed to the reduced densities that occur in regenerated versus fire originated stands.

Table 6.8 Predicted yield of well-stocked fire-origin and regenerated stands of lodgepole pine at 80 years[85]

Model used	Site index (BHA 50)	Top height	% increase in height	Merch. vol. (m^3/ ha)	% yield increase
Fire	13.1	18	n/a	126.2	n/a
Regenerated [1]	16.2	19.2	26	220.5	75
Regenerated [2]	17.6	20.9	31.9	262.6	108

1. Five-year growth intercept
2. Ten-year intercept where available; five-year intercept in other cases

Deciding where to get “the best bang for your buck” became the next challenge. The attention to cost brought out the need to consider the pre-commercial thinning (PCT) program, not in isolation but as a component of both silviculture regimes and timber and non-timber resource planning. The question is not a simple “to PCT or not to PCT” but rather where PCT is biologically and strategically justified.

David Presslee and Stan Navratil collaborated on a stand density management report in 1997.[86] It evaluated a spectrum of silviculture regimes with and without PCT. The regimes presented in Table 6.9 offered options to attain production targets that were to be considered within the context of other values and non-timber targets.

Presslee and Navratil understood the complexities, both biologically and from a corporate investment standpoint. They pointed to the need to improve available computer models and develop new ones that can accurately forecast the growth and yield outcomes of alternative strategies. Also, a strong program of research, monitoring, and validation would be fundamental to the implementation of any chosen strategy. Better decision-making was also expected from the development of the site and stand stratification system. The dependency of yield gains on site and stand conditions strongly implies that an operational PCT program, or any stand density management program, would require the provision of a ranking and stratification system. As Presslee and Navratil noted:[87]

> The most decisive input into our PCT program and stand density management strategies will be motivated by the forest level analysis and planning and by the corporate strategies of the future wood flow and sortment requirements. Ultimately, the decision of whether or not, and to what extent, to reinitiate a pre-commercial thinning program (PCT) will depend on its overall, forest-level impact on timber supply.

Table 6.9 Silviculture regime alternatives for the working groups of pure lodgepole pine, fire-origin and second-growth stands

Silviculture regime	Age Juvenile --------------------------Mid-rotation-----------------------Mature-----------
1	Natural regime, no treatments ⟶ Harvesting
2	Plantation, no treatments ⟶ Harvesting
3	PCT + fertilizer + CT + fertilizer ⟶ Harvesting
4	PCT + fertilizer + CT ⟶ Harvesting
5	PCT + CT + fertilizer ⟶ Harvesting
6	PCT + CT ⟶ Harvesting
7	PCT + fertilizer ⟶ Harvesting
8	PCT ⟶ Harvesting
	No PCT regimes
9	⟶ Fertilizer + CT + fertilizer ⟶ Harvesting
10	⟶ Fertilizer + CT ⟶ Harvesting
11	⟶ CT + fertilizer ⟶ Harvesting
12	⟶ CT ⟶ + (CT2) ⟶ Harvesting
13	⟶ Fertilizer ⟶ Harvesting
14	⟶ Fertilizer ⟶ Harvesting
Note: Relative age of harvesting and other treatments indicated by endpoints of arrows	

As the scope of the silviculture program expands over time, each hectare will be visited and a variety of treatments applied over the course of the rotation, not on all hectares harvested, but with varying intensity on different parts of the land base. (See Table 6.9 and 6.4.)

Beyond this, the Company was trying to quantify the productivity gains from a variety of silvicultural treatments. They built a conceptual model based on work at North Carolina State University. This model was built on the premise that a site has an inherent productivity but that what it actually grows depends on specific silvicultural practices. Productivity levels are described by categories. Presslee explained:[88]

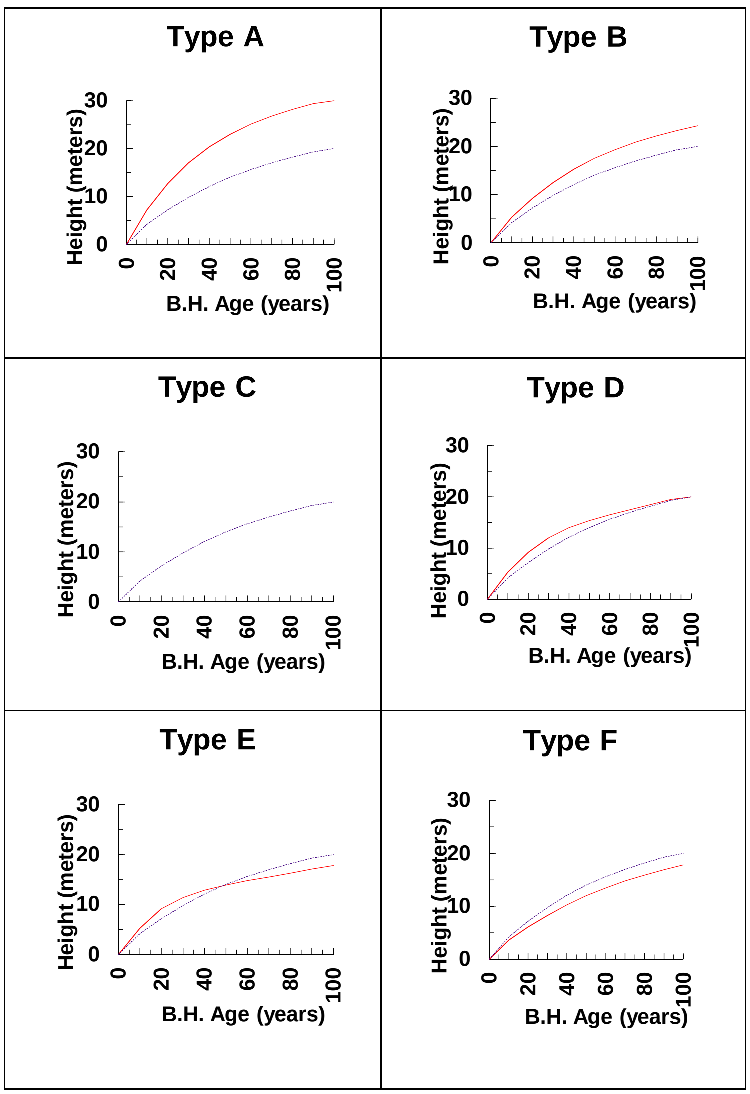
> A C-level category is assigned to the inherent historic natural productivity. This could be reduced to Type D, E, or F levels by poor practices such as, for example, overstocking and understocking, or improper choice of species. On the other hand, production could be increased to Level B through such approaches as sound silvicultural prescriptions, density management, and wise species selection. Above B level is the A level; this enters the era of technological forestry. This would entail such prescriptions as fertilization, competition control, and those types of really intensive treatments. By selective use of appropriate treatments, we should be able to capture almost the full inherent productivity of the site. There is a significant difference between the historic yield and what we believe is the potential for the site.

These differences are illustrated in Table 6.10 and Chart 6.2.

Table 6.10 Characteristic patterns of response to silvicultural treatment

Type	Pattern of response
A	Productivity is increased above inherent site productivity and maintained through the rotation.
B	Inherent productivity of the site is captured through the rotation.
C	Natural, i.e., historic site productivity (fire-origin stands), is replicated and maintained through the rotation.
D	Short-term productivity increases above natural productivity, but no difference by end of rotation.
E	Short-term productivity increase above natural productivity, which results in a long-term productivity decrease at rotation age.
F	Productivity is less than natural site productivity and stays less through rotation.

Chart 6.2 Six characteristic patterns of height growth response to silviculture management



5.8 Tree Improvement

Getting the best “bang for the buck” also applied to the tree improvement program. Tree breeding offers opportunities to increase the AAC significantly by improving growth and survival of planted stands over those of natural populations.

5.8.1 Background

There are two aspects to this program, the tree breeding program and the seed orchard. Each has a distinct population, and a specific role in optimizing gain while maintaining diversity. In the breeding program, a broad-based population of carefully selected superior trees is bred together to provide a large number of offspring from which the best can be chosen to provide the breeding population for the next generation. The cycle can be continued over many generations. This breeding population is managed to maintain broad genetic 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.

Seed orchard trees, like most other orchard trees, are propagated by grafting. Twigs from the very best trees from the breeding population—the “elite”—are clipped off in late winter and grafted in the spring onto seedling rootstocks. As the grafted portion grows, the rootstock branches are pruned back. These grafted trees, or “ramets,” are genetically identical copies of the original selected tree. Several copies of each tree are established in the seed orchard where they can interbreed with ramets from other selected trees to produce genetically superior seed for reforestation, seed with far greater potential for rapid growth than conventional stock.

While tree improvement programs follow principles similar to those of crop or animal breeding programs, the Company has studied their experience to avoid possible disasters, such as have sometimes occurred. For example, disease outbreaks in crops may be a direct result of a narrow genetic base. With too few genes available for selection to combat new or previously rare diseases or insects, populations may be at great risk. In contrast to corn monocultures, where offspring of a single cross (one male parent and one female parent) may be used to plant an entire crop, forestry tree breeding programs maintain breeding populations often in excess of 600 parents, and orchard populations of 20 to 150. The buffering capacity conferred by these high-diversity levels is particularly important for long-lived organisms, such as trees, where growing conditions can change considerably over the life of individual.

5.8.2 History

As early as 1963, Weldwood foresters began to investigate exotic species and exotic provenances of native species through block plantings in a low-elevation arboretum. The Canadian Forest Service Petawawa Forestry Centre contributed many potentially appropriate seedlots. These plantings still retain demonstration value; however, visual inspection and measurements suggest that working with native species and provenances presents less risk than exotics and that native trees generally display superior form, survival, and growth.

Further block plantings of some exotic provenances of lodgepole pine were planted in 1973. Plantings of lodgepole and jack pine hybrids were also established in a high-elevation arboretum. The Canadian Forest Service in Petawawa contributed to seed acquisition and breeding of lodgepole and jack pine crosses in those early years.

These arboreta are places where selected trees are planted for the purpose of studying them more closely. The "lower arboretum" is a half-hectare area planted in 1963 to 1973. Species from North America, northern Europe, and Asia were planted in blocks of approximately 200 trees, as well as natural hybrids of lodgepole and jack pines. This arboretum was quite accessible and visible and, unfortunately, many trees were poached by Christmas tree cutters. Survival was poor for many of the species planted and attempts were made to keep them full by fill-in planting over the first few years. In the end, white spruce, black spruce, lodgepole pine, and western larch generally displayed superior form, survival, and growth.

The “upper arboretum” is a 1.0 hectare area. Lodgepole pine from Fort St. James and Smithers were planted along with lodgepole pine from the FMA (different sources including some from thinned and unthinned stands). Lodgepole and jack pine crosses were planted, as well as a number of local sources of white spruce and black spruce. The highlight of this site is probably the Western gall rust resistance of local lodgepole pine sources in contrast to the heavy and repetitive infection of sources from Smithers and Fort St. James. This is also the oldest black spruce planted on the Hinton FMA and its growth on this site is quite impressive. Although very small and not statistically designed, these arboreta are visually interesting and have demonstration value.

Lower Arboretum, lodgepole/jackpine crosses, 1974
HINTON WOOD PRODUCTS COLLECTION

Good-quality seed has always been seen as an opportunity for improving the genetic make-up of stands on the FMA. Specific stands were frequently targeted for collections, but seed from squirrel caches were still used until 1988. Several seed production areas were reserved on the FMA from 1976 until the mid-1980s. However, the work and resources needed to maintain these young stands in production were very expensive. Since 1989, the Company had been targeting higher productivity wild stands for seed collection; cones have been collected from the ground or from helicopters, using Fandrich rakes or cone harvesters designed specifically for this purpose.

Tree breeding in Alberta began around 1975 when Narinder Dhir, a forest genetics scientist, was hired by the Alberta Lands and Forest Service. He began to develop the comprehensive series of breeding programs in place today in Alberta and still leads many of these programs.

Around the same time, the Company hired its first tree improvement forester, Peter Sziklai, who established seed source and family tests of lodgepole pine. The FMA was divided into eight provenance zones, based on local knowledge of lodgepole pine growth. Seed was collected from 12 parents from each of 13 stands distributed across the eight zones. Source stands selected were of average or better-than-average quality, and selected parents were the best trees in their immediate neighbourhood. Selected trees were separated by at least 100 m, to minimize the possibility of relatedness.

Seedlings grown from seed collected from these parents were planted in tests on eight sites, one in each zone. Both local and Grande Prairie checklots were also included in these tests. On two of the test sites, each seedling's family identity was maintained, while on the other six, seedlings were bulked by source stand. Two sites were dropped in 1985 due to poor survival.

Planting Provenance Trial, McLeod Compartment 2, 1978
HINTON WOOD PRODUCTS COLLECTION

Data were collected from these trials every three years and carefully analyzed. Earlier examination showed no real difference among provenances (geographical source of seed), although large variation among individual families was clearly evident. In 1998, a reclassification of both source and planting sites on the basis of a recently developed ecological classification system allowed re-analysis of the data. The results confirmed local foresters' intuitions and clearly supported the ecological reclassification. Key findings were the following:

- Trees from subalpine seed sources were slower-growing than those from lower or upper foothills sources on foothills sites, but outperformed those other sources on subalpine sites.
- Survival of subalpine seed sources was better than other sources on subalpine sites.
- Upper foothills seed sources were good "generalists," showing the best combination of growth and survival over all sites.

Thanks to Sziklai's foresight, the program at Hinton was now 20 years ahead. Building on these analyses, the Company developed a program to produce planting stock uniquely targeting the FMA's most productive growing sites.

In 1988, Francis Yeh and Sally John were hired under an NSERC co-operative arrangement, funded jointly by the Alberta Land and Forest Service and the Alberta Forest Products Association. Francis Yeh was a professor of forest genetics at the University of Alberta, and Sally John was a research associate from British Columbia with degrees from UBC and North Carolina State. The program was based in the Department of Forest Science (now Renewable Resources) at the University of Alberta to facilitate delivery of tree improvement benefits to the forest community. However, market factors, combined with the still-prevailing feeling that "there was still more wood on the other side of the hill," limited industry enthusiasm and participation in tree improvement.

As the land base became more fully allocated, awareness of the potential of tree improvement increased. The breeding programs grew in size, complexity, and breadth of involvement, and the potential benefits of co-operatives became more apparent. The Huallen Seed Orchard Company (HASOC) was formed in 1993 and is owned jointly owned by Hinton Wood Products (Hinton), Weyerhaeuser (Grande Prairie), Canfor (Grande Prairie), Millar Western (Whitecourt), Alberta Newsprint (Whitecourt), and Weyerhaeuser (Drayton Valley). The orchard occupies a half-section of prime farmland near Grande Prairie and now has orchards from five breeding programs of lodgepole pine, white spruce, and black spruce. Seed collected from the orchard is grown to produce better trees for reforestation. The Company is a co-operator in two of these programs. Two other co-operative programs involving the Company, but not under the HASOC umbrella, are also underway.

Acting ADM Doug Sklar (Alberta Sustainable Resource Development and HASOC President Pat Wearmouth signing the sale of the Huallen Seed Orchard property and Orchard to HASOC, 2003

ROBERT UDELL PHOTO

HASOC members touring the Huallen Seed Orchard, Annual General Meeting, 2003
L-R Glenn Goodwill, PRT; unknown; Sally John; Gregg Branton, Alberta Newsprint
ROBERT UDELL PHOTO

Breeding program development was still under the technical direction of the Alberta Land and Forest Service, but the companies soon recognized that increasing program intensity could markedly accelerate delivery of benefits in terms of quantity of improved seed and amount of genetic gain.

In 1996, after 13 years with no Company tree improvement forester, Diane Renaud was chosen to fill this position. Later that year, Sally John was retained to provide technical advice in forest genetics and tree improvement. She subsequently was also retained by HASOC and other co-operative groups to help with the breeding programs involved.

Sally John, 2003
ROBERT UDELL PHOTO

Renaud introduced some innovative ideas to the program such as "field grafts in a wild stand, a good stand on the FMA, a plantation, to see if we can accelerate the growth of orchard trees." She also made "elite" crosses among the very best individuals in the family trials, stockpiling pollen for future use in the Company's orchard. Both these activities can increase genetic gains.

5.8.3 Current programs

With help from David Todd of Champion, Renaud and Sally John developed the Weldwood Elite Pine Program (WEPP) based on the trials established by Peter Sziklai.

Detailed analyses of 19-year data collected in 1997 suggested that large gains could be achieved by establishing a seed orchard of selected trees from these trials. Families were ranked and initial selections made. The average volume of 26 selected trees from the Athabasca test site was roughly twice that of the site average or of the local control checklot. The best family had more than twice the average volume of the poorest family and was almost 50 per cent taller.

After an extensive search, an orchard site was chosen and purchased near Edson and the Presslee Seed Orchard was established to meet the specific needs of the Company's reforestation program, using genetic material from these trials for low-elevation pine regenerated stands. Fifty unrelated selections were originally planned, and multiple ramets of these trees were established in the orchard. Thirty-six trees were selected in 2000 and 1,550 grafts are currently established out of a plan for 1,872 trees.

Diane Renaud at the Presslee Seed Orchard, 2010
BOB UDELL PHOTO

Although the breadth of the original trials does not provide sufficient diversity to develop a breeding population that could carry the program forward for multiple generations, this orchard will provide a significant gain over the Company's plantations over the first two decades. It is expected that the best genotypes from the WEPP program will eventually be incorporated into other regional program breeding populations.

The Company's tree breeding programs follow well-tested and predictable methods for enhancing and combining desirable traits over generations. They involve crossing individuals of the same species in the same way they could cross naturally, i.e., by wind dispersal of pollen. This continues to be the standard practice. In contrast, the production of GMOs (genetically modified organisms) may involve the insertion of genes from one species into an unrelated species, for example, insertion of an insecticidal gene from a bacterium into a crop plant, or fish genes into tomatoes. Natural gene transfer could never take place in such cases, and no gene insertion or genetic modification of this nature is planned in any of the breeding programs.

Besides the WEPP program, the Company was involved in four co-operative programs:

1. The Region I white spruce program, shared with Millar Western Forest Products, Weyerhaeuser (Drayton Valley), and ANC Timber, was initiated in 1986 but moved slowly for a decade, due to infrequent cone crops on selected parents. In 1997, following transfer of program control to industry, a detailed work plan was developed, and the program is now moving ahead quickly. Orchard establishment at the HASOC orchard site began in 1998; by 1999, 40 per cent of the trees were in place, and planting of the rest was planned for completion by 2003 or 2004. Progeny tests on five sites were planned for establishment in 2001; seed of 289 families and 15 checklots was painstakingly hand-sown in early 2000 at PRTs Beaverlodge nursery.

2. The Region B2 lodgepole pine program, targeting high-elevation pine and developed with Weyerhaeuser (Grande Prairie), has followed a similar trajectory. Initiated in 1976, two progeny test sites were planted in 1990, and three more in 1998; more than 600 parents are represented in these tests. Orchard establishment began in 1994 at the HASOC site, and the orchard was 50 per cent established by 2000.

3. A black spruce program (Region L1) was also developed with Millar Western Forest Products and ANC Timber. Work plan development in 1997 was quickly followed by orchard establishment at Millar Western's Linaria farm in 1999; 10 per cent of trees were established that year. Progeny tests on three sites were planned for 2002.

4. High-elevation spruce seed crops are extremely infrequent, sparse, and expensive to collect. Together with Sunpine and Weyerhaeuser (Grande Cache), a program was developed to improve seed supply for the high-elevation white-Engelmann spruce areas (Region T). While not strictly a tree improvement program, since there are no plans for progeny testing or expectations of genetic gain, prospective parents will be scrutinized for phenotypic superiority, and selected parents will be established in a seed orchard. This program began in 1997. Because of unsuccessful negotiations with the province over issues of expectations for orchard design, location, testing requirements, insecurity of gain, and population size, this program was dropped even after the superior tree selections was completed.

Tree improvement is clearly profitable. Overall, volume gains of 3 to 5 per cent per generation on black spruce and 5 to 8 per cent on white spruce are expected. Depending on the management choices and the sites chosen to plant the improved trees, advances could average 15 per cent on lodgepole pine. Renaud viewed the challenge as "fitting within the enhanced forest management initiative, and fitting in within the whole reforestation and silviculture culture of crop planning. That's what makes tree improvement a viable business."

6. Research Initiatives

In 1994, the Alberta government and industry established a new sawlog stumpage system, linked to the selling price of lumber. As prices rise, industry pays an additional contribution to the Forest Resources Improvement Program (FRIP). FRIP supports forest improvement in areas not the responsibility of industry, for example, recreation development, and is also used to fund research into forest management issues and challenges.

In 1996, the University of Alberta was awarded a major grant from the National Sciences and Engineering Research Council (NSERC) to develop a National Centre of Excellence in Sustainable Forest Management. This network involves over 20 universities across Canada and is supported co-operatively by governments and industries. Research projects are being conducted throughout Canada, generating both new knowledge and graduate students who are joining the ranks of forest scientists.

At Hinton, the new Agreement area was sufficient for only 70 per cent of the mill's wood requirements and the contributing land base was declining as a result of lands being withdrawn or set aside for such things as protected areas, recreation, wildlife habitat, coal mines, etc. The Company, based on protected areas, reduced the amount of productive land dedicated to forest production. These reductions are being made to the FMA that was already at 70 per cent of wood needs.

6.1 Company Research

The Company also conducted a number of operational research trials on its own, with the assistance of external consultants as necessary for data collection and analysis. In an effort to increase the productivity of the remaining land, the Company in 1996 commissioned a year-long review of intensive forest management opportunities to be undertaken by Stan Navratil, a CFS researcher and former professor of forestry at Lakehead University who took a leave of absence for the purpose.

On the basis of his findings, the Company decided to proceed with such a program and hired Navratil—by then retired from the CFS—to provide scientific guidance and to design a suite of research trials to examine alternative treatments. Echoing the words of Des Crossley four decades earlier, Navratil said that "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."[89]

> We decided that we should retain a highly respected consultant or retired scientific person to provide us with some guidance on what are reasonable yield estimates and what process we should go through to actually quantify the potential yield gains for various treatments. We hired Dr. Stan Navratil who began a review of all the scientific literature on white spruce, lodgepole pine, management and what we could expect out of improving yield. The key areas on which we focused were density management, nutrition fertilization and also we were looking at combination treatments of density management and nutrition. We focused on the opportunities that the existing growing stock presented - the natural stands already there and the managed stands that we were actually creating today." (David Presslee, 1997[90])

The main areas investigated were commercial thinning (CT) with and without fertilization, fertilization of mid- to late-rotation pine (FML), and accelerated stand development (ASD). These were seen as particularly useful because large areas suitable for such treatment and resulting AAC increases were available on the FMA. (See Table 6.11.)

Table 6.11
Summary of major enhanced forest management trials established on the Hinton FMA, 1997–2000

Trial	Treatment	Year established	Observations	Next re-measurement
McCardell Creek	CT	1998	2	Fall 2007
Lynx Creek	CT and fertilization	2000	2	2006
Factorial	CT and fertilization	2000	2	Fall 2009
FML 1998	Fertilization	1998	2	Fall 2007
FML 2000	Fertilization	2000	2	Fall 2008
ASD 1997	Fertilization	1997	3	2006
ASD 1998	Fertilization	1998	2	Fall 2008

Other research included manual and herbicide release of young reforestation; selection and propagation of genetically superior seed for plantation use; and alternative, non-traditional silvicultural methods. Specialists from the U.S. parent company, Champion, including Bob Kellison, director of forest technology; Jim Gent, soils and nutrition specialist; and David Todd, tree improvement specialist, participated in semi-annual reviews of the ongoing program.

Enhanced Forest Management Trial Sign, 2000

Stand Fertilization

McCardle Creek Commercial Thinning Trial, 1997

Commercial Thinning Trial, McLeod 18, 2000

HINTON WOOD PRODUCTS AND BOB UDELL PHOTOS

Stan Navrital's work included returning to some past research projects for vital information. Some of these research trials are legendary in Alberta, including a 1941 commercial thinning trial by German prisoners of war at Kananaskis, Alberta, and a 1950 follow-up operational trial by CFS researcher Crossley in the same area. Crossley, who was later (in 1955) to become the first chief forester at Hinton, also established a series of lodgepole pine management studies at Strachan in 1951. Stan Lux, a NAIT forestry graduate and silvicultural research technician with the Canadian Forest Service, proved invaluable in digging out the records and locating the old maps for the majority of the trials revisited.

One trial was also re-measured in British Columbia with permission from the B.C. Ministry of Forests.

Re-measurement of these historic trials gave the Company a quick start on its investigations into the potential benefits and gains of intensive management. So remarkable are some of the findings that the Company and the Canadian Forest Service agreed to jointly publish a series of reports on them.[91]

This work and that of Navratil led to even more questions that needed to be addressed and the Company cultivated collaboration with other companies, scientists, and the Foothills Model Forest to pursue these questions in a series of research trials and reports.

In 1996, the Company signed a Memorandum of Co-operation with the CFS "based on the long history of cooperation between the two parties" that includes cooperation in the establishment, data accumulation, analyses, and reporting of past and future projects of mutual interest. This set the stage for the Company program that began re-measuring a number of old research trials throughout Alberta, including both CFS and AFS projects.

In 2000, Weldwood and Weyerhaeuser jointly supported a new Centre of Enhanced Forest Management at the University of Alberta, headed by Vic Lieffers who was awarded the Weldwood/Weyerhaeuser NSERC Professorship.

6.2 The Role of Canadian Forest Service Research: A Summary Review

At the beginning of this story, we described how Des Crossley engaged the CFS in research trials on the new operation at Hinton. This role continued throughout the period of this story and was summarized in Lorne Brace's 1999 review of the Hinton silviculture program as well as in an excellent 1988 summary report by John Powell,[92] prepared for the information of the Hinton forestry staff. (This report is contained in Appendix 2.)

The research work included 64 projects of which over 60 per cent were silviculture (see Table 6.12), concentrated in the areas of silviculture systems (selection, shelterwood, clear-cutting), scarification and natural regeneration, and thinning. Major CFS silviculture contributions were made by N.R. Walker, H.J. Johnson, J. Quaite, Des Crossley, and Bob Ackerman. Crossley's and Ackerman's contributions were particularly at Kananaskis and Strachan where two of Crossley's trials in commercial thinning are still maintained by the Foothills Growth and Yield Association in a co-operative program with the CFS and Alberta Sustainable Resource Development.

Growth and yield accounted for 34 per cent of the work, involving researchers such as I.E. Bella, R.C. Yang, Keith Horton, Jack Quaite, Wayne Johnstone, and Larry (Bud) Smithers, who had produced a landmark publication on lodgepole pine management in 1961.[93]

Between 1955 and 1985, federal researchers were attracted to the FMA. During that period, they conducted a total of 118 applied forest management research projects in the subalpine and Upper and Lower Foothills forests of Alberta, over 50 per cent of them on the FMA. Des Crossley understood and addressed researcher's needs, reflecting in his interview that "I knew that the main concerns in undertaking forest research were obtaining input from both government and industry on the local problems needing answers, the establishment of priorities, as well as protection of the selected studies after establishing them in the field." Even though early research focused on reforestation, he foresaw changing needs for research, stating "research specialists with the Canadian Forest Service were encouraged to explore yield intensification on our limits," the need for which finally developed in the early 1990s in the Hinton Forest.

Table 6.12 Canadian Forest Service research projects in subalpine and Upper and Lower Foothills forests, Alberta, 1932 to 1985[94]

Research Focus	Alberta Foothills,* 1932–1955	Hinton FMA, 1955–1985†	Alberta Foothills,* 1955–1985	Total, 1932–1985
Silviculture‡	39	32	30	101
Growth and yield§	22	9	13	44
Protection (I&D)**	2	11	3	16
Environmental††	1	13	7	21
Total	64	65	53	182

Archives of CFS projects (excludes all boreal work on spruce 1955+).
† J.M. Powell, Research on FMA lease of Weldwood at Hinton (Edmonton, AB: Northern Forestry Centre, CFS, 1988, unpublished).
‡ Includes silviculture systems, site preparation, natural regeneration, advanced growth, planting bare-root, planting container, juvenile spacing, thinning, fertilization.
§ Includes juvenile growth, yield, site (including ecosite classication).
* Includes insect and disease (archives incomplete for column 3).
†† Includes fire (slash control), hydrology, climate studies.

CFS research was expedited by the establishment of a permanent research (trailer) camp near the junction of highways 16 and 40 in 1967. Previously, research had been conducted partly in tents from 1957 to 1960 and in temporary trailers from 1961 to 1967 at Mosquito Creek and a cabin on the north side of the Highway 40 bridge over the Athabasca River. The permanent trailer camp was closed in 1996.

In the period 1955 to 1960, CFS silviculture research on the Hinton Forest was limited to two projects, both initiated by Bob Ackerman. The first, in 1958, was to monitor pine regeneration on clear-cuts; the second, in 1959, to study pine seed germination. A container research program involving both field and laboratory studies was launched in 1962 in cooperation with the CFS. A variety of containers were tested, including the Walters Bullet, done in cooperation with the University of British Columbia.

Between 1962 and 1970, Dave Kiil conducted fire research into slash disposal and site preparation on problem spruce sites, and the Company continued to work on mechanical scarification techniques.

Increasing concern over the slow growth of heavily stocked pine stands following the large fires of the 1950s led to the establishment of a number of spacing trials and other experiments aimed at reducing this stocking to promote better pine growth.

CFS juvenile spacing research was conducted between 1961 and 1984 by researchers who included Bob Ackerman, Imre Bella, Wayne Johnstone, and Stan Lux. Many of these trials were established in the Gregg Burn, where growth in the "dog hair" pine—up to 1,000,000 stems per hectare—was stagnating. A series of 1963 CFS trials in the Gregg Burn are today maintained by the Foothills Growth and Yield Association (FGYA).* These trials demonstrated the growth and yield benefits that would accrue from spacing in such overstocked fire-origin stands. Company foresters also experimented with a number of other possibilities for juvenile spacing in the Gregg Burn (see Chapter 3, Section 4.5).

* The FGYA is a co-operative of nine Alberta forest companies whose FMAs have a high component of lodgepole pine. They have pooled their resources to conduct research on the growth and yield of pine in Alberta.

Gregg Burn Spacing Trial, Low Site – a Photo Series 1965-1999

Gregg Burn Spacing Trial, low site, 800 trees/acre
Above – 2 years after establishment – 1965; Below - 1999

Gregg Burn Spacing Trial, low site – 1971
HINTON WOOD PRODUCTS COLLECTION

COURTESY CANADIAN FOREST SERVICE

FRI General Manager Tom Archibald and Information sign, Gregg Burn Spacing Trial - 2012
BOB UDELL PHOTO

Between 1961 and 1972, a major container research program was undertaken by the CFS in both the field and in the laboratory. Between 1961 and 1965, tests were mainly field trials of different containers, including the Walter's Bullet (in cooperation with John Walters at UBC). When the Company went into greenhouse production with the Ontario tube in 1965, the CFS redirected work until 1972 on tubeling physiology, on extensive field trials to monitor container survival and growth, and on nursery rearing schedules.[95] Researchers included Bob Ackerman, Harry Johnson, Frank Endean, and Les Carlson.

From 1959 to 1975, the CFS conducted research on refining the natural regeneration system for pine, research conducted mainly by Bob Ackerman. The Company continued to modify and experiment with scarification techniques.[96, 97]

An early approach to scarification using a rudimentary chain drag
HINTON WOOD PRODUCTS COLLECTION

Growth and yield research by the CFS was confined mainly to lodgepole pine between 1962 and 1985, principal researchers being Imre Bella, Wayne Johnstone, Chris Cieszewski, and Hargit Grewal. A monograph on lodgepole pine, published in 1961 by L.A. Smithers, is still considered a valuable reference on lodgepole pine management, including growth and yield and response to treatments.[98] Thinning was confined to one project in 1969, using the chemical Tordon (Brian Jones) and there were three fertilizer projects and one combined fertilizer and thinning project between 1970 and 1983.

Between 1957 and 1983, the CFS conducted entomology and pathology studies. This included work by Herb Cereske on Hylobius root weevil; by Joe Baranyay on Armellaria root rot; by Yasu Hiratsuka and John Powell on Cronartium gall rust and Commandra rust respectively; and an extensive and ongoing 1981 study of insect and disease mortality in regenerating pine stands by Bill Ives and Cam Rentz.[99] This work has subsequently been examined by the Foothills Growth and Yield Association (2010) and shows remarkable consistency with work by the FGYA looking at the impacts of climate change on pathogen activity and pine mortality.

CFS research on the FMA from 1955 to 1985 generated over 140 research reports, thereby distributing the knowledge gained to a wider forestry audience.

6.3 Foothills Model Forest

Silvicultural activities are implied in the Foothills Model Forest (FMF) definition of sustainability of forests *"*to manage the forest resource without prejudice to its future productivity, ecological diversity and capacity for regeneration." A primary role of the FMF was to develop integrated resource planning models and trials to be fed into management planning and operations on the FMA area. Filling knowledge gaps in the Enhanced Silviculture (ES) initiative is a significant role for FMF.

FMF and Company research activities in the program, addressing both timber and non-timber values were summarized by Robert Udell:[100]

1. Traditional forestry research to maintain or increase allowable annual cuts:
   a. Enhanced Forest Management: forest fertilization trials, pre-commercial and commercial thinning trials, tree/stand growth, and yield modelling
   b. tree improvement
2. Research to ensure conservation of non-timber resource values
3. Natural disturbance research:
   a. landscape-level disturbance (fire) patterns, historic
   b. stand-level comparisons between fire origin and regenerated stands
4. Wildlife and fisheries:
   a. habitat suitability research and modelling for a variety of terrestrial wildlife species
   b. Pinto Creek Goat research program
   c. large carnivore (grizzly bear) research
   d. fisheries inventory and habitat characterization
   e. hydrology research
   f. watershed modelling
   g. culvert/stream crossing inventory and remediation
   h. identification of hydrologic "triggers" (activities with potential impact on water quality or quantity)

In the initial (Phase I) period 1992 to 1997, research, information gathering, and biomonitoring programs were established and were pursued and extended in Phase II, 1997 to 2002. The FMF provided both funding and expertise. Silviculture-related activities include improving and expanding the existing ecosystem classification (in part as the basis for pre-harvest prescriptions); reforestation initiatives in coal, petroleum and gas disturbances; improved integration of silviculture and harvest planning by developing an ecologically based pre-harvest assessment and by completing the regenerated stand inventory; developing low-impact silvicultural/harvest systems for riparian zones; and designing and implementing high-elevation silvicultural strategies. During this period, the FMF partially replaced IRMSC in research on resource management integration, especially for wildlife.

Two new initiatives that had direct silviculture implications in Phase II were the Cumulative Effects Project—addressing the potential for significant land base reductions and AAC impact—and the Alberta Forest Biodiversity Monitoring Project, which has potential linkages to silviculture through harvesting, regeneration, and tending schedules and practices on the FMA as they are applied to achieve a variety of timber and non-timber (aesthetic, wildlife) objectives.

Model forest researchers on field tour, 1996. L-R. Jan Traynor (Watershed), Gord Stenhouse (Grizzly Bear), Dan Farr (Natural Disturbance, Biodiversity). The Natural Disturbance research program was in its early stages, and Dr. Farr is describing a fire origin map of the Model Forest research landbase.
BOB UDELL PHOTO

6.4 Foothills Growth and Yield Association (FGYA)

Growth and yield research requires considerable investment of time, money, and technical expertise. Furthermore, validation and confidence are reinforced by the replication of the results elsewhere. Early attempts to form a growth and yield co-operative to pursue this need foundered when a champion to advance the process could not be found.

FGYA Logo 2012
COURTESY FGYA

In 1998, a unique opportunity arose when the Model Forest was asked to accept a large ($3.2 million) research grant from the Environmental Enhancement Trust Fund to be used for research on a broad range of forest industry interests. Bob Udell suggested that seed money to establish a pine growth and yield co-operative could serve the industry well, and the Board of the Model Forest accepted the recommendation.

Dick Dempster accepted a contract to serve as the director of the program for a two-year period, to develop and implement the scientific program. Dempster is a United Kingdom-educated forest scientist with particular strengths in forest ecology and management and was a professor at the University of

Alberta before becoming a forest consultant. He and Udell set out to recruit other companies to join the initiative. To whet their appetite, the Company hosted a tour, led by Stan Navratil, of the historic growth and yield trials in the foothills of Alberta.

By late 1999, nine companies had agreed to join the Foothills Growth and Yield Association as full members and the Alberta Land and Forest Service accepted membership in an advisory capacity. Field trials were designed and the first set of trials was installed in 2000.

FGYA Tour Group, Muttart Forest (Nojack), 1999. The group is about to snowball the photographer
BOB UDELL PHOTO

In 2002, the FGYA signed a Letter of Agreement with the CFS and Alberta Sustainable Resource Development to take over responsibility for the continuing measurement and maintenance of the historic trials covered by the Company-CFS Memorandum of 1996.

6.5 The Camp 1 Story Revisited

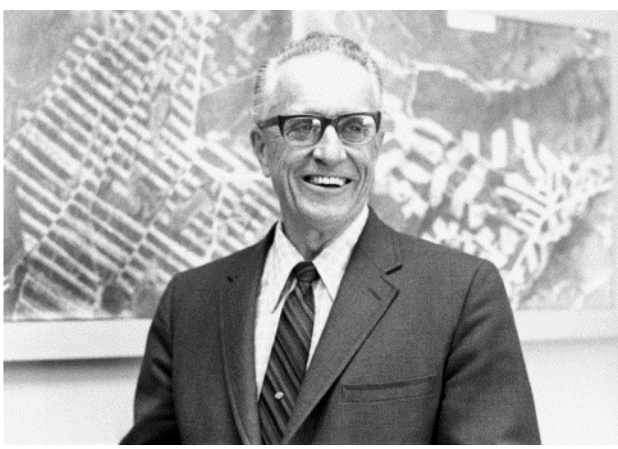
When logging began in the winter of 1955–56, loggers and camp bosses all lived in Company-built camps located in the cutting areas. The cutting areas were identified by camp numbers; Camp 1 was, not surprisingly, the first. It was built on an attractive site with a west-facing view across Wildhorse Lake into a backdrop of the Rockies. It was easily accessible from Highway 16 west of Hinton, and the original stretch of the highway to Jasper passed through the cutting area and within a few kilometres of the camp itself. Since this is where logging and silviculture began and evolved, the “Camp” was of great interest.

The Camp 1 area had been known locally as "The Green Timbers." In the context of this report, it includes all the area within operating compartment McLeod 1, immediately east of the Jasper Park gate and extending between Highway 16 and Brule Lake. It was part of a larger area of older spruce forest that has somehow escaped the many fires that were shown by history to have occurred during the previous centuries. This may have been, in part, because of the natural fire break of Brûlé Lake along its western edge. Because the timber was old—aged up to 400 years—and growing on a wind-exposed site, the wood in the trees was cracked* and also contained considerable pockets of decay. The area was avoided by lumbermen since the wood was not suitable for lumber or ties although, as early as 1909, a timber berth was established covering the whole area.

However, the timber was well suited for making wood pulp. It is interesting that Robert Sweezey had included this area in his first, but unsuccessful, application for an FMA in 1949. The first St. Regis cruisers in 1955 were also quick to identify this as a logical block in which to begin logging.

As Crossley noted,[101] this area "west of the mill site and bordering Jasper National Park became our initial spruce camp." The area was close to the mill, had good access, and met harvesting priorities—cut the oldest first, because the spruce were aged 300 to 350 years—so it was an ideal source of mill "start-up" wood.

The operational inventory was completed and logging started in the winter of 1955–56. The operation was state of the art for the era and was considered a test site for spruce harvesting and regeneration strategies.[102] Planning reforestation systems for harvesting to secure natural regeneration was a new concept in Canada.



Des Crossley with an aerial photo of Camp 1 cuts, 1970
HINTON WOOD PRODUCTS COLLECTION

The prescription was a two-pass strip clear-cutting on a 20-year cycle, removing about 50 per cent of the timber per pass. The strips were narrow, with initial cuts and residuals each 5, 10, or 15 chains wide (100, 200, or 300 m)—testing the effective distance of windblown seedfall—and 40 chains (800 m) long. Later, an average width of 10 chains was adopted. They were laid out perpendicular to the wind to facilitate natural spruce regeneration from adjacent uncut strips following the first pass, and to minimize blowdown. Once the first-pass strips were logged, it was expected that they would have regenerated after 10 years. At that point, in year 11, the second pass would remove the residual strips, the site would be scarified, and regeneration would be assured by planting.

* The larger bottom logs typically had both "ring shake" (separation of the rings) and "checks" (cracks combined with spiral grain so sawn boards would fall apart).

Jack Wright* reported that one of his first assignments when he arrived at Hinton in 1956 was to design and lay out a shelterwood harvest system trial at Camp 1. This was done, but the contractor, Carl Luger, was unable to effectively harvest the area with all the problems of close-growing trees with intertwined crowns, standing dead snags posing imminent danger to workers, etc., and this early approach was abandoned. Had today's sophisticated harvesting machines been available then, it is interesting to contemplate how this might have changed the silvicultural harvest approach selected.

During the planning and harvesting of the Camp 1 cut, there was relatively little known about the soils and sites on the FMA, so no one foresaw the potential problems of trying to reforest a highly calcareous site in an exposed windy environment where tree growth is naturally slow. There was also no apparent concern about public input or public reaction to strip clear-cuts on this highly visible area on the main tourist route to Jasper National Park. Project originators firmly believed that foresters practising sustained yield management would achieve the public good.[103, 104]

The first pass on the area was horse logged, protecting advanced growth where present, and this resulted in a combination of strip clear-cut and strip shelterwood. The plan for the strip clear-cutting approach seemed to be working well. Blowdown was not a serious problem in Camp 1 and regeneration was occurring on the cutovers. Sceptics were invariably impressed when taken out and shown the numerous small seedlings that were evident once they got down on their knees and were shown what to look for.

By the mid-1960s, the first-pass cuts had been surveyed and were found to have met stocking standards, although they were growing slowly, and removal of the second-pass residuals began. The second-pass was a clear-cut with mechanical harvesters with little care to protect advanced growth. Everything looked acceptable. However, regeneration surveys soon showed problems with second-pass stocking.

What was not clearly realized at the time was the importance of the residual strips providing a seed source, protection from the persistent winds, and partial shade and increased moisture on the lee sides. Once they were removed, the original sites lost this protection and the individual seedlings grew slowly.

The planners recognized that the local spruce seed source would be removed with the second-pass logging but had planned to plant those cut areas quickly. They focused on spruce but also tried lodgepole pine, expecting it to show immediate results. Unfortunately, pine was later found to be ”calciphobic”—it could not survive on those high-calcium soils. Douglas fir did not fare much better. As well, the use of standard scarification for site preparation at that time exposed those highly calcareous soils. The result was a long delay in establishing spruce regeneration after the second pass, then slow growth of the survivors. The area appeared like a huge clear-cut since the growth on the first-pass sites was also slow. Over time, poplar and brush pioneering species established themselves, providing some additional shelter, and the area gradually recovered. However, there was a lasting impression that no trees were coming back when, in fact, they were—they just took awhile to make themselves obvious.

In the meantime, other developments were occurring in and around the Camp 1 area. Wildhorse Lake is a pothole-type lake and so was barren of fish. Local fishermen prevailed on the Alberta government to stock it with rainbow trout, establishing a popular put-and-take fishery. As well, nearby Kinky Lake was stocked with arctic grayling. Both lakes drew large numbers of anglers, both summer and

* Personal communication

winter. A campground was built at Kinky Lake, and camping became popular at Wildhorse Lake after the logging camp itself was closed around 1960 when loggers began to commute to work from Hinton.

Trail riding became increasingly popular in the 1960s when the Overlander Lodge was built beside Highway 16 near the Jasper Park Gate, and other riding stables were set up in the Entrance-Prairie Creek area to the east. With the abundant grass in the clear-cuts, this area also became a “free-range” for horses. It was a great place for horse owners and outfitters to turn horses loose to forage during the winter, as they were easily rounded up in the spring as needed. The grazing was not authorized. In fact, Crossley became quite concerned about the impact of horses on the struggling regeneration through trampling, rolling, and pawing for grass through the snow. These concerns led later to government-allotted grazing permit areas along Highway 16 and a community grazing lease near Brule. These were all fenced so horses could be confined and managed.

Highway 16 was relocated to the south of Camp 1 and the new paved road from Edmonton drew increasing numbers of visitors past the area on the way to Jasper. Then, in the early 1970s, a regional airport was constructed at the eastern end, creating more traffic and concerns about the appearance of Camp 1.


Planting “Ontario Tubes” in Block 168Y at Camp 1, 1969 and the same location, 2005. The site is now occupied by healthy white spruce growing at rates unprecedented in time
BOB UDELL PHOTO

The response of wildlife to the cutting was interesting but unfortunately not well documented.[105] The Green Timbers area supported a few moose that fed on willows around natural openings, and deer were found around the edges. Elk passed through on seasonal migrations in and out of Jasper between summer and winter ranges. However, the extensive conifer forest did not provide a lot of feed. All these ungulates greatly increased in numbers after about five years of harvesting. Browse and grass in the cutovers provided year-round feed, and the adjacent residual strips were both shelter and escape cover. These areas, now with roads, were heavily hunted in the fall, but populations continued to increase. This changed when the second-pass logging began, and ungulate numbers declined considerably as the shelter and escape cover was removed. Scattered small populations could be found around the margins in relatively isolated areas. Then, by the early 1980s, trees and brush again began to provide cover and populations again increased. This time, however, in recognition of the ease of access, most of the Camp 1 area has been declared as a no-hunting zone.

In the second-pass logging, the Company was following the agreed-upon plan for removal of the residual blocks after 10 years. Concerns about the apparent wildlife decline with the second-pass logging led to industry-wide discussions involving the Alberta Forest Service, Fish and Wildlife Division, and Company to search for an alternative. Discussions led to the "six-foot rule." Under this system, harvesting of residual strips in areas of concern for ungulate populations would be delayed until a proportion of the regeneration reached six feet (about 2 m) in height or greater. Although not a panacea, the rule helped from the standpoint of wildlife and visual perception. However, for the Company, it necessitated additional investments in roads to make alternative harvesting areas available to maintain its wood flow. This was among the first of the many trade-offs that the Company would have to negotiate as resource conflicts began to emerge.

Crossley recalled that "the major concern wasn't how our clear-cutting and concomitant harvesting patterns were affecting the management of our wild forest lands, but rather how they affect other users of the land—particularly in the case of those involved in Fish and Wildlife."[106]

How well has the area regenerated today? As David Presslee's observations suggested:[107]

> What they didn't recognize was that it was the shelter of the original leave strips that created the conditions that facilitated easy regeneration. Once the leave strips were gone, it was a really difficult situation and, although they were ultimately successful, in their kind of trial-and-error approach to regenerate Camp 1, they made numerous mistakes and it may have seemed rather humbling because I know the individuals involved and they were extremely good at what they were doing.
>
> There still was this illusion that there was nothing growing there because it's a very poor, harsh site, very slow growing. I came here in 1992 and it was always a concern every time the senior managers flew in to the Camp 1 airport from Vancouver. They would always say, "You guys have got to fix that Camp 1; it looks awful." Being silviculturists, we're trained to fix things, so we saw Camp 1 as a real opportunity!
>
> In 1994, the Company hired a reputable silviculture contractor who reported back: "Well, what are you guys talking about? There are trees everywhere out here!" He found acceptable stocking for the most part. What was not good was that the trees were growing slowly and his assessment was that this is exactly the way that forest grows out there because of the high calcareous soils and the high lime content. It caused a condition called "iron chlorosis" in the seedlings. We had to wait until the trees grew out of the grassy layer. Seedlings grew very slowly to breast height and, once they got to breast height, the trees took off. The second-pass cuts for the most part were just approaching breast height. His final recommendation was to wait, inventory the entire area, and set some standards on performance.[108]

In 1999, the Camp 1 area contains less than 3 per cent NSR, as indicated in Table 6.13. These NSR sites comprise mostly higher, exposed, dry west-facing sites.

Table 6.13 Regenerated stand inventory for Camp 1, 1998

Designation	Area (ha)	% of area
SR — Conifer	4,232	73.4
SR — Needs tending	1,382	24.0
NSR — Needs rehabilitation	152	2.6
Totals	5,766	100.0

In retrospect, as Presslee conjectured:[109]

> If the Camp 1 landscape had been mapped by ecological unit and current practices of pre-harvest assessment, joint silviculture and harvest planning, [and if] prescriptions and post-harvest/pre-treatment surveys had been in place, many of the technical problems with Camp 1 may have been avoided. However, these terms and procedures were yet to enter the lexicon or practice of forest management planning. The public input policy now in place would ensure significant public participation to both planning and operations including the addition of "visual landscape quality" objectives for such a highly visible corridor, and could well be a major factor in the choice of silvicultural system and the nature and timing of operations. The technical and public concerns raised by areas like Camp 1 persist to challenge FMA foresters on an ongoing basis. For example, a visual landscape inventory has been completed for the FMA area with attendant guidelines for planning and operations, including, in some cases, no harvest at all.

But, in fairness to those pioneers who designed the system in 1955 and carried it through to successful conclusion, it was a state-of-the-art plan for the period, with considerations for wildlife, recreation, and aesthetics. It was a very early example of an integrated harvest and reforestation plan. In addition, it was an early example of adaptive management when regeneration problems became evident in about 15 years as the residual strips were being removed. No easy answers were immediately found, but a great deal of thought, research, and planting effort were freely expended in the process of searching for alternative treatments.

Over the years, Camp 1 was frequently cited by opponents of the Company as an example of reforestation failure and corporate mismanagement. Company foresters challenged this perception, pointing out that reforestation was successful and the trees were growing at rates that exceeded the natural forest previously on the site. These perspectives continue today, but with far less frequency because the visible evidence of successful restocking, even in the second-pass blocks, is hard to dismiss. There is increasing use of the area for recreation including informal camping, off-highway vehicle use (with attendant damage), horse riding, biking, and hiking.

Soils at Camp 1 are highly-erodable windblown sands that are very susceptible to damage such as that shown here from random camping and off-road quad/dirt bike use

ROBERT UDELL PHOTOS

7 Summary and Conclusions

Crossley and his successors established a culture of excellence at the Hinton operation, which today's foresters feel honour bound to continue. The long history of silviculture is one of continual exploration and search for better and more cost-effective ways to sustain the forest and all it represents to the environment, the economy, and the community that depends on it.

This pattern and tradition was set forward in the first set of operating ground rules for the Company, which provided a view of adaptive forest management that came more than 30 years before its current definition. The description of the proposed approach to management was uncannily close to today's understanding of adaptive management. In essence, it required both Company and government to regard the FMA area as a large palette on which they would test their hypotheses of good forest management, gradually building a base of experience and exemplary practice through this approach.

Early attempts to implement an intensive forest management program were foiled by circumstances beyond Crossley's control but were finally being realized as the century closed. Following a brief loss of focus in the late 1980s, the silviculture program has been revitalized and now makes its full contribution to sustaining the Company's allowable annual cut and biodiversity management program.

Stan Navratil found his personal silvicultural niche with Weldwood at Hinton. In summary remarks during an interview for this project,[110] he commented on both the challenge and satisfaction of his association with Weldwood:

> I can tell you also that it was the challenge. I had to use everything that I knew and I had to go back to the original literature and use my network of contacts, be it in North America or in Europe. First, the reason for that was that I've been designing the program in many subject areas, from thinning to fertilization, to alternative silviculture systems, stand density management, so that's where I think my broad experience from Europe or experience from various research locations in Canada proved to be very valuable.
>
> In addition to that, I had to gather additional information. It was rewarding for me; researchers are always like hobbyists, getting a new piece of information, getting a new toy. We are always learning. It was challenging to provide Weldwood with the best information, not only from my own knowledge and experience, but also from the literature and contacts with other experts. I think we have succeeded in developing a very diversified program for Weldwood.
>
> In terms of my own satisfaction, if I achieved the goal—I want to make some contribution—well, it's for Weldwood to judge. Weldwood has now the program set up for enhanced forest management in several areas, fertilization, thinning, alternative silviculture systems. We had only four or five years to do that and we are already at the stage of working on modified yield curves. It's quite an accomplishment, achieved collectively with the Weldwood staff. Weldwood in this area is far ahead of any company that I know in Alberta. So I'm quite happy about it. It was the great opportunity for me, not only with respect to Weldwood and also to Alberta.

Diane Renaud, silviculture manager for the Hinton Forest, provides her perspective on this 50-year history project and its relationship to current standards, practices, and relationships in Alberta forestry:

> I read this book a bit like the adventures of forest management and reforestation on the Hinton FMA. I, for one, am grateful that you are dedicated to preserving the history and evolution over the last 50 years. The rich heritage of past reforestation on the Hinton FMA was a huge part of the attraction in my moving to Hinton 20 years ago. In reading, though, I am reminded of what has changed since 1992, some for the better and some, well, maybe not so much.
>
> Enduring to this day is the ecologically based Management Interpretation that considers administrative and operational conditions in its annual revisions. This is only possible because the whole FMA was ecologically classified by 2002. Both of these are Dave Presslee's legacy.
>
> The other thing that strikes me is that how much more cooperative relationships tended to be with the government agencies of the day. Now, in this day of allocating resources to administrative requirements of the administratively based Forest Operations Monitoring Program (FOMP) and with the "Auditor General's requirements" being used as a reason for moving from negotiated and results-based standards to "Provincial Standards and Ground Rules," I can't help but feel that we have lost creative energy and our ability to be flexible. It is not all bad. I think that, with performance-based standards at year 14 (i.e., ARS, now RSA) and the ability to tie regenerated performance to yield, the better forest management practitioners will win the day. Despite the threats to the 50 years of successfully regenerated stands by Mountain Pine Beetle and by increasing land base removal by industrial users, most of which not necessarily environmentally sustainable, somehow, here in Hinton we have been able to retain and recruit personnel who are tied to the land and still genuinely care about the Hinton's FMA forest resources. In the end, people have shaped this land by past management practices; hopefully those folks who will come after us can use the 50 years of history in this book as a resource help them shape the future of the Hinton FMA.

The 50-year span of this text embodies an inherent code of ethics passed on from one generation of foresters. Who could break this trust by jumping on the latest bandwagon after having received the torch from the likes of Crossley, Loomis, Wright, Presslee, and all the others who have so carefully husbanded the Hinton Forest for the past 50 years?

The historical contribution of adaptive management through the forest management agreements at Hinton is clearly evident. The prognosis is less clear. Things are much more complicated now. As Albert Einstein noted, "the significant problems we face cannot be solved at the same level of thinking we were at when we created them."* Continued commitment, innovation, creative thinking, and adaptive management will certainly be among the key components of the journey ahead.

* Taken from Jean-Pierre Martel's talk at the CIF/IFC AGM 2001. Reprinted as "People, Trees and Forests in 2020: Is There a Role for the Forest Industry?" in *Forestry Chronicle* 77, no. 6 (2001): 991–93.

Appendix 1 Silviculture and Logging Timeline, 1954–2005

Year	Events
1954	• Forest Management Agreement (FMA) stipulates that the Company is responsible for forest regeneration.
1955	• North Western Pulp & Power Ltd. (NWPP) Woodlands Department is set up in May 1955. It includes a Forestry Department responsible for such activities as mapping, forest management planning, and silviculture. • Desmond I. Crossley with CFS in Calgary is hired on 6 March 1955 as chief forester, heading the Forestry Department. • The initial focus is on aerial photography, mapping, and operational cruising. • The FMA is amended by Order-in-Council 882/55, dated 13 July 1955. The major change was moving the Lease Area west and defining the Provisional Reserve Area (PRA) to the north and south—each about 3,000 square miles—all to supply the mill at its present location at Hinton. • Early discussions between the Company and government (Crossley and Loomis) result in an agreement to use the silvicultural treatment of clear-cutting in even-aged lodgepole pine stands, and clear-cuts in narrow strips in spruce, at least on a trial basis.
1956	• First logging begins in January 1956. • First reforestation trials begin late in 1956. • Experimental scarification trials begin at camps 5 and 10 by Des Crossley using, among others, Flecco Rakes and angle blades during the fall of 1956. Subsequent surveys show that successful natural regeneration had been achieved. This first naturally re-established lodgepole pine stand lies north of Quigley creek in Section 35 of Township 50, Range 24 west of the 5th meridian, on a prominent westerly facing aspect of the valley slope of Quigley creek that originates in "Audubon" Pond, just to the north of the Robb road at Mile eleven (11). Audubon Pond is referred to as Beaver Lake on maps. • First post-logging plant-succession/wildlife study related to silviculture and forest regeneration is carried out by John Stelfox who is at that time with Alberta Fish and Wildlife. The first four plots are established in camps 1, 5, and 9. This study is to be summarized in 1998 as a 40-year review.
1957	• Adrien Provencher is appointed Woodlands Manager, effective 15 July 1957. • Jack Wright starts work, arriving in Hinton on 7 January 1957. With a focus on forest inventory and management, he becomes influential in silviculture, and later chief forester. • First experimental planting takes place with (1) transplants from Gregg Burn, and (2) bare-root seedlings from Oliver Provincial Tree Nursery in Camps 1 and Pedley area; they are not planted on cutovers but under-planted.

	• Crossley negotiates "10 per cent" agreement with the Company to ensure ongoing funding for forest management and silviculture.
1958	• First Ground Rules, a three-page document in Company files dated 11 March 1958, is the first on record: ". . . cutting system to be adopted on a trial basis will appropriately be some pattern of clear cutting. As many modifications of such cutting systems will 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 pulpwood extraction." Preamble statement reflects experimental approach and adaptation; early definition of "Adaptive Management." Sets the stage for silvicultural trials. • Scarification trials with Dick Corser's D-9 and a blade with three ripper bars welded to the blade (predecessor to the Crossley Plough) begin in 1958 under Owen Bradwell.
1959	• Scarification program intensified.
1960	• The first designated silviculture position (Gordon Jones) is established in October 1960. • Steve Ferdinand starts work on 15 October and later becomes silviculturist. • First production planting on harvested areas using the Walters Bullet takes place. • Cone drying shed is constructed.
1961	• First detailed Forest Management Plan is completed 31 October 1961. Lead author is Jack Wright. • Scarification program further intensified. • Hank Somers replaces Gordon Jones as head of silviculture.
1962	• Adrien Provencher, woodlands manager, moves to St. Regis Woodlands in Montreal; Stanton G.V. Hart becomes woodlands manager 1 September 1962, replacing Provencher. • Seeding and planting programs are initiated. • Juvenile spacing trials begin in Gregg Burn.
1963	• Land-form mapping/site classification mapping project is completed by Philip Gimbarzevsky; results are used in both logging and silviculture.
1964	• Bob Carman is hired as silviculturist. Hank Somers, silviculture technician, reports to Carman. Carman builds the first Company and forest industry greenhouse in Alberta. He establishes the first containerized seedling program in Alberta using Ontario split plastic tubes ½" and ¾" in diameter that were then out-planted. This is the start of containerized seedling production in Alberta. • Carman also introduces a formal post-harvest silviculture assessment program, the "Management Opportunity Survey." • Thinning of stagnating regeneration stands in Gregg Burn is initiated.

1965	• First forest industry greenhouse in Alberta opens at Hinton; first containerized seedling production, using ½" and ¾" "Ontario" tubes. • Company purchases Brome Seeder for aerial seeding trials. • First controlled burn by Company for regeneration purposes, at Camp 6, takes place on 13 October.
1966	• First revision of the Forest Management Plan (the second FMP completed) takes place. The lead author is Jack Wright. • Major container planting program is initiated. • Scarification backlog program is initiated. • Aerial seeding trial with Brome Seeder takes place. The results are variable and there is rodent predation. Process is discontinued after 1978. • Des Crossley is elected President of the national Canadian Institute of Forestry; he presents a paper at the World Forestry Congress on the development of the forestry and silviculture program at Hinton. • Bob Udell is hired by Des Crossley.
1968	• New FMA—passed by Order-in-Council 1647/98, dated 30 August 1968—includes commitment to expand pulp mill and build a sawmill, with expansion to start by 1 January 1971. Lease area would become 6,000 square miles (1,554,000 ha) when expansion confirmed. • The woodlands manager, Stanton Hart, accepts the position of Northern Regional Logging Engineer for St. Regis and leaves Hinton on 31 July 1968. • Jim Clark is promoted to woodlands manager in August 1968. • Company planting crew is turned back from going to Berland by IWA strikers. Salaried staff go up and plant the seedlings stockpiled at Camp 23 over two days, staying in the abandoned camp. • Steve Ferdinand becomes forester in charge of silviculture on 1 June 1968. (Carman returns to Ontario on 31 May, eventually becomes top civil servant, and is later awarded the Order of Canada.) • Ray Ranger is seconded to Ferdinand to head up planting program. • In February, there is an investigation of possible sources of jack pine in Lac La Biche area, to meet pulp specifications of potential pulp mill customer.
1969	• IWA strike occurs; the planting program is curtailed; staff finish planting some blocks that had been started; seedlings are sold or given away. • Bill Mattes is hired to supervise the planting program in summer (four months) and to assist Wright on Forest Management program in winter (eight months).
1970	• Crossley writes the intensive silviculture report, the first Intensive Forest Management proposal. It is not accepted since AAC still exceeded needs. • Regeneration survey results indicate 73 per cent of 3,100 acres satisfactorily restocked;

	treatments applied to the other 27 per cent.
1971	• Save Tomorrow, Stop Pollution (S.T.O.P.) member, Arnim Zimmer, in a report for S.T.O.P., alleges erosion problems and lack of regeneration. Company and AFS investigation negates its findings.
1972	• Steve Ferdinand, working with Hank Spencer, designs the Ferdinand Rootrainer containers for seedlings, replacing the Ontario tubes. • Crossley talks to the Canadian Society of Wildlife Biologists at Prairie Habitat Conference on 18 February. He describes the relationships between forest management for fibre productivity and the preservation of a healthy forest environment. Refers to "environmental forest management."
1973	• The Shulco Report on Forest harvesting is released. Report was prepared by C.D. Schultz & Company Ltd. for the Minister of Lands and Forests entitled *The Environmental Effects of Timber Harvesting Operations in the Edson and Grande Prairie Forests of Alberta,* September 1973. Conclusions include the statement that "timber harvesting can remain as a principal and highly legitimate use of the project area." Detailed recommendations provided. • Steve Ferdinand is allowed to recruit women as tree planters. In 1973, these women planters are fired without warning (and against Steve's advice). • There is pressure by the Lands and Forests Department to accelerate treatment of regeneration backlog.
1974	• Bill Mattes takes over Silviculture from Steve Ferdinand who resigns (28 February) to go with AFS. Mattes assisted by Neil Holder. • Decision is made to hire crews of university students—crews to be made up of both men and women. This leads to a long period of relative peace on labour front.
1975	• Des Crossley retires on 31 October 1975 and is accorded a warm send-off in recognition of his substantial contributions. • Jack Wright is named new chief forester, effective 1 November 1975. The period to 1987 resulted in great advances in reforestation trials, tree and stand improvement. • Bob Udell is hired back (from Ontario) to replace Wright in Inventory and Management. • Progressive clear-cut project on Berland Working Circle begins and goes until 1977. • Thinning program commenced.
1976	• Peter Sziklai is hired as tree improvement forester. He takes over the thinning program that switched to pre-commercial thinning of regenerated stands; this leads to both stand and tree improvement programs. • Operational thinning of young fire-origin stands is discontinued; costs are approaching $500 per acre. • Planning takes place to replace the 1965 greenhouses; task is later completed in 1981.

	• The Bracke scarifier is introduced as a SIP tool to address continuing problems with site preparation for planting in Camp 1. The scalps produced by the machine prove very effective in preparing planting sites, a major step towards the reforestation of second-pass cuts in the wind-parched compartment.
1977	• The Environment Council of Alberta begins hearings on the Environmental Effects of Operations in Alberta. Retired Chief Forester Des Crossley is appointed one of four panel members, along with Bruce Dancik (Chair), J.F. Reynolds, and Alistair Crerar (ECA ex officio). • Second revision of the Forest Management Plan (third Forest Management Plan submitted) occurs. The lead author is Bob Udell.
1978	• *Forest Management in Canada*, written by F.L.C. Reed, is published by CFS. Report cites NWPP example positively. Chapter on NWPP operation is written by Crossley.
1979	• The Environment Council of Alberta (ECA) Report on Environmental Effects of Forest Operations is released, dated February 1979. • Cazes & Hepner (C & H) plough is introduced to address problems with excessive vegetative competition, especially poplar. On about 10 per cent of planting sites, the rapid growth of hardwoods (aspen) creates too much competition for the conifer seedlings. A C&H plough is acquired in 1979 and mounted on a modified Komatsu tractor in an attempt to deal with this problem.
1980	• Craig-Simpson (C & S) rear-mounted ripper plough is introduced for SIP in areas of deep duff, supplementing winter blading, which has been the practice up until then. This 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 continues to be a challenge on some sites. • New greenhouse is under construction; there is a 2.5 million seedlings production plan.
1981	• Union Oil Co. of Canada Ltd. and Rescon Holdings announce a new coal mine in the Obed Mountain field northeast of Hinton. Company is very concerned over loss of several thousand acres of well-established reforestation. • New forest nursery and greenhouse is opened; 3 million seedlings are produced.
1982	• Jack Ward Thomas talks about wildlife habitat and forestry practices at Jasper. Jim Clark, St. Regis woodlands manager, gives the summary address to the conference and offers its FMA as the testing grounds for an applied forestry-wildlife study. An industry-government committee spent three years determining the means to bring this integration management of resources into fruition. • Reforestation program is reduced for a year, especially scarification for natural regeneration (done for backlog treatments only, due to poor market conditions; there are some staff layoffs. The full cost of the delay is recognized later as NSR areas come due for planting.
1984	• Full-time IWA crew does operational thinning work; this continues to 1987.

1985	• Vice-President Ken Hall writes a proposal to restructure forest-related units into Forest Resources Department. Woodlands starts an evaluation of the reorganization; proposed 3-year phase-in to merge Woodlands and Forestry. • Before retiring, Clark and Jack Wright collaborate on a proposal to merge the old Forestry and Woodlands departments under one manager. This proposal is accepted and Don Laishley is hired to head up this new department in 1986. • Jim Clark retires at the end of November 1985. • Province and Company conduct Juvenile Stand Surveys. Results lead in 1987 to a provincial committee to study regeneration standards and in 1991 to new free-to-grow standards • Des Crossley writes his final opus, *Towards a Revitalization of Canadian Forests*, in which he proposes that the forest management program and forest tenure systems pioneered at Hinton be emulated in other jurisdictions across Canada.
1986	• Major department restructuring takes place; Forestry and Woodlands are amalgamated into one Forest Resources Department. Don Laishley starts as Forest Resources Manager in January 1986. • Operational responsibility for silviculture is assigned to the districts. Though well-intentioned, silviculture loses some of its focus. • Third revision of Forest Management Plan is submitted (1961, 1966, 1977). The lead author is Bob Udell. • Operational trial of herbicide for regeneration is proposed but withdrawn in response to organized local coalition.
1987	• Jack Wright and Bill Mattes retire. • Bill Rugg is appointed Silviculture Planner; he develops first regenerated Stand Inventory used in 1991 FMP.
1988	• New Forest Management Agreement, passed by Order-in-Council 290/88, dated 26 May 1988. Major change is an enlarged FMA Area upon committed expansion, respectively for expanded pulp mill and new sawmill. • FMA Area increases from 800,000 ha to 1,012,000 ha. • New AAC is expected to provide only 70 per cent of wood needs; this leads to new focus on silviculture.
1989	• Expert Panel on Forest Management in Alberta is set up, chaired by Bruce Dancik of the University of Alberta. Bob Udell is a member, along with Lorne Brace of CFS, and John Stelfox of CWS.
1990	• Expert Panel on Forest Management in Alberta reports. Some of its recommendations will affect the Hinton operations. One recommendation leads to Alberta Forest Conservation Strategy program in 1994. • For tree seedlings, there is the start of a transition from Spencer-Lemaire to styroblock

	containers. Initial focus is on 2/11 plugs (container base 2 cm diameter by 11 cm in length).
1991	• Free-to-grow legislation is passed by Alberta government in 1991; terms have been negotiated with forest industry of which Champion was a part. New standards take effect in March 1991. • New Forest Management Plan for the expanded FMA is completed (fourth revision of FMP), submitted 1961, 1966, 1977, 1986, 1991). The lead author is Douglas Walker. • 50 millionth seedling planted.
1992	• Foothills Model Forest Agreement is signed; successful application by Company with Alberta Forest Service and Forest Technology School. Model Forest submission is the best of the national competition and Foothills Model Forest becomes one of ten across Canada. • Hamish Kimmins is hired to start expert review of silvicultural practices (report showed need to improve); this leads to subsequent expansion of silviculture effort and concentration of silviculture effort under one manager, David Presslee. • David Presslee starts November 1992; there is Integrated and Enhanced Forest Management Planning, including silviculture. • Linked Planning Process is initiated at end of year. Task force is to study linking woodlands and silviculture concerns into a comprehensive, unified approach. Task force includes Bob Udell, Rick Bonar, and Hugh Lougheed from the Company and Tony Sikora and Dan Wilkinson from the government. • Diane Renaud is hired as a silviculturist.
1993	• Kimmins-Brace Report on Silviculture is published. Following a preliminary report by Hamish Kimmins in 1992, he was joined by Lorne Brace in a more comprehensive review of the program. They report that, unless significant changes are implemented, the Company's management plan assumptions would not be achieved and allowable cuts and sustainability would suffer. This February 1993 report leads to three further internal reports and significant changes in the organization. • Report leads to systematic regeneration program monitoring program. • Planning and implementation operations are changed to put silviculture planning and operations under one manager. Silviculturists are pulled out of the districts. • Pre-harvest Prescriptions (PHPs) are initiated by David Presslee. • Side-by-side seedling planting trials are started in Berland Block 140; performance of seedling types, sizes, and sources is compared; 100 of each are planted. Report in 1994 indicates styroblock plugs performed best. • Crossroads Report, 1 November 1993: the first report arising from the Kimmins-Brace review, it advocates a focus on silviculture in operations and leads to additional $1 million in silviculture budget. • Ecological Mapping, based on Ian Corns work and using the Corns and Annis guide; first trial.

1994	• January 31: Linked Planning Process report presented to ADM Ken Higginbotham, and Forest Resource Manager Don Laishley. Prepared by joint company/AFS task force co-chaired by Bob Udell (Weldwood) and Dan Wilkinson (AFS). It is based on Baskerville's Six steps to Sustainable Forest Management and designed to ensure compatibility and consistency in all levels of planning. It includes built-in feedback and control mechanism through the Stewardship Report. Report later reflected in various policy documents in Alberta, including the forest management planning guidelines. • Joint venture company is formed to manage Huallen Seed Orchard. • Don Laishley is transferred to Vancouver; Dennis Hawksworth is appointed General Manager of Forest Resources and Hi-Atha. • February 24: David Presslee is promoted to Forest Operations Area Superintendent with responsibility for all silviculture operations on the FMA. This is a direct result of Crossroads Report, with the goal of getting silviculture practices back into line and supporting forest management plan assumptions. • Ecological Mapping—prototype 1 and trial c 74,000 ha. • Stump-side processing is re-introduced as part of Crossroads Report to enhance regeneration and other silvicultural considerations. • This is the last year of production of Spencer-Lemaire container seedlings; shift to 2/11 styroblock container stock continues. • Nursery: re-evaluation shows that the value derived from the nursery is marginal as the quality of seedlings produced at private facilities is improving as is their cost competitiveness. But there are no compelling reasons to close the nursery down, and some good PR value in keeping it open.
1995	• Tree Improvement Report – New Tree Improvement Division at Weldwood Hinton in January, a major step forward. This is the fourth in a series of reports advocating increasing levels of silviculture performance on the FMA to increase AAC and offset land base losses arising from other activities and land use priorities. • Diane Renaud is appointed Tree Improvement Coordinator. • Ecological Mapping—prototype 2 and expanded trials c 100,000 ha. • Nursery: Improvements are introduced. • Transition to styroblock container seedlings, 2/11 plugs, is completed. • In April, Don Laishley, Bob Udell, Brian Quick, and Rod Beaumont visit Champion operations in North and South Carolina, hosted by VP Don Taylor. As a result of this visit, a cooperative agreement is reached whereby Champion technical experts would visit the Hinton operation and offer guidance and advice on silviculture and enhanced forest management programs. Thus begins a long-term relationship involving Jim Gent, soils and nutrition specialist, David Todd, tree improvement specialist, and Bob Kellison, special advisor. This continues right up to the sale of Champion to International Paper, hearkening back to the early days of St. Regis/NWPP exchanges. • Fifth measurement of the vegetation and wildlife study plots, the longest standing wildlife and study in western Canada, takes place. John Stelfox, with Brad Stelfox and one

	other, re-measures vegetation and wildlife study plots for camps 1, 5 and 9, representing over 40 years of data.
1996	• There is full integration of harvesting and silvicultural planning, with Ecological Classification as the basis. • Enhanced Silviculture Project proposal is made in January. • Ecological Site Classification and Mapping. Beckingham guide published. There is a full launch of program with 270,000 ha with a target of 2005 for completion. • In January, Enhanced Forest Management (EFM) Report presented to Dennis Hawksworth by internal team, outlining and recommending possibilities available through intensification of management on the FMA. It is very similar to Crossley's earlier (1970) report. The wood supply situation was much more restricted in the 1990s and the EFM report is accepted and activities begun to capture the benefits. • Enhanced Forest Management (EFM) program is started. There is a major commitment to increase production of wood on the FMA area through a comprehensive program including cultural and utilization approaches. • Stan Navratil is hired to review and advise on enhanced forest management with a focus on applied silviculture; review of literature, CFS agreement to relocate lodgepole pine trials, data, re-measure, re-analyze. • Diane Renaud is appointed as Tree Improvement Forester. • Nursery: Computer controls are installed. • Seedling container sizes are increased to 3/10 plugs, up to 3/13 for more difficult sites. • New Forest Harvesting and Operating Ground Rules come out, the first ones developed with major public involvement through FRAG. The new edition is greatly expanded and refined.
1997	• Dennis Hawksworth is appointed Vice President of Hinton Forest and Wood Products. • There is a celebration of 90 millionth seedling planted. • Provincial Enhanced Forest Management report and recommendations (co-chairs Udell and Wakelin) is presented in February. • Navratil Report is received. • Enhanced Forest Managament trials begin with a focus on increased wood production—thinning, spacing, fertilization. • Intensive Forest Management Task Force is appointed. • Ecological Mapping—entire Caribou range to be mapped this year—demonstrates tie to wildlife. • Nursery, shelter houses are constructed; two lots per year are programmed.
1998	• FMP data are based on Alberta Vegetation Inventory. • Company initiates program to re-measure old CFS regeneration and spacing trials.

	• Foothills Growth & Yield Association formed. • The 1971 Zimmer (S.T.O.P.) photo points were re-photographed in 1998 by Steve Ferdinand and Bob Stevenson.
1999	• Jim LeLacheur becomes General Manager of Forest Resources and Lumber. • Rick E. Ksiezolposki is hired from Tolko Manitoba operations to replace Muhly as head of Forest Resources. • Forest Management Plan, fifth revision, is completed (submissions 1961, 1966, 1977, 1986, 1991, 1999); lead author is Hugh Lougheed. There is an entirely new approach based on commitment to sustainable forest management with ecosystem approach, tailored to fit with Canadian Standards Association SFM format and CCFM Criteria. It is the first FMP in Canada to include an explicit analysis of forests, wildlife, and hydrological interdependencies. • Company is successful in renewing ForestCare certification through AFPA. • There is a celebration of 100 millionth tree planted. • On June 8, the company announces it will close the container seedling greenhouse upon completion of the current year's crop. Privatization of the nursery business in Alberta, combined with the loss of government support for seedling production costs, has resulted in a very competitive business environment with high-quality seedlings available from private growers at costs the company greenhouse cannot begin to meet. At the time, the company greenhouse could only provide about 30% of the company's seedling needs. All workers are given alternative employment in the company workforce.
2000	• Hugh Lougheed is promoted to Silviculture Manager, replacing David Presslee. Roger Hayward is promoted to Silviculture Co-ordinator. Sharon Meredith is hired to begin the process for the next management plan. • David Presslee passes away 29 January from post-operative infections. Weldwood establishes a scholarship for a second-year NAIT student and announces it at the ETC/FTC 40th Anniversary in Hinton in October. First $1,500 winner is Ed King. Friends of Presslee establish a scholarship fund for the Presslee children. On 23 September, a plaque and memorial are unveiled at the Gregg Cabin, at the site of the 100-millionth tree plantation in September. • In the spring, the ALFS announces the new regeneration standard for Alberta. Due to the inability of the AFPA membership to agree on a standard, this is a unilateral choice by ALFS. The standard appears to have a deciduous bias, and the ADM agrees that industry members could elect to continue to use the 1991 standard or develop an FMA-specific standard (Model 2), the result of an industry-government task force co-chaired by R. Udell and D. Sklar. • Enhanced forest management protocols for Alberta are released along with the new regeneration standards. • Canadian Standards Association -- Sustainable Forest Management Certification under Z809. The FMA is registered as a sustainably managed forest under the demanding CSA standard.

	• Weldwood and Weyerhaeuser jointly support a new Centre of Enhanced Forest Management at University of Alberta. The Centre is headed by Vic Lieffers who had been awarded the Weldwood/Weyerhaeuser NSERC Professorship. • In early September, David Todd returns to Hinton for a final visit on its tree improvement program. He had not been retained by IP and brought Gregg Leach (former Champion, now IP tree improvement specialist) and Siroos Jahromi, head of tree improvement for IP. A farewell dinner is held at the Overlander on 9 September.
2001	• In January, 2001 the company receives the 1995 measurement review of the 1956 Stelfox study. The original plots were re-measured by retired biologist John G. Stelfox and his son J. Brad Stelfox (Forem Technologies) with cooperation from Wayne C. Bessie (Foothills Model Forest) and Calvin R. Clark (Clark Ecodynamics). Study plots have been measured in 1956 (establishment), 1959, 1960, 1961, 1982, 1988, 1995. • On 12 January, Weldwood's David Presslee scholarship for a second-year mature NAIT student is presented to Ed King ($1,500 value). The presentation is made by Rosanne Presslee, widow of David, and her daughter Kerri. Also attending are Bob Udell and Hugh Lougheed. • On 16 May, the company names its new Weldwood Enhanced Pine Program (WEPP) seed orchard in honour of Dave Presslee. • On 28 June, Jasper Park Superintendent Ron Hooper and Ecosystem Manager Kevin van Tighem visit Hinton to hear a presentation on the company forest management program and to tour reforestation and operations
2002	• The *Regulated Forestry Profession Act* comes into effect on 25 April after approvals of the Regulations by the Standing Policy Committee on Learning and Employment, Cabinet and the Lieutenant Governor-in-Council. • On 10 June, IP President John Dillon and the International Paper Company Board of Directors visit Hinton operations. A helicopter tour from Edson to the Gregg Cabin, presentations at the cabin, a logging and reforestation demo in McLeod 7 and a HI ATHA sawmill tour are highlights. Public Affairs Forester Aaron Jones chaired the organizing committee. • On 13 November, the Company is advised by NAIT that the third winner of the David J. Presslee Memorial Award ($1500) is Maury Simoneau. He achieved an 89.54 per cent average in his first-year program. • On 13 December, Hugh Lougheed is given an expanded role in the Forest Resource Department, assuming the role formerly held by Rob Stauffer, while retaining his existing responsibilities as forestry manager. To assist Lougheed, Roger Hayward is promoted to silviculture/GIS co-ordinator and Rick Bonar is promoted to coordinate all planning activities. Dave Kmet remains as lands/Aboriginal co-ordinator and Kevin Land as stewardship forester. • The ecological classification of the Hinton FMA is completed.
2003	• On 14 March, Pat Wearmouth, president of the Huallen Seed Orchard Company, signs an agreement with Doug Sklar of Sustainable Resource Development, completing the

	purchase of the land for the seed orchard, the culmination of a multi-year negotiation. • In July, *Learning from the Forest – A Fifty-year Journey Towards Sustainable Forest Management* is published by Fifth House Publishers and Foothills Model Forest. Authors are Bob Bott, Pete Murphy, and Bob Udell. The book covers the history of adaptive and sustainable forest management at the Hinton forest. On 4 September, the Hinton Forest Resource Department is reorganized, with Hugh Lougheed, Sharon Meredith, and Bob Held (Sunpine) now reporting to Bryon Muhly and dealing with forest resources issues and opportunities of a company-wide and strategic nature. Roger Hayward is moved from silviculture coordinator to area coordinator. The silviculture and tree improvement specialists become a self-directed team reporting to Dan Rollert. Included in the reorganization is the elimination of 11 positions in Alberta Woodlands, most through retirement or eliminating vacant positions. • On 21–28 September, the XII World Forestry Congress is held at Quebec City, with the theme, "Forests, Source of Life." Weldwood delegates Rod Beaumont and Bob Udell each present papers at the Congress, the only two Canadian industry foresters to be invited to do so based on the papers submitted for consideration. Udell's paper, "Evolution of Adaptive Forest Management in an Historic Canadian Forest," outlines the evolution of adaptive management on the Hinton Forest. • The Forest Management Area is successfully re-registered to the CSA/Z809 standard for Sustainable Forest Management. On 18 November, NAIT is advised that the David J. Presslee Memorial Award winner ($1,500) for 2003–04 is Ashley Williscroft, a second-year student in the Forest Technology program.
2004	• Vice President Dennis Hawksworth retires. • Bob Udell retires. • Diane Renaud is re-assigned as silviculture manager but continues to carry her responsibilities in tree improvement. • Operational application of herbicides for competition control begins on the FMA.
2005	• On 5 February strategic planning manager, and former forest resource manager, Bryon Muhly, retires. • On 28 September, Sharon Meredith, Management Forest in charge of the 2008 forest management plan, resigns from the Hinton operation to join the staff of Timberline Forest Consultants. • On 31 October, Hugh Lougheed also resigns from Forest Resources to join the staff of the new J.S. Thrower and Associates team in Alberta. Hugh was the author of the 1999 Forest Management Plan.

Endnotes

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Appendix 2 Summary of CFS Projects on the Hinton Forest 1955-1988

RESEARCH ON FMA LEASE OF WELDWOOD AT HINTON

COMPILED BY
J.M. POWELL

SEPTEMBER, 1988

NORTHERN FORESTRY CENTRE
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RESEARCH ON FMA LEASE OF WELDWOOD AT HINTON

The following is a summary compilation of research studies carried out by the Canadian Forestry Service since the late 1950's on the FMA lease area of Weldwood at Hinton. The summaries are arranged by program area:

i) Resources (stand productivity, site productivity, silviculture);

ii) Protection (insects, diseases);

iii) Environment (fire, hydrology, climate); and

iv) Economics.

Some studies have been arbitrarily placed in this arrangement as they overlap forestry disciplines. The following format is used for each study listing:

(a) Study title, including study number(s);

(b) Objectives;

(c) Status or major findings;

(d) Reports;

(e) Contact person, wherever possible; and

(f) Current or long term plans, if applicable.

TABLE OF CONTENTS

i) Resources

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

Study : Seed release from slash-borne lodgepole pine cones (A 80)

Objectives: a) To determine rate of release, deterioration in quality and loss to squirrels of slash-borne seeds following clearcutting.

b) determine major factors affecting loss of quality and rate of seed release from slash-borne serotinous cones.

Status : Initiated in 1962 when three 5-acre lodgepole pine stands were selected for study and clearcutting. After logging, the amount and quality of slash-borne seeds were determined by periodic sampling during 1962, 1963, 1964 and 1966.

Reports : Ackerman, R.F. 1963. Seed release from slash-borne lodgepole pine cones after clear-cutting. Can. Dep. For., For.Res. Br., Calgary. Establishment Rep. 63-A-5.

Ackerman, R.F. 1966. Effect of storage in slash on quantity and quality of lodgepole pine seeds available for regeneration. Can. Dep. For. Rural Dev., For. Br., For. Res. Lab., Calgary. Inf. Rep. A-X-3.

Contact : L.G. Brace

Current and Long-term plans : None

Study : Container planting in Alberta (A/T 105)

Objective: Experiments were designed to answer a series of questions related to container planting.

Status : Experiments were carried out between 1962 and 1966 with field plantings of various container stock. In 1965 NW Pulp & Power Ltd. initiated pilot trials of container plantings, based on the results of the experiments, with 1/4 million planted in 1965 and 1/2 million in 1966.

Reports : Ackerman, R.F. 1964. A field test of bullet planting in Alberta. Progress Report (Mimeo 64-A-7); 1965. Progress Report (Mimeo. 65-A-6)

Ackerman, R.F., D.I. Crossley, L.L. Kennedy and J. Chedzoy. 1965. Preliminary results of a field test of bullet planting in Alberta. Can. Dep. For., For. Res. Br., Publ. No. 1098.

Contact : L.G. Brace

Current and Long- term plans : None

Study : Evaluation of pilot scale container planting in the Alberta Foothills Section (A 268: NOR-002) and subsequent container studies including NOR-10-111.

Objective: Evaluate present system of container planting used by NWPP for white spruce and lodgepole pine on a variety of sites.

Status : Approximately 180 plots containing 100 marked seedlings were established in 1965, 1966 and 1967. First, third and fifth year tallies of survival and growth were carried out.

Reports :

H.J. Johnson and F. Marsh. 1967. Preliminary evaluation of pilot-scale container planting in the foothills of Alberta. Can. Dep. For. Rural Dev., For. Br., For. Res. Lab., Calgary. Inf. Rep. A-X-11.

H.J. Johnson and G. Dixon. 1968. Preliminary evaluation of pilot-scale container planting in the foothills of Alberta-1966 planting. Can. Dep. For. Rural Devel., For. Br., For. Res. Lab., Calgary. Internal Rep. A-11.

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H.J. Johnson. 1972. Performance of container stock in Alberta. pp. 101-118. In. Proceedings of a workshop on container planting in Canada. Environ. Can., Can. For. Serv., DPC Ottawa Inf. Rep. DPC-X-2.

N.R. Walker and H.J. Johnson. 1974. Field performance of pine and spruce reared in the BC/CFS Styroblock-Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-84.

H.J. Johnson and N.R. Walker. 1976. Five-year field performance of pine and spruce styroplugs in Alberta. For. Chron. 52:197-198.

N.R. Walker. 1978. Field performance of Spencer-Lemaire container seedlings in west-central Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-207.

N.R. Walker and H.J. Johnson. 1980. Containerized conifer seedling performance in Alberta and the NWT. Environ. Can. Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-218.

N.R. Walker and W.J. Ball. 1987. Container seedling field performance after 10 years. Can. For. Serv., North. For. Cent., Edmonton. For. Manag. Note 44.

Contact : (H.J. Johnson) and N.R. Walker

Current and Long-term plans : None

Study : Stand modelling of the growth and development of important forest types in the Prairie Provinces (NOR-4-75, NOR-4-02)

Objective: To forecast growth and yield of forest stands growing under a range of site and density conditions using a stand growth model developed for this purpose.

Status : STEMS (Stand and Tree Evaluation and Modelling System) was tested on stands of jack pine, aspen, lodgeple pine and white spruce using PSP data, and has been calibrated for these species. Demonstations of model have been given.

Reports : Nil

Contacts : H. Grewal and I.E. Bella

Current and long term plans : Publish an information report on the testing and calibration work done on "STEMS" on jack pine and aspen in the Prairie Provinces. This model was developed and is being continuously updated at the NEFES of the USFS in St. Paul, Minn.

Study : Managed stand yield tables for lodgepole pine and white spruce in Alberta.

Objectives: To develop a growth and yield prediction system for second growth lodgepole pine and white spruce -- i.e., new stands that follow harvest and are being established through either natural regeneration or planting -- within an appropriate and available site classification framework. Yield estimates thus obtained should be suitable input for timber management system models (e.g., TIMPLAN) for AAC calculations.

Status : A new polymorphic height growth model has been developed for lodgepole pine in Alberta. The first version of a lodgepole pine growth model has been completed. Present efforts concentrate on report writing.

Reports : A paper by Tait, Cieszewski and Bella on lodgepole pine stands dynamics has been accepted for publication. A paper by Cieszewski on the new polymorphic height growth model is in review. A paper on the lodgepole pine stand growth model is in preparation.

Contact : C. Cieszewski

Current and
Long term
Plans : See Reports

Study : Juvenile height growth of white spruce and lodgepole pine following logging and scarification in west-central Alberta.

Objective: To obtain information on the juvenile growth rates of pine and spruce following logging.

Status : Results indicated that lodgepole pine regeneration exceeds the minimum 6-foot standards within 20-years but in many areas white spruce regeneration will not reach this minimum. Terminated.

Reports : W.D. Johnstone. 1976. Juvenile height growth of white spruce and lodgepole pine following logging and scarification in west-central Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-171.

Contact : (W.D. Johnstone, B.C. For. Serv., Vernon)

Current and Long term plans : None

Study : Growth and yield of five commercially important native species in Alberta, Saskatchewan, and Manitoba. (NOR-4-008, NOR-4-45, NOR-4-01)

Objectives:

1. To construct yield tables for use in natural, unmanaged lodgepole pine, jack pine and aspen stands.

2. To determine the effect of different types and intensities of thinning on subsequent growth and yield of lodgepole pine, jack pine and aspen.

3. To determine growth and development of four indigenous conifer species, *Picea glauca*, *Pinus banksiana*, *P. resinosa*, and *P. contorta* var. *latifolia* at various spacings on major site types, so that optimum spacing can be selected for specific management objectives in future planting.

4. Use all available growth and yield information on these species to derive and/or adapt a suitable stand growth model for evaluating stand management options in terms of growth and yield.

Status: Continuing. Some major findings are listed below:

- new equations derived to predict yield of lodgepole pine stands for age, stand density and site productivity

- spacing and thinning recommendations for lodgepole pine

- operational thinning guidelines

- yield losses relative to line clearings in stands

- incidence and impact assessment of major pests in second growth lP and deriving strategies to reduce impact.

Reports : W.D. Johnstone. 1981. Effects of spacing 7 year-old lodgepole pine in west-central Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-236.

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W.D. Johnstone. 1976. Variable density yield tables for natural stands of lodgepole pine in Alberta. Can. Dep. Fish. Environ., Can. For. Serv., Ottawa. Forestry Tech. Rep. 20.

I.E. Bella. 1974. Thinning young lodgepole pine is faster with a brush saw. For. Chron. 50:151-154.

I.E. Bella. 1982. Effect of line clearing in forest stands on tree growth in western Canada. Can. For. Serv., North. For. Res. Cent., Edmonton. File Report.

I.E. Bella. 1983. Natural lodgepole pine in west-central Alberta. Part I: Regeneration stocking. pp. 5-7. In. Lodgepole pine: Regeneration and Management. U.S.D.A., For. Serv., Pacific Northwest For. Ra. Exp. Stn., Portland, Ore., Gen. Tech. Rep. PNW-157.

W.D. Johnstone. 1983. Natural lodgepole pine in west-central Alberta. Part II: Juvenile spacing. pp. 8-14. In. Lodgepole pine: Regeneration and Management. U.S.D.A. For. Serv., Pacific Northwest For. Ra. Exp. Stn., Portland, Ore., Gen. Tech. Rep. PNW-157.

Bella, I.E. 1984. Growth models for yield forecasting in aspen and jack pine. Page 2 In Growth, yield, and ENFOR. Environ. Can., Can. For. Serv., North For. Res. Cent., Edmonton, Alberta. For. Rep. 29.

Bella, I.E. 1984. Spacing is the key to improved yields in lodgepole pine. Page 4 In Growth, yield and ENFOR. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. For. Rep. 29.

Bella, I.E. 1985. Pest damage incidence in natural and thinned lodgepole pine in Alberta. For. Chron. 61(3):233-238.

Bella, I.E. 1985. Western gall rust and insect leader damage in relation to tree size in young lodgepole pine in Alberta. Can. J. For. Res. 15:1008-1010.

Bella, I.E. and Navratil, S. 1987. Growth losses from winter drying (red belt damage) in lodgepole pine stands on the east slopes of the Rockies in Alberta. Can. J. For.Res. 17:1289-1292.

Bella, Imre E. and Stoszek, Karl J. 1988 Strategies for reducing impacts of terminal shoot insects. pp. 286-287. In Proc. "Future Forests of the Mountain West: A Stand Culture Symposium", Missoula, MT, Sep. 29 Oct. 3, 1986. USDA, Gen. Tech Rep. INT-243.

Navratil, S. And Bella, Imre E. 1988. Impact and reduction strategies for foliage and stem diseases and abiotic injuries of coniferous species. 310-321. <u>In</u> Proc. "Future Forests of the Mountain West: A Stand Culture Symposium". Missoula, MT, Sep. 29 - Oct. 3, 1986. USDA, Gen. Tech. Rep. INT-243.

Bella, I.E. and Navratil, S. 1988. Western gall rust dynamics and impact in young lodgepole pine stands in Alberta. Can. J. For. Res. (in press)

Tait, D.E., Cieszewski, C.J. and Bella, I.E. 1988. The stand dynamics of lodgepole pine. Can. J. For. Res. (in press)

Contact : I.E. Bella

Current and Long term plans :

- reanalyse the Gregg Burn lP spacing data including current remeasurement and write up results.
- analyse leader damage (mainly from <u>Pissodes</u> spp.) impact on lP height growth and prepare report.
- develop precommercial thinning prescriptions for young lP that will consider western gall rust dynamics.
- develop yield prediction system for Alberta that will tie in with the provincial inventory and can be used for AAC calculation.

Study : Assessment of regeneration stocking standards used in Alberta.

Objective: To evaluate the suitability of the present stocking standards from the viewpoint of a desirable minimum standard that would ensure an acceptable wood fibre production.

Status : New minimum stocking standards were derived for the two most important commercial conifers, requiring 220 well dispersed lodgepole pine per acre or 300 well dispersed white spruce per acre. Also a larger 10 m^2 quadrat is suitable for spruce and 12 m^2 for pine. The corresponding minimum stocking percentages should be around 75% and 70% respectively.

Reports : I.E. Bella. 1976. Assessment of regeneration stocking standards use in Alberta. Environ. Can., Can. For. Serv. North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-167.

I.E. Bella and J.P. DeFranceschi. 1978. Assessment of regeneration stocking standards used in Alberta. A follow-up. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-211.

Contact : I.E. Bella

Current and Long term Plans : None

Study : Growth of fir and spruce advance growth and logging residuals following logging in west-central Alberta.

Objective: To obtain information on growth after clearcutting of white spruce, black spruce, and alpine fir advance growth and logging residuals.

Status : Spruce and fir logging residuals showed significant growth release after logging. The greatest release was in diameter growth; white spruce demonstrated the largest response of the species examined. Terminated.

Reports : W.D. Johnstone. 1978. Growth of fir and spruce advance growth and logging residuals following logging in west-central Alberta. Fish. Environ. Can., Can. for.Serv., North.For. Res. Cent., Edmonton. Inf. Rep. NOR-X-203.

Contact : (W.D. Johnstone, B.C. For. Serv., Vernon

Current and Long term plans : None

Study : Ingress of lodgepole pine and white spruce regeneration following logging and scarification in west-central Alberta.

Objective: To determine the rate of seedling ingress following logging and scarification.

Status : Recommended that surveys be conducted after 8 growing seasons and consideration be given to acceptance of all seedlings. Terminated.

Reports : W.D. Johnstone. 1976. Ingess of lodgepole pine and white spruce regeneration following logging and scarification in west-central Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Inf. Rep. NOR-X-170.

Contact : (W.D. Johnstone, B.C. For. Serv., Vernon).

Current and Long term Plans : None

Study : Planting chance and spacing trials in white spruce on different soils, in the Foothills Section, Alberta (A-83)

Objective: To determine the effects of site and intitial spacing on planting chance, seedling mortality, and period growth in plantations of white spruce under aspen.

Status : Thirty-six acres of plantations were established in 1962 in 70-year old aspen with scattered white spruce. Four plantations were planted on crown land in the vicinity of Marlboro and Bickerdike. Terminated in 1969.

Report : Duffy, P.J.B. 1963. Plantations of white spruce under aspen on different soils, Foothills Section, Alberta. Can. Dept. For., For. Res. Br., Calgary. Establishment Rep. 63-A-11.

Contact : (P.J.B. Duffy, P.J.B. Duffy & Associates Ltd., West Vancouver)

Current and Long term plans : Potential to have plantations resurveyed in next few years.

Study : Development of regeneration silviculture for white spruce and lodgepole pine in the B.19 Forest Section of Alberta (A-54: A/T 54)

Objectives:

1. To test clearcutting and mechanical scarification as a regeneration method for lodgepole pine and white spruce on the major site types found within the Foothills Section.

2. To determine the major factors affecting success of scarification.

3. To establish demonstration areas.

Status : Initiated in 1958 on the lease area to determine optimum regeneration silvicultural practices for the major site conditions of the area. Regeneration response on eleven 5-acre scarified and un-scarified areas were measured during the first, second and fifth years following treatment. Terminated in 1969.

Reports :

Ackerman, R.F. 1960. The development of regeneration silviculture for white spruce and lodgepole pine in the B. 19 Forest Section of Alberta. Progress Report - 1961.

Ackerman, R.F. 1962. Modifications in the environment of lodgepole pine germinants induced by scarification. Can. Dep. For., For. Res. Br., Mimeo. 62-13.

Contact : L.G. Brace

Current and Long-term plans : None

Study : Forest ecosystem classification and interpretations for forest management (NOR-27-169; NOR-10-193; NOR-10-04)

Objective: To classify forest ecosystems and make interpretations for forest management using available forest ecological and reconnaissance soil survey information.

Status : Field guide is published for west-central Alberta study area which includes NTS map sheets 83F (Edson), 83L (Wapiti) and 83K (Iosegun Lake). Eleven sample plots located during the Bigeoclimatic classification (1977-1980) are situated in the McLeod (6 plots), Embarras (3 plots) and Athabasca (2 plots) working circles.

Reports : Corns, I.G.W. and R.M. Annas. 1986. Field guide to forest ecosystems of west-central Alberta. Can. For. Serv. North. For. Cent., Edmonton, Alberta.

Corns, I.G.W. 1987. The study area-background supplement to Field Guide to forest ecosystems of west-central Alberta. File report. Can. For. Serv. North. For. Cent., Edmonton, Alberta.

Contact : I.G.W. Corns

Current and Long term plans : None

Study : Plant succession following clearcutting and scarification in lodgepole pine forests in the Lower Foothills of Alberta. (NOR-10-193)

Objective: To document plant succession and tree biomass accumulation following pulpwood clearcutting in west-central Alberta.

Status : Early plant succession and tree biomass accumulation was documented by Corns (1972) and Corns and LaRoi (1976) on 6 to 12 year old clearcuts sampled in 1970 and logged between 1958 and 1964. Twenty-five sample plots are located in the Marlboro working circle, compartment VII. In 1982, several (3) of the 25 year old plot areas were sampled for species composition and tree biomass. A report is in preparation.

Reports:

Corns, I.G.W. 1972. Early plant succession after clearcutting of lodgepole pine in the Lower Foothills of Alberta. M.Sc. thesis, University of Alberta, Edmonton, Alberta.

Corns, I.G.W. and G.H. LaRoi. 1976. A comparison of mature with recently clear-cut and scarified lodgepole pine forests in the Lower Foothills of Alberta. Can. J. For. Res. 6:20-32.

Contact : I.G.W. Corns

Current and Long term plans : A manuscript "Succession and tree biomass accumulation after clear-cutting lodgepole pine in west-central Alberta - the first 24 years" was submitted to Can. J. For. Res. and is presently under revision.

Study : Compaction by forestry equipment and effects on coniferous seedling growth on four soils in the Alberta foothills.

Objective: To document the effects of summer logging and the use of site preparation equipment on soil bulk density in four soil associations encompassing a wide range of physical properties in west-central Alberta. White spruce and lodgepole pine seedling growth on soils compacted to field bulk densities was also studied in the greenhouse.

Status : Field work was done in 1983 and 1984 within the McLeod, Athabasca, Marlboro and Embarrass working circles of the Weldwood FMA.

Reports : Corns, I.G.W. 1988. Compaction by forestry equipment and effects on coniferous seedling growth on four soils in the Alberta foothills. Can. J. For. Res. 18:75-84.

Contact : I.G.W. Corns

Current and Long term plans : None

Study : Land classification for forest fertilization (NOR-12-122)

Objectives: To develop and provide a land classification system for the consideration and efficient application of fertilizers for increasing forest productivity.

Status : In 1970, three 40+ acre blocks were selected in 3 age classes of lodgepole pine on two soil types south of Hinton. Plots were systematically laid out in the blocks and the soils were sampled and described, including some chemical analyses. Funding was not continued.

Reports : Nil, except the base work was incorporated with the 10 year report of the fertilizer results.

Contacts : (W. Holland). R. Yang

Current and long term plans : None

Study : Fertilization of established lodgepole pine stands (NOR-04-04)

Objective: To assess the effects of fertilizing 70-year-old and 30-year-old lodgepole pine stands on stand growth and yield.

Status : Nitrogen (N) fertilizer improved total stand and merchantable volume production in 70-year-old pine stands on both Coalspur and Mercoal soils by as much as 34 m^3 in total and 33 m^3 in merchantable volume per hectare over the 10-year period, or a 50% improvement in wood production. In 30-year-old stands, fertilization improved tree diameter and volume increments but not stand volume. Fertilization effects were probably obscured by mortality. Fertilizer should be used in combination with thinning for effective fertilization of young dense lodgepole pine stands.

Fertilization had little effects on wood density tracheid length on 70-year-old lodgepole pine.

Reports :

R.C. Yang. 1983a. Natural lodgepole pine in west-central Alberta. Part III. Fertilization. pp. 15-19. In. Lodgepole pine: Regeneration and Management. U.S.D.A. For. Serv., Pacific Northwest For. Range Exp. Stn., Portland, Ore., Gen. Tech. Rep. PNW-157.

R.C. Yang. 1983b. Composite design versus factorial experiments in forest fertilization trials. Can. J. For. Res. 13(3):438-444.

R.C. Yang. 1985a. Ten-year growth response of 70-year-old lodgepole pine to fertilization in Alberta. North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-266.

R.C. Yang. 1985b. Effects of fertilization on growth of 30-year-old lodgepole pine in west-central Alberta. North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-268.

G.F. Weetman, R.C. Yang and I.E. Bella. 1985. Nutrition and fertilization of lodgepole pine. Pages 225-232. In. Lodgepole pine: The species and its management. Symposium Proceedings (Ed.) D.M. Baumgartner, R.G. Krebill, J.T. Arnott and G.F. Weetman. Washington State Univ., Pullman, WA.

- 2 -

R.C. Yang and I.E. Bella. 1986. Fertilization improves stand productivity of preharvest lodgepole pine. North. For. Cent., Edmonton, Alberta. For. Management Note No. 36.

R.C. Yang, E.I.C. Wang and M.M. Micko. 1988. Effects of fertilization on wood density and tracheid length of 70-year-old lodgepole pine in west-central Alberta. Can. J. For. Res. In press.

Contact : R. Yang

Current and Long term plans : Study closed.

Study : Fertilization and thinning of semimature lodgepole pine stands (NOR-0405)

Objective: To assess the combined effects of fertilization and thinning on semimature lodgepole pine stand growth and to examine the interrelations of soil nutrient status, thinning, fertilization, foliar nutrient, foliar dimensional changes and tree/stand growth.

Status : Eighteen experimental blocks each consisting of four 9.5 m radius circular plots were established and half of these blocks were thinned in 1984. Four levels of N at 0, 180, 360, and 540 kg/ha were applied in the fall of 1985.

Foliar and soil samples have been taken annually since 1984 and nutrient status determined. Statistical analysis to determine effects of fertilization and thinning on foliar dimensional changes, foliar and soil nutrient status are in progress.

Reports : Nil

Contact : R. Yang

Current and Long term plan : Remeasurement to assess tree and stand responses to combined effects of fertilization and thinning is scheduled for the fall of 1990.

Study: Transformation and movement of applied fertilizer elements (N,P,S) in selected lodgepole pine stands (NOR-4-102, NOR-4-03)

Objective: To determine the influence of a soil series on the transformation of N, P and S fertilizers and the accumulation and distribution of these in the various inorganic and organic soil fractions. To also determine the association, if any, of a specific nutrient fraction with growth.

Status: The physical and chemical properties of two luvisols (Mercoal and Coalspur) influenced the distribution patterns of N, S and P observed.

Reports:

J. Baker. 1973. Nitrogen fractionation of two forest soils in Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-63.

J. Baker. 1982. Five year residual effects of nitrogen, phosphorus and sulfur fertilization on the concentrations and distribution of these nutrients in the soil profiles of two luvisols. Can. For. Serv., North. For. Res. Cent., Edmonton. File Rep.

J. Baker. 1982. Five year residual effects of nitrogen, phosphorus, and sulfur fertilization on the foliar composition of lodgepole pine current growth. Can. For. Serv., North. For. Res. Cent., Edmonton. File Rep.

J. Baker. 1977. The reaction of two luvisolic forest soils to phosphate fertilization. Can. J. Soil Sci. 57:385-395.

J. Baker. 1987. Distribution of N in a simulated profile of a Podsolic Gray Luvisol following urea fertilization. Can. J. Soil Sci. 67:271-280.

J. Baker. 1987. Current information regarding fertilization of lodgepole pine and suggestions for future research. North. For. Cent., File Report.

- 2 -

J. Baker. 1987. The status of 3-N fractions in the profile of a Podsolic Gray Luvisol 6 and 12 weeks after fertilization with urea, NH_4NO_3 and $(NH_4)_2SO_4$. North. For. Cent., File Report.

J. Baker. 1988. An approach to balanced applications of N, P and S in the fertilization of lodgepole pine in the foothills. Rept. submitted to Can. J. For. Res.

Contact : (J. Baker)

Current and Long term Plans : None

Study : Differences in forest land productivity between five physiographic land conditions, Foothills Section, Alberta (A82)

Objective : To describe and explain a) the differences in productivity between five physiographic groups of land, b) the variation in productivity within each group, and c) the site factors which are useful in classifying denuded forest land or land supporting suitable stands for the sample of year. Terminated.

Status : Field work was completed in 1962 but no reporting was completed.

Reports : Nil

Contact : (P.J.B. Duffy, P.J.B. Duffy & Associates Ltd., West Vancouver)

Current and Long term plans : None

Study	:	Aspen ingress on cutovers designated for conifer production (NOR-10)
Objective	:	To quantify aspen ingress by suckering and seeding-in on pine cutovers and competition levels impacting growth, and to define the needs and efficacy of release treatments.
Status	:	Field surveys are in progress to relate aspen ingress to site, site preparation and composition of parent stands. Trials of alternative approaches to pine release are in a planning stage.
Reports	:	A progress report will be available in 1989.
Contact	:	S. Navratil
Current and Long term plans	:	See above - Reports

Study : Development and application of large-scale photography and image analysis techniques to forestry. (NOR-22-142)

Objectives:

a. To utilize new techniques and apply appropriate sampling designs in the application of large-scale photography in acquiring resource inventory data; and,

b. To provide advisory and technology transfer services in the acquisition, uses, and analyses of remote sensing imagery, mapping, and in the operation of interpretation equipment.

Status : Some preliminary work for this on-going project was undertaken on the lease and used in the following report on assessment of regeneration by use of large-scale photography.

Report : C.L. Kirby. 1980. A camera and interpretation system for assessment of regeneration. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-221.

Contact : R.J. Hall

Current and Long term plans : None

Study : Estimation of logging residues using large-scale aerial photographs.

Objective: To investigate the application of large-scale aerial photographs to the estimation of logging residues using the line intersect technique.

Status : Measurement rates and precisions from photographs compared to ground survey were favorable and considerable potential for operational application was evident. A few problems were identified with solutions presented where applicable. Software programs are being developed for a fuelwood application in the Yukon Territories in conjunction with the Department of Indian Affairs and Northern Development in Whitehorse. Was updated and copy given but no Yukon activity at present.

Report : C.L. Kirby and R.J. Hall. 1979. The estimation of logging residues using large-scale aerial photographs. pp. 57-62. In D. Quintilio (Compiler) Proceedings of the International Fire Management Workshop. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-215.

Contact : R.J. Hall

Current and Long term plans : None

Study : Evaluation of mortality in stands of young trees in plantations and scarified areas (NOR-10-08).

Objective: To determine whether or not pine tree survival from establishment to age 35 years is related to site conditions, and if so, to prepare a set of survival curves for each site class.

Status : The locations of 69 sampling areas established in juvenile lodgepole pine stands near Hinton, Alberta, to monitor growth and survival are mapped. Brief descriptions of field and analytical methods are given. Annual and cumulative survival curves for low, medium, and high productivity areas are presented. Partial life tables were prepared for each of these areas and showed that the cumulative mortality after 25 years amounted to approximately 6, 34, and 22 % for low,medium and high productivity areas respectively. Armillaria root rot, Armillaria obscura (Pers.) Herink, and the Warren root collar weevil, Hylobius warreni Wood, caused most of the mortality on low productivity areas. Snowshoe hares, Lepus americanus Erxleben, were the most important mortality factor on medium productivity areas, while Armillaria root rot was the principal identified mortality agent on high productivity areas. Curves showing the infestation or damage rates of the major pests on an annual basis and in relation to stand age and density are given, followed by a discussion of the trends. Height increments of potential crop trees are influenced by tree age and area productivity, but not by stand density or Pissodes damage.

Reports : Ives, W.G.H. and C.L. Rentz. 1988. Life tables for juvenile lodgepole pine in the foothills of west-central Alberta: a progress report. Gov. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta. Unpubl. Rep.

Contact : W.G.H. Ives

Current and Long term plans : It is hoped that 1987-88 mortality and tree condition can still be assessed in the fall of 1988, but this is contingent upon help being available, and upon an open fall, especially if the work extends into October. Long-term plans are difficult to formulate. Ideally, the study should be continued another 5 years, with annual examinations, as this would take the study through one complete snowshoe hare cycle, but this is probably impractical.

If the 1987-88 data is obtained, it is planned to incorporate it into the progress report, which would then be upgraded to an information report, to be completed after the contact person retires. No future publications are planned, at least until the future of the study is more certain.

Study : Protecting white spruce understories (Project 1480)

Objective: To evaluate harvestable aspen stands with white spruce understories from the point of view of logging costs, understory damage and subsequent understory development for a range of harvesting options and understory densities, and to report results.

Status : Stand selection and logging option criteria have been determined . Stands selected on company limits and stand inventories completed. Logging plans have been prepared and harvesting is expected to proceed by mid-September 1988.

Reports : Brace, L.G. and Bella, I.E. 1988. Understanding the understory: dilemma and opportunity. In Proc. Management and utilization of northern mixedwoods. Edmonton, Alberta, Apr. 11-14, 1988. Can. For. Serv., North. For. Cent., Edmonton. NOR-X-296, pp. 69-86.

Contact : L. Brace or R. Waldron

Current and Long-term plans : See status

Study : Detection and appraisal of tree pests and vegetative disturbance (CP-2; CR-2; A/T 217; A/T 237; NOR-1-033; NOR-11-01)

Objectives: To investigate and monitor the occurrence, abundance and damage caused by forest insects and diseases and other tree damage agents and to report these pest conditions in annual reports.

Status : Annual surveys of pests and conspicuous forest damage have been conducted since 1941. Infestations of major insect and disease outbreaks have been monitored and their impact on the forest resource have been assessed and published.

Permanent plots of 2-6 years duration, were established in the 1960's in the leased area to study the impact of Armillaria root rot. Atropellis canker, western gall rust, root collar weevil, red belt, etc.

Reports :
Anonymous. 1939-1983. Annual reports of the Forest Insect and Disease Survey, 1936 to 1983. Environ. Can., Can. For. Serv. Ottawa, Ont.

__________. 1946-70. Annual district reports, Forest Insect and Disease Survey, 1945-1969. Dep. Fish. For. Can. For. Serv. Calgary, Alberta.

__________. 1971-77. Annual district reports: Forest Insect and Disease Survey, Prairies Region, 1970-1977. Environ. Can., Can. For. Serv., Edmonton, Alberta.

__________. 1978-83. Forest insect and disease conditions in Alberta, Saskatchewan, Manitoba, and the Northwest Territories, 1977-82. Environ. Can., Can. For. Serv., Edmonton, Alberta.

__________. Several Annual File Reports.

Baranyay, J.A. and G.R. Stevenson. 1964. Mortality caused by Armillaria root rot, Peridermium rusts, and other destructive agents in lodgepole pine regeneration. For. Chron. 40:350-361.

- 2 -

Bourchier, R.J. 1954. Armillaria root rot of natural lodgepole pine regeneration in Alberta. Can. Dep. Agric., Sci. Serv., For. Biol. Div. Bi-mon. Prog. Rep. 10(1):4.

Bourchier, R.J. 1957. Red belt, Atropellis canker, and tree mortality of lodgepole pine in Alberta. Can. Dep. Agric., Sci. Serv., For. Biol. Div. Bi-mon. Prog. Rep. 13(2):2-3.

J.K. Robins and J.P. Susut. 1972. Weather damage to lodgepole pine in the Coal Branch area of Alberta in 1971. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. File Rep. NOR-Y-18.

J.K. Robins and J.P. Susut. 1974. Red belt in Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-99.

Additional Reports and Publications

Anon. Forest insect and disease conditions in Alberta, Saskatchewan, Manitoba, and the Northwest Territories in 1979 (Inf. Rep. NOR-X-225); in 1980 (Inf. Rep. NOR-X-231); in 1981 (Inf. Rep. NOR-X-239); in 1982 (Inf. Rep. NOR-X-248); in 1983 (Inf. Rep. NOR-X-261); in 1984 (Inf. Rep. NOR-X-269); in 1985 (Inf. Rep. NOR-X-276) and in 1987 (Inf. Rep. in Press)

See also the following for references specific to *Hylobius warreni* control trials on FMA lease of Weldwood:

Project NOR-132

Drouin, J.A. and D.S. Kusch. 1975. Pesticide field trials on shade and shelterbelt trees in Alberta and Saskatchewan, 1974. Environ. Can., Can. For. Serv., North. For. Res. Cent. Inf. Rep. NOR.X-131.

Drouin, J.A. and D.S. Kusch. 1978. Pesticide field trials on shade and ornamental trees in Alberta, 1977. Fisheries and Environ. Can., Can. For. Serv., North. For. Res. Cent., Inf. Rep. NOR-X-205.

- 3 -

Include also: Re ref. to pests in McLeod Working Circle:

Dempster, W.R. and N.A. Stevens. 1987. Risk management in forest planning. Joint publ. of Canadian For. Serv. (North. For. Cent.) and Alberta For. Serv. under the Canada-Alberta Forest Resource Devel. Agreement.

Contacts : H. Cerezke, and W.J.A. Volney

Current and Long term plans : Forest Insect and Disease Survey unit of CFS will continue to monitor for pests and tree damaging agents on an annual basis within FMA lease of Weldwood on a request basis, and will seek to include the FMA in plantation surveys for pests and pest damage impact

Study : Studies of the root-collar weevil, Hylobius warreni Wood and its ecological relationships in lodgepole pine stands. (CZ-9; A/T 244; NOR-024; NOR-11-03).

Objective : To investigate weevil abundance, its distribution, damage relationships and behavior in lodgepole pine stands in Alberta.

Status : Studies of the root-collar weevil commenced in 1961 and continued to 1967, with carry over of some aspects to 1975. Initially, most field plot studies were conducted in natural stands within St. Regis (Alberta) Lease Area, then later expanded to other locations along the Alberta foothills from west of Sundre to near Grande Prairie. Most of the data have been summarized in reports cited below. Some major findings are as follows:

Highest incidence of the weevil occurs within the Lower Foothills Section between 760 and 1220 m elevation and none were found above 1585 m. Within even-aged stands weevil numbers were proportional to stand density, tree size, and site quality. Population estimates varied mostly between 494 and 2965 per ha., and can be present in stands from about age 6 years to maturity. Tree mortality, resulting from girdling feeding activity of the larvae, rarely exceeded 10%, and was most common on trees less than 20 years old growing on high quality sites, and particularly when well spaced. Up to 100% of trees within infested stands, however, exhibit cumulative weevil feeding scars in the root-collar zone by age 60 years. Growth loss effects from degrees of partial girdling were evaluated radially on the stem and root, and vertically on the stem. The life cycle development of H. warreni, its survival, sex ratios, oviposition, host selection pattern and dispersal behaviour were described within and adjacent to commercial clearcut stands. Sampling methodology was developed for general survey and population census. A field experiment was conducted to evaluate thinning treatment on subsequent weevil abundance and tree damage, but some of the field results were negated by severe hail damage.

Reports :
Cerezke, H.F. 1967. A method for rearing the root collar weevil, Hylobius warreni Wood (Coleoptera: Curculionidae). Can. Entom. 99:1087-1090.

- 2 -

______________. 1968, A root collar weevil on lodgepole pine in Alberta. Can. Dep. For. Rural Develop., For. Br. Res. News 11 (3):11.

______________. 1970. The distribution and abundance of the root weevil, Hylobius warreni Wood in relation to lodgepole pine stand conditions in Alberta. (Abstr.) Diss. Abstr. Int., B.Sci. Eng. 30(9):4187-7-B.

______________. 1970. A method for estimating abundance of the weevil Hylobius warreni Wood, and its damage in lodgepole pine stands. For. Chron. 46:392-396.

______________. 1970. Biology and control of Warren's collar weevil, Hylobius warreni Wood, in Alberta. Can. For. Serv., Edmonton. Internal Rep. A-27.

______________. 1970. Survey report of the weevil, Hylobius warreni Wood, in the foothills of Alberta. Can. For. Serv., Edmonton, Internal Rep. A-38.

______________. 1972. Effects of weevil feeding on resin duct density and radial increment in lodgepole pine. Can. J. For. Res. 2:11-15.

______________. 1973. Bark thickness and bark resin cavities on young lodgepole pine in relation to Hylobius warreni Wood (Coleoptera: Curculionidae). Can. J. For. Res. 3:599-601.

______________. 1973. Some parasites and predators of H. warreni in Alberta. Environ. Can., Can. For. Serv. Bi-Mon. Res. Notes 29:24-28.

Cerezke, H.F. 1973. Survival of the weevil, Hylobius warreni Wood, in lodgepole pine stumps. Can. J. For. Res. 3:367-372.

______________. 1974. Effects of partial girdling on growth in lodgepole pine with application to damage by the weevil Hylobius warreni Wood. Can. J. For. Res. 4:312-320.

Contact: H.F. Cerezke

- 3 -

Current and Long term plans : Plantation surveys initiated in 1987 in all three Prairie Provinces indicated *H. warreni* to be one of the 3 to 5 top damaging agents in young lodgepole and jack pine stands. In June, 1988, visitation was made to the Grande Prairie area to view three plantations established in 1981 that represent part of a major genetic tree improvement program. The sites examined were progeny tests of 400 families of lodgepole pine; all were established in previously logged pine sites that supported rootcollar weevil populations. In each of the three plantations, *H. warreni* was now the main damage agent, accounting for 2-10% tree mortality, and its larvae and damage were present on an estimated 30% of trees in one of the plantations.

Based on provincial and industrial concerns of the above scenario, a new research proposal is being discussed to initiate studies on rootcollar weevils, specifically in relation to young high-value stands. Five short (2-4 yrs) and long-term (5-6 yrs) objectives identified include:

1) Identify sources and levels of rootcollar weevil populations in mature pine stands during pre- and post-harvest periods;

2) Identify rootcollar weevil distribution and attack patterns within young planted or naturally stocked pine stands;

3) Test and modify or adapt established methods for estimating populations of root collar weevils and their dispersal behavior in young stands;

4) Investigate control options (e.g. biological agents, cultural and insecticidal controls and pheromones) and undertake field test trials;

5) Prepare guidelines for an integrated pest management strategy of rootcollar weevils in young high-value stands.

It is anticipated that experimental locations would mostly include the Alberta foothills initially, with application of experimental trials in other locations of the Prairie Provinces.

Study : Armillaria mellea, stem rusts, and other destructive agents in young lodgepole pine stands (A/T-217, NOR-034).

Objectives:

1. Describe the long-term variation of disease occurrence in post-fir natural lodgepole pine stands.

2. Identify and assess the factors affecting the incidence and rate of damage caused by Armillaria mellea.

3. Record the presence and effect of other infectious and non-infectious agents in the development of lodgepole pine stands.

Status : An area of about 1,000 acres known as the Robb Burn was burned in May, 1941. Area surveyed at different times in the 1950's. In 1957 seven 1/20-acre sample plots were established and then re-surveyed every three years until 1976. Data has been analysed and has been used in some general reports to which it related, however, the results of the 1962 re-survey were published separately.

Reports : Baranyay, J.A. and G.R. Stevenson. 1964. Mortality caused by Armillaria root rot, Peridermium rusts and other destructive agents in lodgepole pine regeneration. For. Chron. 40:350-361.

Contact: Y. Hiratsuka

Current and Long-term plans : A survey of the present situation of the seven plots may be feasible and worthy of reporting.

Study : Studies on the _Armillaria mellea_ complex in the Northern and Western region. NOR-11-09

Objectives:

1. To determine what members of the _Armillaria_ complex are found in northern and western region and their geographic and host distribution.
2. To determine the relative pathogenicity of the _Armillaria_ complex to lodgepole pine.
3. To map the distribution of _Armillaria_ in specific sites by use of the trap log technique.
4. To develop early detection and survey techniques for Armillaria root rot.

Status : Study is ongoing. Results to date have shown that two species of _Armillaria_ are in Alberta, that both of these species are pathogenic to lodgepole pine, that the trap log technique can be used to detect and map the distribution of _Armillaria_ in a site.

Reports :

Mallett, K.I. and Y. Hiratsuka. 1984. The identity of the _Armillaria mellea_ complex in Alberta. Am. Phytopath. & Can. Phytopath. Societies joint meeting. Phytopathology 74:824.

Mallett, K.I. and Y. Hiratsuka. 1985. The "traplog" method to survey the distribution of _Armillaria mellea_ in forest soils. Can. J. For. Res. 15:1191-1193.

Mallett, K.I. and Y. Hiratsuka. 1988. Inoculation studies of lodgepole pine with Alberta isolates of the _Armillaria mellea_ complex. Can. J. For. Res. 18:292-296.

Contact : Ken Mallett

Current and Long term plans : A study into the use of the traplog technique as a survey tool to detect Armillaria root rot is planned for the next 3 years. A report on the identity and distribution of the _Armillaria_ species in the prairie provinces is in preparation. An information report on Armillaria root rot in the prairie provinces is in preparation.

Study : Western gall rust resistant/susceptibility study in relation to genetic improvement program of lodgepole pine; NOR-11-06

Objective: To investigate the relative resistant/susceptibility or phenological escape of lodgepole pine to western gall rust.

Status : A study plot 31 km south east of Hinton on the Forestry Trunk road was established in 1983. Scions from 10 tagged field resistant and 10 field susceptible trees were collected and grafted. Four graftlings for each tree (20 x 4 = 80) have been planted at NoFC site for further study.

Contact : Y. Hiratsuka and P.J. Maruyama

Current and Long term plans : Want to keep tagged trees (20) for future observation and possible seed collection.

Study : Impact of a fir needle rust, *Pucciniastrum epilobii*, on regeneration of alpine fir in Hinton, Alberta area (A/T-254; NOR-35-026; NOR-11-06)

Objectives:

1. To appraise the impact of needle rust on *Abies* spp. in potentially commercial stands.
2. To investigate, susceptibility and resistance taking into consideration such factors as morphological variations, site and age.
3. Investigate recurrence in a given area and on any given tree.
4. Correlate presence or absence of rusts on alternate hosts with rust on fir.

Status : Established in 1968 in the Camp 22 area southeast of Hinton. Analysis of preliminary data obtained in 1971 indicated the feasibility of continuing this project.

Reports : There are no reports to date, however, samples collected in 1965 from the same site were used for the publication.

Y. Hiratsuka, L.E. McArthur, and F.J. Emond. 1967. A distinction between *Pucciniastrum goeppertianum* and *P. epilobii* with classification of status of *Peridermium holwayi* and *P. ornamentale*. Can. J. Botany 45:1913-1915.

Contact : Y. Hiratsuka

Current and Long-term plans : In 1989 or 1990, intend to re-locate the site; find 10 tagged trees (4 heavily infected; 3 lightly infected; 3 not infected); and measure heights, diameters, etc. of the ten tagged trees to evaluate the impact of the needle rust in young stands.

Study : Aerobiology of Comandra blister rust, *Cronartium comandrae* (A 236; NOR-7-094)

Objective: Conduct surveys to ascertain the distribution of the rust in the region, and the incidence and role of the associated rodents, insects and microflora: (Other objectives not relevant to studies on lease area).

Status : Annual surveys carried out between 1964 and 1972 included monitoring of one plot in the Robb burn area. The odd other collection was also made on the lease area. The data on canker growth from this plot has not been published although some information on the associated agents has been published in the following publications.

Reports :

J.M. Powell. 1970. *Cronartium comandrae* in Canada, its distribution and hosts. Can. Plant Dis. Surv. 50:130-135.

J.M. Powell. 1971. Occurrence of *Tuberculina maxima* on pine stem rusts in western Canada. Can. Plant Dis. Surv. 51:83-85.

J.M. Powell. 1982. Rodent and lagomorph damage to pine stem rusts, with special mention of studies in Alberta. Can. Field-Naturalist 96:287-294.

Contact : J.M. Powell

Current and Long-term plans : None

Study : Microbial populations associated with various forest sites (A 303)

Objective : To characterize the microbial population found under three forest types as to fluctuation in total population and the nutritional requirement of that population, and to correlate these fluctuations with differences in soil temperature, moisture and pH.

Status : Initiated in 1968 with selection of white spruce, lodgepole pine and aspen plots. Populations were sampled from various horizons and 400 organisms were picked. Technique used proved to be unsuitable for grouping the forested soil microflora.

Reports :

Contact : (J.A. Dangerfield, FORINTEK Canada Ltd.)

Study : Effects of atmospheric effluents on forest soils (NOR-7-162)

Objective: To determine the influence of air pollutants such as SO_2 on 1) amount, form and region of accumulation of chemical constituents in the soil, 2) soil micro-flora, especially sulfur and nitrogen organisms, 3) sulfur availability in the soil and the effect of this on sulfur up-take in plants.

Status : Laboratory studies were undertaken with soil samples from the L-F-H, AE, Bf and Bt horizons of the Mercoal, Bisequa Luvisol Gray Wooded soil from the Hinton area, to determine specific soil properties likely to be influenced by SO_2 contamination. In 1974 an evaluation of airborne sulfur and suspected sources of emission was undertaken in the vicinity of Hinton. A build up of sulfur in soil and vegetation was recorded in the vicinity of Hinton but there were no indications of damage.

Reports : J. Baker. 1975. Atmospheric sulfur compounds and their effect on soil. North. For.Res. Cent., Edmonton., File Rep.

J. Baker, 1976. Atmospheric deposition of sulfur, calcium and magnesium at sites surrounding the North Western Pulp & Power Plant, Hinton, Alberta. North. For.Res. Cent., Edmonton. File Rep.

J. Baker. 1976. Accumulation and impact of airborne sulfur compounds on soil and vegetation in the vicinity of Hinton, Alberta. Environ. Can., North. For. Res. Cent., Edmonton. File Rep. 162.

Contact : (J. Baker)

Current and Long term plans : None

Study : Effect of risk factors on annual allowable cut.

Objective: To develop improved modelling techniques for making realistic projections of future timber supplies under fire, and insect and disease risk factors. The implications of risk in relation to harvest schedules, investment decisions, and to boreal forest management in general were examined, and the importance of risk management in forest planning was emphasized.

Status : This study conducted by W.R. Dempster & Associates in the McLeod Working Circle of Hinton leasehold in 1987.

Reports :

Dempster, W.R., and N.A. Stevens. 1987. Risk management in forest planning. Canada-Alberta Forest Resource Development Agreement.

Singh, T. 1987. Risk factor modelling for forest yield predictions in Alberta, Canada. Pages - <u>In</u> U.S. Forest Service, Proceedings of the Forest Growth Modelling and Prediction Conference, Department of Forest Resources, U. of Minnesota, St. Paul, Mn.

Singh, T. 1988. Modelling forest yield risk factors in Canada. National Woodlands 11(1):21-22.

Contact : T. Singh

Current and Long term plans : Climate change is likely to be a major risk factor in the future management of Hinton FMA. The following studies are required for providing the needed solutions for all the above-mentioned risk factors influencing annual allowable cut.

1. Develop climate related forest productivity models for adjusting forest productivity estimates under the changed climatic conditions.

2. Study the likely changes in commercial and nonmarket values of the boreal forest as its boundaries shift gradually northwards.

Study : Technical and advisory services program in fire (NOR-087)

Objectives: a. 1. To determine the feasibility of using prescribed fire to reduce or eliminate pine saplings in a 14-year-old, overdense pine stand of fire origin.

2. To determine the short-term effects of fire on pine saplings, duff layer, and lesser vegetation.

b. 1. To establish the correlation between seasonal and yearly fire severity and fire business on N.W.P.P. lease limits and adjacent areas.

Status : a. An area was selected for burning on the Gregg Burn, a 1-acre plot and a one 20′ x 20′ test plot, both plots supporting about 500,000 stems/acre. Plans to burn in 1971 were not completed because of unsuitable weather conditions.

b. Analysis was undertaken of 10 years of weather data obtained from seven weather stations located on the lease prior to 1970 to establish seasons and daily fire weather severity. A file report was submitted to NWPP and the information incorporated for future fire control planning on the lease limits.

Report : (See above)

Contacts : A.D. Kiil (D. Quintilio)

Current and Long term plan : None

Study : A study of hazard and flammability of white spruce and lodgepole pine slash in Alberta (A-603; A/T 127)

Objectives: To assess the relative slash hazard and flammability of lopped and unlopped white spruce and lodgepole pine slash at various stages of decay.

To study fire behaviour under controlled burning conditions, to develop practical proceduress for prescribed burning.

Status : Initiated in 1962 and carried out north of Chip Lake, before being terminated in 1969.

Reports : A.D. Kiil. 1964. A study of slash hazard and flammability on cutovers in Alberta. Can. Dep. For., For. Res. Br., Calgary. Mimeo. 64-A-4.

A.D. Kiil, 1966. Three prescribed burns in 1-year old white spruce slash. Can. Dep. For., For. Res. Lab., Calgary. Int. Rep. A-6.

Contact : A.D. Kiil

Current and Long-term plans : None

Study : Slash weight and size tables for white spruce and lodgepole pine in Alberta (A-601; A/T 125)

Objectives:

1. To determine the effect of stem and crown parameters on crown weight and size distribution.

2. To determine the weight of the unmerchantable portion of the stem of different tree sizes.

3. To prepare fuel weight and size tables.

Status : Initiated in 1962 and completed in 1967. Included analysis of 60 white spruce, 101 lodgepole pine, black spruce and alpine fir.

Reports :

Kiil, A.D. 1965. Weight and size distribution of slash of white spruce and lodgepole pine. Can. Dep. For., For. Res. Br., Calgary. Mimeo 65-A-6.

Kiil, A.D. 1965. Weight and size distribution of slash of white spruce and lodgepole pine crowns in Alberta. For. Chron. 41:432-437.

Kiil, A.D. 1967. Fuel weight tables for white spruce and lodgepole pine crowns in Alberta. Can. Dep. For. Rural Develop., For.Br. Ottawa. Publ. No. 1196.

Kiil, A.D. 1969. Estimating fuel weights of black spruce and alpine fir crowns in Alberta. Can. Dep. Fish. For., For. Br., Ottawa. Bi-mon. Res. Notes 25:31-32.

Contact : A.D. Kiil

Current and Long-term plans : None

Study : A preliminary study of the physical characteristics and moisture content of clearcut lodgepole pine and white spruce slash in Alberta. (A-602; A/T 126).

Objective: To provide a basis for a practical assessment of slash hazard at various stages after logging for lodgepole pine and white spruce slash.

Status : Initiated in 1963 and terminated in 1969. Fuel moisture sampling immediately after clearfelling was carried out in the springs of 1963 to 1966. Most pronounced changes in slash moisture occur during the first two fire seasons after logging, with subsequent fluctuations being dependent on weather conditions.

Reports : A.D. Kiil. 1964. A preliminary study of the physical characteristics and moisture content of clearcut lodgepole pine and white spruce slash in Alberta. Can. Dep. For., For. Res. Br., Calgary. Progress Rep. 64-A-5.

A.D. Kiil. 1968. Changes in the physical characteristics and moisture content of pine and spruce-fir slash during the first five years after logging. Can. Dep. For. Rural Develop., For. Br., For. Res. Lab., Edmonton. Int. Rep. A-14.

Contact : A.D. Kiil

Current and Long-term plans : None

Study : The fuel complex in mature lodgepole pine stands of fire origin (A-605; A/T 129)

Objective: To develop a quantitative method of fuel classification whereby fuel weight and size can be predicted from measurement of stand parameters.

Status : Thirty 1/10 acre sample plots and 90 sub-plots were measured during 1965 and 1966.

Reports : A.D. Kiil. 1967. The fuel complex in 70-year-old lodgepole pine stands of different densities. Univ. Montana, Missoula. M.Sc. Thesis.

A.D. Kiil, 1968. Weight of the fuel complex in 70-year-old lodgepole pine stands of different densities. Can. Dep. For. Rural Devel., For. Br., Ottawa. Publ. No. 1228.

Contact : A.D. Kiil

Current and Long-term plans : None

Study : Prescribed fire following clearcutting of overmature spruce-fir in the Foothills Section of Alberta (A 304; NOR-5-092)

Objectives:

a. Investigate the techniques and logistics of prescribed fire use in the overmature spruce-fir slash-fuel type.

b. Evaluate the effects of prescribed burning in terms of slash hazard, fuel moisture, burning indices and fire intensity.

c. Determine the relationship between the U.S. Buildup Index and the moisture content of the L,F and H layers in spruce-fir stands and in clearcut areas.

Status : Study begun in 1967 and completed in 1973. Involved blocks selected on each of two site conditions, shallow or deep organic. Inventories carried out prior to clearcutting and following clearcutting to establish weight-and-size distribution of slash prior to burning. Sampling points used to facilitate assessment of fuel consumption and depth of prescribed burn.

Reports :

Kiil, A.D. 1969. Basic considerations in the planning and use of prescribed fire. Can. Dep. Fish. For., Can. For. Serv., For. Res. Lab., Calgary. Inf. Rep. A-X-21.

Kiil, A.D. 1969. Fuel consumption by a prescribed burn in spruce-fir logging slash in Alberta. For. Chron. 45:100-102.

Kiil, A.D. 1970. Distribution of moisture in spruce-fir duff and its relevance to fire danger rating. Can. Dep. Fish. For., Can. For. Serv., For. Res. Lab., Edmonton. Int. Rep. A-34.

Kiil, A.D. and Z. Chrosciewicz. 1970. Prescribed fire - its place in reforestation. For. Chron. 46:448-451.

Kiil, A.D. 1971. Prescribed burning in spruce-fir slash in Alberta. A 16-mm color movie with sound track.

Kiil, A.D. 1971. Prescribed fire effects in subalpine spruce-fir slash. Can. Dep. Environ. Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-3.

Kiil, A.D. 1971. fire hazard from large block clearcutting in Alberta. pp. 75-94. In. Some implications of large-scale clearcutting in Alberta-A literature review. Can. Dep. Environ., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-6.

Contact : A.D. Kiil

Current and Long-term plans : None, but consideration could be given to measure plantation performance on the burned blocks.

Study : Prescribed burning following cutting of spruce/fir in the foothills section of Alberta (A-270; NOR-003)

Objectives:

1. To describe the effects of prescribed burning at a range of intensities on the following site factors which are regarded as of major importance to the establishment and growth of regeneration; nature of seed bed and root environment in terms of depth of moss, L, F and H layers; ground vegetation regarded as possible competitor with seedings, soil temperature in the seedling rooting zone, soil moisture.

2. To evaluate the effect and permanency of these changes in terms of growth and survival of artificially established seedlings of lodgepole pine and white spruce, reversal of site deterioration.

3. From these facts, to decide whether prescribed burning has any silvicultural value on these and similar sites and to suggest necessary further investigation on techniques for general use.

Status : Commenced in 1968 with the selection of four 15-25 acre blocks on two different sites, one with shallow and one with deep duff. Burning treatments were applied in 1968 and 1969 and post burning assessments carried out. Soil temperatures were followed, and survival and growth measurements of planted and seeded stock were undertaken. Recolonising vegetation was enumerated.

Reports :

F. Endean. 1972. Soil temperature, seedling growth and white spruce regeneration. pp. 15-20 In. R.G. McMinn. White spruce: the ecology of a northern resource. Environ. Can., Can. For. Serv., North For. Res. Cent., Edmonton. Inf. Rep. NOR-X-40.

F. Endean and W.D. Johnstone. 1974. Prescribed fire and regeneration on clearcut spruce-fir sites in the foothills of Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-126.

Contact : (F. Endean; W.D. Johnstone) L.G. Brace

Current and Long term plans : None

Study : Effects of prescribed fire on peaty humic gleysols and gray wooded soils under spruce-fir forests (A 295; NOR-10-004)

Objective : Evaluate the prescribed fire effects on various physical and chemical soil properties.

Status : Commenced in 1967 on the lease area, when series of soil moisture units were established on each of four blocks following prescribed burning. Measurements of soil moisture and temperature were obtained for five growing seasons, and soil samples were collected for chemical analyses for four consecutive years.

Reports : Lesko, G.L. 1971. Early effects of a prescribed fire in spruce-fir slash on some soil properties. Can. Dep. Fish. For., For. Res. Lab., Edmonton. Internal Rep. A-44.

Lesko, G.L. 1972. Immediate effects of a prescribed fire on soil properties. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Forestry Report 1(6):4.

Contact : (G.L. Lesko, syncrude Ltd.)

Current and Long term plans : None

Study : Infiltration and erosion as influenced by land use (NOR-13-141)

Objective : To develop and test methodology for on-site evaluation and assessment of infiltration capacity ratings of vegetation-soil types for erosion hazard.

Status : Different forest types and soil associations were selected on the lease area for infiltration capacity ratings and assessment. Study completed and report published.

Reports : T. Singh. 1983. Proposed method of preliminary assessment of estimating erosion hazards in west-central Alberta. Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-251.

T. Singh. 1984. Infiltration as an indicator of erosion susceptibility. National Woodlands 7(2):23.

Contact : T. Singh

Current and Long term Plans : None

Study : Impact of clearcutting on forest environment: Quantitative evaluation of the effects of pulpwood harvesting in Western Alberta on water yield, physical water quality, and streamflow regime. (NOR-13-121)

Objectives:

a. To quantitatively determine the impact of present and past timber harvesting operations on channelized streamflow and physical water quality.

b. To identify sources of sediment.

Status : Composite streamflow hydrographs were developed for 9 uncut and 9 harvested catchments. The water yield from the logged catchments was 42 mm more than the unlogged controls, a difference of 27%. Most of the increase occurred during the early spring snowmelt period which is associated with frequent periods of rain in this region. Suspended sediment measurements confirmed that most sediment originates from erosion at road stream crossings. A bush mulch was found to be effective in controlling erosion and sediment from these sources.

Reports :

Swanson, R.H. and G.R. Hillman. 1977. Predicted increased water yield after clearcutting verified in west central Alberta. Fish. and Environ. Can., Can. For. Serv., North. For. Res. Cen., Inf. Rep. NOR-X-198.

Swanson, R.L. and G.R. Hillman. 1977. Effect of large-scale-clearcutting on water yield in western Alberta. pp. 256-271. In. R.H. Swanson and P.A. Logan (Eds.) Alberta Watershed Research Program Symposium Proceedings, 1977. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-176.

Rothwell, R.L. 1977. Suspended sediment and soil disturbance in a small mountain watershed after road construction and logging. pp. 285-300. In. R.H. Swanson and P.A. Logan (Eds.). Alberta Watershed Research Program Symposium Proceedings, 1977. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent. Edmonton. Inf. Rep. NOR-X-176.

- 2 -

Rothwell, R.L. 1983. Erosion and sediment control at road-stream crossings. Forestry Chronicle 59:62-66.

Hillman, G.R., J.M. Powell and R.L. Rothwell. 1978. Hydrometeorology of the Hinton-Edson area, Alberta, 1972-1975. Fish. and Environ. Can., Can. For. Serv., North. For. Res. Cent., Inf. Rep. NOR-X-202.

Contacts : R.H. Swanson, G.R. Hillman (NoFC); R.L. Rothwell (U of Alberta).

Current and Long term plans : None

Study : Water quality and road-side soil erosion and sedimentation at logging road-stream intersections (NOR-13-161).

Objective: To determine and demonstrate the effects of erosion-sedimentation controls at logging road-stream intersections in terms of suspended sediment concentrations and discharge determined upstream and downstream from road-stream crossings.

Status : The effectiveness of a "brush mulch" to control erosion and sediment at road-stream crossings was evaluated by measurement and comparison of upstream and downstream suspended sediment. The brush mulch consisted of logging debris, such as branches, tree tops and logs 2-15 cm in diameter, laid on the ground to intercept and to slow overland flow and to trap sediment. Two treatments were defined and tested. Treatment no. 1 was a brush mulch and grass-fertilizer mixture applied by hydroseeding to three bare soil road-strseam crossings. Treatment no. 2 was a grass-fertilizer mixture applied by hydroseeding to another three road-stream crossings.

Total seasonal and storm sediment production for mulched and unmulched crossings averaged 31 and 37, and 566 and 2297 kg/day/ha, respectively. Tests showed significant differences between treatments for both seasonal and storm sediment production. The levels of significance were low because of high variability in sediment production among treatments and road crossings. Frequent onsite inspections during storm and nonstorm conditions, however, identified sources of variability and supported a final conclusion that the brush mulch was effective for erosion and sediment control at road-stream crossings.

Reports : Rothwell, R.L. 1973. How to design logging road drainage systems. Can. For. Ind. 93(3):39-43.

__________. 1974. Erosion control measures for logging and road construction. In Proc. of Practical Forest Watershed Management Course Fp2402. Cranbrook, B.C., April 23-24, 1974. Available from: Centre for Continuing Education, Univ. B.C., Vancouver.

- 2 -

__________. 1974. Erosion control of forest roads. Paper presented at Environmental Considerations of Road Construction, A short Course of Instruction for Forest Road Builders and Field Men. Forest Technology School, Hinton, Alberta. Oct. 8-11, 1974.

__________. 1974. Progress Report: Road-bank stabilization in the Hinton-Edson area, Alberta. File Rep. NOR-017.

__________. 1976. Progress Report 1975-76. Erosion sediment control at road-stream crossings in the Hinton-Edson area, Alberta. Rpt. to Steering Comm., Alta. Watershed Res. Prog. 3 p.

__________. 1978. Watershed management guidelines for logging and road construction in Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent.,Edmonton. Inf. Rep. NOR-X-208.

__________. 1983. Erosion and sediment control at road-stream crossings. Forestry Chronicle 59:62-66.

Contact : (R.L. Rothwell, U. of Alberta)

Current and Long-term plans : None

Study : Changes in chemical and physical water quality following forest harvesting and related land disturbances (NOR-13-104).

Objective : To assess changes in the concentration and yields of nutrients as a result of clearcutting and to determine the water chemistry of natural waters in the Hinton lease area.

Status : More change in the yield of some nutrients than in their concentration, as a result of progressive clearcutting in forest catchments.

Reports : Singh, T., Y.P. Kalra, and G.R. Hillman. 1974. Effects of pulpwood harvesting on the quality of stream waters of forest catchments representing a large area in Western Alberta, Canada. pp. 421-427. In. Effects of man on the interface of the hydrological cycle with the physical environment--Symposium, IAHS Publication 113, Paris, France.

Singh, T. and Y.P. Kalra. 1975. Changes in chemical composition of natural waters resulting from progressive clearcutting of forest catchments in west-central Alberta Canada, pp. 435-444. In. The hydrological characteristics of river basins and the effects on these characteristics of better water management--Symposium, IAHS Publication 117, Tokyo, Japan.

Singh, T. and Y.P. Kalra. 1977. Impact of pulpwood clearcutting on stream water quality in west central Alberta. pp. 272-284. In R.H. Swanson and P.A. Logan (Eds.). Alberta Watershed Research Program Symposium Proceedings, 1977. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-176.

Singh, T. and Y.P. Kalra. 1977. Estimation of natural pollution loads from streamflow measurements in remote catchments. Water, Air and Soil Pollution. 7:111-116.

Singh, T. 1976. Yields of dissolved solids for aspen grassland and spruce-fir watersheds in southwestern Alberta. J. Range Manage. 29:401-405.

Singh, T. and Y.P. Kalra. 1975. Specific conductance method for in situ estimation of total dissolved solids. J. Waterworks Assoc. 67:99-100.

Contacts : T. Singh and Y.P. Kalra

Current and Long term Plans : None

Study : Climatic zonation for the forested areas of the Prairie Provinces (NOR-2-115)

Objective : To classify the climate of the main forested regions of the Prairie Provinces, such that areas having similar climatic regimes can be delineated on a map.

Status : Completed with several publications which included the lease area and with one restricted to area.

Report : Powell, J.M. and D.C. MacIver. 1976. Summer climate of Hinton-Edson area, west-central Alberta, 1961-1970. Fish. Environ. Can., Can. For. Serv., North For. Res. Cent., Edmonton. Inf. Rep. NOR-X-149.

Powell, J.M. 1977. Precipitation climatology of the Eastern Slopes area of Alberta. pp. 187-204. In R.H. Swanson and P.A. Logan (Eds.). Alberta Watershed Research Program Symposium Proceedings, 1977. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. NOR-X-176.

Contact: J.M. Powell

Current and Long term plans : None

Study : The climate of clearcut forested areas (NOR-14-138; NOR-31-179; NOR-28-04/07)

Objectives:

a. To determine the effect of clearcutting of different sizes on the various climatic parameters.

b. To identify the zones of stand border influence for each climatic parameter and to relate this to size and orientation of cut.

c. To assess the use of fixed ground based climatic stations, with ground level mobile sensors and airborne sensors, for obtaining climatic data for forestry purposes.

Status : Climate stations were maintained on different areas of the lease from 1971 to 1977 each summer. On average 50 stations were run each year with in total over 100 locations sampled. Most stations were situated on clearcuts but some were in the uncut forest. Sixteen to 20 stations were also run throughout the winter of 1971-72 and snow surveys were run in four winters. All regular or satellite stations were equipped for measuring temperature, humidity and precipitation. Base stations (7) and some other stations were equipped for measuring wind, radiation, soil temperature, (some soil moisture) and some evaporation (1 or 2 years only). Additional percipitation stations were also employed. Transects of soil temperature profiles (6 to 26 stations) were established on 8 cut blocks. In 1971 and 1972 a dozen mobile temperature traverses were run between four study compartments. Thermal infrared line scan images were taken in 1971 along two transects in McLeod Working Circle. Most of the data has been analysed and tabulated and some used in publications.

Reports : Powell, J.M. 1971. Environmental factors affected by clearcutting. pp. 4-18. In: Johnson, H.J., H.F. Cerezke, F. Endean, G.R. Hillman, A.D. Kiil, J.C. Lees, A.A. Loman and J.M. Powell. Some implications of large-scale clearcutting in Alberta, a literature review. Can. Dep. Environ., Can. For. Serv., Edmonton. Inf. Rep. NOR-X-6.

- 2 -

Reports : MacIver, D.C. and Powell, J.M. 1973. thermal soil variations as a function of clearcut size: preliminary analysis. Paper presented at the 11th Conf. Agr. and For. Meteorology, Amer. Meteorol. Soc., Durham, N.C. January 9, 1973. (Also Environ. Can., North. For. Res. Cent., Edmonton, File Report NOR-Y-53. pp. 10).

Lubitz, E.D. and J.M. Powell. 1974. Some computer techniques for presentation of thermal infrared line scan data. Environ. Can., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-79.

Hillman, G.R., J.M. Powell and R.L. Rothwell. 1978. Hydrometeorology of the Hinton-Edson Area, Alberta, 1972-1975. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-202.

Powell, J.M. 1977. Precipitation climatology of the Eastern Slopes area of Alberta. pp. 187-204. In: Watershed Research Program Symposium Proceedings, 1977. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-176.

Singh, T. 1986. Microclimate of clearcuts in west-central Alberta. Pages 47-59 In: Proceeds. of the 10th Annual General Meeting, Alberta Climatological Assoc. Feb. 20, 1986. Envir. Can., Edmonton, Alberta.

Contacts : J.M. Powell and T. Singh

Current and Long-term Plans : Paper in preparation on soil temperature variations in clearcuts.

Study : The effect of the microclimate of clearcut areas on survival and growth of conifer regeneration (NOR-14-139)

Objective : To determine the significance of microclimatic regimes created by clearcutting in terms relevant to growth and survival of planted spruce and pine.

Status : Four areas were selected on the lease representative of two major soil types. Two transects of five sample plots were located outward from the stand edge up to 180 m. White spruce and lodgepole pine container stock were planted at 1-m spacing in 6 rows each of 50 trees. Growth was monitored through three growing seasons. Temperature, humidity, precipitation, wind and solar radiation were recorded on the cut areas. Temperature profiles (10,0,-7.5,-15 cm) were measured during 30 min intervals continuously at each plot. Analysis of the seedling growth data has been completed and a report published. Much of the climatological data has been extracted and analysed and a report is planned.

Report : W.D. Johnstone. 1984. Influence of stand edge on planted white spruce and lodgepole pine. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-256.

Contact : (W.J. Johnstone, H.P. Sims) J.M. Powell, T. Singh

Current and Long term plans : Paper in preparation on soil temperature variations in clearcuts.

Study: Study of soil moisture and temperature in relation to topography, soil, vegetation and climate. (NOR-016).

Objectives:

a. To accumulate information on soil moisture and temperature conditions of some forest types in Alberta.

b. To relate soil moisture and temperature regimes to microclimate, edaphic conditions, and floristic composition.

c. To relate soil moisture and soil temperature to forest productivity.

d. To find a method for the estimation and expression of ecosystem moisture regime.

Status: Initiated in 1967 with the study of forest types and soils within lease area near Hinton. Vegetation, forest stand and soils were described on 35 one/tenth acre sample plots which were assigned to 10 forest types. Five commercial forest types were chosen out of these 10 and 10 permanent plots for study of soil temperature and moisture were established using a series of 6 Colman fiberglass soil moisture units with thermistors at depths to 100 cm. In 1968 microclimatic stations were established in conjunction with the five forest types. Measurements were taken during the summers of 1968-1972, with air temperature and relative humidity recorded continuously and soil moisture and temperature, and precipitation observed weekly. Soils were analysed for physical and chemical characteristics. Preliminary assessment suggested that soil temperatures in general were lower than the optimum and differences in soil temperatures between forest types are substantial during the growing season. Tree growth seemed to be more influenced by soil temperature than moisture deficiency. A potential internal moisture stress combining five factors was developed as a measure of forest type moisture regime.

Study was terminated with resignation of study leader, G.L. Lesko, in 1975, although some of the climate data is held by J.M. Powell.

Reports: Lesko, G.L. 1970. Considerations in the quantitative evaluation of ecosystem moisture regime. pp. 69-75 In Powell, J.M. Proceedings of the 3rd Forest Microclimate Symposium, Can. For. Serv., Alta./Territories Region, Calgary, Alta.

Contacts: (G.L. Lesko), J.M. Powell

Current and Long term plans : None

Study : Mined-land reclamation and environmental protection (NOR-15-126)

Objectives: a) To develop, adapt and demonstrate effective and economical methods of reclamation and environmental projection associated with specific land-use and water-use objectives for the range of lands and associated water affected by mining in the Prairies Region.

b) To develop, adapt and demonstrate methods for use on mined-land and associated water courses that will reduce accelerated erosion and sedimentation, improve and protect fish and wildlife habitats, maintain water quality, and conserve the aesthetics and potential uses of mined areas.

Status : Some of this study was carried out on the Luscar Coal area adjacent to the lease commencing in the fall of 1970 and concluding in 1972. Major emphasis was on selection of suitable species, seeding time and surface preparation for revegetation trials. Two reports were published from the study which grew out of a background report (listed below) while a thesis by Dillon based on some of the work was done at the U of Calgary.

Reports :

Peterson, E.B. and H.M. Etter. 1970. A background for disturbed land reclamation and research in the Rocky Mountain region of Alberta. Can. For. Serv., Inf. Rep. A-X-34.

Etter, H.M. 1971. Preliminary report of water quality measurements and revegetation trials on mined land at Luscar, Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Internal Rep. NOR-3.

Lesko, G.L., H.M. Etter and T.M. Dillon. 1975. Species selection, seedling establishment and early growth on coal mine spoils at Luscar, Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-117.

Contact : (G.L. Lesko, Syncrude Ltd.)

Current and Long term plans : None

Study : Forestry development and fire management economics (NOR-3-03).

Objectives & Status : Economics related research conducted by the CFS on the Weldwood (Hinton) lease area at Hinton has been limited to two interviews of company representatives conducted for the primry wood using industry surveys of 1972 and 1979. Both of these studies showed that Weldwood (Hinton) is a major component of not only the regional economy surrounding Hinton but also the forest economy of Alberta. The 1972 study showed that Weldwood (Hinton) (at that time Northwest Pulp and Power Ltd.) produced 100% of the Kraft pulp produced in Alberta and accounted for roughly 16% of total employment by primary wood using industries in the province. The construction of the company's stud mill in 1972 increased both total sales and the number of persons employed at the mill. This was reflected in the second survey conducted in 1979 which showed that employment had increased from a level of 788 person years in 1972 to 873 person years in 1979. (Note: A third survey was conducted by the Alberta Forest Service in 87/87).

Reports :

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Ondro, W.J., B.W. Karaim, R.A. Bohning, and G.R.Stevenson. 1980. A directory of primary wood-using industries in Alberta, 1979. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton. Inf. Rep. NOR-X-220.

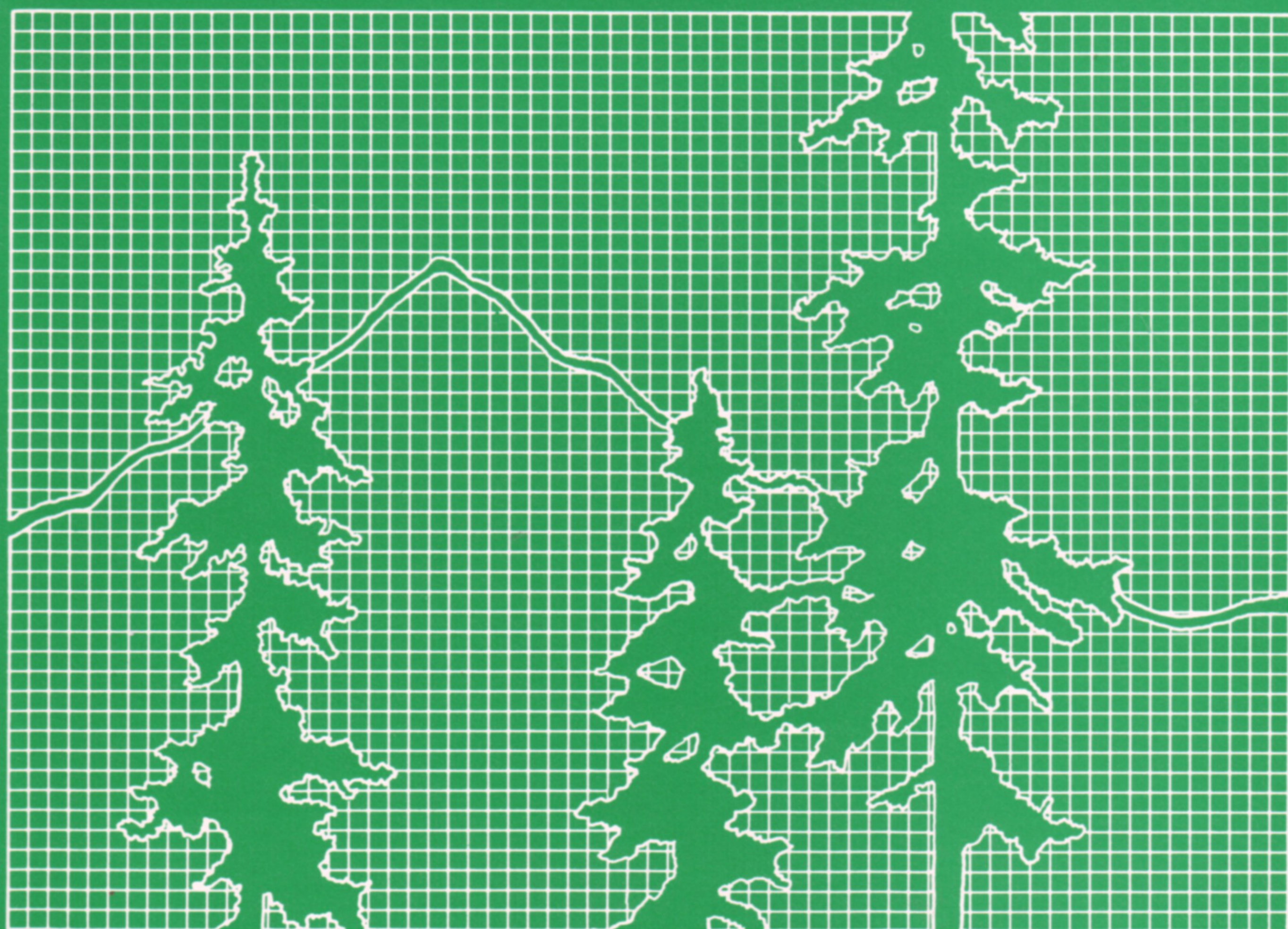
Ondro, W.J. and T.B. Williamson. 1982. The forest industry in the economy of Alberta, 1978-79. Environ. Can., Inf. Rep. NOR-X-246.

Contact : T.B. Williamson, R. Bohning

Current and Long term plans : To maintain continuity in the data base and to update industry information a fourth survey should be undertaken in 1992 or 1993. The study could be conducted by CFS or by the AFS or jointly.

Appendix 3 Crossley's Opus: Toward a Vitalization of Canadian Forests

TOWARD A VITALIZATION OF CANADIAN FORESTS



D. I. Crossley

Forest Consultant

Published in the Interests of Improved Forest Management

ALBERTA FORESTRY ASSOCIATION

TOWARD A VITALIZATION OF CANADIAN FORESTS

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1985

GOVERNMENT WITHOUT DIRECTION AND MEN WITHOUT IMAGINATION RESULT IN A POVERTY OF PURPOSE

The Alberta Forestry Association, in recognition of the work that Des Crossley has done in forestry over many years, is pleased to present a case study which was prepared by Des Crossley, and is intended for general information, and perhaps to spark some discussion."

Foreword

by
Professor F.L.C. Reed
Faculty of Forestry
University of British Columbia

"We need to reshape our fundamental attitudes toward our forest heritage. Only then will we have a solid philosophical base on which to reshape forest policies." (Reed) The Alberta government recognized this need more than three decades ago, when it moved from the usual exploitation of its timber resources to a managed approach which emphasized collaboration between government and industry, and provided incentives to that end. A solid workable base was co-operatively formulated and responsibilities equitably shared. The first forest management licence has served as a bellwether to subsequent licences.

An innovative trail has *been* blazed with impressive results. This report should be of interest to those seeking new and practical approaches to the management of our forests.

Abstract

This presentation offers a set of guidelines for improved forest management in Canada. It recognizes that many of the existing systems are fraught with pitfalls that the provinces have been encountering for decades, and that have left us with a depleting renewable resource and a country-wide outcry over the lack of effective husbandry.

Some three decades ago. one province. Alberta. introduced a new system of management that avoided many of the pitfalls. Sufficient time has elapsed since its first management agreement was initiated, and accepted by a major forest company. to report on its obvious success.

The recognition of the need for close co-operation and sharing of responsibilities between the Government of Alberta and industry is documented, as well as the importance given to security of tenure, industry's acceptance of the complete responsibility for forest renewal, and the accommodation of multiple use in its management program. Pitfalls are also recognized that have not been successfully avoided by the government.

The implications resulting from the company's acceptance of the total financial burden for its management program are discussed, as well as the imagination that made such a commitment possible.

A proposed scenario for successful management programs that could have wide application is presented. It incorporates the positive aspects of the Alberta government's approach and includes suggestions for improvement, as well as the benefits that could accrue to involved parties by the ultimate substitution of rent of forest land for the current system of stumpage royalties.

This presentation places the responsibility for forest renewal of the inadequately stocked acreages that have been allowed to accumulate nationally on the back of the federal and provincial governments, and by so doing allows industry to get on with the task of initiating a more responsible program of current management.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1. Introduction

The transcontinental forest estate that we inherited from our forefathers no longer exists in its original lavish form. This estate was of such magnitude that the only thought was to reduce it as rapidly as possible in order to promote agriculture. Reaping its largess was a way to speed up this process, but felling and burning was more often adopted.

It would be unfair to say that approaches to the eventual husbandry of this valuable renewable resource did not gradually become evident. Concern did result in the initiation of professional education of foresters to undertake its management, but little progress was evident, primarily because governments were not prepared to release timberlands to patent, or to provide continuing tenure conducive to sustained management. Public sector control was promoted with grants of timber to the private sector to harvest over relatively short periods of time, but in general no attempt was made to *equate* this time interval to the life of the forest. Therein lies the cause of the continuous decline *in* our forest heritage. The rotation of politicians in the electoral process has resulted *in* a lack of perception of the time interval of 70 or more years that elapses between crop harvesting.

It would be of little interest here to record the general lack of progress that was made throughout the decades in establishing effective rules and regulations under which these grants were to be controlled. It will be sufficient to confine my remarks to the post-war period which was the product of all the previous retreats and advances. By mid-20th century, big industry had become firmly established in the exploitation of our forests. Large industrial complexes, involving huge pulp and paper mills, as well as large sawmills with a great variety of products, dominated the scene from Manitoba to the eastern seaboard, as well as the west coast of British Columbia. Because of the huge capital investments that these complexes involved, large volumes of wood furnish were necessary, which in turn required huge areas of available timber close by. Each province approached the administration of such properties in ways considered suitable to the Crown's responsibilities. The agreements between the Crown as the landlord and the industrialist as the tenant contained various commitments to which both signators were to agree. They will not be detailed here, but two important but contradictory ones provide an explanation of why these management programs have been ineffective. While they usually specified that the management operations were to be conducted on a sustained yield basis. i.e. the capital account in wood inventory must not be violated, no provision was made to provide adequate long-term tenure over the land holdings. The areas allocated to lease were, on the whole, excessive and therefore capable of producing more wood than required by either existing or proposed mill expansion. The result was little incentive on the part of a tenant to regenerate the harvested area. The lack of extended tenure that was characteristic of the times mitigated against a tenant undertaking the heavy capital cost of regeneration. For these and other reasons — some political — this usually left the problem of forest renewal in limbo, the result being an enormous backlog of inadequately regenerated land, currently estimated to approach 100 million acres 140 000 km^2) across the nation, and increasing by about 500 000 acres annually Such poor husbandry has gradually resulted in increased wood hauling distances and, in some cases. actual wood shortages.

Mismanagement of our forest is becoming more and more obvious to the media and therefore the public. Witness the recent CBC television documentary The Decline and Fall of the Canadian Forest, and Maclean's magazine cover article on Canada's Vanishing Forests. Unfortunately the CBC did not see fit to include in its visual presentation any examples of effective management programs. It neglected to point out that the province of Alberta is at the forefront in an enlightened approach and its success should be an encouragement to others to rethink their *modus operand!.*

2. A Case History of Forest **Management**

It is my intention to document the forest management program initiated by the Department of Lands and Forests in Alberta some 30 years ago. It is a major milestone in the history of Canadian forest husbandry. and its success can be credited to the determination to develop effective management regulations that would permit both public and private sectors to work effectively and amicably together on Crown timber allocations.

- The Alberta government recognized that forest renewal was essential and that land tenure was a major element needed to ensure industry's commitment. This was resolved by granting tenure for an initial period of 20 years. to be renewed in subsequent 20-year periods provided that the tenant could demonstrate the sustaining of the original wood capital. Adequate management assured a perpetual timber supply and the periodic control over tenure satisfied the politician.
- The immediate renewal of harvested forests is fundamental to the sustaining of yield and is therefore vital to the satisfaction of tenure rights. Seven years following harvesting, regeneration surveys were obligatory. with three years to rectify any not-satisfactorily restocked areas. Failure to rectify by the 10th year would result in default and would seriously jeopardize tenure renewal in the 20th year.
- Fire hazard created by slash accumulation following harvest was to be reduced no later than the second year, and fire control was the responsibility of the Alberta Forest Service Protection Branch.
- Overall management plans were to be prepared by the tenant for Forest Service approval, and operating guidelines and ground rules were to result from joint consultation. The tenant's operating plan had to be submitted and approved before the next year's program could commence.
- The agreement contained a clause which recognized the growing and harvesting of timber as a prime use of the forest land held under lease, but legitimate co-users were to be accommodated wherever possible.
- It also set forth the right of others to travel, hunt, fish and otherwise use the said lands for recreational purposes, "as well as to conduct any work in connection with geological or geophysical exploration and development".
- Another clause provided for the protection of the tenant's land base. Once the aggregate area of lands withdrawn from the forest management area exceeded one per cent, any further land deletions would be replaced by the Crown.

3. Program Inception

The first Forest Management Agreement was issued in the fall of 1954 between the Crown and North Western Pulp and Power Ltd. It was a joint venture between North Canadian Oils Ltd. of Calgary and St. Regis Paper Company in New York City, with St. Regis obtaining all management rights and responsibilities. The timber lease involved two million acres in the foothills of the Rocky Mountains. Previously, it has supported many small lumber and tie operations but had not been seriously disturbed by timber harvesting other than leaving a relatively small acreage of unregenerated cutovers.

There was little for the principals to turn to in the way of applicable information on the initiation of the management program. The general opinion was that the long distances to the pulp markets would doom North Western's enterprise. This. in effect, provided an incentive not to fail, and it was under the resolution to succeed that the company responded.

Senior management of the company assured its Forestry Department that the agreement would be honored *in toto.* that it would be the latter's responsibility to recommend the approaches to that end, and to incorporate them during the preparation of the first Management Plan. This department responded enthusiastically to the challenge, and herein lies an important key to a successful management program. Success throughout Canada had often been thwarted by the excessive costs involved and on the uncertainty of co-operative funding. It was internally predicted that public funding would always be scarce, or, at best, intermittent and its availability unpredictable. The solution would be a company commitment to finance its own management program. thereby avoiding falling behind in its management performance targets. In this connection it should be recognized that the current assumption of the costs of forest renewal by some provincial governments precludes the option of claiming a tax rebate from the senior government. The challenge that North Western faced was to make a concerted effort to initiate a program that would keep costs to an acceptable level, without destroying the goal of sustained yield management to which it was committed. Innovation became an on-going challenge and the staff was encouraged to adopt a critical attitude to previously acceptable procedures and to become aware that improved and less expensive approaches lay all around, that it would require wit and imagination to recognize them, and that it must keep abreast of advancing technology and the possibility of adapting it to its cause. The challenge turned out to be very productive in innovative cost-cutting approaches. and staff involvement resulted in an invaluable *esprit de corps.*

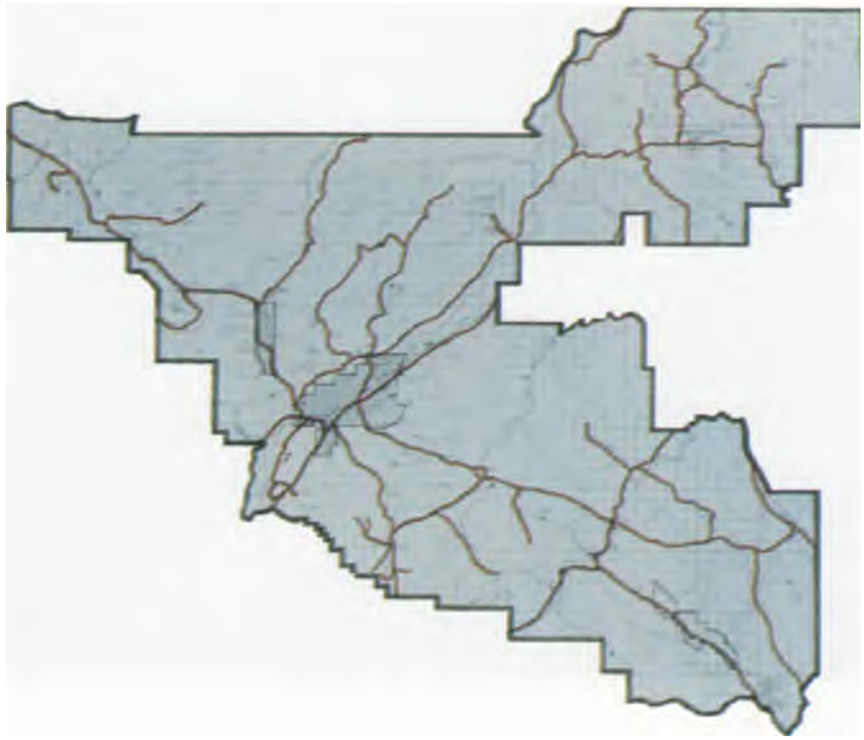
The Crown had provided the initial motivation to ultimate success in the adoption of renewable tenure. The company's contribution was to provide the operational funding in an effective dual approach to management. This could be described as "management by innovation" or "incentives to affordable management" (See Appendix for examples).

Those interested in the details of management are referred to the Reed report. (p17 I

2 Overmature and Decadent Stand

3 Twenty Year Cutting Compartments

Red - First Cycle
Green - Second Cycle
Brown - Third Cycle
Yellow - Fourth Cycle



4 Extraction Roads. Open Road Policy

5 Harvesting Patterns and Second Growth Regeneration Establishment

6. Stream Side Residuals

7. Site Preparation Following Harvesting

8. Lodgepole Pine Plugs in Plastic Containers. System initiated in 1971 - 72

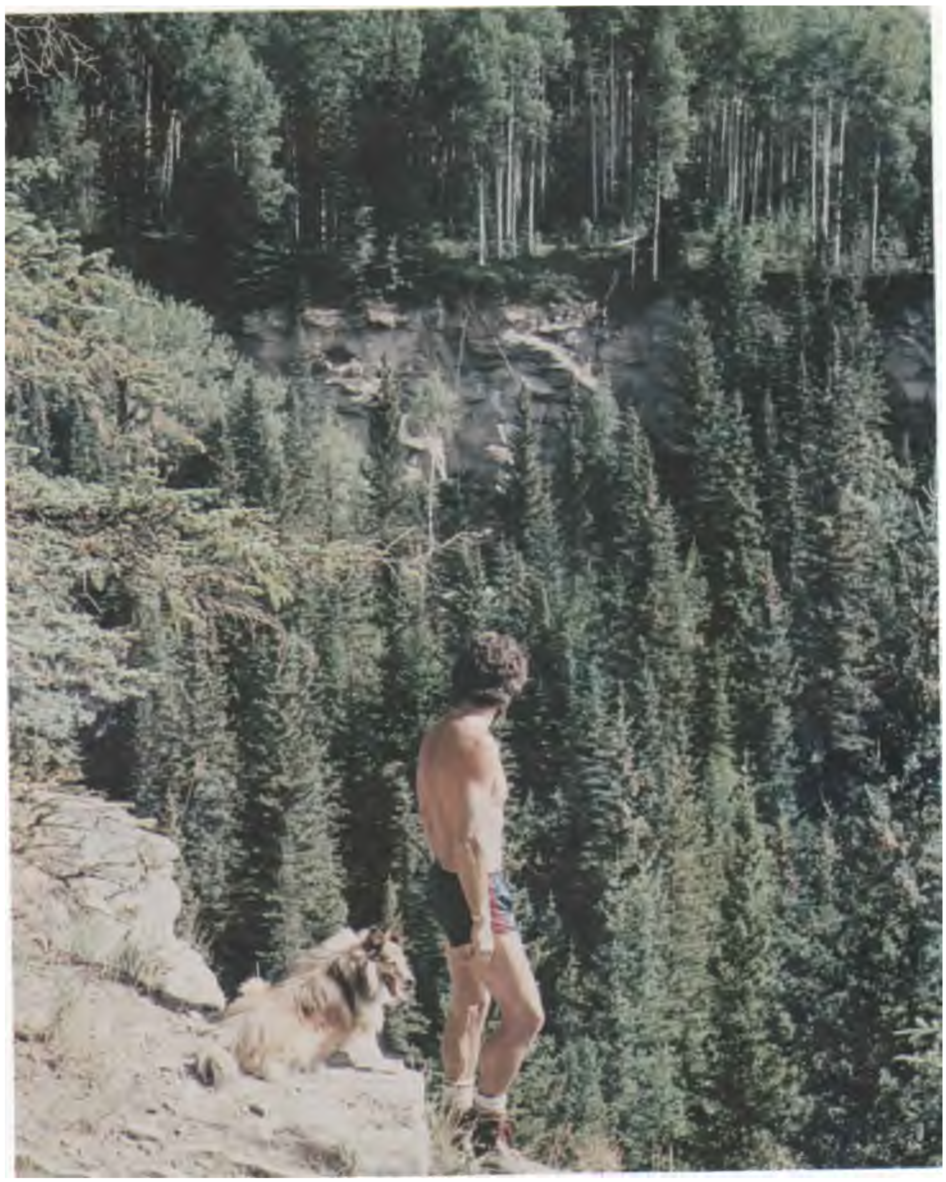
9 Tree Planting

10 Second Growth Regeneration

11 Forest Recreation

12 Emerson Lakes Recreation Area

13. Cross-country Skiing



14. Hiking on the Wild Sculpture Trail

Concern over national wood supply is becoming more and more evident and we hear urgent calls to <u>intensify management.</u> This is a loosely used term. The public can be excused if it considers that it means simply to increase the degree of effort in order to keep abreast of what nature has already done. To the forest manager, however, it means to increase the effort to improve the yield <u>beyond</u> the sustained or natural level. This usually involves the use of fertilizers, seeding or planting genetically improved stock, stand thinning and so on. all of which involve extra expense. It must be obvious that it would be unconscionable to spend money in this area until the original forest base is adequately protected.' but this is just what others appear to be promoting. Hence the company's insistence on first reaching the primary goal of sustaining the natural yield.

In this connection North Western initiated a clause in its revised agreement that <u>upon arriving at the natural sustained yield level</u> and the annual harvesting of its total annual allowable cut (AAC), entrance into the field of intensifying its efforts to out-produce nature would be encouraged by the Crown's commitment to waive current stumpage royalty payments for all timber volumes resulting therefrom, which, in effect, suggests a switch to the system of forest land rent. The rationale upon which this was accepted was presented as follows. The costs involved to intensify the yields would be at the expense of the company. The attraction would be the increase in wood furnish to implement mill expansion in both manufacturing and the increase in staff, all of which would result in an increased taxation base which would be gleaned by federal, provincial and municipal governments without any financial input on their part. It might be expected that the company's savings from free stumpage would be insufficient to cover the costs involved in intensifying the management. but this might be balanced by the fact that increases in AAC would permit plant expansion without making extra forest land available and thereby increasing hauling distances. It was also considered a corporate responsibility to go beyond the call of duty with the company prepared to embrace extra costs, provided it was not by external compulsion.

The accommodation of other renewable resource opportunities i.e. water yield. fish and game habitat, grazing and outdoor recreation. (illustrations 11 to 14), were given due consideration during the management planning process, and when these other users could bring themselves to recognize that in a multiple use context, each user must be prepared to forego maximum use and accept optimum use, then all could be accommodated without undue hurt. The catch comes when wasting resource use is imposed by Crown decree. This only became evident on North Western's limits some time after the agreement was signed. First the search for and the development of gas and oil fields was superimposed as a legitimate use, followed later by strip mining for coal. None of these users was prepared to yield in any significant degree to other surface rights.

Renewable resource management should never be subject to the destruction that results from wasting resource extraction, unless or until such minerals become vital to the public interest, and only then if maximum protection of the renewable resources can be provided. The hundreds of thousands of cubic metres of wood that have been destroyed, the thousands of acres of second growth as yet unmerchantable that have been laid waste, the destruction of age classes of timber that are vital to sustain the forest management program, all threaten periodic, lengthy mill shut-downs that could cripple and even destroy the enterprise and the infra-structure that it supports.

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* According to published fire statistics, forest fires in Canada during an average fire season consume 1.3 million hectares of productive forests. In the last five years. the annual area burned has averaged 3.5 times the area harvested.

5. Scenario for Effective Dual Management on Public Lands

Term tenure will have periodic renewal dependent upon effective performance. Failure to perform would invite rigidly enforced and discouraging punitive penalties which could include discontinuance of operations, or loss of licence.

The tenant will initiate a management program to sustain the natural timber yield, and to utilize the periodic AAC. It would have no obligation to proceed beyond this point.

In the interest of forest sanitation the tenant will initiate into forest management planning the identification of decadent and badly over-mature timber stands (illustrations I and *2). and* will schedule them for early removal. This will result in a planned primary road system that will minimize *average* hauling distances over the whole rotation period, and in getting static acres back Into production at an early date and increasing the AAC.

The government will assume the responsibility at its own expense for the protection against undue losses to fire, insects and disease. It will be obligated to select a realistic but inevitable maximum annual average area or volume loss, and to maintain it at or below that level. Translated into wood volume, this can be accommodated in the tenant's calculated AAC.

5. The tenant will absorb all active forest management costs, including roading, forest renewal and subsequent silvicultural programs. The landlord will accommodate by suitably negotiated levels of royalty payments.

6 Rules and regulations will be formulated in consultation with the tenant, with final decrees resting with the landlord.

7. Protection of the tenant's land base will be the responsibility of the landlord, but the intensification of yield will not be considered as an alternative source of wood.

8 Research will be a public sector responsibility with pertinent, on the ground support provided by the tenant. This would not preclude voluntary supporting grants from the private sector.

9 Once the tenant has proven satisfactory management performance, e.g. at the time of tenure renewal, the landlord will encourage the tenant's demonstrated professional competence by confining its subsequent involvement to the periodic performance checks as laid down in the regulations.

10 Multiple use of wildland renewable resources will be initiated by the landlord in co-operation with the tenant. The prime use for wood will be recognized, with the objective being optimum use for all. It should not be ignored that forest renewal ensures a perpetual yield of non-timber benefits.

11. The integration of non-renewable resource extraction into the renewable resource program will be avoided by the landlord, unless it can be demonstrated that the provincial economy demands it. If it can *be* proven imperative, and if extraction methods can be adapted to the rights of other users on the same principle of optimum use rather than single use. and that its ravages can be completely rectified within an acceptable time. only then will it be allowed to proceed, and it must proceed cautiously.

12 Once the sustained yield level of forest management has been reached the tenant, at his own volition, will consider moving to an increasingly intensive program.

13 Intensification of yield, once initiated by the tenant. will be encouraged by the landlord with the replacement of royalty payments for wood with a nominal annual rent for forest land. Greater wood volumes will not only result in increases in Woodlands' staffing to undertake the additional harvest, but in mill expansion and staffing to process it, and to the supporting infra-structure, all of which will result in increased tax revenues to federal, provincial and municipal governments.

14. The landlord will not exert pressure on the tenant to purchase wood furnish from outside sources, thus avoiding the necessity for the latter to reduce its own woodland's work force and subjecting it to the uncertainties of wood supply over which it has no control, for example, wild fires and strikes, and to default on its commitment to harvest the AAC.

15 If the proposed dichotomy of stewardship is to be successful, the sanctity of contracts must not be violated

6. General

To complete the recommended approach to the vitalization of our forest, the tremendous backlog of unregenerated acres that exists across the nation cannot be ignored. It exists in varying degrees in each province, and is generally the result of the reluctance of the public sector to emphasize forest renewal and to introduce effective land tenure, the invidious practice of leverage that prevailed, and the economists' insistence on the capitalization of the costs that would be involved in stand renewal.

In fairness, the responsibility for this backlog obviously cannot be placed at the door of the private sector. The public sector must accept the task of eliminating it How it should be apportioned between the federal and provincial governments must be their decision, but one cannot ignore the huge tax revenues that the former has amassed, with comparatively small contributions to the maintenance of resource viability.

It is recognized that it would be difficult for those forest management operations already established on Crown lands to accommodate such an approach as presented here, but it should not be too difficult to switch to renewable tenure, to ensure that the immediate goal is the initial sustaining of yield. and to assume all forest management costs.

Canadian industry in general is being encouraged to cut costs aggressively in order to initiate a philosophy of momentum. In the forestry sector costs can be reduced significantly by curtailing public sector involvement in operational management.

It is pertinent to report the following information provided by St. Regis (Alberta) Ltd's Chief Forester.

I During the period 1956-77, 184 724 acres were harvested, of which all but 3 698 acres have been regenerated to stiff Forest Service seventh year establishment standards, or a success rate of 98 per cent (illustration 10). The 2 per cent NSR backlog is scheduled for enhancement planting in 1985.

2 We are at present conservatively estimating a 30 per cent increase in AAC in the 1986 revision to the forest management plan, based on current 20-year growth rates from our permanent growth sample plot* data This does not include the effect of managed second growth stand yields which will have a further significant positive effect 10 years from now.

Finally, those more aware readers will recognize that this presentation contains little in the way of management approaches that have not been attempted in various combinations *elsewhere.* It does however, propose a comprehensive and logical approach which has, in St Regis case. withstood the early test of time, is responding to its entrance into the field of intensive management with an encouraging increase in the AAC, and whose success has depended and will continue to depend upon the catalyst of men's imagination and co-operative activity* *

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* 3000 0.20-acre permanent sample plots. established in the late 1950s. which have recently undergone their third remeasurement.

** In this presentation I have intentionally concentrated on the vast areas of public forest across *the* nation. Timber resources on private lands are by no means unimportant and their improved husbandry could *be a* significant contribution by some qualified to address the subject.

Appendix

Examples of incentives to Affordable Private Sector Management adopted by St. Regis.

1. Air-photo-cruising, with aerial stand-volume tables and photo-point sampling.
2. Physiographic site classification.
3. Acceptable annual average burn set at a realistic minimum.
4. Mechanical disposal of slash to reduce fire hazard and prepare a suitable seed bed (illustration 7).
5. Planning for minimum average hauling distance over whole rotation (illustrations 3 and 4).
6. Expensing rather than capitalizing of forest renewal costs.
7. Regenerating from natural seed sources. as opposed to dependence upon planting.
8. Subjective regeneration surveying.
9. Ingress of lodgepole pine regeneration and its accommodation in subjective surveying.
10. Field transportation by helicopter.
11. Internal program of helicopter photography
12. Company photo-lab facilities.
13. Container planting (illustrations 8 and 9).
14. Harvesting of standing dead and of fire-killed stands.
15. The option to substitute forest land rent for stumpage royalty payments.
16. Government acceptance of a freer rein in company's management approaches following demonstrated competence.
17. Physical research the responsibility of government funded institutions, with on-the-ground company support.

List of References

Reed, F.L.0 and Associates. 1977. Forest Management in Canada. The Forest Management Institute. Canadian Forestry Service, Environment Canada. Two volumes. The second volume includes five case studies intended to illustrate the potential costs and benefits of forest management in locations representing major forest types and regions across Canada. Case Study No. 3, titled Forest Management by North Western Pulp and Power Ltd. is based on *the* lodgepole pine and white spruce forest on the Eastern Slopes of the Rocky Mountains in Alberta. Information Report F.M.R.-X-103.

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Biography of the Author

by Dr. James Beck Jr.
Chairman
Department of Forest Science
University of Alberta

Desmond Ivan Crossley was born in Lloydminster, Saskatchewan in 1910. He was educated at the Universities of Alberta, Toronto and Minnesota and holds a B.Sc.F. with Honors from the University of Toronto and *an* M.Sc. from the University of Minnesota. He received an honorary doctorate from the University of Toronto.

After graduation in 1935 and *a brief* interval in Ontario, he became tree planting supervisor at the Dominion Forest Nursery Station. Indian Head, Saskatchewan *where* he supervised the extensive field and home shelterbelt projects in Manitoba and Saskatchewan.

During the Second World War he served for five years *in* the Royal Canadian Air Force where he was assigned to instructional work in navigational training in the Empire Air Training Plan, in Canada and England.

After demobilization with the rank of squadron leader. Des joined the Federal Forestry Branch at Calgary where for the next 10 years he engaged in a wide variety of research, dealing mainly with the ecology and silviculture of lodgepole pine and white spruce.

In 1955 Dr. Crossley joined North Western Pulp and Power Limited (now St. Regis (Alberta) Ltd.) at Hinton, Alberta as chief forester at the start of Alberta's first pulp mill. As chief forester he systematically introduced a level of forest management that is unsurpassed on any area of similar size in Canada.

Des Crossley is the author of more than 40 technical publications which have appeared in professional journals and as bulletins, notes and leaflets issued by the Federal Forestry Branch

He has been active in many forestry organizations. councils, research councils and associations including the Canadian Institute of Forestry, Woodlands Section of the Canadian Pulp and Paper Association. Society of American Foresters. Alberta Forestry Association. Arctic Land Use Research Advisory Council, Alberta Forest Service Research Advisory Council, and the Advisory Committee Alberta Environment Council of Alberta. Dr. Crossley also served as a member of the Senate of the University of Alberta.

Excellence in his career has been recognized by many distinguished awards, honors and lectureships and by an honorary doctorate. Among these are:

Forestry Achievement Award	Canadian Institute of Forestry 1969
Award Winning Paper	Woodlands Section, Canadian Pulp and Paper Association Annual Convention 1975
Achievement Award	Province of Alberta 1975
H.R MacMillan Lectureship	University of British Columbia 1976
Appointed Fellow of Institute	Canadian Institute of Forestry 1979
Doctor of Laws	University of Toronto 1982

Des Crossley retired from his position as chief forester of North Western Pulp and Power Ltd. in 1975. Since his retirement he has been active in numerous professional and consulting activities.

Acknowledgements

I owe a major debt of gratitude to Professor Les Reed, Faculty of Forestry, University of British Columbia and former Assistant Deputy Minister, Federal Department of Environment, who brought a wealth of insight and understanding to his criticisms of the draft copies of this presentation. and who wrote the foreword to the final copy. Also Bill Young, retired Chief Forester, B.C. Forest Service deserves recognition for his original encouragement to set my thoughts and convictions on paper.

My thanks go to the following for reading and constructively commenting on the drafts as they appeared:

Dr. Phil Thomas, retired Director General. Canadian Forestry Service;

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Mr. Jack Wright, Chief Forester, St. Regis (Alberta) Ltd.;

Mr. Edo Nyland, retired Chief Forester. Yukon Forest Service;

Mr. Ray Mordan. retired Engineer, and:

Mr. Chuck Geale, President, Canadian Forestry Association.

Special thanks are also due to Mr. Dave Kiil, Past President and Dr. Jim Beck. President of the Alberta Forestry Association for their part in the production of this publication, and of course, the Association's shouldering of its publication and distribution.

Since this will likely be my swan song as a concerned forester, it is fitting that I record my gratitude to my wife. Isobel, for those many hours of separation spent throughout the years in my study pondering the vicissitudes of the Canadian forestry situation, and for her involvement in the editorial work and patient preparation of my outpourings.