An Independent Review of Forest Practices in Nova Scotia

Addendum

August 2018

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Foreword

This addendum to Professor William Lahey's Independent Review of Forest Practices in Nova Scotia includes background material and supporting documents prepared by the expert advisors who provided assistance to the Review.

The writing of each section of this addendum has been led by the named author(s). All sections have been reviewed by other members of the Review team.

In addition, this addendum includes an appendix of submissions that were prepared at Prof. Lahey's request by other individuals and organizations.

Contents

1 Forest Practices Review Process

(Prepared by David Foster)

On August 30, 2017, Natural Resources Minister Margaret Miller announced that Professor William Lahey, President of the University of King's College and professor of law at Dalhousie University, was appointed to lead a review of forest practices in Nova Scotia. Prof. Lahey's mandate is to examine current forest practices and market situations and to make recommendations for how to improve the balance of environmental, social, and economic goals in Nova Scotia's forests. The report was to be delivered to the Minister of Natural Resources at the end of February 2018, though this was later extended to the end of April 2018.

The terms of reference for the Review (DNR 2017d) define the scope as follows:

> The Review will examine current practices, including strengths and weaknesses, and provide recommendations for improvement regarding how Nova Scotia balances long-term environmental, social and economic interests in managing the province's forests. In particular, the Review has the mandate to examine the following components:
>
> 1. Evaluate the effectiveness and identify opportunities to improve the legislation, regulations, policies and guidelines, as well as the science-based tools that determine whether and where harvesting occurs, as well as the harvesting methods (e.g.: clear cut, partial harvest) that can or should be used.
> 2. Evaluate market access for private forest owners, particularly in the western region, and provide recommendations to address any identified issues.

The Lahey Review commenced in September 2017 and, over the course of eight months, involved the input of expert advisors, stakeholder consultations, field trips led by DNR, industry, and ENGOs, and workshops involving various stakeholders and advising experts. This process is briefly summarized here.

1.1 Expert Advisors

To assist in the Review, Prof. Lahey assembled a team of expert advisors to provide detailed insight into the technical aspects of forest management, forest ecology, and forest economics. Prof. Lahey held two full weeks of meetings with most of the members of the team of independent advisors: one in January and one in February. In addition, Prof. Lahey and various members of his team examined forest conditions and forest practices in the field. Site visits were held in all three regions, and different field visits were led and organized by DNR, industry representatives, and environmental representatives.

The expert advisors included

- Dr Peter Duinker, professor, School for Resource and Environmental Studies, Dalhousie University
- Al Gorley, President of Triangle Resources Inc., former Assistant Deputy Minister of Forests in BC, and founding Chair of BC's Forest Practices Board
- Dr Malcolm L. Hunter, Jr, professor of Wildlife Ecology and Libra Professor of Conservation Biology, University of Maine
- Dr Robert Seymour, professor emeritus and formerly Curtis Hutchins Professor of Forest Resources, Quantitative Silviculture, University of Maine

- Mr Laird Van Damme, RPF, senior partner, KBM Resources Group, and external adjunct professor, Natural Resources Management, Lakehead University
- Mr Chris Wedeles, wildlife biologist, partner, Aborvitae Environmental Services Ltd
- Dr Jeremy Williams, RPF, forest economist, partner, Arborvitae Environmental Services Ltd

In addition, Prof. Lahey was assisted by David Foster, research associate at Dalhousie University.

1.2 Assistance from Other Individuals and Organizations

A number of additional individuals and organizations provided contributions at Prof. Lahey's request:

1. Nathan Ayer, a graduate student at Dalhousie University, provided a policy review: Forest Management in Nova Scotia: A Summary and Reflection on Provincial Forest Policy from 1980 to 2017 (Appendix C).
2. The Mersey Tobeatic Research Institute provided a review of the Nova Scotia Department of Natural Resources *State of the Forest 2016* report and reports on biodiversity modules: State of Nova Scotia Forest and Biodiversity Review (Appendix D).
3. The Mersey Tobeatic Research Institute also organized a workshop: "Opportunities for Consensus and Conflict Resolution in Forestry" (Appendix E).
4. Nova Scotia's Forest Science Advisory Committee provided advice on the key issues of concern for biodiversity with respect to forestry (Appendix F).

1.3 Department Briefings

Prof. Lahey and his team received presentations by DNR staff to familiarize the Review team on forestry and forest policy in Nova Scotia:

- Acts, regulations, and the Natural Resources Strategy
- The state of Nova Scotia's forests
- Biodiversity in Nova Scotia
- Forest industry overview
- Code of Forest Practice and ecosystem-based planning
- Ecosystem-based planning tools
- Historical and current trends in wood supply
- Forest resource modelling
- Site productivity programs
- Landscape-level planning
- Managing for biodiversity and species at risk
- Private land silviculture
- Timber management
- Managing for multiple values on Crown land
- Crown land harvest plan approval process

- Recreation and outreach
- Forest management policy for Crown lands
- Climate change and Nova Scotia forests
- Forest protection
- Outlook of biodiversity
- Nova Scotia forests future outlook

1.4 Meetings and Correspondence

In November 2017, Professor Lahey and members of the Review team held a first round of "scoping" meetings with a cross-section of groups and individuals, most of whom were invited by the Review to participate in this round of meetings. The purpose these meetings was both to help the Review identify the issues that would be critical to its work and to hear a representative sampling of information, advice, and opinion on those issues. Through December, Professor Lahey and members of the Review team held additional meetings with a broader range of groups and individuals, most of whom requested to meet. In these meetings, the Review's listening was informed by its first scoping round of meetings, written submissions, two days of briefing on forestry by the Department of Natural Resources and its own analysis of the issues and the applicable literature, including the various reports which contributed to or flowed from the development of the department's Natural Resources Strategy that was released in 2011.

Over the course of the Review, Prof. Lahey and his team of experts held meetings with a diverse cross-section of more than 80 groups and individuals, totalling approximately 160 participants.

- Private citizens
- Woodlot owners and organizations
- Non-governmental organizations (NGOs)
- Academics
- Industry, including forest companies, wood brokers, contractors, silviculture workers, and service providers
- Government officials
- Mi'kmaq representatives

From August 30, 2017, to April 15, 2018, the Review received over 250 written submissions from an equally diverse group. Written submissions spoke to a broad range of concerns about forest practices, the forest industry, and governance of natural resources.

Clearcutting was by far the most common forest practices issue raised (Figure 1.1). The majority of submissions from private citizens and non-governmental organizations called clearcutting inappropriate for Nova Scotia forests or called for an outright ban of the practice. The majority of submissions in favour of clearcutting provided a more nuanced perspective – that clearcutting is appropriate in some circumstances. This was expressed in submissions predominantly from industry, woodlot owner groups and NGOs involved in, or advocating for, sustainable forestry.

The next most frequently raised issues related to the sustainability of forest practices, the health of the province's forests, and concerns about biodiversity. Other issues included whole-tree harvesting, herbicide use, and management of riparian zones.

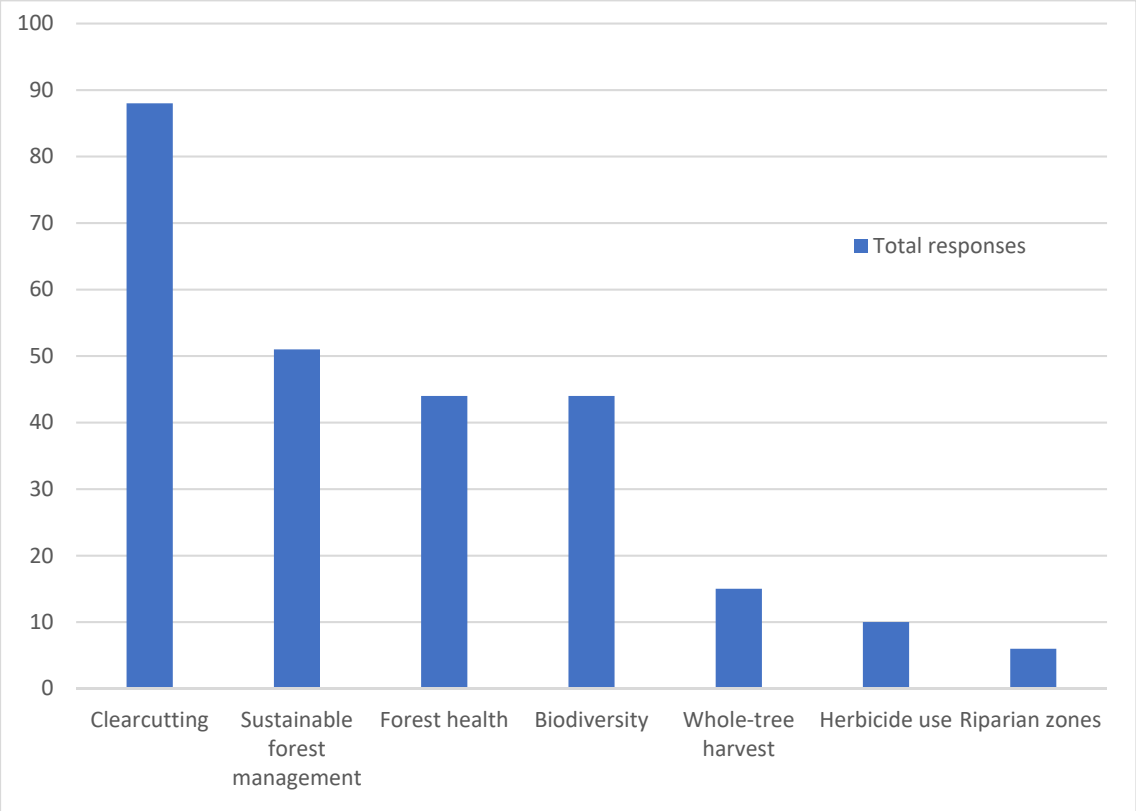


Figure 1.1. Summary of issues about forest practices raised in submissions to the Review.

Issues relating specifically to the industry included forest sector employment, biomass harvesting, the operation of WestFor in western Nova Scotia, transparency of decision making and the economic importance of pulp and lumber mills (Figure 1.2). The importance of the forest industry to the rural economy was highlighted by many. The majority of submissions from private citizens and NGOs opposed the use of biomass for electricity generation. Submissions, primarily from industry, suggested that the suitability of biomass be determined based on operation size, fibre supply (roundwood versus mill leftovers), location, and as a market for low-grade fibre. With respect to western Nova Scotia, concerns were raised about forest practices, in particular with respect to the area's poor soils, and the concentration of harvesting rights for Crown land to multiple sawmills through a single management group (WestFor).

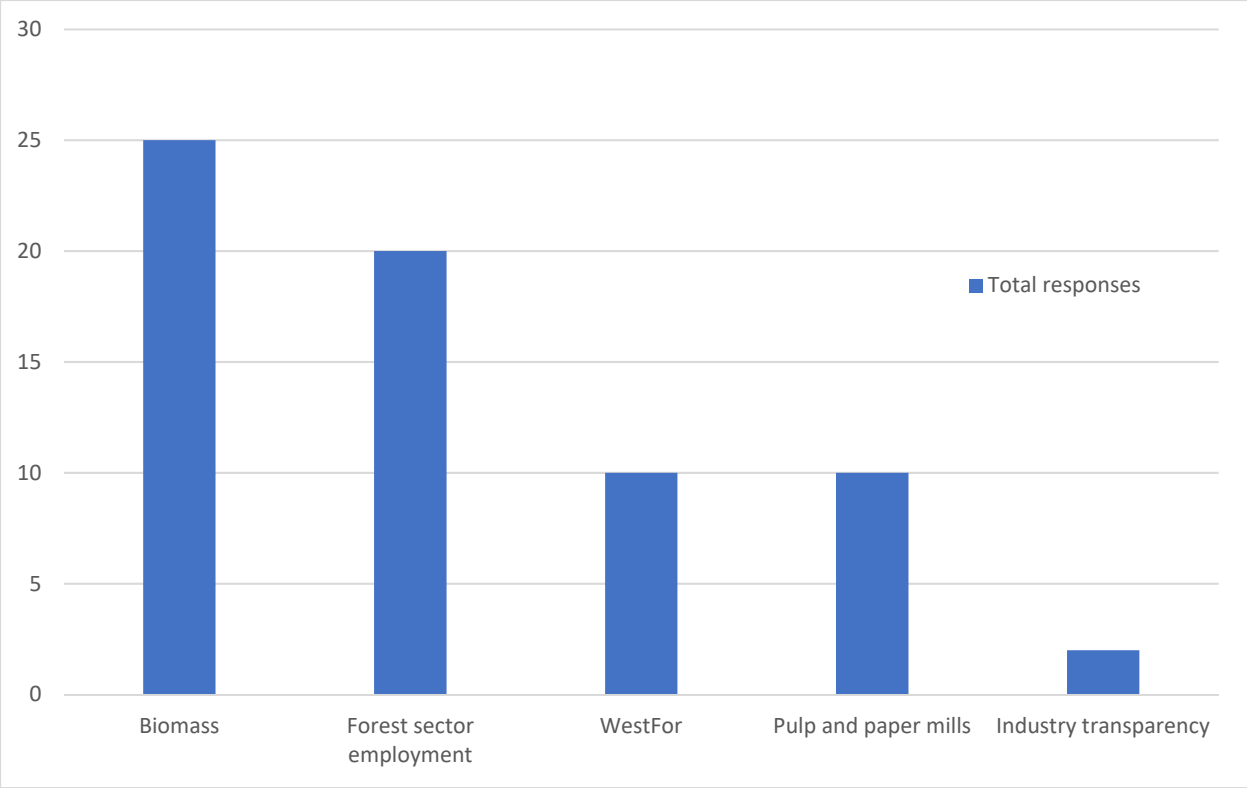


Figure 1.2. Summary of issues in submissions to the Review about the forest industry.

Many individuals and groups who corresponded with the Review mentioned the governance of Nova Scotia's forests, both public and private. The majority who wrote about the organization and operation of DNR felt that it needs to be more transparent in its use of science in decision making. Similarly, a majority of submissions expressed that Crown land is used inequitably and that forestry is emphasized to the detriment of other forest values such as biodiversity, tourism, and recreation. Concerns were also raised about the sustainability of timber supply and timber prices (Crown and private). Those who advocated for more-ecological forestry overwhelmingly supported third-party certification and carbon credits for unharvested wood. However, there was mixed support for reverting to the recommendations of the Natural Resources Strategy.

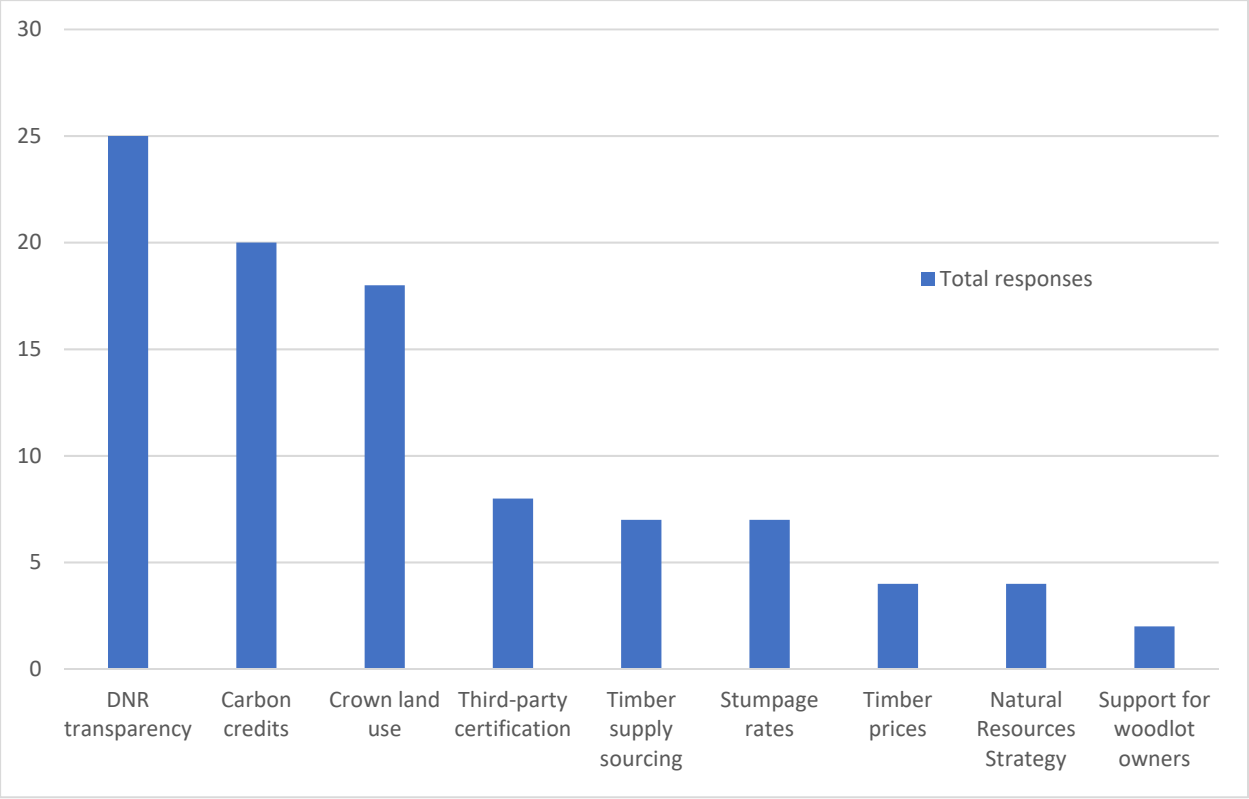


Figure 1.3. Summary of issues in submissions, by correspondence, regarding forest governance in Nova Scotia.

In addition to the meetings with individuals or groups, a workshop with a cross-section of 21 participants was held February 20, 2018, on "Opportunities for Consensus and Conflict Resolution in Forestry." A technical workshop was also held February 21, 2018, on "Nova Scotia's Natural Disturbance Regime and Ecological Forestry Framework."

1.4.1 Forest Practices Review: meeting participants

Individual/Organization	Participants
Adam Forrest	
Alain Belliveau	
Allan Eddy	
Allan Shaw	
Association for Sustainable Forestry	David Sutherland
Athol Forestry Co-op	Ian Ripley
Bob Bancroft	
Cape Breton Private Land Partnership	Kari Easthouse
Centre for Local Prosperity	Robert Cervelli
Cindy Staicer	

Colin Hughes	
Community Forests International	Dale Prest
Confederacy of Mainland Mi'kmaq	Alton Hudson, Anthony King, Ashley Childs, Wolf MacGregor
Conform Ltd.	Ed McDonnell
Dale Smith	
David Dagley	
David Patriquin	
DNR Forest Sciences	Bruce Stewart, Peter Neily, Ryan McIntyre, Tim McGrath, Kevin Keys, Chris Bailey, Peter Bush, Elizabeth McGarrigle, Rob O'Keefe
DNR Wildlife Division	Bob Petrie, Randy Milton, Shaun Basquill, Mark Pulsifer
Donna Crossland	
Ecology Action Centre	Raymond Plourde
Evangeline Transport	Ed Corkum
Forest Nova Scotia	Jeff Bishop, Doug Ledwidge, Kent Dykeman, Stacie Carroll, Darrin Carter
Forest Science Biodiversity Science Advisory Committee	Sherman Boates, Peter Duinker, Tom Herman, Thom Erdle, Graham Forbes, Peter Bush
Freeman Lumber	Richard Freeman, Billy Freeman, Charlie Freeman, Craig Hartlen
Friends of Nature	Syd Dumaresq, Ken McCrury, Brad Armstrong
Gerald Keddy	
Gerry Van Dyk	
Great Northern Timber Inc	Earle Miller
Greg Carter	
Gregor Wilson	
Groupe Savoie	John Vautour
HC Haynes Inc	Andrew West
Healthy Forest Coalition	Paul Pross, Soren Bondrup-Nielsen
Helga Guderley	
Jamie Simpson	
J.D. Irving Limited	Jason Limongelli, Ian McCabe, Andrew Willett
Kermit Degooyer	
Kyle Miller	
Large Land Owners Group	Debbie Reeves, Darcy Merryweather, Jason Stewart
Ledwidge Lumber	Doug Ledwidge, Cassie Turple, Robert Lively
Leo Glavine	
Lewis Mouldings	Jamie Lewis
Matt Miller	
Medway Community Forest Co-op	Mary Jane Rodger, Will Martin, Don Kimball, Jane Barker
Mersey Tobeatic Research Institute	Amanda Lavers, Jane Barker, Tom Herman, Leif Helmer
Michel Palmer	

Mi'kmaq Rights Initiative/ Kwilmu'kw Maw-lusuaqn	Eric Zscheile, Kelly Peters
Municipality of the County of Annapolis	Gregory Heming, Michael Gunn, Timothy Habinski, John Ferguson
Neal Livingstone	
Next Generation Forest Management	Calvin Archibald
Norris Whiston	
North Nova Forest Owners Co-op	Greg Watson
Northern Pulp	Rick Archibald, Troy Hromadnik, Heidi Higgins, Paul Orser
Nova Scotia Innovation Hub	Rod Badcock
Nova Scotia New Democratic Party	Lisa Roberts, Mary-Dan Johnston
NS Environment	Lorrie Roberts, Andrew Murphy, Peter Labor, David MacKinnon, Elizabeth Kennedy, Neil Morehouse, Rob Cameron
NS Land Owners and Forest Fiber Producers Assocition	Kingsley Brown, Kari Easthouse, Peter Burchell, Bill Hill
NS Woodlot Owners & Operators Association	Andrew Kekacs
Peter MacQuarrie	
Port Hawkesbury Paper Ltd.	Mark Dube
Propel Bioenergy	Barry Zwicker
Registered Professional Foresters Association of Nova Scotia	Robert Young, Peter Francis, Kevin Keys
Richmond Campbell and Susan Sherwin	
Royce Ford	
Scott & Stewart Forestry Consultants	Shaun Scott, Chuck Bowers
Seven Gulches Forest Products	Peter Spicer
Southwest Nova Biosphere Reserve	Cliff Drysdale, Ian Manning, Peter Hall
Stacie Carroll	
Sustainable Forestry Initiative	Darren Sleep, Gregor MacInosh
Taylor Lumber	Robert, Seth, Jocelyn and Jess Taylor
Teal Forest Resources	Steven Teal
Tourism Industry Association of Nova Scotia	Darlene Grant Fiander, Lisa Dahr
Travis Parsons	
Unama'ki Institute of Natural Resources	Jason MacLean
Wade Prest	
Wagner Forest Management Ltd.	Ian Johnstone

Western Region Stakeholder Interaction Committee	Peter Jones, John Wightman, Mervin Hartlen, Cliff Drysdale, Gordon Beanlands, Mac Barkhouse, Amanda Lavers, Michael Gunn, Markus Zwicker, Jillian Weldon-Genge, Mary Jane Rodger, Scott Merry, Mike Marriott, Andy Looke
Western Woodlot Cooperative	Patricia Amero, Harold Alexander
WestFor Management	Marcus Zwicker, Richard Freeman, Charlie Freeman, Kent Dykeman, Jamie Lewis
Westwind Stewardship Inc.	Tom Clark
Woodscamp	Will Martin, Alastair Jarvis

1.4.2 Participants in Workshop on Opportunities for Consensus and Conflict Resolution in Forestry, Mersey Tobeatic Research Institute, February 20, 2018

Amanda Lavers	Debbie Reeves	Mary Jane Rodger
Andrew Fedora	Greg Watson	Matt Miller
Andy Kekacs	Harold Alexander	Mike Lancaster
Bill Lahey	Jane Barker	Patricia Amero
Cassie Turple	Jeremy Williams	Peter Duinker
Chris Wedeles	Kari Easthouse	Rick Archibald
Dale Prest	Marcus Zwicker	Stacie Carroll

1.4.3 Participants in Workshop on Nova Scotia's Natural Disturbance Regime and Ecological Forestry Framework, February 21, 2018

Alain Belliveau	Karen Beazley	Jon Porter
Bob Petrie	Kevin Keys	Raymond Plourde
Bruce Stewart	Laird Van Damme	Rob O'Keefe
Chris Wedeles	Mary Jane Rodger	Robert Seymour
David Foster	Peter Bush	Ryan McIntyre
David Patriquin	Peter Duinker	Tim McGrath
Donna Crossland	Peter Neily	Tom Soehl
Jeremy Williams	Randy Milton	William Lahey

1.4.4 Forest Practices Review: written contributions

Aaron Ward	Andrew Kekacs	Beert Verstraete
Adam Forrest	Andrew Roof	Bernadette Regnier
Adrian Wilson	Art Lynds	Bill McCarthy
Alain Belliveau	Barbara Gallagher	Bob Bancroft
Alex Lindsay	Barbara Markovits	Brad Armstrong
Andrew Griffin	Barry Geddes	Brad Hennigar

Brian Gifford
Brian Purdy
Brian Van Rooyen
Burkhard Plache
Byron Rogers
C. Saul
Calvin Archibald
Carol Bradley
Carol E. Harris
Carol Klar
Carolyn Green
Carolyn Pineau
Cassie Turple
Christian Thibaudeau
Christie Schurtleff
Churchill Page
Cindy Staicer
Cliff Corning
Cliff Drysdale
Corey Hirtle
Dale Prest
Dale Smith
Dan Asad
Dan Doucette
Dana Mills
Danny George
Dave Gunning
David Banks
David Dagley
David Patriquin
David Sutherland
David Walmark
Debbie Reeves
Dennis Nash
Don Rushton
Don Wilson
Donna Crossland
Doug Hickman
East Coast Environmental Law Association
Ed Bailey
Ed Johnson
Eric Ruff
Federation of NS Woodland Owners
Forest Nova Scotia
Frank Thomas
Fred Gilbert
Freeman Brothers Ltd.
Gary Fisher
Gaston Damecour
George I. Child
Gerald Keddy
Gerry Van Dyk
Gordon Hammond
Great Northern Timber Inc.
Greg Carter
Greg Watson
Gregor Wilson
Gregory Heming
Groupe Savoie
H. Cross
Harold Alexander
Harold Clapp
HC Haynes
Heather McKenna
Helga Guderley
Hike Nova Scotia
Howard Williams
Hugh Chipman
Ian McCabe
Ian Ripley
Irmgaard Lipp
James Vincent O'Brien
Jamie Lewis
Jamie Simpson
Jamie Stephen
Jane Barker
Janet Barkhouse
J.D. Irving Ltd
Jeff Bishop
Jeff Moore
Jefferson Muise
Jennifer West
Jill Hartling-Clark
Jim Crooker
Jim Harpell
Joan Massey
John Bragg
John LeDuc
John Leefe
John Nhung
John Sollows
Joyce Kublin
Judith Lipp
Karen Beazley
Kathleen Hall
Kathleen Milan
Ken Burrows
Kingsley Brown
Kris Larson
Leslie Ann Bateman
Leslie Robinson
Leslie Wade
Linda O'Neill
Lisa Roberts
Lorie-Ann Martin
Mac and Lynn Barkhouse
Maelissa Watson
Marc Dube
Mary Davey
Mary Jane Rodger
Mersey Tobeatic Research Institute
Michael Bradfield
Michel Palmer
Mike Parker
Mildred Thill
Nature Conservancy of Canada
Neal Livingston
Nicholas MacInnis
Norris Whiston
NS Silviculture Contractors Association
Pam Gaul
Pamela Ackerman
Patricia Amero
Patricia Leader
Paul Brison

Paul Pross
Peter Drummond
Peter Jones
Peter MacQuarrie
Peter Ritchie
Peter Spicer
Peter Wallace
Private Land Forest Co-Ops
Randall Caruana
Raymond Plourde
Richard Beazley
Richard Freeman
Rick and Janet Whitman
Rob Murray
Robert Cervelli
Robert Corning
Robert Monk
Robert Murray
Robert Young
Robin Barrett
Rod Badcock
Ronald Cosper
Royce Ford
Sarah Jenson
Sarah MacDonald
Sheila Hulford
Shelley Hipson
Soren Bondrup-Nielsen
South Shore Council of Canadians
St Margaret's Bay Stewardship Association
Stacie Carroll
Stephanie MacWhirter
Stephanie Robertson
Stephen Gleich
Steven Teal
Susan Moxon
Susan Wehrell
Sustainable Forestry Initiative
Syd Dumaresq
Thomas Hatt
Tim McMahon
Tim Miller
Tom Miller
Tourism Industry Association of NS
Twila Robar-Decoste
Val Traversy
Van Penick
Virginia Proulx
Wayne Mulock
WestFor Management Inc.
Will Martin

2 Summary of Provincial Forest Policy from 1980 to 2017

(Prepared by Nathan Ayer)

Canada's forest industry is undergoing major changes due to shifting global demand for traditional forest products (e.g., paper, newsprint) and increasing interest in using wood fibre to produce bioenergy and biomaterials. These trends are reflected clearly in Nova Scotia's forest sector, as pulp and paper production has declined significantly in recent years, overall harvesting levels have declined, wood fibre is increasingly being used for electricity generation and production of wood pellets, and research and development is ongoing to develop technologies for production of biofuels and biomaterials.

As the Nova Scotia forest industry goes through this period of uncertainty and change, there is also uncertainty about the effectiveness of the provincial government's forest management policies.

The overall objective of this report is to summarize and reflect, but not to provide a quantitative assessment of the health of the NS forest, and not to provide critical policy analysis and recommendations.

The initial conception of this paper was during a directed studies course at the School for Resource and Environmental Studies in 2011–2012. The research and preliminary report from 2012 have been revised and updated with information on new policy developments between 2011 and 2017, as well as new reflections on key policy issues.

Find this paper in Appendix C to this report.

3 The Natural Resources Strategy

(Prepared by David Foster)

The most recent iteration of natural resource management policy in Nova Scotia is the 2011 Natural Resources Strategy (NRS). The NRS was informed by a third-party-led public consultation and expert input. It was authored by the Department of Natural Resources and included an action plan to guide management until 2020. This chapter briefly outlines the process leading to the authorship of the NRS, and subsequent developments in implementation.

3.1 Process

The Environmental Goals and Sustainable Prosperity Act prescribed that the province adopt a natural resources strategy by 2010 – focusing on the areas of biodiversity, forestry, geological resources, and parks – and implement the strategy accordingly. The government mandated Voluntary Planning to form a Citizen Engagement Committee in 2008. The group hosted 27 public meetings in 2009, hearing from around 2,000 people in communities across Nova Scotia. Participants spoke to a wide range of natural resource issues, and this input was published by Voluntary Planning (2009) in *Our Common Ground: The Future of Nova Scotia's Natural Resources*.

On forestry, participants expressed opinions about a variety of forestry-related topics, including practices such as clearcutting and herbicide spraying. Though there were both supporters of clearcutting as a harvesting technique and those who called for an outright ban, there was generally consensus that its prevalence should be reduced. Many expressed support for a ban on herbicide and other pesticide spraying on both public and private property. Support for a strong rural economy was unanimous, but opinions differed on how it can be achieved. Participants agreed that silviculture funding should be increased, along with fewer restrictions, based on woodlot size, while some expressed that non-forestry industry groups (e.g., tourism, wildlife, recreation) should be engaged and consulted on forestry decisions. Many wished for DNR to respect private property owner rights and take less direction on forestry matters from urban residents.

To ensure that the values expressed by members of the public were reflected in recommendations to the strategy, the Minister of Natural Resources appointed a steering panel comprising the Honourable Constance R. Glube, Joe Marshall, and Allan Shaw. The steering panel was additionally tasked with providing high-level oversight and guidance to expert panels on each of the resource categories to be addressed within the NRS: forests, biodiversity, geological resources, and provincial parks. The panels of expertise were to consult technical stakeholders across the province and analyze technical information in their respective fields, providing the steering panel with a report including specific recommendations for the NRS. The forestry expert panel comprised Robert (Bob) Bancroft, Donna Crossland, and Jonathan Porter. Unlike the other three expert panel reports, the forests panel provided two reports to the steering panel due to differing opinions.

Bob Bancroft, now retired, was an employee of both the Nova Scotia Department of Lands and Forests and the Nova Scotia Department of Fisheries and Aquaculture. Donna Crossland is a forest ecologist who works at Kejimkujik National Park as a resource management officer. These authors provided a report that supported a shift toward more ecologically based forestry, integrated resource management,

balancing forest utilization, and ceasing forest practices regarded by many as unsustainable (Bancroft and Crossland 2010). Here are the five key recommendations of their report:

1. Adopt an ecologically based, multi-aged forest management paradigm, using uneven-aged harvest approaches that produce various-sized gaps or patches to promote restoration of high-quality, late-successional trees; multi-aged stands; and meet the needs of a wide array of ecosystem components at once.
2. Implement the Integrated Resource Management process on Crown lands, entailing pivotal approaches and new management tools that will lead the way to ecosystem-based forestry. Consider some IRM approaches for private lands, using educational tools, and incentives.
3. Forest management should take a balanced approach between harvesting and ecosystem objectives that include provisions for landscape connectivity, watershed protection, wildlife, biodiversity, and predicted climate change. This will end a legacy of dry stream beds and shorten the list of endangered species needing old-forest habitats.
4. Promote strong stewardship and educational initiatives to improve the land use relationships of Nova Scotians with their forests.
5. Amend forest regulations to stop whole-tree harvesting, phase out clearcutting, and promote uneven-aged management. Whole-tree harvesting has increased during the course of this strategy and appears to be accelerating the decline of forest ecological integrity for minimal profits and few jobs. A return to removing only tree trunks will not occur without regulation.

Jonathan Porter was the manager of forestry and fibre resources at Bowater Mersey Paper Co. Ltd from 1980 to 2012, briefly the manager of forestry and fibre resources at Renova Scotia Bioenergy Inc., and is now the executive director of renewable resources at the Nova Scotia Department of Natural Resources. He provided a report that supported a best-management-practices approach to forestry, using the Code of Forest Practice on Crown land to model the type of forestry that is hoped for private land, encouraging a shift toward non-clearcut harvesting through education and management planning (Porter 2010). Here are the five key recommendations from his report:

1. Complete and implement the Code of Forest Practices (CFP) as a requirement on Crown lands. Crown lands should include protected, extensive-management, and intensive-management areas and should be certified to an internationally recognized forest certification system (SFI, CSA, or FSC).
2. Implement a comprehensive best-management-practices approach to improving forest management on private lands, rather than a conventional command-and-control approach. Encourage the use of forest management plans.
3. Support a range of management practices, including clearcutting and herbicide application. Improved forest management decisions will increase the use of alternative harvesting methods and will lead to a reduction in the proportion of clearcutting.
4. Implement a greatly enhanced and expanded extension effort to support the best-management-practices approach and to help private landowners understand their rights and responsibilities. Develop programs to increase Nova Scotians' understanding of the many values of our forests.
5. Improve compliance with existing regulations, particularly the Wildlife Habitat and Watercourses Protection Regulations, and complete a full review of the regulatory framework to support the new NRS.

The steering panel provided its report to government in April 2010: *A Natural Balance: Working Toward Nova Scotia's Natural Resources Strategy* (Glube et al. 2010). This document formed the basis for DNR to prepare its NRS in December 2010: *The Path We Share, A Natural Resources Strategy for Nova Scotia 2011-2020* (DNR 2011d). The strategy provided strategic direction for forestry including on the following:

1. Reduce clearcutting and establish a harvest tracking system.
2. Review and redesign silviculture programs.
3. Prohibit removing whole trees from forest sites to maintain woody debris for soil and biodiversity.
4. Limit herbicide use.
5. Clarify the use of forest biomass for energy.

Pertaining to clearcutting, the NRS states:

> An ecosystem-based analysis of the province's forests showed that about 50 per cent of these lands are suited for uneven-aged management, or non-clearcutting. The policy framework set a target for reducing clearcutting to no more than 50 per cent of all harvests. The target, to be phased in over five years, will be set in regulation. (p. 42)

In addition, the NRS states that "public support will no longer be extended to the use of herbicides" (p. 43) and included a reduction in the cap for consumption of forest biomass for electricity generation. These commitments were met with a variety of responses from industry and the public, but most acknowledged that a reduction in the use of clearcutting would be good for Nova Scotia forests. Though nearly nine years have passed since the consultations hosted by Voluntary Planning, there is no indication that public opinions have shifted significantly away from those expressed in 2009, and therefore these records captured by the Citizen Engagement Committee should still help shape public policy respecting the forest today.

3.2 Implementing the Natural Resources Strategy

At the time of the NRS publication, DNR had already produced, or was in the process of producing, science-based publications and tools that would make it possible to act on the commitments of the NRS. The Forest Ecosystem Classification (FEC) is a key tool for understanding conditions to make appropriate management prescriptions. The pre-treatment assessment (PTA) and Forest Management Guides (FMG) are important tools for site-level treatment prescriptions of ecosystem-based forestry. The Ecosystem Land Classification is a tool for landscape-scale planning based on enduring physical attributes, to enable sustainable natural resource management.

The NRS mandated periodic reports on DNR's efforts to implement policy changes. Over the course of these reports, progress was reported on many items, including

- the FEC guide, which provides higher-level guidance to good forest management
- the PTA process that assists in making environmentally appropriate silvicultural and harvest prescriptions
- mandating the Code of Forest Practice on Crown lands
- data sharing with the public through the Nova Scotia Government open data portal, and the opportunity for public input into planned harvests through the harvest map plan viewer

- a reduction in the proportion of clearcutting on both Crown and private lands compared to pre-NRS data

Some of these reports updated the NRS itself, most notably on the issue of clearcutting. Though the NRS made a commitment to reduce clearcutting to 50 per cent of total harvests, updates to the strategy affected the pursuit of these targets. The 12-month report introduced a new definition of clearcuts, which has been criticized by some. Most noteworthy, the 5-year report indicated that DNR was abandoning the 50 per cent clearcut reduction target in favour of a site-specific, ecosystem-based determination of appropriate harvest methods, with no overarching target. This decision received widespread criticism from the public and the media.

4 Condition of Nova Scotia's Forests

(Prepared by Peter Duinker)

4.1 The Forests

A strong relationship exists between the state or condition of a forest and the forest practices used to manage it. On one hand, the practices influence how the forest will evolve, and on the other, the forest condition predicates what forest practices are desirable and even possible. Therefore, a word about the condition of the province's forests is warranted.

Few would argue that the forests across the province today are anything like the forests that greeted European settlers early in the 17th century. Indigenous peoples have occupied the territory now known as Nova Scotia for millennia, and it is safe to say that their occupancy of the forest landscape would have altered it little. Descriptive accounts of the pre-colonization woods exist. For example, an anonymous letter reprinted in *The Gentleman's Magazine* in September 1749 (vol. 19, pp. 408–9) spoke of "a great quantity of pines, fit for masts" growing along the western side of the [Halifax] harbour entrance. Speaking specifically of Point Pleasant Park, that letter spoke of "the wood being chiefly oak, ash, beech and birch" (quoted from Point Pleasant Park Comprehensive Plan, 2008).

Since colonization, Nova Scotia's woodlands have been under assault. Early logging provided fuel and building materials, and also served to clear land for farming. Prize timbers of white pine and red oak were cut for shipbuilding through the centuries. Early lumber-making was complemented with pulp and paper manufacture late in the 19th century, followed by a pulp mill established near Liverpool in the 1920s and two pulp mills added, in Abercrombie and Port Hawkesbury, in the 1960s (two of those mills also made paper). Modernization of sawmills made it possible to saw progressively smaller logs into lumber for export, mostly to the USA. It is fair to say that most of the province's woodlands have been used, since colonization, for a wide range of wood-based products. Indeed, whatever settlers could use from the woods in the growing economy, they did, and we still do today. It is also fair to say that, apart from the list of tree species native to the province, the present forests bear little resemblance to the forests found here by the colonizers.

Some would argue (e.g., Wilson and Colman 2001) that today's forests are highly degraded compared to the pre-settlement forests, and others call for forest restoration (e.g., Simpson 2015). Still others claim that the rate and type of timber harvesting used in the past few centuries have actually borealized Nova Scotia's forests, meaning that levels of standing stock are lower, stands are younger, and the composition is much more heavily dominated by species such as balsam fir, white birch, and trembling aspen, species characteristic of Canada's boreal forests to the north. In sum, largely as a consequence of four centuries of forest exploitation, the forests of Nova Scotia have (a) much greater domination by short-lived pioneer species, (b) lower standing stocks, (c) much greater domination by even-aged stands, and (d) distressing levels of species at risk, both tree species and others.

The claim that Nova Scotia's forests are degraded depends on the reference point. Compared to the forests of 1900, there has actually been much improvement to the forest estate because prior to that time many woodlands across the province had been cleared for farming, and since that time much land has reverted to woodland due to farm abandonment. However, compared to the forests of 1600 and earlier, the stance that current forests are degraded seems well grounded.

Nova Scotia's forests are under stress. Timber harvests, both long past (due to high-grading) and recent (due to clearcutting), have left a legacy of impoverished forests. Acid rain through the 20th century has taken its toll, especially on already acidic forest soils, of which there are plenty in Nova Scotia, with little buffering capacity. Insects and diseases from other continents have found their way to Nova Scotia and wreaked havoc with some dominant tree species, such as elm and beech. New invasions of destructive species have started (e.g., hemlock woolly adelgid) or are imminent (e.g., emerald ash borer). Finally, while clear signals of forest effects of climate change are hardly distinct at present, all signs point to dramatic effects through the 21st century and beyond (Williamson et al. 2009).

If the forests of Nova Scotia were in good condition, there would be no need for this Review of forest practices. However, they are not. Substantial changes are needed in forest practices if further degradation is to be avoided and restoration pursued. Nova Scotians expect much from their forests – continued timber production and other economic pursuits, high environmental quality, and a wide range of social benefits. The forests would have a much greater chance to satisfy these desires if they were in better shape, especially given future stresses like climate change and alien species invasions that are out of Nova Scotians' control. While forest practices done badly can exacerbate the sad state of the forests, forest practices done well can accelerate restoration.

4.2 Reporting on the State of the Forests

Since the late 1980s, jurisdictions across Canada have become increasingly interested in publicizing data on the state of the forests. Nationally, the Canadian Council of Forest Ministers (CCFM) produced the first national state-of-the-forest report in 1990. In 1996, it published the first national set of criteria and indicators of sustainable forest management, updated in 2003 (CCFM 2003). Both initiatives were stimuli for all the provinces to engage in state-of-the-forest reporting.

Nova Scotia produced its first state-of-the-forest (SOF) report in 2008, with an update in 2016 (DNR 2017e). Other accounts of the state of the province's forests are available (e.g., May 2005; Wilson and Coleman, 2001). As part of this Review, an independent review and analysis of Nova Scotia's SOF report was commissioned to be undertaken by the Mersey Tobeatic Research Institute (MTRI 2018; see Appendix D to this Review).

While some reported trends have strong supporting data, confidence in, and availability of, data for some key ecological trends were reported as medium, low, or unavailable (DNR 2017e). Perhaps an urgent outcome of such a finding is that much greater attention is needed by the provincial government to develop more confident datasets. Moreover, a key recommendation arising from the MTRI (2018; see the full set of recommendations in Section 7 of the MTRI report) review and analysis is this: "Fully utilize Canada's Sustainable Forest Management Criteria and Indicators (2003) and collaboratively adapt them to a Nova Scotian context." Such an initiative was begun during the first phase of the Nova Forest Alliance (NFA, Canada's only model forest in Nova Scotia) in 1998–2002, culminating in the production of an interim report to Natural Resources Canada. An initiative like that of NFA is desperately needed now.

5 Nova Scotia Forest Industry – Overview

(Prepared by Jeremy Williams)

Forestry is an important industry in Nova Scotia. It contributes positively to Nova Scotia's balance of trade and provides a high level of employment; most of the jobs in the sector are well-paying. Despite the declines that the sector has experienced, especially in the wake of the 2008–2009 recession and collapse of the US housing market, forestry remains one of the most important industries in rural Nova Scotia. Many of the people who presented to the Review described forestry as the backbone of the rural economy.

Part of the reason that forestry is important in the rural economy is that it provides a number of seasonal jobs, which can mesh well with other seasonal work in the fishery, seafood processing, and agriculture industries. Silvicultural work such as tree planting and pre-commercial spacing is labour intensive and provides a welcome contribution to income levels of rural residents. A number of communities are classed as forest-dependent communities, which means that a high percentage of their employment is tied up directly and indirectly in the forestry sectors. There are still many small sawmills in the province that operate part time, and all of them have services requirements that are met locally. Harvest contractors also provide relatively high levels of spinoff work for servicing and repairing equipment, and for road building and maintenance. Most of this work is done by local residents.

The importance of the forest industry is also connected with the importance of woodlots. Of the woodlot owners in the province, about 81 per cent own woodlots smaller than 50 ha, 18 per cent own between 50 and 400 ha, and another 1 per cent own areas larger than 400 ha. Private woodlots are looked upon by many owners as a supplement to incomes and pensions, and as a source for funds when a new truck or other larger occasional expenditure is required. A healthy forest sector enables more people to live rurally because their woodlots are better able to provide income from time to time as well as fuelwood, game habitat, and recreation.

The period between 1995 and 2005 was favourable for the industry. Lumber production more than doubled from 351 million foot board measure (FBM) in 1995 to 751 million FBM in 2005. Sawmills added small-log lines and improved their efficiency. The provincial harvest rose from 5 million cubic metres (m^3) in 1995 to a level generally at or above 6 million m^3 between 1997 and 2005, led by a sharp increase in hardwood from 348,000 m^3 in 1995 to a level of approximately 800,000 m^3 in 2016. Demand for hardwood chip exports primarily fuelled this rise. The entire forest sector made a major contribution to the provincial economy, supplying more than $1 billion in exports in 2000, 2001, 2002, and 2004. This represented more than 17 per cent of Nova Scotia's total exports. Its contribution to gross domestic product (GDP) was in the order of $700 million, or 2.6% of GDP in 2005 (APEC 2008), and it provided approximately 11,000 direct jobs as recently as 2005.

However, 2004 and 2005 proved to be the peak years for the sector. In 2006, the Stora Enso pulp and paper mill at Port Tupper was closed for nine months and then sold to NewPage. The value of forest products exports fell below $700 million that year for the first time since 1997. The combination of a strong Canadian dollar, relatively low industry productivity (APEC 2008), a deteriorating US housing market, and shrinking newsprint demand created further challenges for the sector in 2007 and onward, culminating in the value of exports falling to $384 million in 2012, a record low. Numerous sawmill

closures during the 2007–2012 period, as well as the permanent closing of the Bowater Mersey pulp mill in 2012, greatly reduced the contribution of the sector to the provincial economy.

The forest sector as a whole has stabilized since 2012. Forestry shows up in two sectors in the National Accounts data – the woodlands operations are part of the "agriculture, forestry, and fishing" category, while the mills and other processing facilities are part of "manufacturing." Statistics Canada reported that in 2016 the production of lumber, composite board, and pulp contributed $344.2 million to the GDP of Nova Scotia. In addition, forestry and logging contributed $62.5 million, while forestry support accounted for $25.6 million. In total, forest-related economic activity contributed $432.3 million to Nova Scotia's $41.7 billion GDP, or 1.1 per cent. Gardner Pinfold (2016) estimated that GDP from spinoff activities was $390 million in 2015, comparable to the 2016 value. In total, the direct and indirect contribution of forestry to Nova Scotia's 2016 GDP was 2.0 per cent.

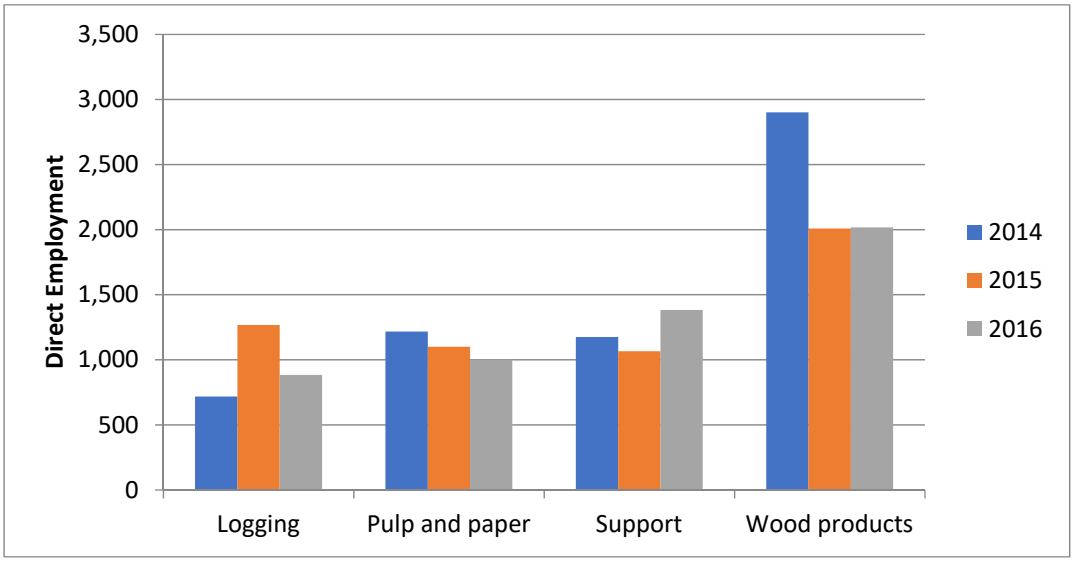


Figure 5.1. Direct employment in forestry subsectors.

The balance of trade has also improved. Exports exceeded $600 million in 2014 and 2015, although they declined to $559 million in 2016. This is still well in excess of the $50 million value of wood fibre imports. Figure 5.2 shows the export value of timber products (including chips), pulp and paper, and lumber and other manufactured products. Pulp and paper accounted for 75–80 per cent of the forest sector's export earnings. In 2015, forest products represented 11.5 per cent of Nova Scotia's exports of goods and 4 per cent of goods and services exported. The contribution of the sector in 2016 was somewhat lower as a share of provincial exports.

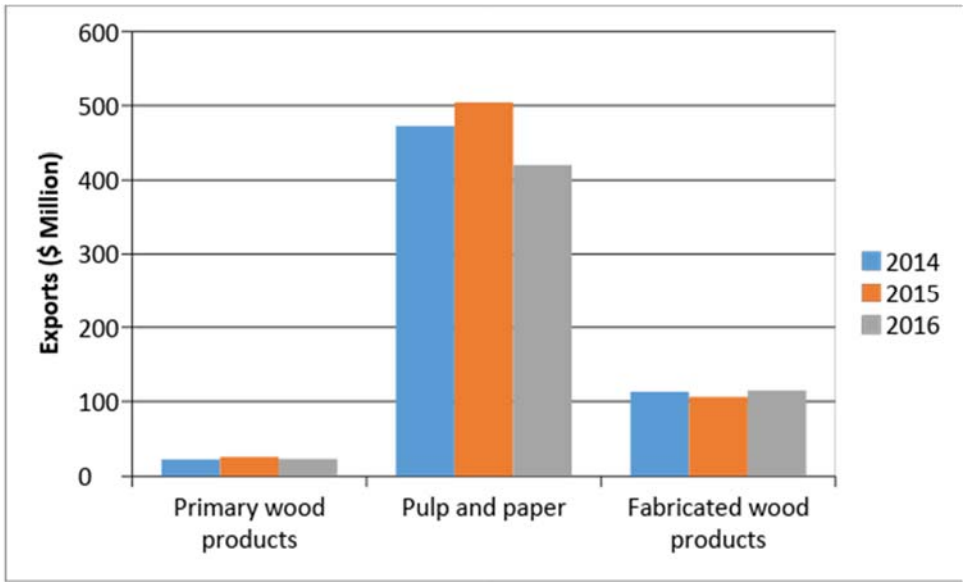


Figure 5.2. Value of exports by forestry sub-sector ($ million).

In addition to the cyclical impacts associated with the ups and downs of the economy, forestry, like almost all industries, has been affected by broad social trends such as the replacement of labour with capital, industrial consolidation, and the digitalization of the economy. The 2008 *State of the Forest* report noted that the number of sawmill businesses declined from 322 in 1995 to 288 in 2005, and there have been further declines since then. Direct employment has also been declining steadily for more than a decade, from a peak of 13,400 in 2003 (APEC 2004) to a 2015 level of approximately 6,100 workers (Gardner Pinfold 2016). There were also 5,400 indirect jobs created by the sector in 2015. During the mid-1990s, the Nova Scotia industry transitioned from a pulpwood-based industry to a sawlog- and studwood-based industry, with the pulp and paper sector now obtaining a large part of its wood supply from sawmill chips. The Atlantic Provinces Economic Council report card of 2014 illustrated both the decline of the sector in general and, in particular, a strong shift away from newsprint.

A report prepared for DNR in 2011 by Woodbridge Associates (2011) profiled the forest sector and expressed concern regarding the lack of critical mass within the sector. Woodbridge was referring to the relatively small number of facilities, lack of diversity in terms of the products that are manufactured, and the importance of the pulp and paper mills in maintaining the whole forest products industry. The pulp and paper mills now depend heavily on sawmills for their chip supply, while the sawmills are just as reliant on the pulp and paper mills to buy their chips. The closure of the Bowater Mersey pulp mill led to additional sawmill closures, and the fear is that the closure of one of the two remaining pulp and paper mills would deal a devastating blow to the entire sector. Although the sector has stabilized over the past several years, there is still a lot of nervousness.

The industry remains very tightly integrated. The Review was told by many presenters that the two pulp mills were extremely important to the entire sector, since the sawmills depend on them to purchase their chips. Northern Pulp is of particular importance given its central location in the province. It is the only large buyer of sawmill chips and pulpwood from the western region, as well as much of the central region, and its closure would likely cripple much of the remaining forest industry in those two regions. Conversely, the health of the sawmills is important to the pulp and paper producers. The integrated

nature of the industry also extends into the forest: once a harvest is conducted, the range of products yielded is consumed by a variety of end users. Reductions in the diversity of the sector limit the marketability of harvested wood, as has been the case with pulpwood in the more westerly counties.

The closure of Bowater and the shift by the remaining two pulp and paper mills to the use of a high proportion of sawmill chips has helped to create a glut of conifer pulpwood. The Review team was told by many people in the industry that it was uneconomical to transport pulpwood more than 150 km.

One potential use of this lower-quality wood is as a source of energy. Biomass for energy has emerged as a viable wood use, and numerous people referred to the number of district heating systems installed recently in PEI as an example for Nova Scotia to emulate. Having said this, using wood for energy is scarcely a value-added use, and it is not without controversy. It will not by itself be a panacea for the industry; a resilient industry is one that has a high degree of product and ownership diversity, and adding bioenergy to the mix will increase resilience.

Other forest benefits are steadily increasing in importance and value. Recreational use and tourism are two high-valued forest uses that are important to people on a personal level and are also important to the Nova Scotia economy. The value of the biological diversity of forests, and the carbon stored in them, is real and increasingly able to be monetized. With national carbon pricing taking effect in Canada, there is an opportunity to provide some financial incentive to landowners who maintain or increase the carbon stored in their woodlots. Well-managed healthy and diverse forests confer many benefits, including the provision of the best defence against climate change impacts.

6 Ecological Considerations Related to Forestry

(Prepared by Malcolm Hunter and Chris Wedeles)

Foresters and other resource managers often categorize ecological effects according to the scale at which they are evident, or the nature of the values they affect. Frequently, the scales used are site, stand, forest, and landscape – with each scale progressively larger by several times, or even orders of magnitude. However, the boundaries between scales are not discrete. Recognizing this continuum, the following discussion proceeds generally from a site/stand scale to landscape scale in an attempt to provide a sense of the general scope of issues.

The topics discussed here are not intended to be a comprehensive account of all ecological effects associated with forest management, but to highlight those that were brought to our attention and became topics of discussion.

6.1 Forest Soils

Forest soils can bear the brunt of mechanical operations in a number of ways, including the following:

- Heavy use of machinery, which is common in harvesting operations, particularly clearcutting, can lead to localized or widespread rutting of moist or wet soils and compaction of drier sites.
- Clearing of vegetation can lead to desiccation, or saturation, depending on the precursor stand type, site, and exposure conditions.
- Increased erosion from exposure of bare earth and operations on steep slopes can deplete the soil layer.

Nova Scotia's classification of soil types provides an in-depth description and rating of soils according to various hazards, including compaction, rutting, erosion, frost heave, and forest floor loss. A number of sensitive soil types map onto ecosites that occur disproportionately in the western part of the province, and it is also in that region that impacts of acid rain are of most concern. Nova Scotia soils have a poor tolerance for acid precipitation because of their low buffering capacity and neutralization abilities of aquatic and terrestrial ecosystems (see discussion below). We heard concern expressed that the forest management activities in western Nova Scotia are not sufficiently attuned to the soil conditions there. For example, we heard that the timber harvest guidelines of the 2008 *Code of Forest Practice*, which draw attention to the need to act cautiously on sensitive soils, are not being adhered to, and the best-management practices related to soils identified in the Biodiversity Stewardship guide are not well implemented on private lands.

Another issue related to forest soils is full-tree harvesting (see Chapter 10), which has impacts on soil quality and nutrients as organic matter of tops and branches is removed from the site when the entire tree (excluding the stump) is processed offsite. Even if the entire tree is not used, when delimbing occurs at roadside, and no effort is made to redistribute branches back across the site, soil impoverishment will occur. Given the limited quality of soils in much of the province, full-tree harvesting may have significant detrimental impacts.

6.2 Impacts of Forestry on Wildlife and Biodiversity

This topic is so vast that entire books and hundreds of academic papers have been devoted to it. Suffice it to say that by the removal of trees and concomitant changes to other aspects of the forest environment, habitat for many species is affected in myriad ways. Logically, at a stand scale, the greater the extent of tree removal, the greater the impact on the wildlife that existed prior to harvesting. One recent publication reviewed more than 600 studies and affirmed, among other things, that changes in stand structures and age distributions significantly affect terrestrial biodiversity, including wildlife. Silviculture systems that remove fewer trees, such as selection harvesting, have more-tempered effects, whereas others, like clearcutting, affect whole species assemblages by removal of the entire (or almost entire) overstory of trees. Nevertheless, clearcutting does produce habitat for some early successional species. Below, we briefly explore four specific aspects of the interface between forestry and wildlife or biodiversity.

6.2.1 Wildlife and the Code of Forest Practice (CFP)

The CFP requires that pre-treatment assessments (PTAs) be performed prior to harvest and silviculture operations on Crown land. *Nova Scotia's Forest Management Guide* (DNR 2018) encourages their use on private land as well. According to the Guide, the PTA is a cruising/inventory system designed to collect information on site and stand conditions to identify the best means by which to implement ecosystem-based management (EBM). The system is comprehensive from an inventory and silviculture perspective and is supported by in-depth instructions on its use, a detailed user manual and tally sheets, and software that facilitates collection, compilation, and submission of required PTA data. However, a shortfall of the system is that the data collected are not used to (1) predict impacts on wildlife, (2) consider wildlife-based concerns in silvicultural prescriptions, or (3) identify ameliorative measures. The data collected include information on tree species, maturity, size class, patchiness of the stand, the state of existing regeneration, and Forest Ecosystem Classification (FEC) vegetation types, soil types, and ecosites – all information that could be interpreted from a wildlife perspective or used as input to habitat suitability indices or models, or even broader stand-level ecological impact analyses. In addition, data collected do not include any related to specific wildlife conditions, such as existence of stick nests, dens, or vernal pools. Instead, wildlife issues are considered at a later stage during DNR's Integrated Resource Management (IRM) review.

The province's *Code of Forest Practice* and other strategic material herald the use of EBM as a system that strives to balance ecological goals with economic and social goals, and notes that forest management practices designed in an EBM template respect ecological integrity. It is striking that a potentially useful tool by which EBM is to be implemented (via PTAs) is not used to address an ecosystem value (wildlife) that is the subject of considerable interest and concern.

6.2.2 Impacts on birds

Among the concerns related to wildlife, particular attention has been focused recently on the impact of harvesting, particularly clearcutting, on nesting birds in the province. The concern has been informed by a national study completed under the auspices of the Canadian Wildlife Service (Hobson et al. 2013). It estimated that the number of nests destroyed annually from forestry operations in Nova Scotia ranged from approximately 18,700 to 159,000 (The wide range is mainly a function of an imprecise estimate of the proportion of harvesting that occurs during the breeding seasons.) The same concern has been

voiced in other jurisdictions in Canada. One means of addressing this issue is to implement a "silent season" in which harvesting operations are shut down or curtailed during breeding season, which varies by bird species but generally occurs from mid-May through to late June or mid-July. The silent season may extend 4–6 weeks (or so) longer if it includes the time for young birds to fledge and leave their nesting area when they are fully self-sufficient.

Nova Scotia has some of the highest densities of forest-dwelling songbirds in Canada, particularly in its coniferous forests. Given the density of breeding songbirds, there is no doubt that many nests are destroyed by forestry operations in the province. On a continental scale, many bird species are declining precipitously, including species that nest in Nova Scotia's forests. It is, however, difficult to assess the extent to which forestry is the main causal agent in the decline of these species, as many are migratory and face degradation and loss of winter and migration habitat. Nonetheless, conservationists point out that migratory bird populations are limited simultaneously in summer and winter by factors such as the dynamic equilibrium between fecundity (which occurs in the summer and may be affected by destruction of nests) and mortality (which occurs mostly in winter). This perspective highlights the fact that effects from forestry operations are not immaterial, even considering the extent of mortality that may occur over winter and during migration.

6.2.3 Species at risk

Wildlife and biodiversity concerns come to centre stage with species that are at risk of being extirpated from the province's biota. Nova Scotia's list of species at risk (SAR), contains 71 species, eight of which are either extinct or have been extirpated. Of those that still exist in the province, a number are uniquely associated with its forests, including high-profile species such as Canada lynx, American marten, and boreal felt lichen, and less renowned ones like rusty blackbird and vole-ears lichen. In 2016, Nova Scotia's Auditor General assessed the province's performance in management and conservation of SAR. While complimentary about some aspects of the province's management, the assessment also identified the need for a number of improvements.[1] The conclusions of the assessment included findings that SAR need to be a greater priority and that DNR is not fully managing conservation and recovery of SAR. The Auditor General made a number of specific recommendations that addressed the need for DNR to

- establish recovery teams and develop and review recovery and management plans for SAR, as required under the Endangered Species Act
- implement a process for communicating with recovery teams
- review all species listed in the Endangered Species Regulations and amend or develop appropriate practices as guided by recovery plans, to protect their habitat
- create a comprehensive monitoring program for all SAR
- establish detailed action plans with measurable outcomes to implement its biodiversity strategy

DNR committed to initiating actions to address all the Auditor General's recommendations by Oct 31, 2016. They included

[1] https://oag-ns.ca/sites/default/files/publications/Chapter%203_0.pdf

- a multi-year work-plan to prioritize the most critical tasks related to the formation of recovery teams and their responsibilities
- development of a process to track and respond to recommendations from recovery teams
- the use of complementary approaches such as special management practices, protected areas, EBM, and other methods
- the development of clear performance criteria

Correspondence and information from the DNR Wildlife Branch indicates that while efforts have been made in addressing the recommendations, progress has been uneven. This is attributed to staffing shortfalls and disproportionate effort required by some tasks.

6.2.4 Biodiversity at a landscape scale

Society has long been concerned with the welfare of wildlife species, especially those that are in jeopardy of extinction or that are highly valued, such as game species, but conserving biodiversity means that all species merit some level of attention. That said, with a single ecosystem comprising hundreds or thousands of species, it is not feasible to address species one by one. The practical response to this dilemma is a two-pronged approach to conservation that starts with focusing on conserving ecosystems (often called the coarse-filter approach [Hunter 1991]) and goes on to address those individual species that are not adequately conserved by ecosystem conservation (i.e., a fine-filter approach targeting species that fall through the pores of a coarse filter). The attention to SAR and nesting birds described above is a good example. The most straightforward way to conserve entire ecosystems for their biodiversity values is to designate them as protected areas in which most activities except non-motorized recreation are restricted. Moreover, many elements of biodiversity might be conserved in concert with careful, sustainable use of natural resources undertaken in ways that are consistent with natural ecological processes. This is a key role for ecological forestry, as described in various parts of Chapter 3.

6.3 Fragmentation and Connectivity

Forest fragmentation is a major threat to forest ecosystems in many parts of the globe. *Fragmentation* occurs where forests persist as “islands” in a matrix of agriculture or development, thereby constraining species that need to move across the landscape to forage, migrate, or disperse. In forest-dominated landscapes like Nova Scotia, one can speak of the forest being *dissected* by roads and *perforated* by clearcuts (using the terminology of Forman [1995]) but true fragmentation that leaves the forest in small, isolated patches is uncommon. Dissection by forestry roads and perforation by logging generates edge effects (such as warmer microclimates) in remaining stands, but they are unlikely to have a significant impact on landscape connectivity for most species. That said, for certain species, road networks that facilitate access by hunters and trappers can have repercussions for their populations (Beazley et al. 2005). Addressing this issue is primarily a matter of gating roads, or even eliminating road systems (in concert with setting aside roadless protected areas), rather than selecting silvicultural systems, although the longer interval between clearcuts can lead to longer periods when road systems can be “put to bed” (i.e., rendered unusable by removing culverts and bridges).

6.4 Impacts on Adjacent Wilderness Areas

Nova Scotia's protected area network includes national parks, provincial parks, wilderness areas, heritage rivers, and nature reserves. Of these, the province's 68 wilderness areas and two national parks contribute disproportionately in protecting the wild spaces and providing important wilderness recreation opportunities. We heard significant concern about existing and planned clearcutting adjacent to a number of wilderness areas and Kejimkujik National Park. Members of the public argue that buffer zones should be in place to guard against edge effects through which negative qualities and dynamics associated with degraded or harvested areas leak into the protected areas. Furthermore, it is striking that Section 16 of the Wilderness Areas Protection Act calls for the minister to "encourage the voluntary planning and management of land adjoining or affecting wilderness areas in a manner consistent with the purpose of this act and the regulations," but it is unclear how that mandate is being carried out.

6.5 Vulnerability to Climate Change

We heard concerns about the interaction between climate change and the present state of forest management – specifically that poor management will increase the vulnerability of forests to climate change. For example, it magnifies the concern about borealization because boreal tree species are predicted to be particularly vulnerable to the effects of climate change in Atlantic Canada (e.g., balsam fir, which is expected in the long term to disappear from the region). Insects such as spruce budworm are expected to undergo more-frequent and longer outbreaks, and shallow-rooted trees like the spruces are more vulnerable to windthrow that is likely to become more common as storms increase in number and intensity. As the climate warms, the threat of fires will also increase, and boreal species are more susceptible than are the hardwoods of the Acadian forest. In general, Acadian forests have higher levels of plant species diversity than boreal forests, and more-diverse ecosystems are likely to be more resilient and stable. In addition, older trees are genetic storehouses, and their loss in poorly managed forests may reduce the genetic variability that could help adapt to a changing climate.

Climate change also has the potential to exacerbate the impacts of full-tree harvesting. Should greater precipitation occur, as is forecast, removal of organic matter from the harvest block will lead to higher and faster runoff, which may become a greater concern if there are more large storm events in the future. In addition, decomposition rates are expected to accelerate, so it will be increasingly important to maintain woody debris and humus on site.

6.6 Impacts on Water Supply

We heard concerns that forest harvesting in watersheds near settlements could have adverse impacts on human health and access to safe and abundant water. This issue is recognized in the *Code of Forest Practice,* which requires that "designated watersheds will have no more than 25 per cent of the area in a state of recent (5 years or less) forest timber harvest." Designated watersheds are those identified as important to municipal water supplies and that require some level of protection from surface and groundwater contamination. There are 24 such watersheds, or designated Protected Water Areas, in the province, with forest areas ranging in size from 33 ha to 8,066 ha. The 2016 *State of the Forest* report notes that all 24 DWSAs have less than the 25 per cent disturbance identified as acceptable in the *Code of Forest Practice*, with disturbance levels ranging from zero to approximately 22 per cent. However, these results do not suffice to ameliorate the following concerns:

- The data used to calculate the levels of disturbance are not up-to-date for all watersheds.
- Future private-land harvesting activities may not be sufficiently controlled to ensure that disturbance levels remain low.
- There is uncertainty as to whether the 25 per cent benchmark is actually appropriate for all designated watersheds.

6.7 Impacts Related to Acid Rain

Nova Scotia, particularly the southwestern part of the province, is extraordinarily sensitive to acid precipitation. Notably, despite the widespread decrease in acid rain that has occurred across eastern North America over the last 30 or so years, many of the province's lakes and rivers remain acid-stressed compared to many other places that have shown considerable improvements. The effect of acid rain can be ameliorated to some extent by the buffering capacity of soils, which is directly related to the presence of positive ions, particularly calcium and magnesium. In landscapes with calcium-poor soils, such as Nova Scotia, little buffering capacity exists, and lakes and rivers are especially prone to acidification. The effects of acid rain on aquatic life are well known: increased acidity kills fish and other aquatic life. Sensitive species such as salmon and trout are the first to disappear, but others follow as levels of acidity increase. In Nova Scotia, Atlantic salmon are still absent from many rivers in which they formerly existed.

There is a complex relationship among forests, forestry, and acid rain. Clearcutting can exacerbate the effects of acid rain by increasing nutrient losses through the removal of biomass, erosion, and exposing soils to increased leaching. This reduces the already-low buffering capacity of poor soils, forgoing the ameliorative chemistry behind the buffering process. In addition, loss of calcium and magnesium can have deleterious effects on tree health and growth; maple trees are known to be particularly sensitive, and growth of other species may be affected too. Amphibians are known to be particularly sensitive to acid-stressed waters in forests, and there may be effects on birds and invertebrates as the impacts cascade through their trophic levels.

There is a strong argument to be made for managing forestry very carefully in watersheds with poor buffering capacity. Positive efforts should include limiting clearcutting wherever possible and ensuring that harvest cycles are sufficiently long for nutrients to be replenished by natural processes.

7 Old Forests

(Prepared by Peter Duinker)

Whether we call them old forests or old growth, they are special wooded ecosystems. Their conservation has been termed a wicked problem (Pesklevits et al. 2011). Nova Scotians cherish old forests for a far wider array of values, especially ecological and psycho-social ones, than they do any other components of the forest matrix (Moyer et al. 2008; Owen et al. 2009).

In the simplest of terms, old forests are defined as relatively old and relatively undisturbed forest ecosystems (Hunter 1989). *Nova Scotia's Old Forest Policy* (DNR 2012b) defines old growth as "a forest stand where 30 per cent or more of the basal area is in trees 125 years or older, at least half of the basal area is composed of climax species, and total crown closure is a minimum of 30 per cent." The climax species implicated in the policy include sugar maple, beech, yellow birch, white pine, eastern hemlock, and red spruce.

Three key old-forest issues vex forest managers in Nova Scotia. First, many agree that not enough old forest exists across the wooded landscape today. This observation can be reached on two bases. Without historical context, old forests satisfy such a vast array of values that more of them, given their putative rarity, would simply be a good thing. However, with historical context, many believe that the primeval forests of the region, before European settlement, were actually dominated by the old-forest condition (e.g., Loo and Ives 2003). Thus, trying to get back some semblance of the natural forest conditions, with much more old forest, is a good thing.

What happened to all the old forest? Simply put, the trees were cut and used for a plethora of applications and products, at a much faster rate than young forests could develop into the old-forest condition. In some parts of the province, land was cleared for agriculture and infrastructure development. This started in earnest during the 17th century and has continued apace until recently. For centuries, the harvest approach can be described as "cut the best and leave the rest," or *high-grading*. Starting in the mid-20th century and continuing today, the harvest approach has been dominated by clearcutting. The old-forest policy is government's attempt to conserve old-forest conditions across all 38 ecodistricts of the province.

The second issue is the general lack of data on which forest stands across the province are actually old forest. The data are uneven: in some areas the government has a good handle on all the old forest, and in other areas it does not. Determining with confidence that a forest stand is old forest, by any definition, requires a field visit for data gathering. Interpretation of aerial photographs has been demonstrated to lead to calls on stand age that are decades lower than the stand age determined by field data (Pesklevits 2006). Perhaps new forms of data acquisition, such as LiDAR, can improve the accuracy of age and species determination of forest stands. Another approach is to require tree-coring during pre-treatment assessments (PTAs) so that tree-rings – the only reliable way to age a tree unless the year of seedling establishment is known from records – can be counted.

The third issue is government's influence on old forest on private land. The Government of Nova Scotia has, of course, full authority to conserve old forest on Crown land (amounting to about one-third of the wooded land base), but not currently on private land.

What pathways can be used to protect the old forest we still have, and increase the amount of old forest across the province? On Crown land outside protected areas, we need better information on the existence of old forest. Also, we may have opportunity to protect more of it than the 8 per cent target set in the old-forest policy, if indeed more than that even exists. Full protection is the only way to satisfy both the old-age and low-disturbance requirements of the conceptual definition. However, if one accepts that some silvicultural intervention may be warranted in the long-term conservation of old forest (Duinker and Bush 2009), then perhaps single-tree selection or other restoration-oriented harvest approaches could be used to perpetuate or even accelerate the arrival of the old-forest condition. For example, since the old-forest definition in the provincial policy calls for more than half the basal area to be occupied by climax tree species, careful removal of non-climax species might be a way to accelerate development of a greater dominance of climax species.

On the matter of which species can contribute to the old-growth condition, our observation is that the Nova Scotia policy is both unduly restrictive and unduly inclusive. Regarding inclusivity, American beech has been ravaged across the province for more than a century by the non-native beech-bark disease, to such an extent that old, uninfected beech trees are truly a rarity (whereas infected younger trees are ubiquitous). Regarding exclusivity, at least two broadleaf species normally classified as "mid-tolerant to competition" should be added: red oak and red maple. We note that a mid-tolerant species is already in the conifer suite, that being white pine. In stands across the province, many trees of these species can easily exceed the old-growth threshold age of 125 years.

A much greater challenge is the conservation of old forest on private land. Tools for protection do exist – conservation easements, for example. Tools for the encouragement of partial harvests where the residual stand can develop old-forest conditions (apart from the "relatively undisturbed" condition) also exist. If the Review recommends the compulsory use of a PTA for forest sites from which wood is acquired by a Registered Buyer, then the professional who prepares the PTA, in discussion with the landowner, might encourage a shift in the timber harvest approach – depending on site and stand conditions – from overstory removal to a partial felling designed to retain or restore old-forest traits. Indeed, broad adoption of ecological forestry should, by definition, increase the number of trees and stands across the province that resemble old forests. Should the situation ever arise where old forests are the norm rather than the exception, the province's Old Forest policy can be amended to take a different approach to old-forest conservation.

It would be useful to consider a few actions that, taken together, could go a long way in improving the abundance and conservation of old forests in Nova Scotia:

- Accelerated and improved data collection on the existence of old forests across all unprotected Crown lands (This could include improvements to the PTA process, targeted field assessments, and advanced applications of spatial modelling (GIS) and data-capture technology such as LiDAR.)
- Revisitation of the area-proportion targets in the Old Forest policy, as well as potential inclusion of other tree species in the climax group, such as red oak and red maple (This would require a targeted research program that, like other DNR initiatives, should become an inclusive process with participation of a suitable range of scholars and experts from various walks of life.)
- Addition of old-forest restoration targets alongside the old-forest protection targets in the policy
- Implementation of ecological forestry, with emphasis on long-rotation stand development and multi-aged stand structures

- Development of a silviculture manual for old-forest restoration

8 Clearcutting

(Prepared by Robert Seymour, Chris Wedeles, and Laird Van Damme)

8.1 Clearcutting Defined – Harvesting versus Silviculture

Clearcutting is arguably the most contentious forest practice worldwide, especially when applied in natural forests that were either unmanaged or managed differently in the past. Clearcutting creates abrupt changes in the forest vegetation, is visually offensive to most people, and was historically associated with forest exploitation prior to the emergence of the profession of forestry. Clearcutting and its alternatives are thus a central focus of this report, as this practice has dominated forestry in Nova Scotia for decades despite the growing unrest from many about its role in the ecological sustainability of the Acadian forest.

The Acadian forests of Nova Scotia are characterized by shade-tolerant and long-lived commercially valuable species such as maple and red spruce. The disturbance patterns are largely gap dynamics driven by small-scale wind and insect events and individual tree mortality. Multi-aged selection and shelterwood silvicultural systems are thus most appropriate with natural disturbance processes leading to multi-aged, structurally complex stand conditions. There is little doubt that clearcutting in Nova Scotia has developed a bad reputation among many people because it is ecologically and silviculturally inappropriate in many of the province's forests, it is visually unappealing, and there has been a failure to meet past commitments to decrease substantially the extent of the practice.

Any discussion of clearcutting as a forest practice must recognize that in forestry, the term "clearcutting" has at least two distinctly different meanings, which no doubt creates confusion among interested stakeholders and even within the profession of forestry itself. This confusion results from the fact that clearcutting is both a harvesting practice and a natural regeneration method in silviculture.

As a *harvesting practice,* the focus is on how much of the overstory timber is harvested:

> [Harvest] Clearcutting = removal of most or all of the merchantable timber in a single harvesting operation.

As a *regeneration method in silviculture,* the focus is on how the tree regeneration (seedlings and sprouts) becomes established:

> [Silvicultural] Clearcutting = complete removal of all vegetation, with all growing space made available for establishment of new plants *after the harvest*. Silvicultural clearcutting relies on new seedlings established by seeding from surrounding uncut stands, seed crops on harvested trees, dormant seed in the forest floor, or artificial regeneration (planting or direct seeding). Advance regeneration can be a minor, but not dominant, component.

Most members of the public, who find any kind of intensive timber harvesting offensive or problematic, arguably don't care about the distinction between the two methods, but it is a far from purely semantic matter among professional foresters and ecologists. This distinction is especially important when alternatives to traditional clearcutting are considered; they may appear superficially similar but in fact are very different in terms of silvicultural intent and ecological function.

To illustrate the difference, consider two alternative silvicultural approaches for the same forest stand. The stand is mostly mature (age 70–80) red spruce and balsam fir, with a small component of white pine

of the same age. There are also scattered large pines that are now very old remnants of the original forest that was harvested heavily 80 years ago. The regeneration layer in the understory is sparsely stocked with small advance seedlings, mostly fir.

Option A: Harvest all trees in a single operation and allow the stand to regenerate naturally from whatever seeds may fall on the site afterwards or germinate from the forest floor.

Option B (two harvests): Harvest 40 per cent of the spruce and all of the fir in one harvest (a shelterwood establishment cutting) Then, in the final, incomplete overstory removal cutting, return in 15 years and remove 90 per cent of the remaining stand (all but the white pines of both age classes). The regeneration layer is now 2 m tall and is carefully protected in the final harvest.

Option A is a true silvicultural clearcut that has no explicit provision for regeneration and, of course, is also a harvest clearcut. Option B follows a simple variant of the irregular shelterwood system, initially leaving some trees to provide seed and shade, then in the second entry, leaving the pines as reserves for future growth and as biological legacies to enhance biodiversity. Note, however, that the final harvest here is also a "clearcut" from a harvesting, operational perspective, and would leave the site mostly (but not entirely) devoid of large trees for several decades. But from an ecological perspective, the differences between these two options are stark, arising from a single emergent property: how much residual vegetation is left after the harvests – what foresters and ecologists commonly call retention (see Section 8.7 below). In the case of the shelterwood system, the remaining large trees maintain some degree of vertical canopy diversity, maintaining and enhancing the two-aged character of the forest, whereas Option A simplifies the original two-aged stand and likely would not maintain the dominance of the shade-tolerant spruce and fir in the regeneration.

A major theme of this report is to embrace the practice of ecological forestry by expanding the use of multi-aged silvicultural systems, including the simple two-aged variant (Option B), and replacing the former single-aged paradigm epitomized by Option A wherever feasible. A narrow-minded focus simply on eliminating clearcut harvesting in any form would, in this example, be counterproductive because the final step in the irregular shelterwood sequence is a heavy harvest removal and could also be considered a clearcut by definition under some categorizations of forest practices. Stated another way, it is *the silvicultural systems, not the specific harvest methods used to implement them, that should define the discussion*, because doing otherwise will not truly change forest practices in Nova Scotia. In *this* context, clearcut harvests used to perpetuate the single-aged systems are thus to be discouraged, but such harvests in the context of ecologically based silvicultural systems informed by natural disturbance regimes are perfectly defensible ecologically.

This being said, we recognize that the term "clearcutting" is usually used without defining its forestry context; it usually refers to the practice as the harvest, not the specifics of the silviculture. This discussion endeavours to describe the context where appropriate, using the term "clearcut harvesting" to include the most general definition that encompasses heavy cuttings of all silviculture types.

8.2 DNR's Use (and Non-use) of the Term *Clearcutting*

Nova Scotia defines a clearcut as follows: "… an area is considered clearcut when less than 60 percent is sufficiently occupied with trees taller than 1.3 metres." The Nova Scotia Forest Operations Manual (DNR 2017b) includes a table on pages 128–31 that groups all silvicultural treatments into "partial harvest,"

"final felling," or "clearcut." This is largely a harvest-based definition, and it forms the basis for record keeping on areas treated by various practices in the province. It references "An operational clearcut definition," a DNR web page that defines a clearcut as "a forest harvest where less than 60 per cent of the area is sufficiently occupied with trees taller than 1.3 meters."[2] A sample point with at least 10 m^2/ha of basal area also counts as sufficiently occupied. Nine examples are illustrated with photos and clarify this definition. The rationale for the 60 per cent and 1.3 m thresholds is found in a separate white paper FAQ;[3] they involve concepts from landscape connectivity and traditional silvicultural stocking standards.

Nova Scotia's recently published *Forest Management Guide* (McGrath 2018) attempts to compile in a single volume a comprehensive decision process to develop ecosystem-based silvicultural prescriptions for 14 important forest vegetation types. The term "clearcut" or "clearcutting" appears only four times in 158 pages, all in a harvesting context. Natural regeneration methods occupy five pages and emphasize, appropriately, variants of the shelterwood method. Complete harvests that would be considered clearcuts in a logging context are all defined in the Guide as either "overstory removal" or "final felling," depending on the size and stocking of advance regeneration being released. Overstory removal is the conventional term for the final step in the simple uniform shelterwood method.

The second use of "overstory removal (not stocked)" is problematic relative to conventional silvicultural terminology. If advance regeneration is absent or not well represented, then such a complete harvest would be considered a true silvicultural clearcut. In this case, "overstory removal" is not descriptive because there is nothing to release. Use of the term "final felling" to describe release of sapling regeneration over 1.3 m tall is still an "overstory removal" in conventional silvicultural terminology.

The absence of a "clearcutting" prescription from the Guide is noteworthy, given the prominence of the practice in the province, and conflicts with the terminology commonly produced from the pre-treatment assessment system. Presumably, revisions of the Guide recommended elsewhere will address this item more comprehensively.

8.3 Harvest Levels and Trends

In 2011, DNR committed to reducing clearcutting to no more than 50 per cent of all harvest area in the province. The target was to be phased in over five years and set in regulation. Although there has been some progress in reducing the proportional amount of clearcutting, this goal has not been met. Figure 8.1 shows the per cent harvest area by non-clearcut methods (selection, first-pass shelterwood, commercial thinning) in the province, and for Crown lands and private lands separately. In 2016, 37 per cent of harvesting on Crown land was by non-clearcut methods, while only 11 per cent of private industrial lands, and 10 per cent of small private lands, were harvested using non-clearcut methods. Combined, this means that 20 per cent of the proportion of harvesting in the province as a whole in 2016 was by non-clearcut methods.

Most partial harvest treatments are basically steps in an even-aged silvicultural sequence (commercial thinning and first-step shelterwood). True multi-aged silviculture ("selection" cutting as defined by DNR)

[2] http://novascotia.ca/natr/strategy/clear-cut-definition.asp

[3] http://novascotia.ca/natr/strategy/pdf/Clearcut_FAQs.pdf

is quite uncommon (Fig. 3.2). During the last 20 years, selection comprised only 2.6 per cent of all harvest area and affected only 0.8 per cent of the working forest. During the same period, clearcuts comprised 90.3 per cent of all harvests, and affected 28.5 per cent of the working forest. Clearly, most of Nova Scotia is managed under a single-aged silvicultural paradigm that is fundamentally at odds with the natural disturbance regime that affects these Acadian ecosystems.

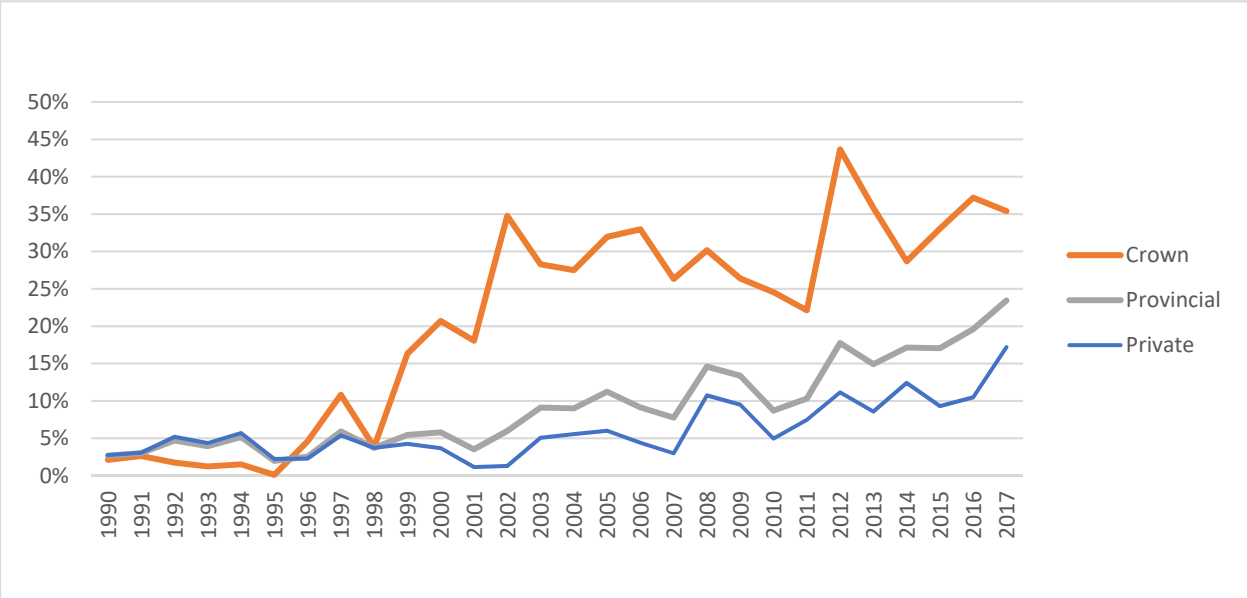


Figure 8.1. Percent harvest area by non-clearcut methods, 1990–2016. (source: DNR)

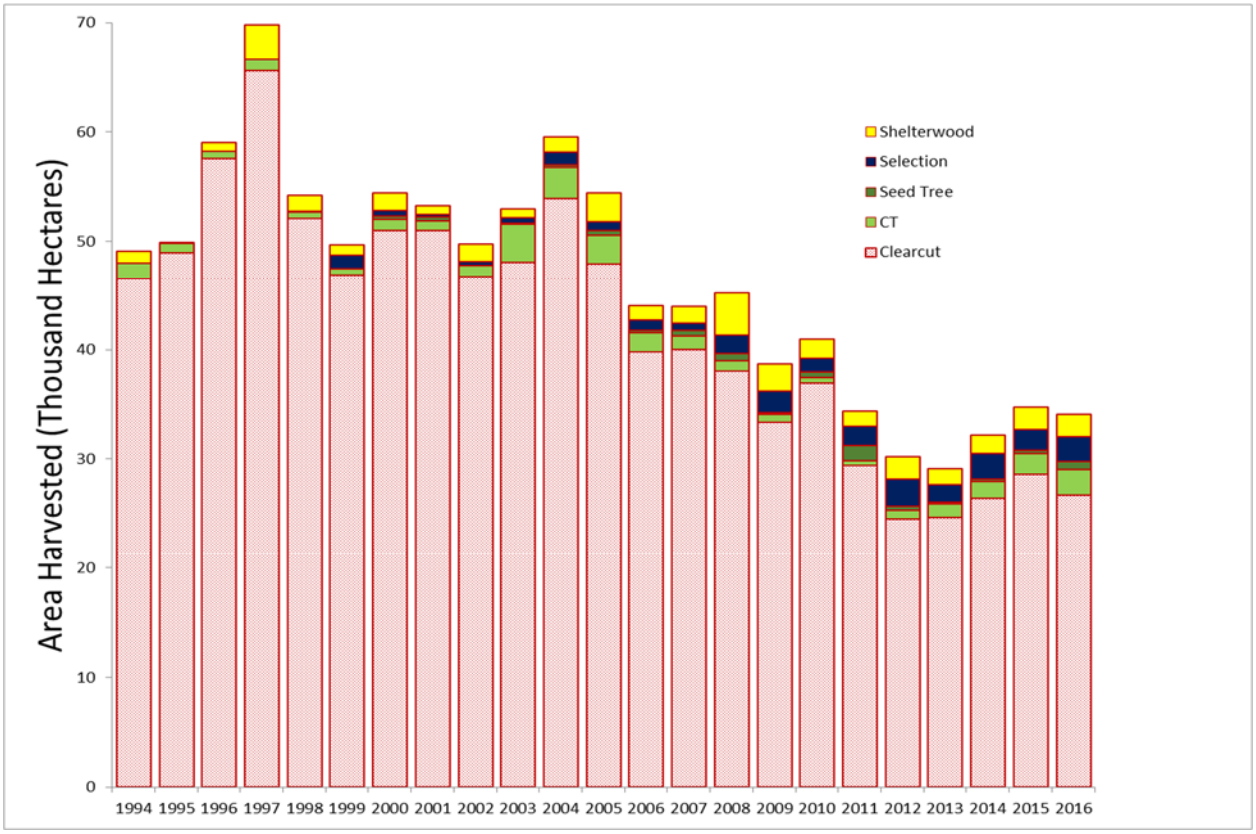


Figure 8.2. Distribution of harvest, by type, 1994–2016. (Source: DNR)

Figure 8.2 also reveals that both the total area harvested in the province and the total area clearcut are on a declining trend. Total harvest area has declined from a peak of approximately 69,800 ha in 1997 to a low of approximately 26,700 ha in 2017.

The proportion of area clearcut on private lands is significantly greater than on Crown lands. In addition to illustrating the relative extent of clearcutting on different ownerships, Figure 8.3 shows a progressive decline in the area clearcut in the province. Although there has been a very significant decline in the province as a whole, the area clearcut on Crown lands has actually increased, although the role of the purchase of the Bowater lands in western Nova Scotia, and other timberlands, complicates the picture. The increase in proportion of non-clearcut on Crown lands exists only because the extent of partial cutting on Crown land has increased at a greater pace than the increase in clearcutting. To illustrate this – in 1990, 4,904 ha were cut in total on Crown lands, but only 104 ha was cut using partial harvesting; in 2016, 11,628 ha were cut on Crown lands, of which 4,326 was partially harvested.

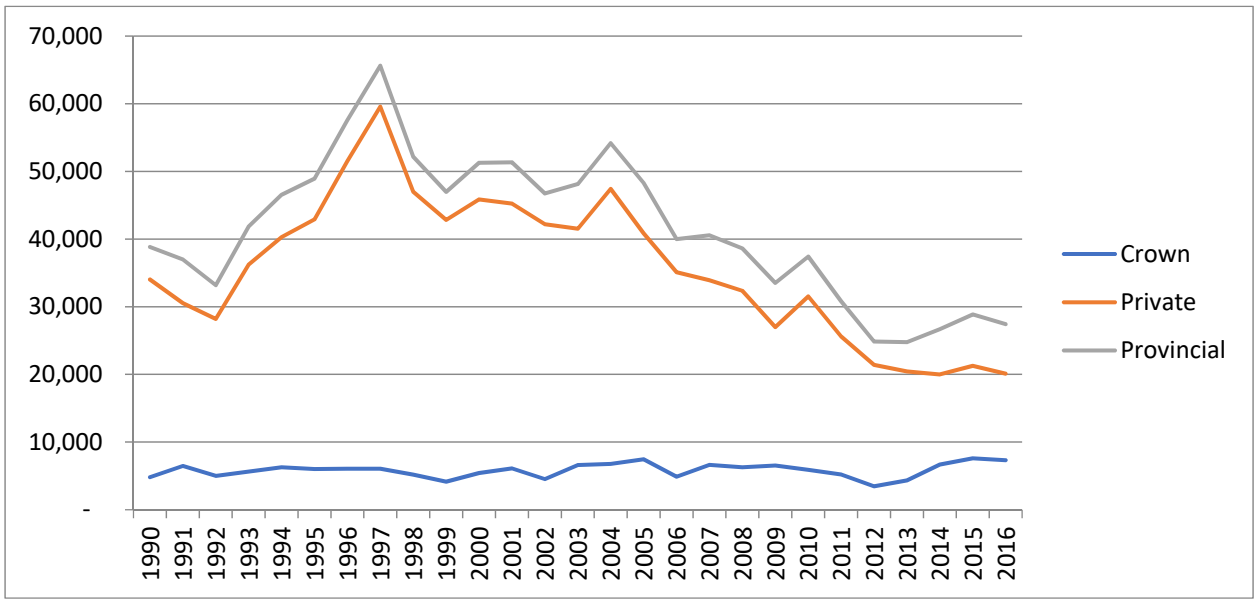


Figure 8.3. Area clearcut on Crown and private lands, 1990–2016, in ha. (source: DNR)

8.4 The Ecology of Clearcutting

Obviously, clearcut harvesting drastically changes a forested area – from mature forest to a generally open area. It is often argued that clearcutting provides a good approximation of a stand-replacing disturbance, such as a fire. This is debatable; research on nutrient levels, arthropod populations (Venier et al, 2017), and soil carbon balance (Kishchuk et al. 2016) have shown that clearcuts do not provide conditions that are very close to post-fire conditions. However, there is more merit in the argument that clearcutting creates conditions as close to a post-natural disturbance event as it is feasible for humans to create.

Even in these circumstances, clearcut harvesting gives rise to very notable changes in the forest ecosystem. At a landscape scale, as discussed in Chapter 6 (Ecological Considerations), the connectivity or perforation of the forest is affected. Given the generally forested nature of the province, this may not be as severe an issue in Nova Scotia as in other less-forested landscapes; nonetheless, because connectivity is a species-based concept, it may have implications for some sensitive species that require contiguous areas of mature forest, such as marten and wood thrush.

In broad terms, consideration of the detrimental effects of clearcutting should include the following:

1. Clearcutting is not an appropriate silvicultural system for many of the province's forest groups (as identified in the province's ecological classification); in most circumstances when clearcuts are practised on tolerant hardwoods or semi-tolerant hardwoods, these forest groups often do not regenerate well, and the site's ecological conditions can be permanently changed (unless restoration activities occur in the future). This principle is dramatically at odds with current (2017) practice in Nova Scotia, where harvest blocks mapped under the "gap" natural disturbance regime were clearcut 57 per cent of the time on Crown ownership and 80 per cent of the time on private lands.
2. As currently practised on biologically short rotations, few clearcut forests can reach maturity in subsequent rotations; in other words, the practice perpetuates intolerant and early successional

forests to the detriment of maintaining late-successional forest communities. Negative impacts may include

a. the general loss of old forests and the associated biodiversity
b. the general loss of other ecosystem amenities associated with old forests, such as stabilizing water flow and the provision of unique recreational opportunities
c. negative effects on forest soils and substrates that may lead to related issues in productivity, acidification of waterbodies, and impacts on riparian ecosystems
d. changes to the character of the landscape from a healthy mature forest to a (potentially) degraded condition if clearcutting is not implemented appropriately

It is easier to articulate the ecological downsides of clearcutting than to identify its benefits. In most parts of Canada's managed forests, young forests are not in short supply and are likely not to be scarce wherever clearcutting is part of the management paradigm. Therefore, concern naturally gravitates to those forest age classes or types in which clearcutting is practised.

8.5 Silvicultural Application of Clearcutting in Nova Scotia

It is well established that the regeneration ecology of virtually all Acadian tree species that characterize the forests and forest industry of Nova Scotia depends on advance regeneration establishing in the shaded understory prior to removal or death of the forest canopy. In silviculture, such species are managed under a shelterwood paradigm, and is certainly why the *Forest Management Guide* (McGrath 2018) emphasizes this system. We stress that this is true even under most disturbance regimes that have been defined as stand-replacing, primarily driven by severe windstorms or uncontrolled spruce budworm outbreaks. Crown fires are, of course, an exception to this, after which trees do start over from new regeneration after the disturbance, but such fires are rare in Nova Scotia.

This prominent mechanism of advance regeneration means that silvicultural clearcutting is largely inappropriate or ineffective for most purposes in Nova Scotia involving natural regeneration. In fact, the extensive site disturbance associated with clearcutting usually encourages early successional vegetation that quickly becomes severe competition for the more desired later-successional shade-tolerant species, requiring herbicide release or expensive manual tending to remediate. Exceptions would be where the landowner seeks to manage for early successional species that demand full sunlight and require severe site disturbance (typically fire) to regenerate well afterward. Several species of Canada's forest trees are adapted to regenerating in full sunlight, such as jack pine and trembling aspen. After a fire kills most trees in an area, jack pine seeds, which have been dropped by cones in response to the heat of a fire, take root, and aspen suckers emerge in response to the open environment. Paper birch is also a well-known fire follower, though it can thrive under other stand-replacing disturbance agents. So, if the landowner's objective is to perpetuate intolerant hardwood communities, clearcutting would be the preferred silvicultural method.

Clearcutting as a harvest practice, with appropriate ecologically based structural retention, would become a component of some forest types within the ecologically managed leg of the triad (see Chapter 13). Such harvests would occur in the overstory removal stage of irregular shelterwood treatments, ideally limited to forests dominated by frequent stand-replacing disturbances (assuming these are refined from the current draft map).

Storm damage and other forest health issues such as insect or disease outbreaks may require salvage and clearcutting to reduce fire risks and restore forest health. These operations should include tree retention and watershed protection practices.

Some forests of early successional species that have developed following colonial burning and farming practices may not be representative of natural conditions. These forests will require special measures, within the realm of ecological restoration, to return them to more-natural forest cover types. In some instances, patch cutting, or clearcutting followed by planting and tending, may be necessary to move these stands in the desired direction, albeit at significant cost.

Finally, we stress that clearcutting as a harvesting practice must continue to play a role in Nova Scotia as the necessary first step in creating site conditions conducive to tree planting, as a key part of a strategic landscape plan that embraces the triad concept. The questions of how much area should be clearcut and planted, as well as the specific sites chosen for planting, should be an outcome of a forest-level planning process that balances wood supply demands with maintenance of naturally managed forests. Given that Nova Scotia's working forest is currently 9 per cent planted, one simple point of departure would be to maintain about the same proportion going forward, such that about one-tenth of regeneration harvesting in the province (and less of the total harvesting that would include commercial thinning and other partial cuttings under irregular shelterwood management) would be clearcuts prior to planting.

Therefore, in simple terms, clearcut harvesting can be considered

- in vegetation types that are naturally subject to frequent stand-replacing disturbances (subject to appropriate retention)
- in stands in which shade-intolerant, early successional species are to be perpetuated
- as part of well-considered restoration activities intended to address degraded conditions caused by anthropogenic influences (e.g., poor regeneration, infestation by alien species)
- in extraordinary circumstances, such as salvage cutting after intensive natural disturbances
- to create areas for plantations managed intensively to provide long-term stable sources of industrial fibre

8.6 Where Are Clearcuts of Any Kind Not Appropriate?

With respect to the overarching premise of ecological forestry that links silvicultural systems with natural disturbance regimes, clearcut harvesting is not suitable for areas governed by disturbance regimes that have a slow turnover of trees and those in which stand-replacing natural disturbances are uncommon, because it would greatly simplify their natural multi-aged structure. Examples are vegetation types governed by gap dynamics regimes (like those dominated by maple/beech associations), and in most instances in those governed by infrequent stand-initiating regimes (like red oak / white pine associations).

There are many potential negative ecological and social impacts of clearcutting to consider in determining its appropriateness in specific circumstances. Within the working forest subject to harvesting, clearcut harvesting is not appropriate

- in natural stands that are governed by Gap Dynamic and Infrequent Stand Initiating regimes
- in young stands that are still exhibiting rapid growth in volume or value
- in forests with high recreational or social value
- where ecological values are likely to be impaired at a landscape scale
- in areas characterized by sensitive or thin soils, or on steep slopes

- in situations that may cause damage to the forest site through desiccation, rutting, or compaction
- in situations that may impair aquatic values through processes such as erosion, siltation, or runoff of surface water
- in municipal water supply watersheds or when a high proportion (e.g. 50%) of any watershed area has already been clearcut or otherwise disturbed
- adjacent to the boundaries of parks or other ecological reserves

We emphasize that this list does not include forests that should be reserved from any and all harvesting activity, such as old-growth stands, rare ecosystems that are unrepresented in protected areas, and critical habitats for species at risk that require old-forest conditions. Such special habitats must be addressed and appropriately conserved by landscape planning at a higher level that specifically addresses and accurately maps these features.

8.7 Retention Requirements for Clearcutting

Retention is the term used to define the extent and distribution of trees that remain unharvested after any timber harvest and is especially relevant to the practice of clearcutting. Retention is important in an ecological context because it provides some remnants of habitat in the clearcut area ("biological legacies") and seed sources for regeneration. Trees left for this purpose are termed "reserves." Retention can occur as single trees, or in clumps of trees. Single trees are most useful for birds as roosts, hunting perches, or as opportunities for nesting. Clumps of trees can provide cover for a variety of wildlife, depending on the size and number of the clumps. Retention is a very important practice in designing silvicultural systems to emulate natural disturbances where disturbances are at least partially stand-replacing.

Most provinces in Canada have direction regarding retention measures to ameliorate or avoid potential negative effects of clearcutting and other harvest methods. Such direction has varying levels of legality and enforceability, ranging from regulatory requirements, to guidelines, to best practices. In Nova Scotia, the Wildlife Habitat and Watercourse Protection Regulations are the best example of this direction. They require protection of legacy trees and habitat structure that address the requirement to leave clumps of trees, snags, and coarse woody debris, and they require watercourse protection using special management zones as buffers (see Chapter 11).

Nova Scotia's Wildlife Habitat and Watercourses Protection Regulations, which apply on both Crown and private land, require that at least 10 living or partially living large trees be left for each hectare of cut forest land on sites greater than 3 hectares. The regulations also require that trees be retained in clumps with no fewer than 30 trees. Additional direction is given relating to the distribution of clumps. These requirements for retention are among the weakest in Canada. Many practitioners consulted during the Review process questioned the utility of the clumps – their small size, low density, and propensity to be windthrown – for protecting wildlife values.

For context, in a sample of fully stocked, mature stands visited by members of the Review panel along with DNR forest management staff in February 2018, densities ranged from 664 to 2568 merchantable trees per hectare. Under these conditions, such clumps would thus retain from 0.3 to 1.5 per cent of the pre-harvest stand. Ecologically based retention, even in stand-replacing disturbance regimes, should be at least 10–30 times these percentages to have a meaningful impact.

Ontario has required 25 trees/ha (2–5% retention) since 2010 on Crown land. There was concern that tree planters and other forest workers could be at risk of injury or death from falling residual trees and branches. This has proven not to be an issue. Trees that are not wind-firm are usually brought down during the first winter, leaving only wind-firm trees behind. Planters avoid areas with residual trees on high-wind days. In addition, residual trees must be 30 m away from roads and landings.

Although it is useful to envision specific levels of retention for discussing changes in silvicultural systems and analyzing their effects on wood supply, prescriptions for levels of retention should be made individually for specific stands based on desired silvicultural outcomes. *Nova Scotia's Forest Management Guide* currently offers little guidance on this topic, and adding detailed type-specific requirements for retention should be an important focus of its revision. We offer ideas for doing so in Chapter 14 of this report.

9 Herbicides

(Prepared by Robert Seymour)

Herbicides are pesticides designed to kill or damage plants that are considered weeds in the sense that they compete for resources needed by a crop plant. Herbicides are the main tool used in the science and practice of *forest vegetation management*, the sub-discipline within silviculture that manages the course and rate of forest succession to achieve specific silvicultural objectives, usually wood production (Wagner 1994).

In forestry, herbicides are used primarily in young forest plantations, usually of conifer species, to control competition from herbaceous and woody vegetation that develops after harvesting and which will likely kill or suppress the planted trees if unchecked. Herbicides may be applied prior to planting, a so-called *site preparation* treatment, or 2–4 years after planting as a *release* treatment. The development of effective and economical herbicide treatment regimens has played a critical role in advancing high-yield production forestry worldwide, and a voluminous body of scientific studies attests to their efficacy (Wagner et al. 2006). Such dramatic increases in the yield of wood can, with appropriate landscape planning under a triad framework (see Chapter 13), actually reduce pressure to produce commodities from the remaining ecologically managed land base, thereby contributing to conservation goals in a given region (Wagner et al. 2004). Forest herbicides have been used in Nova Scotia for over 40 years, but a single herbicide, glyphosate, has accounted for virtually all treatments since its approval in Canada in 1984. Glyphosate dominates usage for three reasons (Thompson and Pitt 2011): (1) it has an excellent record of efficacy and reliability in controlling most competing species, (2) it has a relatively favourable behaviour in the environment (e.g., it is non-persistent in soils, vegetation, and water; does not accumulate in animals; and has a very low potential to leach into groundwater), and (3) it has a relatively low innate toxicity to humans and wildlife. In a recent exhaustive review containing 146 references of the risks associated with glyphosate in forestry spanning over four decades, Rolando et al. (2017) found “a general lack of significant deleterious effects to humans, terrestrial and aquatic fauna, and environmental quality.” Properly registered herbicides such as glyphosate are not prohibited by any third-party forest certification system, including the Forest Stewardship Council, although over-reliance on them is discouraged and alternatives are encouraged where feasible.

Forest herbicide applications are tightly regulated by the Province of Nova Scotia, and prior approvals are required for any aerial applications to forest land. Applications typically occur once during a rotation of 40–80 years. During the period 1990 (the first year of records) through 2008, herbicide application averaged just under 10,000 ha annually (Figure 9.1), about one-fifth of the area clearcut during this period. In the peak year of 2005, 12,637 ha were sprayed, equal to 0.44 per cent of the working forest land base of Nova Scotia. In 2016, only 0.06 per cent was treated. During these 26 years of records, slightly less than 200,000 ha have been treated with a single application of herbicides, about 7 per cent of the provincial working forest land base.

Under some circumstances, when the competing vegetation consists of individual woody stems, non-chemical methods, such as motor-manual cutting with brush saws, can be used as an alternative to herbicides. However, such alternatives are far more costly (4–5 times that of herbicides), are rarely as effective (owing to resprouting), and incur much higher risk to the forest workers. Despite these drawbacks, some jurisdictions – including Sweden, Quebec, and, more recently, Nova Scotia in 2011 –

have ceased using herbicides on public lands. The eastern Crown licence, now held by Port Hawkesbury Paper, also voluntarily stopped herbicide spraying in 1998 but continues to plant trees and protect them using only non-chemical control methods on competing vegetation, largely at the Crown's expense.

Although such prohibitions may be well-meaning political reactions to public skepticism about chemical use in the forest, we believe their silvicultural underpinnings are weak or non-existent and that such a policy could actually be a threat to long-term wood supply. A detailed audit of 97 plantations in Nova Scotia that were not sprayed or otherwise treated revealed a striking failure rate (defined as less than 60% stocking) of 87 per cent, and only 3 per cent met free-to-grow standards after 6–8 years post-harvesting (Nicholson 2007). The strategic wood supply model used to estimate future forest yields assumes that some fraction of untreated plantations will fail and that those remaining will yield lower volumes than if they had been sprayed. It also appears that far too many pre-commercial thinning (PCT) operations, which should target improving stocking and density of naturally regenerated stands, are instead directed at bailing out former high investments in plantations that are not sprayed under this politically driven policy.

In 2018, the Registry of Buyers silviculture credits schedule for private lands assigns twice as many credits for motor-manual cutting than it does for herbicide release, despite the lower efficacy of cutting. When the costs of planting and site preparation are added, it is difficult to see how the total cost of non-chemical plantation forestry could possibly be a sensible investment under any feasible market scenario.

Nova Scotia's Forest Management Guide (McGrath 2018) contains two pages on "artificial regeneration" (planting), mostly discussing species and site selection. It does emphasize the importance of competition control, as follows: "For a plantation to be successful, adequate stocking must be maintained and the seedlings must be free from competition." However, there is no specific recommendation to use herbicides (or any other specific treatment for that matter). Table 5 in the Guide recommends planting only on ecosites that are reasonably productive, which is where the competition from unwanted shrubs and herbaceous vegetation is the most severe and most difficult to control with non-chemical methods. The Guide does not mention herbicide use for any of the other vegetation types or prescription options.

The need for herbicide release treatments can usually be avoided when using natural regeneration, if an extended shelterwood regeneration process is followed (Seymour 1994; 2016). Under this system, advance regeneration of shade-tolerant or intermediate species is recruited after a partial cutting that leaves partial shade that fosters germination and establishment of desirable trees without promoting competing weeds. Advance regeneration is held in the shade until it reaches at least 1–2 m tall (5–20 years) and is then partially or fully released to grow freely. After release from the overstory, this early height advantage usually allows the favoured tree species to compete successfully with any early successional weeds that may come in after the overstory removal cutting. These steps are clearly articulated for many vegetation types in the Forest Management Guide.

Forests managed under a natural disturbance paradigm would rarely, if ever, require herbicide treatment for successful regeneration because most seedlings would develop in the shaded environments of gaps or partial overstories resulting from the requisite multi-aged silvicultural systems (see Chapter 14). Herbicide treatment would thus be largely limited to the intensive production forestry leg of the triad, specifically to achieve the highest possible wood yields from the smallest possible land base. In addition, one can imagine several innovative uses of highly targeted herbicide treatments under

ecological forestry where the objective is to 1) restore, via enrichment planting, a species (such as red spruce or white pine) that has become locally absent owing to excessive past disturbance; 2) treatment of diseased American beech regeneration that can prevent the establishment of more desirable Acadian species; and (3) eradication of undesirable invasive exotic plants that threaten native floral biodiversity. In these situations, there is really no feasible non-chemical option that is both effective and economical.

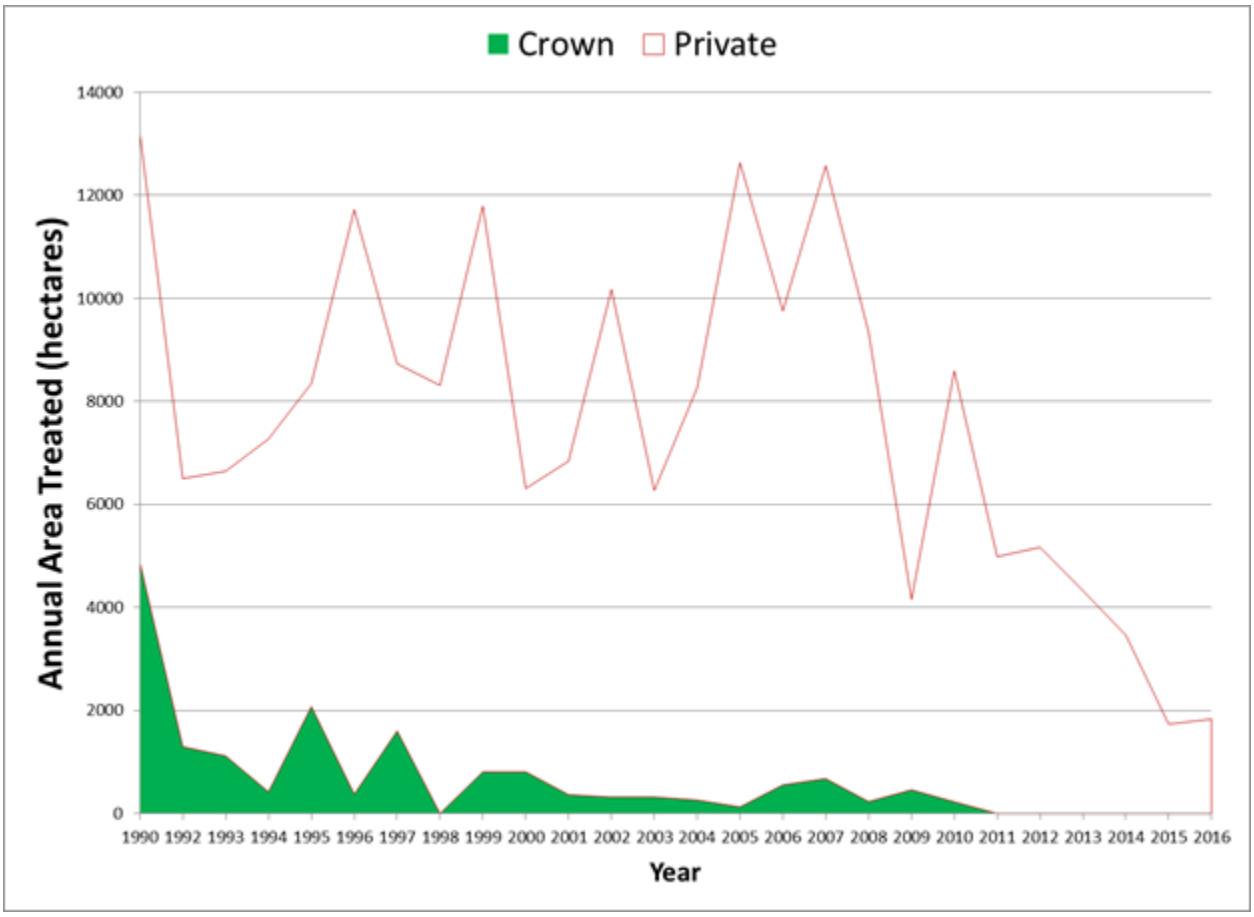


Figure 9.1. History of forest herbicide use in Nova Scotia since 1990.

10 Full-Tree Harvesting

{Prepared by Peter Duinker, Jeremy Williams, and Laird Van Damme)

Pulkki (no date) describes full-tree harvesting (FTH) as the logging method whereby trees are felled and transported to roadside with branches and tops intact. Transport to roadside is mainly by cable or grapple skidders. The full trees are processed at roadside or hauled as full trees to central processing yards or the mill. The tops and branches may be chipped or bundled and taken to the mill for energy production, they may be left piled at roadside, or they may be distributed back into the cut block.

Statistics on the extent to which FTH is used in Nova Scotia were not available, but it is estimated to be used in less than 10 per cent of the harvest areas in the province. It is often associated with clearcutting. FTH differs from whole-tree harvesting, in which full trees and stumps are removed to roadside for processing and utilization (Pulkki, n.d.). Whole-tree harvesting is not used in Nova Scotia except for the purpose of land clearing, when forest land is converted to a non-forest use such as agriculture, infrastructure, or development.

The use of FTH is criticized in Nova Scotia because of its negative ecological impacts, especially when the tops and branches are not distributed back into the cutover area. Most notably, under FTH the nutrients and organic matter in the tops and branches of the tree are removed from the majority of the site, and completely if the entire tree is processed offsite. This will reduce the fertility of soils, which is a major concern in Nova Scotia. The impact on soil fertility may also occur via changes in the soil pH. Studies in other provinces and countries have found that soil fertility recovers to pre-harvest levels over time, depending on the rate of growth, climate conditions, and soil characteristics. Recovery rates are typically around 20–40 years, which is often less than the age at which the next stand is harvested. However, because Nova Scotia's soils are, in many places, thin, and have been negatively impacted by acid precipitation, the results of other studies cannot be readily transferred to Nova Scotia. FTH also removes most of the biodiversity associated with tree crowns, and it removes potential conifer seed sources from the site as the branches and tops are taken away.

As climate change continues, FTH is likely to contribute even greater negative ecological impacts. Nova Scotia is expected to have a wetter climate, but with more variability. Removal of organic matter from the harvest block will lead to higher and faster runoff, which may become a greater concern if there are more large storm events in the future. Decomposition rates are expected to accelerate, so it will be increasingly important to maintain woody debris and humus on site. There may also be more-frequent droughts, and young renewal on blocks harvested using FTH is more susceptible.

There are some benefits associated with FTH in some conditions. In salvage operations, where stems are damaged or tree form is poor or decay levels are high, FTH combined with in-bush chipping can recover some 15–50 per cent more volume for pulp or energy purposes compared to tree-length or log-length systems. In some cases, this may be the only economically feasible choice of harvesting system for salvage logging.

The reduction of slash makes it easier to scarify the site to create seed beds for species like yellow birch and red spruce or to plant trees. In partial cutting, FTH that uses heavy equipment like feller bunchers can be more effective in removing large trees without damaging advance regeneration and residual stems compared to conventional cut-to-length or hand-felling systems.

At this time, FTH is not permitted on Crown land. It is possible to secure some of the benefits of FTH and mitigate the environmental risks by limiting FTH on Crown land to some partial-cutting systems. Clearcutting using the FTH system could be limited to salvage areas. Salvage areas should be required to use the same tree and coarse-woody-debris retention levels as on conventional operations. In the case of both partial and salvage harvesting, operators should be required to redistribute the nutrient-rich slash and chipper debris across the harvest block with skidders/forwarders during the harvest operation to protect soils from rutting, compaction, and nutrient losses. This will also improve aesthetics and fire risk along roadsides and landings.

Based on the considerations reviewed above, restricting the use of FTH on private land should be strongly considered. Given the modest amount of FTH that is estimated to occur, this should have minimal commercial impact to purchasers of stumpage, harvesters/contractors, and woodlot owners. Of particular concern and worthy of consideration for special regulations is prohibiting FTH in young forests (less than 40 years) on private lands.

11 The Shores of Watercourses (Riparian Areas)

(Prepared by Malcolm Hunter and Laird Van Damme)

Riparian or shore areas are widely recognized as being vastly more important than their limited footprint on the landscape might suggest (Naiman et al. 2005, Luke et al. 2007, Hunter & Schmiegelow 2011). They are habitat for a diverse array of plants and animals that thrive where water and land intersect, many of them uniquely tied to this interface. Their influence reaches across entire landscapes as they facilitate the large-scale movements of animals and filter the movements of soil nutrients that might otherwise contaminate water bodies. Their social and economic importance mirrors and greatly extends their ecological values, given that Nova Scotians spend much of their outdoor time on shorelines or within sight of them: walking, boating, fishing, or just taking in the view.

These values have led to restrictions on forestry operations in riparian areas (often called special management zones, or SMZs) throughout Canada and the rest of the world. Nova Scotia's current standards are presented below along with a summary of SMZ management in other provinces.

The inevitable question is, how wide should SMZs be to protect public values (Lee et al. 2004, Stoffyn-Egli & Duinker 2013)? The answer is much more a matter of public policy than science. Scientifically, one can measure ecological values and justify special management for riparian areas across hundreds of metres. This is particularly true in landscapes subjected to intensive forestry where riparian areas are often the last refuge for large old trees and snags, and they act as critical visual buffers between lakes and rivers and any aesthetic intrusions in the adjacent uplands. Economically, however, having wide SMZs on all watercourses would have an enormous impact on wood supply. The answer requires balancing competing values, and science cannot point to a "correct" answer because there is no threshold or tipping point beyond which the ecological values of riparian areas diminish sharply (Hunter et al. 2009). In other words, the balance required to set the appropriate width of SMZs cannot be determined using only scientific analysis.

11.1 Current Requirements for Riparian Areas as Special Management Zones

Requirements for tree retention and SMZs in riparian areas are the same for both Crown and private land in Nova Scotia. These requirements are specified in the Wildlife Habitat and Watercourse Protection Regulations and are enforced by the Enforcement Branch through Nova Scotia Environment using a case-by-case/complaint-based system. These requirements are also specified in the Forest Operations Manual (DNR 2017b) as follows:

Boundaries must stay free of brush and woody debris created from forest operations. Buffering widths vary depending on the average width of a watercourse and the slope of the riparian area.

For watercourses ≥ 50 cm average width on or adjacent to forest operations:

- Buffer width must be
  - ≥ 20 m and ribboned on both sides
  - increased by 1 m for each additional 2% slope where slopes > 20% (up to 60 m total width)
- Partial harvesting is allowed within the SMZ, unless notified otherwise by NSDNR, if
  - the basal area of living trees remains > 20 m^2/ha

- an opening in the dominant tree canopy remains < 15 m at its greatest dimension
- the understory vegetation and non-commercial trees are retained to the fullest possible extent within the 20 m buffer

For watercourses < 50 cm average width on or adjacent to forest operations:

- All merchantable timber may be removed, leaving a 20 m wide strip of immature vegetation intact on each side.

Best-management practices:

- When in doubt about SMZs, the regional biologist should be consulted before continuing operations in that area.

11.2 Machine Exclusion Zone (MEZ)

No forest operation vehicle is allowed within an MEZ except for crossing a watercourse where an approved crossing was installed. Buffer width requirements for MEZs, as measured from the watercourse's edges:

- 7 m for watercourses with an average width ≥ 50 cm
- 5 m for watercourses with an average width < 50 cm

Best-management practices:

- High stumps should be left in proximity to MEZs (> 6 m from the watercourse) to prevent access after harvest, preferably using lower-value trees where possible.

Compliance with forest practice requirements such as riparian widths for Crown land operations is measured during periodic operations inspections by licensees (Level 1 inspections) and DNR staff (Level 2 inspections, Level 3 audits).

If a private landowner signs a "land clearing declaration" indicating they will be converting their land to a use other than forestry (e.g., agriculture, development), they are not required to leave clumps, just watercourse buffers. If land clearing is for development, watercourse buffer requirements default to the municipal regulations.

11.3 A New Balance

The Review's experts have concluded that the balance for Nova Scotia's SMZs would benefit from being modestly altered in favour of more protection, particularly when adjacent to clearcuts. On various field tours the team saw no clear violations of the current standards, which were primarily designed to shade small streams and thus regulate water temperatures. However, they saw many SMZs between clearcuts and waterbodies that appeared to be so narrow and thin as to have a significantly altered microclimate and to provide an insufficient visual buffer for the clearcuts that defined their upland edge. Certainly, they were too narrow to provide an adequate reservoir for the structural features of old forests stretching across the landscape.

The following changes could be considered to current standards on all land ownerships:

- Where SMZs are adjacent to clearcuts, their width on both shorelines should be increased to either 30 m (if the watercourse is so narrow that the forest canopy is unbroken above it) or 40 m for wider water courses.
- The MEZ should be increased to 10 m and also be a no-cut zone to provide an area to retain large old trees and snags.
- Much wider SMZs (even >100 m) should be established on larger lakes and rivers on a case-by-case basis to account for recreational and aesthetic issues, especially on Crown Lands, or wherever other considerations are relevant, such as habitat for species at risk or in community watersheds.

Finally, it is notable that new technology will facilitate SMZ management. Specifically, LiDAR-derived terrain models are being acquired by DNR that can greatly enhance the identification, layout, and enforcement of SMZs.

11.4 Summary of Riparian Zone Management Practices in Other Provinces

All provinces have developed some type of mandatory guidelines for the protection of riparian systems. These guidelines include requirements for assessing riparian values (e.g., stream and lake size classifications, topography). Protection measures range from applying rudimentary 20 m fixed-width buffers (NL, QC) to more-complex approaches that incorporate natural disturbance and natural range of variation principles (e.g., ON, through the *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales* [OMNR 2010].

Although several provinces lay out mandatory requirements or default prescriptions for fixed-width buffers, they also permit companies to develop alternative approaches to riparian management under a results-based approach (BC, AB, SK). Any alternative approach must be supported by a sound scientific rationale and is generally subject to government approval.

Manitoba is unique in that the province has developed a Riparian Management Decision Framework, which leads practitioners through a decision key to provide direction on the application of the required management approach (Manitoba Conservation 2008). The framework leaves some flexibility in that it specifies that outcomes can be overridden through the government approvals process if specific values warrant different prescriptions.

Table 11.1 provides a general description of the requirements in each province. The complexity of some of the provincial guidelines makes a detailed comparison challenging.

Table 11.1. Summary of riparian guidelines.

Province	Summary of Riparian Guidelines
British Columbia	▪ Default prescriptive approach uses fixed-width buffers ranging from 0 to 50 m, no-harvest riparian reserve zones and possibly additional modified riparian management zones between 20 and 100 m ▪ Alternative approaches are possible subject to approval
Alberta	▪ Default is fixed-width buffer approach, though harvesting may be permitted subject to approval through the Annual Operating Plan

	▪ Alternative approaches in ground rules may be used subject to government approval
Saskatchewan	▪ Common practice is to apply fixed-width buffers (15–90 m) ▪ Alternative approach is possible subject to approval
Manitoba	▪ Forest Management Guidelines for Riparian Areas are based on a series of keys called the Riparian Management Decision Framework (RMDF) (Manitoba Conservation 2008) ▪ These provide flexibility to allow forest operations in the "Riparian Management Area" subject to approval, recognizing the natural range of variability on the landscape
Ontario	▪ The guidelines not only permit, but encourage, management in shoreline areas ▪ The guidelines use a risk-based approach, setting conditions under which operations may or may not occur based on the potential sensitivity of the riparian system or value as detailed in the guide
Quebec	▪ Interim approach until approval of new regulations is a slope-dependent, fixed-width reserve, which may permit selective harvesting subject to retention requirements (e.g., slope < 40%) ▪ Different standards may apply where fisheries are identified (e.g., salmon streams)
Newfoundland and Labrador	▪ Fixed-width buffer approach ranging from 20 to 200 m depending on slope and riparian values

British Columbia

- Results-based approaches to riparian management under the *Forest and Range Practices Act* (FRPA) are designed to provide for increased management flexibility and are informed by existing watershed-scale information and (or) new data from integrated riparian assessments.
- Under the FRPA, two options are available for riparian system management (Tschaplinski and Pike 2010):
  - the default prescriptive approach, using fixed width buffers ranging from 0 to 50 m, no-harvest riparian reserve zones, and possibly additional modified riparian management zones 20–100 m (see *Forest Planning and Practices Regulation* Part 4, Practices Requirements, Division 3 – Riparian Areas).
  - an alternative approach set out in a Forest Stewardship Plan and approved by government, which contains results or strategies that are consistent with government's objectives for riparian areas.
- Common practice is often to use default prescription since many lack the resources to develop rationale for alternative approaches.

Alberta

- The Forests Act, Timber Management Regulation and Timber Harvest Planning and Operating Ground Rules (Section 6.0, Watershed Protection) provide mandatory direction for protection of riparian systems in forest management.

- Riparian protection areas shall be established as per Standards and Guidelines for Operating Beside Watercourses (Table 2 of the Ground Rules, Section 6.0).
- Section 6.0.6 – Unless otherwise approved in an FMP, variances from the standards in Table 2 must demonstrate that aquatic and terrestrial objectives are met. Any such proposals shall undergo a full review by Alberta as a component of the FMP review and are required to be approved by the Forestry Program Manager.
- As per the Ground Rules, riparian buffers can range in width from 30 m to 200 m, depending on the riparian value.
- Since 2011, a Riparian Management Review Committee has been examining the question of how best to manage riparian systems to maintain functions and value (FRI Research 2013).
- In instances of overlapping land use or activities (e.g., forest harvest operating together with oil and gas exploration), the manner in which riparian lands are managed is directed by the laws, regulations, and standards that are specific to that particular land use or activity.

Saskatchewan

- In SK each major FMA holder did its own Environmental Impact Assessment and 20-year forest management plan.
- As a result, each FMA has its own 'custom' standards and guidelines (FMA Standards and Guidelines).
- Direction on riparian management is provided by the Saskatchewan Environment/DFO Fish Habitat and Protection Guidelines on Road Construction and Stream Crossings (1995), including recommended vegetation buffers for bodies of water and different stream classes.
- Common practice is to apply the SE/DFO fixed-width buffers to protect riparian values.
- The plan Weyerhaeuser submitted at the time included an effort to move toward variable-width riparian zones, rather than fixed-width, but this proved difficult to implement in practice.
    - No one else followed suit on variable-width riparian zones, so the guidelines written for the PA FMA area (where Weyerhaeuser was operating) were only applied there.

Manitoba

- Forest Management Guidelines for Riparian Areas (2009) are based on a series of keys called the Riparian Management Decision Framework (RMDF).
- These provide flexibility to accommodate the various resource values and site conditions identified through pre-harvest surveys, recognizing the natural range of variability on the landscape.
- Management actions are guided by defined zones that include the following:
    - Riparian Area (RA): For operational purposes, the RA will end at the edge of the merchantable forest. No forestry activity will be permitted within the RA.
    - Riparian Management Area (RMA): The forested area adjacent to the RA where forest management activities can be approved. Management may include protection or disturbance through forest management activities.
    - Any proposed activities in the RMA must be approved by Manitoba Conservation's IRMTs.
    - RMA is further divided into three zone types:

- Machine-free zone (MFZ) – no operation of machinery is allowed within this approximately 7 m zone, but harvesting is allowed.
- Management zone (MZ) – prescribed harvesting activities may take place (as described in Table 2 of the Guidelines).
- Reserve zone (RZ) – no harvest, mechanical, or ground disturbance will take place in the RZ, (width will depend on the feature or function being protected).
- RZ and MZ, or in some cases only BMPs, may be applied as defined in the Guidelines.

Ontario

- The 2010 Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales (Section 4.1 – Maintaining Ecological Functions of Aquatic and Wetland Ecosystems and Shoreline Forest Including Habitat Suitability and Productive Capacity) provides mandatory direction on how impacts from forestry activities on riparian systems will be mitigated.
- Ontario has moved on from the fixed-width buffer approach and permits harvesting in riparian zones, subject to detailed conditions laid out in the guide – riparian harvesting is considered in wood supply calculations for forest management plans.
- The guide divides riparian systems and standards into two main categories:
  - Standards, guidelines, and best-management practices for lakes and ponds and associated shoreline forest
  - Standards, guidelines, and best-management practices for rivers, streams, and associated shoreline forest
- The guidelines are very detailed, and allow for a wide range of approaches to the management of riparian systems.
- They take a risk-based approach to management prescriptions, in that the prescriptions consider the sensitivity of a given riparian system to different types of disturbance.

Quebec

- The Quebec government is currently conducting a comprehensive review of its forest management regulations to incorporate criteria of sustainable forest management. However, it is not expected that the Regulations on sustainable forest development (RADF) will come into force until 2015.[4]
- In the interim, riparian management is regulated under the Regulation Respecting Standards of Forest Management for Forests in the Domain of the State, Section II, Protection of Banks, Lakes and Rivers which describes riparian management standards for Quebec Crown lands (*Règlement sur les normes d'intervention dans les forêts du domaine public)*.
- Riparian forests along the banks of streams, lakes, and wetlands with a shoreline slope inclination of less than 40% receive a 20 m riparian management zone. Selective logging is permissible in this zone, provided a minimum of 500 trees/ha (with diameter of 10 cm measured at 1.3m) is retained.

[4] Règlement sur les normes d'intervention dans les forêts du domaine de l'État. http://www.mrn.gouv.qc.ca/forets/amenagement/amenagement-rni.jsp

- Riparian forests along the banks of streams, lakes, and wetlands with a shoreline slope inclination greater than 40% receive a 20 m riparian reserve zone.
- There are separate standards for salmon streams, which can receive a 20–100 m riparian buffer, depending on the values identified (e.g., juvenile vs. adult salmon – approximately 115 of thousands of known rivers and streams are classified as salmon streams in the province). See Intégration des territoires et habitats fauniques aux stratégies d'aménagement forestier des UAF 09751 et 02452 – Octobre 2011.

Newfoundland and Labrador

- NL has a policy recommendation for riparian forest protection that is incorporated as a binding contractual provision in forest management contracts.
- The 1998 Environmental Protection Guidelines for Ecologically Based Forest Resource Management (Section 1.2, Operations) recommend a 20 m reserve zone around all water bodies greater than 1 m wide. These requirements may be increased at the discretion of the district manager to account for shoreline slope as well as fish and wildlife habitat needs. Where the slope is greater than 30% there shall be a no-harvest buffer of 20 m + (1.5 x % slope).
- Unspecified additional buffer zone requirements may be imposed when operations are within water supply areas or within 200 m of certain designated salmon streams.
- Small waterbodies, less than 1 m wide, which do not appear on 1:50,000 scale topographic maps, have no recommended protection for their riparian forests.
- Reasonable efforts will be made to identify intermittent streams.

12 Ecological Forestry

(Prepared by Malcolm Hunter and Chris Wedeles)

In broad brush strokes, undertaking ecological forestry requires (1) conceptualizing forests as ecosystems, and (2) being concerned about the effects of forestry on various ecological values such as water, soil, and habitat for an array of species. To see a forest as an ecosystem means thinking about structure, composition, and particularly the processes that shape the forest over time – the dynamic patterns of disturbance and succession. Developing a deep understanding of these dynamics and using them to inform forestry is fundamental to ecological forestry and has been labelled "Using Nature's Template" (Hunter and Schmiegelow 2011). This paradigm's underlying assumption is that if forestry practices can approximate natural processes, many of the negative consequences of these practices can be moderated (though not eliminated) because forest-dwelling species have evolved to cope with such disturbances.

Turning this idea into operational practices typically means focusing on three key issues:

1. How do the spatial patterns of disturbance generated by logging compare to those created by fires, wind storms, and such?
2. How do the time intervals in a cutting cycle compare to the temporal patterns of natural disturbances?
3. How do the residual materials (snags, coarse woody material, live trees, saplings, seedlings, and seeds) differ between logging and natural disturbances?

Much of this revolves around a central question of whether the natural disturbances in question are stand-replacing events or only partial disturbances. Of course, timber harvests cannot emulate natural disturbances perfectly, but minimizing the difference is the gold standard for practising ecological forestry. The closest one might come to this is through salvage logging after a natural disturbance, but even this has limitations, such as needing roads to extract timber and coping with the exigencies of timber markets.

Some people might argue that there are many practices that help maintain ecological values and that collectively they constitute ecological forestry. These would include avoiding soil erosion and thus water contamination, limiting use of pesticides, restricting cutting in riparian zones, and leaving snags and logs, to name four. Certainly, such practices do make a difference for ecological values in the spirit of the physicians' principle, "First, do no harm." They are also relevant wherever forestry is practised, even in sites, such as plantations, where the dominant goal is timber production. However, they constitute a motley collection of good practices and do not collectively constitute "ecological forestry" per se. For this, one needs an underlying principle; simply following a list of do's and don'ts does not really suffice. Undertaking ecological forestry is challenging because it requires a firm, sophisticated understanding of forest dynamics and a creative approach to using this information to shape forestry operations. Nova Scotia has developed the intellectual foundation for ecological forestry but still needs to further refine how that understanding translates into on-the-ground forestry.

Evidence of the province's foundation for ecological forestry is in a series of documents describing a sound state of understanding of the structure, composition, and processes of forest ecosystems. Chief among these are the series of ecosystem classifications that describe the ecosites, soils, and vegetation

types of the province's forests. Of these documents, the latter meshes most obviously into the province's classification of natural disturbance regimes that are sorted into four classes: frequent stand-initiating disturbances, infrequent stand-initiating disturbances, gap dynamics disturbances, and open seral community types. This document provides a good basis for applying silvicultural systems that approximate natural disturbance regimes, although concern has been expressed that frequent disturbance regimes may be over-represented in mapping of the regimes and that this may open the door for, or rationalize, overuse of clearcutting compared to partial harvest systems. This topic also appears in subsequent sections.

The main document providing a conceptual basis for ecosystem-based management (EBM), the province's analogue of "using nature's template," is the *Code of Forest Practice*. The Code uses generic wording to describe the aspirations of EBM, such as "… strives to balance economic, social, and ecological goals within a single management process" and "… works with both nature and society to generate a future forest with all the values we treasure." The Code also acknowledges that natural disturbance ecology is to be reflected in its application, including consideration of spatial pattern and age distribution of forest types, stand sizes and shapes, successional stages of forest types, and internal stand structures. A comprehensive overview of DNR's approach requires considering an array of tools and reports, some of which are reviewed in Chapters 13 and 14. Addressing EBM at the landscape level remains a gap, but DNR has a pilot project underway in the eastern region for which the methodology is yet to be finalized.

13 Balanced Forestry and the Triad

(Prepared by Robert Seymour)

13.1 Introduction

Nearly 30 years ago, forestry in North America experienced a major paradigm shift, from a nearly exclusive focus on growing trees to a realization that, at least on some lands, a more holistic, ecosystem-based approach is critical to conserving biodiversity. A key feature of this new approach was the recognition by conservation biologists and others that some forests should not be managed at all but, rather, retained in their natural state as reservoirs of biological diversity and benchmarks against which to measure and monitor the effects of active forest management. Such areas have become known as "ecological reserves," or perhaps more commonly in Canada, "protected areas."

In the process of designing representative arrays of forest reserves, two issues became apparent. First, in regions with robust timber economies, such withdrawals of mature forest would likely come at the expense of lowering timber harvest levels, assuming no changes in the management of the remaining area. Second, conservationists recognized that reserving 10–20 per cent of the forest from human exploitation would not be sufficient on its own to conserve biodiversity, and that how the matrix landscape is managed is also critically important.

At first, the goals of timber supply and conservation appeared to be in direct conflict, but foresters recognized that expanding the use of high-yield, commodity-production silviculture (via planting and early competition and density control) could, at least in the long run, offset any "loss" of timber productivity to forest reserves. Furthermore, it became apparent that this offset could be achieved by a relatively small area in production forestry, roughly equal to that in reserves, thus leaving half or more of the entire forest landscape to be managed under less-intensive, ecologically based silvicultural systems (*ecological forestry,* described in detail elsewhere in this report) designed to conserve biodiversity as well as to produce some commodities.

In this model, ecological forestry constitutes the matrix into which reserves and production forestry are embedded. Seymour and Hunter (1992) termed this vision a landscape *triad* in order to highlight the three fundamentally different objectives to which forest land would be dedicated on the landscape. Designing and managing such a landscape that attempts to provide for all societal demands would be an example of *balanced forestry* (Seymour and Hunter 1999), a term chosen to acknowledge explicitly that all uses have inherent worth and thus must be balanced against one another in practice. Balanced forestry recognizes that there is no single right way to manage (or not manage) forests, and that thoughtful, cooperative design of forest landscapes can both conserve native biodiversity and sustain forest-based economies. This concept that all legitimate forest uses have merit has proven to be a valuable vehicle to move beyond the former polarized "preservation versus utilization" arguments that have historically fostered only conflict, not resolution.

The triad concept has gained wide acceptance as a forest landscape zoning model in North America and has been recently featured prominently in forest management textbooks in both Canada (Tittler et al. 2016) and the United States (Franklin et al. 2018). Large-scale analyses of Crown lands in Quebec showed that triad zoning yields greater conservation benefits, and often higher long-term timber supply, than conventional planning models without such zoning (Messier et al. 2009; Cote et al. 2010). A similar

comprehensive analysis of a 400,000 ha Crown licence in northern New Brunswick also supported the fundamental triad logic that increasing production forestry can also yield landscape-level conservation benefits (Ward and Erdle 2015). Experience with the triad on large landscapes in private ownership is less well studied (MacLean et al. 2009). One such example on J.D. Irving's Black Brook freehold in northwestern New Brunswick showed that increasing reserves (protected areas) up to 15 per cent of the forest had essentially no negative long-term impact on wood supply. Although all studies support the inherent rationale of the triad on actual landscapes in the long run, the timber supply benefits of expanding production forestry may not be evident in the short term (10–20 years) where the existing mature forest is fully allocated to support existing industrial demand, as appears to be the case in much of Nova Scotia.

Although the triad is meant to be a holistic, inclusive vision for an entire forest landscape, not all forest land automatically qualifies into one of its three components. Land that is mismanaged, exploited for commodities without any prior or follow-up silvicultural intervention, or non-sustainably treated without regard for long-term ecological structure and function does not contribute anywhere. Where land use is not fully regulated, as is typical of forest regions dominated by private ownership, the matrix will likely contain a mix of ecological forestry, exploitation, and a full spectrum of harvesting practices on a gradient between. On Crown lands in Nova Scotia, which are all managed at various levels by forestry professionals under well-defined, scientifically based rules and procedures, it should be possible to rapidly improve both production forestry and ecologically based silviculture, assuming the recommendations detailed elsewhere in this report are implemented. The greater challenge will be to convince private landowners that explicitly embracing some form of the triad is in their personal interest and will thereby contribute to the public interest of all Nova Scotians in productive, ecologically sustainable forests.

13.2 Balanced Forestry in Nova Scotia

The Nova Scotia Department of Natural Resources formed a forest ecosystems group in the 1990s, and by 2008 the fundamental structure of the triad was firmly established in *Nova Scotia's Code of Forest Practice* (DNR 2008; Stewart and Neily 2008). At the same time, the Colin Stewart Forest Forum was at work designing a large-scale protected areas strategy for Nova Scotia. Its final report (CSFF 2009) provides an outstanding example of the triad's "win-win" logic, whereby a comprehensive array of timber supply mitigation measures (including expanded production forestry) were proposed to offset the designation of nearly 15 per cent of Nova Scotia's forests (615,000 ha) as forest reserves off limits to any human intervention. Many of the Forum's recommended protected areas have since been adopted under the provincial government's protected areas strategy, which currently protects approximately 12.4 per cent of the provincial land base. According to DNR, this amount represents 14.7 per cent of all forest land (DNR 2017c). Note that Canada has an overall national target of 17 per cent protection (conforming to the Aichi Targets of the Convention on Biological Diversity) and that some conservationists have argued for much higher set-asides; for example, 32 per cent for Nova Scotia (Beazley et al. 2005).

High-yield production forestry began in earnest in Nova Scotia in the late 1970s, and the land base now occupied by single-aged stands managed by planting or pre-commercial thinning (PCT) comprises 9.4 per cent of all forest land in the province (392,000 ha; O'Keefe, personal communication), or nearly 14 per cent of the "working forest" land base after removing forests restricted from harvesting. This means

that 86 per cent of Nova Scotia's working forests – the predominant matrix condition over the province – are managed by other silvicultural systems, or not managed at all. On Crown lands, 18 per cent of all working forest land is in production forestry. Forests treated by partial (non-clearcut) harvesting practices, which include commercial thinning, shelterwood establishment cuttings, and multi-aged selection systems, are predicted to make up only 37 per cent of all harvests on Crown lands, and only 18 per cent of all private lands, over the next 20 years, according to the 2016 Strategic Forest Analysis (DNR 2017c), despite a stated policy in the newly released *Forest Management Guide* to favour such practices (McGrath 2018). The majority of Nova Scotia's forests are thus expected to follow a clearcutting pathway. On Crown lands, 43 per cent of these clearcut lands are either planted or pre-commercially thinned; on private lands, only 30 per cent are so treated with high-yield silviculture. Both of these silvicultural scenarios assume that funding is fully available to support these investments; if this does not materialize, actual outcomes would be lower. Thus, the dominant management regime on all working forest lands in Nova Scotia has been, and in 2016 was predicted to be, a single-aged silvicultural paradigm implemented via clearcut harvesting with no follow-up silvicultural treatment. As described in detail elsewhere in this report, such management is not consistent with the natural disturbance regimes of most Nova Scotia forest types and thus cannot claim to be an example of ecosystem-based management that could define the dominant matrix landscape of a Nova Scotia triad. Neither does this unmanaged land contribute to high future timber yields and so cannot be considered to be a contributing part of any triad strategy.

A high-yield timber resource of 392,000 ha should, if well managed to maturity, yield about 2 million cubic metres of timber annually (assuming a mean annual growth of 5.1 m^3/ha per year) – 54 per cent of the annual 2016 roundwood harvest in Nova Scotia – from 14 per cent of the working land base. By subtraction, the remaining 86 per cent of the forest land would need to yield only 0.7 m^3/ha per year – only 14 per cent of the land's potential under plantation silviculture – to sustain the current annual harvest. One would thus presume that achieving an effective triad in Nova Scotia should be easy, but the reality of Nova Scotia's timber supply is quite different. The recent *Strategic Forest Analysis* (DNR 2017c) shows that the maximum sustainable harvest, given the current condition and age structure of the forest and other constraints, is only 2.0 m^3/ha per year. Actual harvest is only 1.3 m^3/ha, seemingly leaving quite a buffer; however, the widespread perception is that timber supply is very tight. In contrast, the State of Maine, with similar Acadian forest types to Nova Scotia, currently harvests about 2.1 m^3/ha per year (1.6 times that of Nova Scotia), a figure that appears to be well below its current growth. Maine has regulated clearcutting for nearly 30 years, and clearcutting now comprises only 6 per cent of all harvests there. Further, Maine's harvest is achieved almost entirely from naturally managed forests; only 4.3 per cent of Maine's forest has been either planted or pre-commercially thinned.

The foregoing discussion, although grossly oversimplified, clearly demonstrates that Nova Scotia has embraced two of the three triad elements (reserves and production forests), but the remaining forest that dominates the landscape falls short of the vision. Its historical management by single-aged silviculture and clearcutting, with little or no follow-up stand tending, is incongruent with the multi-aged silvicultural systems required to practice ecological forestry. Perhaps more seriously, this approach appears to be yielding relatively low volumes of wood, thereby expanding the harvesting pressure everywhere on the working forest. Nova Scotia is not alone here; in virtually all jurisdictions where the triad has been attempted, implementing meaningful changes toward ecological forestry on the dominant matrix has been the most difficult challenge.

This raises a key question: Is the triad a good idea only in theory, but not in practice? Some have argued that forest land use conflicts ultimately degenerate into a two-part dyad, with roughly equal areas in plantations and reserves but no ecologically managed natural forest matrix. Indeed, New Zealanders became so polarized in the 1980s that they have followed this path now for about 30 years. We believe such a vision for Nova Scotia is unrealistic and it would squander a great opportunity to demonstrate over time the value of true ecologically based silviculture where biodiversity and timber production are both important objectives.

Another plausible scenario would involve de-emphasizing the high-yield plantation leg of the triad, and over time applying ecological forestry to the entire managed forest. There is little doubt that over the long term, well-managed forests under a balanced ecological natural disturbance paradigm could yield at least 2 m^3/ha per year, sufficient not only to maintain but expand industrial wood use in Nova Scotia. Arsenault et al (2011) found that net growth in an irregular group shelterwood experiment (0.2 ha groups) averaged 2.6 m^3/ha. Another more compelling benchmark is Maine's public lands of about 213,000 ha, which have been managed for over 40 years largely under long-rotation, multi-aged silvicultural systems, 84 per cent of which is stocked at over 100 m^3/ha. Recent growth since 2000 on this land base has averaged 2.5 m^3/ha, much of which is in large sawtimber-sized trees (Seymour, unpublished data). If the entire working land base in Nova Scotia met these yield targets, the sustainable harvest would be over 7 million m^3, twice the current harvest. Keeping the existing area in production forestry offers an even more optimistic scenario, with a sustainable harvest of over 8.1 million m^3, 1.4 times the most recent estimate of 5.739 million m^3 (DNR 2017c).

The contribution of production forestry to overall wood supply seems simple. Without exception, in any hypothetical analysis, expanding the high-yield silviculture part of the triad will either a) increase long-term wood supply, or b) allow the same wood supply to come from a much smaller forest area, with the attendant conservation benefits. However, the situation is not so clear in the short run because it requires several decades for investments in planting to be realized as higher wood volumes in the forest. Where there is an overabundance of mature forests, harvests can sometimes be increased immediately, or areas reserved from timber production, without impacting the sustainable harvest level. Such was true in eastern Canada 30 years ago when intensive forestry began but is largely no longer true because this so-called allowable cut effect has been largely taken or consumed. This is why expanding high-yield silvicultural investment has little short-term positive impact at this time in Nova Scotia.

This unfortunate reality does not mean, however, that existing production forestry programs can be reduced with no consequence. Quite the opposite is true; if tree planting and PCT were halted in Nova Scotia tomorrow, the current harvest level would immediately become non-sustainable (O'Keefe, personal communication). We therefore reject the concept of de-emphasizing the production leg of the triad. Modest increases in production forestry, including on Crown lands, could be warranted if it can be demonstrated through analysis that the long-term wood supply increases will also contribute to landscape-level conservation benefits.

Long-term examples of multi-aged silviculture of the sort that would better embrace ecological forestry are uncommon in Nova Scotia, though one can certainly find recent local examples like the Medway Community Forest. Unlike other provinces and US states, Nova Scotia has no long-term silviculture research installations that include such silvicultural systems, so some practitioners are reluctant to embrace practices that seem novel and locally untested. We are reassured by the fact that multi-aged

silviculture is increasingly seen as both practical and ecologically effective in many parts of the world (O'Hara 2014) and that a silvicultural paradigm shift in natural forests to more multi-aged silviculture is essential to embrace the triad concept and improve both the productivity and ecological sustainability of Nova Scotia's forests.

We conclude that, given the dominance of small private ownership in Nova Scotia, by owners who seek income and other rewards from land stewardship, there appears to be no downside to expanding ecological forestry (and also, potentially, production forestry) in a way that both improves Nova Scotia's future forest industry and maintains or enhances the ecological integrity of the forest landscape. We believe the DNR has been wise to promote this concept, and that future actions are needed to bring this vision to fruition.

13.3 Implementing the Triad in Nova Scotia – Issues and Challenges

As described above, Nova Scotia has, to some degree, embraced the triad concept, at least in practice if not as a formal strategy. The province recently established a network of ecological reserves (protected areas), where no timber harvesting occurs. Furthermore, 14 per cent of the province's working forest is in immature plantations or pre-commercially thinned stands, representing a strategic investment of over $200 million in future wood supplies over the past four decades. Despite these investments, however, forest productivity in Nova Scotia's working forest is discouragingly low, about 2 cubic metres per hectare (m^3/ha) per year. Furthermore, there is serious concern over very tight timber supplies in some regions, despite the fact that demand is significantly lower than a decade ago. Little of the forest matrix apart from production forests – the bulk of Nova Scotia's working forest – is managed under a strong ecological paradigm using multi-aged silvicultural systems.

If Nova Scotia is to benefit from the long-term landscape vision of the triad, it must change silvicultural practices in the matrix forest and maintain the area devoted to high-yield production forests and possibly expand protected areas. Although this mandate seems straightforward, several difficult issues must be confronted. The following subsections characterize these issues and suggest possible solutions.

13.3.1 Issue 1: Production forestry not living up to its promise

Much evidence presented to the team suggests that the predicted high timber yields from plantation forestry are not being routinely realized. To determine this convincingly, and the reasons why, would require a separate major study, and we recommend that such an analysis be done. At the stand level, the policy not to apply proven methods of vegetation management (herbicides) whose efficacy has been well established for three decades is disconcerting and is likely an important cause of this shortcoming.

Another equally concerning phenomenon is the fact that plantations are being queued for harvest decades before they are optimally mature for timber production, simply because there is no other merchantable wood available to harvest (DNR staff, personal communication). Large regions of Nova Scotia have become critically deficient in mature forests within the working land base, owing in part to historical over-exploitation during the 2000s (Woodbridge 2011).

To illustrate, consider two alternative silvicultural regimens for a red spruce plantation, 80 per cent stocked, on Land Capability Class 6. According to DNR's Growth and Yield Model (v. 2.10), clearcutting this stand at age 35 would yield 172 m^3/ha of wood averaging 21.7 cm in diameter (diameter at breast height, or DBH). Alternatively, allowing this stand to grow to age 75, with two commercial thinnings

(30% removals at ages 40 and 60), the same stand would yield 439 m^3/ha of wood averaging 34.7 cm DBH (295 from the final harvest plus 143 from both thinnings). Allowing the plantation to grow from age 35 to 75 yields 267 m^3 over this 40-year period, or an impressive 6.7 m^3/ha per year. Clearcutting the stand at age 35, planting and tending a new stand at a cost of many hundreds of dollars per hectare, and clearcutting again after the same 40 years, would yield only 226 m^3 of 23.2 cm DBH wood. Portrayed this way, the choice to extend the rotation of the plantation seems compelling, yet it cannot and will not be done, as long as society and forest industry prioritize the present over the future, if the only wood on the landscape is in the 35-year old stands.

The message here is obvious, but solutions are less so. One strategy would be to expand commercial thinning to its maximum possible extent, prolonging the lives of as many plantations as possible. This practice is an integral part of the strategic forest analysis (SFA) wood supply model, but we have not explored the viability of this option.

This example also helps to illustrate why a hypothetical expanded planting and pre-commercial thinning (PCT) program, to increase the area in the production leg of the triad, has absolutely zero effect on timber supply in the short run. Virtually every softwood sawlog tree that Nova Scotians will harvest over the next 40 years is already growing somewhere in the province, and no amount of accelerated tree planting will change this fact. On the other hand, expanding the area of production forestry, as well as improving harvest scheduling and silvicultural practices to ensure high yields, is arguably the only strategy that would allow harvests to be increased substantially at some time in the future.

13.3.2 Issue 2: Land not being managed silviculturally

This issue is probably the largest and most difficult one to confront, if only because it affects far more of the land base than the other legs of the triad. Given that silvicultural treatments to enhance forest productivity and biodiversity are well developed and well known among professionals, the lack of ecologically based management here must be treated mainly as a political and social issue. To be clear, we are not talking about those landowners who are apparently unwilling to engage in any kind of timber harvesting (estimated at 15% in the recent SFA). Rather, we are addressing the much larger issue of those who do harvest for short-term financial reasons but who do not practise any kind of tending or regeneration silviculture.

One solution to this problem is to encourage some kind of pre-harvest assessment (such as the PTA now used on all Crown lands) by an independent professional forester before any harvest, so that the landowner at least makes an informed decision. Mechanisms to accomplish this could include the entire gamut from voluntary incentives, to preferential property taxation, to regulatory limits on practices that are generally viewed as contrary to the public interest of Nova Scotians.

Policies at every level should encourage landowner membership in woodlot owners' associations that offer stewardship advice and a peer network to reinforce responsible long-term forest stewardship. A growing and convincing body of research on private woodlot owners in the United States has shown that local peer networks are more effective than more-traditionally favoured options like written forest management plans in influencing desirable behaviour (Kittredge et al. 2013; Knoot and Rickenbach 2011; Kueper et al. 2013; Ma et al. 2012; Rickenbach 2009; Sagor and Becker 2014).

13.3.3 Issue 3: More effort needed to reverse forest simplification

The multi-aged silviculture needed to replicate natural dynamics of most Nova Scotian forests needs a massive infusion of effort to reverse historical patterns of forest simplification.

If forestry in Nova Scotia is to become truly ecosystem based, as has been the provincial policy (at least for Crown lands for at least a decade), far more area of natural forest should be treated by silvicultural systems other than simple single-aged models best suitable for production forestry. The scientific and ecological arguments for this recommendation are detailed at length in Chapter 12 and Section 14.4, where we discuss their applicability to Crown lands. But for the true benefits of the triad to be realized, given the dominance of private lands on the matrix forest landscape, such a change in practice should be more pervasive than in just publicly owned forests.

Multi-aged systems of silviculture appear to be unfamiliar or novel to many Nova Scotian foresters, especially the variants of irregular shelterwood (Raymond et al. 2009; Seymour 2017) that are so flexible in replicating natural forest dynamics while still producing significant volumes of timber economically. Irregular shelterwood is not even mentioned in the new *Forest Management Guide* (McGrath 2018), and it is not among the practices that qualify for silviculture funding under the Nova Scotia Registry of Buyers system.

The critical step in addressing this issue is the revision of the *Forest Management Guide*, described in considerable detail in Section 14.4. We recommend that this be done as a small-group project using a team of foresters from the region experienced in natural forest management. This is too large a task for any single individual. The Guide in its current form is highly prescriptive and would likely benefit from relaxing many of the detailed decision criteria while keeping within clearly defined ecological sideboards. It is also a large, highly technical reference (as it should be) aimed at professional foresters for making rigorous silvicultural decisions and, as such, will tend to become the “last word” on silviculture in Nova Scotia. Such a format is not readily accessible to landowners without forestry training, so we urge that a much-simplified version, emphasizing the benefits of multi-aged silviculture for both wood production and ecosystem conservation, be developed.

13.3.4 Issue 4: Too much reliance on single wood supply analysis

Nova Scotia relies too heavily on a single, comprehensive strategic wood supply analysis rather than generating a wide variety of forest futures based on different choices vis-à-vis land allocation to the triad and other trends.

The Nova Scotia wood supply model and its use in the SFA is a major positive accomplishment for forestry in the province. Once such a tool is in place, why use it to generate only a single “best-case” scenario, as valuable as that might be? Instead, we strongly urge the province to commission a study of alternative forest futures, just as New Brunswick did about a decade ago (Erdle and Ward 2008), in which seven distinct conservation alternatives were compared to the status quo, using modelling systems very similar to the ones Nova Scotia now has in place.

The key point here is that fully embracing the triad, as we advocate, ultimately requires important strategic and political decisions about *how much* and *what*. While we can urge the adoption of the triad as a useful model, it would be highly presumptuous for us to recommend specifics without further analysis. Only a rigorous modelling exercise can estimate these details, based on a comprehensive set of

alternatives chosen by all stakeholders. We firmly believe, however, that the triad offers a promising model to find a future for Nova Scotians that is better in every respect than the laissez-faire market-driven dynamics currently in place, as it has in the other jurisdictions noted in this report.

14 Ecological-based Silviculture on Crown Lands: Review of DNR's Forest Management Guide

(Prepared by Robert Seymour)

14.1 Background

Over the past decade or so, Nova Scotia has begun to embrace an ecosystem-based forest management strategy, as have many FSC-certified lands in Maine and elsewhere in the Acadian forest. A key tenet of such an approach is using natural disturbance regimes (e.g., windstorms, insect outbreaks) to inform silvicultural choices and manage for biodiversity as well as traditional commodities. This chapter reviews and critiques DNR's treatment of these issues and offers suggestions for improvement, primarily with the aim of greatly reducing the area of natural forest managed by single-aged silvicultural systems.

There is much to like about Nova Scotia's approach to embrace an ecological approach to forestry. Nearly a decade ago, DNR scientists released a report, *Mapping Nova Scotia's Natural Disturbance Regimes* (Neily et al. 2008), that attempted to characterize and map disturbance regimes for the province, using four categories: frequent, infrequent, gap dynamics, and open seral. The finding (Table 1, Appendix VI) that 43 per cent of all forests are dominated by "frequent stand-initiating" dynamics was surprising because it disagreed with much research in other parts of the Acadian forest where such patterns are (or were, pre-settlement) much rarer (Lorimer 1977; Seymour et al 2002; Lorimer and White 2003, Fraver et al. 2009 – none of which were cited by Neily et al.). Although this report has been widely criticized in its specifics (e.g., Beazley 2018), it nevertheless remains an appropriate conceptual framework from which to develop stand-specific silvicultural approaches that are in harmony with natural forest dynamics.

Another laudable accomplishment by DNR staff is the *Forest Ecosystem Classification of Nova Scotia* (Neily et al. 2013) which categorizes all forest land in the province into vegetation types, soil types, and ecosites. This 452-page document distills the seemingly bewildering array of vegetative and edaphic conditions over the province into a finite, recognizable number of forest types that have become the basis for management prescriptions. Province-wide there are 110 individual vegetation types (VT) within 14 "forest groups." Each VT has a two-page description, which includes a section on "successional dynamics" that links the VT with its characteristic natural disturbance regime. When linked with equally detailed soils and ecosite characterizations, this guide is an exemplary way to characterize forest vegetation as a platform for developing ecologically based silvicultural systems and treatments.

The most recent, and still evolving, development has been the release of Nova Scotia's *Forest Management Guide* (McGrath 2018). This document describes a comprehensive suite of silvicultural treatments, then provides a series of decision trees (organized by the major forest groups) for the prescribing forester to choose a suitable treatment. Data used to inform the decisions come from a rigorous *pre-treatment assessment* (PTA) process that requires the field forester to measure overstory vegetation, regeneration, soil type, windthrow hazard, and special ecological features, if present. This PTA process is relatively new, but it is facilitated by a software application that allows the user to enter field data, record other observations, make silvicultural prescriptions, and predict harvest yields.

Consistent with the province's goals to embrace ecosystem-based management and reduce clearcutting, the Guide purports to

- prescribe uneven-aged management and non-clearcut harvesting methods when appropriate as a first choice, and
- favour natural regeneration harvest methods where possible within stand and site limitations. (p. 4)

In stands where forest composition has been greatly altered to early successional tree species, usually as a consequence of historical heavy harvesting or conversion to agriculture, the Guide recognizes the possibility of restoring later-successional, shade-tolerant tree species and offers a narrow prescription pathway to attempt such conversions. The PTA process explicitly recognizes so-called "LIT (long-lived intermediate to tolerant)" tree species as minor stand components, which in the case of harvest-origin intolerant hardwood stands are presumably legacies of earlier stand conditions.

14.2 Ecologically Based Silviculture on Crown Forest Lands

When designing and applying silvicultural systems under any forest management paradigm, ecological or otherwise, the overarching decision is the *age structure of the stand* being managed and regenerated (Seymour and Hunter 1999). Under ecological forestry, this key feature has a direct analogue in the characteristics of the natural disturbance regime. In much of the Acadian forest region, forest stand structure is naturally multi-aged; indeed, old-growth forests may have 20 or more distinct age cohorts arising from light, partial disturbances every decade (Fraver et al. 2009). Forests of simpler composition on sites where water or nutrients are limiting may experience more episodic, heavier disturbances (mostly from wind or spruce budworm), but even they typically maintain at least a two- or three-aged character. With the possible exception of stand-replacing crown fires, all natural disturbances, even very severe ones like hurricanes, leave much vegetation in place to recolonize the disturbed site and accelerate recovery to a later-successional stage. True even-aged (single-cohort) silviculture, with no retention during the regeneration harvest, is thus quite unnatural, especially when practised on short rotations that are well under half the life-spans of most commercial tree species. Under such management, the ecosystem is, in effect, turning over much more rapidly, more completely, and at much larger scales, than it ever did in nature (Seymour et al. 2002).

If forest management in Nova Scotia were truly ecosystem based, using natural disturbance regimes and other ecological science to guide silvicultural decision making, one would expect the *Forest Management Guide* to prescribe multi-aged silvicultural systems on the vast majority of the natural forest landscape. As described below, this appears not to be the case. Here, multi-aged silviculture is defined, following O'Hara (2014), as any system that creates and maintains stand structures with two or more age classes. Multi-aged silviculture is thus not limited to classical single-tree selection cutting, but rather includes a broad array of two- and three-aged systems as would be maintained under *irregular shelterwood systems*, which are arguably better suited to most conditions than balanced selection systems (Raymond et al. 2009; Raymond and Bedard 2017; Arsenault et al. 2011; Seymour 1994, 2005, 2017).

14.3 How the Forest Management Guide Limits Multi-aged Prescriptions

A thorough review of the current *Forest Management Guide* by the Review team and other foresters experienced in practising multi-aged silviculture suggests that the fundamental problem with the *Forest Management Guide* is that it seemingly preordains an even-aged (single-cohort) forest management paradigm in virtually all forest types. Alternatives are often mentioned but are never required and must meet overly stringent criteria even to be attempted. As long as foresters follow this guide religiously,

clearcutting (complete overstory removal) will likely remain the dominant regeneration practice in Nova Scotia. In general, the decision trees use questionable criteria for stand maturity, appear too eager to establish and release regeneration at the expense of retaining growing stock, and do not mandate any sort of structural or compositional retention during final harvests.

This over-reliance on single-cohort silviculture would not necessary be seen as a deficiency if the goal of the guide were primarily efficient timber production. Most Acadian tree species can, and do, grow productively in single-aged stands. Rather, this criticism is about the lack of agreement with natural disturbance regimes, arguably the key tenet in the application of ecological forestry.

Some specifics to illustrate these issues:

1. The first node in many keys is whether or not the stand is "over-mature." This pejorative term is a relic of a past era when efficient, economically driven timber management sought to create forest structures devoid of biologically old trees and is no longer used in scientific literature or textbooks. Table 4 of the Guide (p. 15) attempts to define over-maturity using tree ages that are often only one-third or less the lifespan of the species. For example, if a hemlock forest is over age 100, it is deemed "over-mature," unsuitable for multi-aged silviculture, and is instead sent to the "Regenerate" key, where complete overstory removal is prescribed once advance regeneration is present. Such a complete disturbance in a biologically young hemlock forest (hemlock lives to age 400–500) would be virtually unprecedented in nature.

   The concept of tree and stand maturity clearly does belong in any silvicultural decision guide, but the various definitions of maturity (ecological, biophysical, economic) should be clearly distinguished, defined, and applied more appropriately.

2. In virtually all the forest groups, complete overstory removal is prescribed once *advance regeneration stocking* is adequate (typically 70%). If the only goal is good regeneration, this practice suffices, but even the necessity for advance regeneration is overridden where windthrow hazard is high. Options to retain immature growing stock trees, rare species, or large legacies are not addressed.

3. In the forest types where multi-aged silviculture is considered, high windthrow hazard, or deficient stocking of acceptable growing stock (AGS) trees, trigger a regeneration treatment as above. In strict ecological terms, where the goal is to maintain or restore the LIT stand component, these factors are largely irrelevant. Both decision variables thus appear to have strong economic underpinnings. Residual trees that are subsequently blown down or broken off are viewed as "wasted wood" rather than valuable biological legacies and habitat structures. Also, from an ecological standpoint, there is nothing wrong with carrying substantial stocking in unacceptable growing stock (UGS), which is strictly a timber-driven criterion based on suitability of trees for sawlogs. AGS/UGS can be a valuable concept, but the current definition mixes tree health and vigour (future growth potential) and stem quality (a product-based criterion).

4. When considering early successional forest types (e.g., intolerant hardwoods such as aspen and paper birch), the criteria for stocking of LITs required to follow a restoration pathway is far too stringent and would only infrequently be met. Principles of conservation biology applied to silviculture strongly suggest that all LITs be left, especially in cases where such LITs have become rare. Whether they are AGS, vigorous, have low windthrow risk, and meet other traditional timber-based criteria is irrelevant.

   The precautionary principle dictates that we should never kill the last of anything that will occupy a given ecosite. A limited review of nine recent harvest plans revealed several cases where small

components of eastern white pine, red spruce, sugar maple, yellow birch, and red oak documented in the PTA were prescribed for clearcutting because the dominant stand components were shorter-lived balsam fir, white birch, and black spruce. These prescriptions will ensure that the LITs will likely never again reach the main canopy, furthering the dominance of offsite, shade-intolerant pioneer tree species where they are ill adapted (the process sometimes characterized as borealization of the Acadian forest). Borealization is a particularly bad trend in the face of a changing climate, where species adapted to colder regions to the north may become highly vulnerable to stress agents and mortality.

5. The PTA and prescription process do not appear to employ the excellent, synthetic concept of *ecosite*, which is well developed in the Forest Ecosystem Classification manual, even though all the information needed to do so (vegetation type, soil type, ecoregion) is collected. This is particularly relevant to item 4 above regarding restoration of forest composition and structure that have been degraded ecologically from excessive past disturbance, usually clearcut harvesting. For example, all intolerant hardwood vegetation types – nominal candidates for restoration – occupy ecosites that can be found in later-successional vegetation types, suggesting that these could routinely become restoration targets mandated in any prescriptions for such conditions.

The *Forest Management Guide* could be reconfigured using similar decision trees but with re-ordered priorities and perhaps other criteria that would better reflect important ecological factors as well as traditional commodity-based issues. This would still take full advantage of DNR's excellent ecosystem classification and PTA process development but would aim at less commodity-driven and more ecologically grounded outcomes.

14.4 Some Suggested Improvements Relative to the Forest Management Guide:

1. Drawing on work from other nearby jurisdictions, describe and emphasize a wider range of silviculture options, including irregular shelterwood, that result in at least two age classes after harvesting to improve management of growing stock, enhance biological diversity, better manage light and regeneration, retain and enhance stand structures, and improve aesthetics of harvested sites. DNR could begin this process with the simple step of eliminating complete overstory removals from *all* keys, in essence declaring that this outcome is no longer acceptable, and then see where this leads. If developments play out as they have in other regions, the ingenuity and creativity of the forestry profession will flourish, and life will go on with the dominance of clearcutting becoming a distant memory. Research and experience in Quebec, Maine, and southern Ontario suggest strongly that variants of the irregular shelterwood silvicultural systems should find a central place in such an alternative approach (Seymour 2005; Raymond et al. 2009).
2. During the PTA, require an assessment of stand structure, as follows:

   Vertical structure:

   a. Single-canopy, apparently even-aged (single-cohort)
   b. Largely single-canopy, but also stocked with a minor component of older, taller trees that are likely relics (legacies) of the previous stand
   c. Distinctly two-storied, as one would find in a single-cohort stand under extended shelterwood regeneration. Here the two cohorts are more balanced in area and likely overlap in horizontal growing space.

d. Multi-storied, as in an old multi-aged monoculture, or possible a single- or two-cohort mixed-species stand that is vertically stratified owing to variation in longevity and shade tolerance of the component species.

Horizontal structure (patchiness):

a. This might already be in place, but it should be a decision variable for some prescriptions.

b. In stands that are highly variable spatially, the overstory basal area criteria for partial cutting might not be met overall (because understocked patches "dilute" the overall average) but would still be feasible if treated as a separate matrix condition that is not actually mapped.

3. Maintain/enhance diversity in age and structure; never simplify. Incorporate guiding principles that prescriptions must *never*

   a. reduce the age or vertical diversity of the existing stand (e.g., a complete removal cutting in stand structures in 1–3 above)

   b. release or regenerate commercial tree species that are shorter-lived or early successional than the present overstory (examples here are overstories dominated by either red spruce or white pine, with an understory heavily dominated by balsam fir)

   c. simplify the species composition by harvesting minor components of LIT species in a complete overstory removal; these trees are obvious candidates for retention as reserve trees in two-aged systems

4. Following on Principle 3, mandate that any stand with single-canopy vertical structure of type 2a (above) be converted to a two-cohort structure after a regeneration harvest (overstory removal) wherever possible. Such a structure arguably better emulates what most natural disturbances would create in the "frequent" and "infrequent" natural disturbance regime (NDR) categories and puts the next rotation on a pathway to further restoration if that continues to be an important ecological objective. The best silvicultural term for this treatment is "incomplete removal cutting," or "shelterwood removal with reserves." This is also the simplest variant of irregular shelterwood silviculture.

   To accomplish this, the Guide should mandate that the prescribing forester list opportunities for leaving reserve trees from the existing stand in any final, incomplete overstory removal. Traditional timber-based criteria (i.e., AGS, UGS) should be largely irrelevant to this decision. Some of this could be built into the PTA framework using stocking of LIT species. The current policy on such retention requires a clump of 30 trees every 8 hectares (barely 1% of the pre-harvest stocking in most cases); serious retention policies would keep 10 or more times this level.

   It is important to stress that such a conversion from one to two cohorts is all that is feasible. It is not possible or realistic to restore truly multi-aged conditions in a single harvest prescription, no matter how innovative or ecologically designed. Restoration of a more-natural age structure is thus a very protracted process requiring generations of trees and foresters to accomplish.

5. Revamp or eliminate the "mature" and "over-mature" definitions to permit longer rotations and structural retention. Do not be so eager to recruit and release regeneration. The purpose here is to balance traditional timber concepts with ecological maturity. Table 3 in the *Forest Management Guide* (Silvics of Nova Scotia trees) needs a thorough overhaul in this regard.

6. Define "mature" (of even- and two-aged stands with one dominant cohort) based on the proximity to the peak mean annual increment based on vegetation type and the Forestry Field Handbook (DNR 1993), or when the dominant stand height is about 70–80 per cent of the site maximum. Few

foresters and no ecologists would define a red spruce as "mature" at 45 years old when it is three decades at least from peak MAI and less than half its potential height.

Such a definition of maturity would be a better threshold criterion for considering stand regeneration, but not necessarily mandated to do so. Below this age, only tending treatments would be considered.

7. Eliminate the "over-mature" category entirely. This pejorative term is a relic of a past era – when efficient, economically driven timber management sought to create forest structures devoid of biologically old trees – and is no longer used in scientific literature or textbooks. Table 4 of the Guide (page 15) attempts to define over-maturity using tree ages that are often only one-third or less the lifespan of the species. For example, if a hemlock forest is over age 100, it is deemed "over-mature" and unsuitable for multi-aged silviculture and is instead sent to the "Regenerate" key, where complete overstory removal is prescribed once advance regeneration is present. Such a complete disturbance in a biologically young (hemlock lives to age 400–500) hemlock forest would be virtually unprecedented in nature.
8. Address the gaps in, and questions about, the science underlying DNR's understanding of the applicable NDRs in Nova Scotia. As noted by many critics, the categories of "gap," "infrequent," and "frequent" confuse spatial and temporal attributes; further, many lands mapped as "frequent" appear to be mis-classified.
9. Eliminate or reduce any bias that the PTA process has toward single-aged, clearcut prescriptions, as described above.
10. Add more rigour to the wildlife assessment during the PTA process. Currently, it appears to be optional and rarely seems to influence prescriptions.
11. Revamp the prescription approval process to ensure a timely consideration of requests for progressive multi-aged silviculture not specifically addressed in the *Forest Management Guide* and continue to encourage and approve such requests in the spirit of diversity, continual improvement, and adaptive management (see, for example, the Medway Community Forest).

Like any general guidelines, the above principles will likely have exceptions in some situations, but these should be uncommon and decisions that deviate should be of last resort if the goal is to enhance forest biodiversity at the stand scale.

14.5 Permanent Structural Retention

Silvicultural prescriptions, and management in general, should be as stand-specific as possible, and not be overly driven by simple prescriptive guidelines. This is true whether the silviculture is aimed at commodity production or driven strongly by ecological objectives. As forestry strives to become less commodity based and more ecological, one key issue is that of *structural retention.* Some have even argued that a new discipline within forestry has emerged – so-called "Retention Forestry" – under which the key stand-level focus is not on what to remove but what to keep (Gustafsson et al. 2012).

Following a multi-aged silvicultural paradigm to better emulate partial disturbance regimes common to Nova Scotia is partly an issue of what to retain in each and every harvest. In silviculture, there are essentially three reasons to retain any given tree in a harvest prescription: its future as growing stock, its role in providing seeds and shade to enhance the regeneration process (e.g., the overwood in a shelterwood regeneration system), and its value for wildlife or biodiversity (e.g., cavities for nesting birds, snags for coarse woody material, conserving rare species). Any given prescription can, and should,

combine these elements for the optimum stand-level outcome. The first two are traditional timber-oriented silvicultural issues, the third has entered mainstream silvicultural thinking since about 1990 (Hunter 1990).

As noted in Chapter 8, the only requirement currently in Nova Scotia for retention is for so-called "wildlife clumps" equal to 30 or more representative trees for every eight hectares of even-aged regeneration harvest. A serious retention policy, aimed at significantly reducing single-aged silviculture and greatly expanding two- and three-aged irregular shelterwood systems, would retain perhaps 5–30 times this quantity (10–30% of the pre-harvest stand) to make a real difference in the ecological outcome. As the *Forest Management Guide* is modified, it should include the development of more-specific and targeted retention recommendations; at this point, only general estimates of possible outcomes can be made, based on what has been done in other jurisdictions faced with similar issues as Nova Scotia.

14.6 Wood Supply Impacts of Expanded Ecological Forestry via Increased Retention

To estimate potential impacts of expanding multi-aged silviculture, the Review commissioned Rob O'Keefe, wood supply analyst for DNR, to re-run the Nova Scotia wood supply model used in the provincial strategic forest analysis (SFA). Accurate simulation of the various multi-aged silviculture systems described above would require extensive new analysis and model revisions and was thus not considered further, given time constraints. Instead, estimates of impacts on wood supply were made by simply varying permanent retention levels and mandating more partial harvesting treatments than had previously been assumed by the base model or status quo.

The following scenarios were chosen:

1. All single-aged regeneration harvest prescriptions (modelled as a 100% removal of all merchantable wood) were modified so that either 10 per cent or 25 per cent of this volume was permanently retained, in effect reducing harvests to 90 per cent or 75 per cent of the original stocking. (Note that we are not suggesting these numbers as hard targets in any silvicultural systems; they are merely endpoints that might bracket actual modifications of single-aged silvicultural systems in the Management Guide.)
2. The requirement for a certain percentage of partial harvesting in the "frequent" and "infrequent" NDR categories was increased, by increments, to a maximum of 75 per cent, the same as the "gap" NDR category. The baseline expectation here, used in the provincial SFA, is 25 per cent for frequent and 50 per cent for infrequent. This has the effect of increasing the area under shelterwood silviculture, and in some scenarios, the area under selection (multi-aged) treatments.
3. Planting and pre-commercial thinning were increased over the base levels, up to 50 per cent more than currently.

To economize on modelling effort, O'Keefe ran these simulations only for the eastern Crown management region, the main wood supply for the Port Hawkesbury Paper mill.

Here are some highlights:

1. Retaining 10 per cent of the pre-harvest volume in all single-aged regeneration prescriptions reduces the annual allowable cut (AAC) by 7 per cent; retaining 25 per cent causes a 17 per cent reduction.

2. These reductions from increased retention are unaffected by increases in mandated partial harvesting, up until 50 per cent of the frequent and infrequent NDR categories are so treated. Above 50 per cent, the AAC drops with all levels of retention (including zero, the base model). In the most stringent case (75% partial harvesting in all NDR categories, 25% retention in the remaining single-aged harvests), the reduction in AAC is 33 per cent.
3. Increasing the silviculture budget for early intensive treatments (planting, PCT) has absolutely no effect on the 20-year AAC (this would not be true in the long term). This results in large part from the fact that the allowable cut effect has long since been taken, and there is no "surplus" wood in the region. It is certainly possible that other regions of Nova Scotia, with somewhat different forest structures and silviculture budgets, might have a different outcome.

   Unfortunately, the model was not able to separate planted clearcuts for others and thus kept all plantations subject to the 10 per cent or 25 per cent retention mandate. If planted clearcuts had no retention, the actual wood supply impact would be lower than estimated.
4. Mandating that 50 per cent of the frequent and infrequent NDR categories be treated by partial harvesting (mostly commercial thinning or shelterwood establishment cutting), and also requiring 25 per cent permanent retention on all final regeneration harvests – a feasible strategy that would end "clearcutting" in Nova Scotia as it is currently predominantly conducted – reduces the softwood AAC only 16 per cent. However, even under this scenario, single-aged final harvests (with retention) comprise 47 per cent of all harvest area.
5. True multi-aged silviculture – modelled as light repeated partial cutting – is very limited, from 9 to 12 per cent of all harvest area (and even less by volume), owing to strict eligibility rules for this treatment relative to conditions on the land base. Thus, even under the most restrictive (of clearcutting) scenarios, single-aged silvicultural systems (with retention) comprise about 90 per cent of the land base.

14.7 Conclusions

It appears that widespread adoption of a more ecologically driven silvicultural approach, implemented largely by increased retention on all single-aged final harvest treatments, would cause a modest reduction in the softwood AAC in eastern Nova Scotia. The results were not compared with the actual harvest level on this land base, but if the calculated AAC, with no constraints, exceeds the industrial demand, as it clearly does in the entire province (DNR 2017c), such a revised strategy may be worth pursuing further.

Because the model, as formulated currently, is incapable of simulating some of the "middle-ground" options under irregular shelterwood silviculture, such as 50 per cent removals in a series of small gaps with retention, the true impact of wide adoption of more irregular silvicultural systems will remain unknown until the model is so enhanced.

15 Funding Silviculture in Nova Scotia

(Prepared by Laird Van Damme and Jeremy Williams)

15.1 Nova Scotia Silviculture Programs and Eligible Activities

There are three silviculture programs in place in Nova Scotia:

- A fund for silviculture on Crown land is resourced by payments made by the Crown licensees on each cubic metre of Crown timber harvested, supplemented with monies from discretionary funding provided by the provincial government to pay for Crown licensees to conduct silviculture on the province's behalf.
- The Association for Sustainable Forestry (ASF) supports silviculture on non-industrial private woodlots.
- A credit-based program that operates through and at the expense of Registered Buyers applies to industrial and non-industrial private ownerships.

All three programs allow for standard forest renewal activities as well as certain partial harvesting treatments. Additionally, private landowners might choose to undertake additional silviculture work at their own expense.

Forest Sustainability Regulations specify the technical standards associated with the silviculture obligations imposed on Registered Buyers. The technical criteria under the Forest Sustainability Regulations are based on post-treatment results, and they generally do not focus on how those results are achieved.

Table 15.1. Eligible silviculture activities.

Category #	Description
1	Natural Regeneration Establishment
1a	Regeneration and Fill Plant < 300 trees/ha
1b	Regeneration and Fill Plant ≥ 300 trees/ha
2	Plantation
2a	Plantation Establishment
2b	Intensive Plantation
3	Early Competition Control
4	Density Control and Release in Plantations
5	Density Control and Release in Natural Stands
6	Commercial Thinning
7	Forest Quality Improvement
7a	Crop Tree Release
7b	Crop Tree Pruning
7c	Selection Management

One implication of the approach of listing eligible silviculture activities is that silvicultural prescriptions that are not specified in the regulations are not recognized as eligible activities. While all of the main silvicultural operations are included, unusual or experimental approaches not listed are ineligible.

Without their inclusion, it is likely that this type of silviculture would not be conducted (except, perhaps, by owners of private and industrial lands who have an economic incentive to maximize the value of their standing timber assets). Moreover, the silviculture system in Nova Scotia is structurally aimed at ensuring that silviculture is being conducted, rather than concentrating on what results are achieved. This may be remedied through the use of comprehensive forest management plans that are calibrated to specific result targets.

15.2 Silviculture Activities on Crown Land

Silviculture on Crown land is predominantly conducted through a funding mechanism whereby for each cubic metre of timber harvested on Crown land the Crown land licensee deposits an amount into a dedicated Crown Land Silviculture Fund ($3.00/$m^3$ for softwood and $0.60/$m^3$ for hardwood). The licensee then conducts eligible silviculture on the Crown land. Subject to government audit, if the silviculture activities meet the guidelines, the money deposited into the Crown Land Silviculture Fund reimburses the licensee the cost of the silviculture undertaken. Revenue generated by government for harvesting on Crown land is reinvested into the Crown lands where the contributing licensee operates. Any part of the fund unused after three years reverts to the general Crown land silviculture expenditure account administered by the province. The province also has a budgetary item used for DNR general maintenance on Crown land.

15.3 Silviculture Activities on Private Land

The province requires silviculture on private land through the Registry of Buyers program. A Registered Buyer is a person or business that

- processes primary forest products into secondary forest products in Nova Scotia
- acquires primary forest products for processing into energy (e.g., electricity)
- acquires primary forest products to sell as a fuel to the consumer (when >1,000 m^3 of primary forest product is acquired)
- imports primary forest products into Nova Scotia for processing into secondary forest products
- exports primary forest products in unprocessed form from Nova Scotia to other provinces or countries[5]

Registered Buyers who acquire more than 5,000 m^3/year from private land must report total harvesting activity to DNR.

The Forest Sustainability Regulations, enacted pursuant to the Forests Act, require Registered Buyers to invest in silviculture on Nova Scotia forest land in proportion to the quantity of primary forest products they acquire in a year. Section 19(a) of the Forest Act makes provisions for the creation of the Sustainable Forestry Fund (SFF) as a method by which Registered Buyers can satisfy their silviculture requirements under the Forest Sustainability Regulations. Thus, a Registered Buyer has three options to meet its silviculture requirements:

- Option A: make a cash contribution to the SFF

[5] https://novascotia.ca/natr/forestry/registry/ovrvuindx.asp

- Option B: undertake its own silviculture program
- Option C: a combination of both A and B

Under Option A, a Registered Buyer would provide funding to the SFF equal to $3/m^3 of softwood and $0.60/m^3 of hardwood acquired. Under Option B, a Registered Buyer is required to undertake an amount of silviculture that accounts for a total amount of credits equal to 3 credits/m^3 of softwood and 0.60 credits/m^3 of hardwood, with the amount of credits per silviculture activity as set out in Table 15.2 (which is part of the regulation). In all cases except crop tree release, the units of activity are hectares treated.

Table 15.2. Schedule of credits retired per unit of eligible activity.

Category #	Description	Credits/ha
1	Natural Regeneration Establishment	
1a	Regeneration and Fill Plant < 300 trees/ha	70
1b	Regeneration and Fill Plant ≥ 300 trees/ha	300
2	Plantations	
2a	Plantation Establishment	600
2b	Intensive Plantation	150
3	Early Competition Control	400
4	Density Control and Release in Plantations	800
5	Density Control and Release in Natural Stands	800
6	Commercial Thinning	550
7	Forest Quality Improvement	
7a	Crop Tree Release	3/tree
7b	Crop Tree Pruning	300
7c	Selection Management	550

Historically, nearly all of the Registered Buyers in Nova Scotia have elected to satisfy silviculture obligations by conducting their own silviculture program.

There are provisions for a minor amount of carry-over from year to year, but almost all of the credits must be retired in the year they are generated. In addition, harvesting on industrial land requires the associated silviculture obligations to be retired by conducting silviculture on industrial land. The same tenure limitation exists for silviculture obligations incurred from harvesting activity on non-industrial private land.

In addition to the Registered Buyers program, the ASF undertakes silviculture on non-industrial private land. While its original aim was to aid small woodlot owners in conducting silviculture, it has expanded the range of properties that it can undertake silviculture on to include non-industrial landowners owning up to 20,000 ha. The Review team heard from numerous presenters that the ASF is well regarded and would be a credible organization to assume a greater role in implementing silviculture on private lands.

15.4 Observations and Concerns

The Review team noted four observations and concerns with regard to the province's silvicultural programs.

First, because the majority of harvested timber is generated from private land and the Registry of Buyers program grants substantial autonomy to Registered Buyers how, when, and where to conduct silviculture, there is limited direct action that the province can take to direct Registered Buyers to conduct a specific silviculture treatment on a specific tract of land. In addition, the structure of Nova Scotia's silviculture regime focuses primarily on silviculture activities being conducted rather than on what is achieved through silviculture. The Review believes that more focus should be paid to the latter. This would require a recalibration of DNR's auditing system to audit not only that silviculture was conducted but that it achieved specific results in line with the pre-treatment assessment and/or a comprehensive forest management plan. Moreover, due to the one-year period requirement to complete silviculture obligations under the regulatory system, certain long-term silviculture treatments may not be used or may not have the desired effect.

Second, a review of the total amount of silviculture expenses in 2016 indicates that substantial funds are contributed to silviculture in the province, as shown in Table 15.3. Silviculture spending on Crown land appears adequate when compared to other jurisdictions, and higher rates of silviculture are undertaken on private land in Nova Scotia compared with most other Canadian jurisdictions.

Table 15.3. Summary of estimated 2016 silviculture expenditures in Nova Scotia.

Ownership Category	Mechanism	Amount ($ millions)
Crown	Crown licensee payments	2.44
Crown	Crown land budget	3.5–4.0
Private	Registry of Buyers program and eligible grants	7.19*
Total		**13.13–13.63**

**Estimate based on area treated by an estimated unit cost*

However, the Review team was made aware of the fact that, although Registered Buyers report silviculture expenses to the province, not all silviculture undertaken is reported because certain silviculture treatments are not sufficient to retire silviculture obligations. Actual silviculture investments made by Registered Buyers may be significantly higher for both industrial and non-industrial private land. Given the predominance of wood harvested from private land in the province, an unknown and potentially significant amount of silviculture expenses on private land is not reported.

Private-land silviculture is generally directed toward locations where the return to private parties will be high, and there is no mechanism to ensure that silviculture dollars are spent where they will have the greatest impact on the forest. The Review team observed that on both Crown and private lands, there is no systematic effectiveness monitoring that is transparent to the public. This makes it difficult to determine whether the forest renewal program is as effective as it might be. There have been some comprehensive studies in the past to verify that the accepted practices are, on average, effective at the provincial scale (Stewart and Quigley 2000). However, determining cause and effect requires more-frequent monitoring at finer scales (see Chapter 16).

Third, the Review team observed that silviculture programs that are not included in the eligible silviculture list are not likely to be used by Crown licensees and Registered Buyers, or at least not reported as being used. The Review team is concerned that the omission of certain techniques or a catch-all category has the effect of discouraging the use of experimental or costly new silviculture

techniques in Nova Scotia. Even assuming that these techniques are being used, they are not being reported or tracked by government to determine their overall effectiveness.

Fourth, the type of silviculture treatments chosen are likely not the most productive, and the Review has observed that silviculture treatments are uneven across land tenure categories. For example, during their field inspections, forestry experts supporting the Review observed that commercial thinning was being done on private land in a variety of ways to meet the standards in the regulation. However, the use of commercial thinning, as shown in Table 15.5, was not the dominant treatment used to retire silviculture obligations.

Fifth, the silviculture programs were not designed to provide for a large amount of partial harvesting, and at the current levels of partial cutting on Crown land, most of the silviculture budgets are being spent on these activities. If the province shifts forest management so that more of it is ecosystem based, there will be much higher levels of partial harvesting that may be beyond the capacity of the silviculture funding systems to accommodate.

The softwood harvest data suggest that, if partial harvesting (selection and commercial thinning) provides one-third the yield of clearcutting, and the average softwood yield from a clearcut in 2016 was 111 m^3/ha, then the partial cutting yielded 37 m^3/ha. Applying these same yields and keeping the private-land softwood harvest volume at the 2016 level, while ensuring that half of the harvest area is clearcutting and the other half is partial harvesting, leads to an almost 40 per cent increase in the total harvest area, as shown in Table 15.4.

Table 15.4. Comparison of actual private land harvest area (2016) and equivalent under 50% cap on clearcutting.

	2016 Actual Private Land Harvest Area (ha)	**Hypothetical Private Land Harvest Area at 50% Clearcut (ha)**
Clearcut	20,103	15,600
Partial cut	2,358	15,600
Total harvest	**22,461**	**31,200**

This harvest would generate almost 7 million credits, but would also retire a substantial portion of these credits.[6] This could potentially lead to a deficiency of credits for other meaningful silviculture treatments like artificial regeneration or tending. It is noted that the 50 per cent clearcut scenario has not included any mechanism for encouraging more partial harvesting. If a higher number of credits were offered for partial harvesting treatments, there would probably be more of it, but there would also be less of the other types of renewal. There is also no category in the silviculture credit schedule for such partial harvest prescriptions as group shelterwood or irregular shelterwood, and perhaps adding such classes

[6] Softwood credits from clearcut area = 15,600 ha × 110 m^3/ha × 3 credits/m^3 = 5.19 million credits. Softwood credits from partial cut area = 15,600 ha × 37 m^3/ha × 3 credits/m^3 = 1.73 million credits. Total = 6.92 million credits. Credits for partial harvest = 7,800 ha selection cut × 550 credits/ha + 7,800 ha CT × 500 credits/ha = 8.19 million credits.

will encourage their use. That said, under the existing silviculture program, there is little incentive for the use of commercial thinning as a silviculture treatment on private land, which explains why it is not predominantly selected as a silviculture treatment, as demonstrated in Table 15.5. Table 15.5 breaks down the operational data by private ownership class (industrial and non-industrial) and by whether the activity was conducted in softwoods or hardwoods. These data are derived from the 2016 Registry of Buyers' Summary.

Table 15.5. Registry of Buyers activity data, by private ownership and species group.

		Softwood		Hardwood	
Category	**Description**	**Indust.**	**Non-Ind.**	**Indust.**	**Non-Ind.**
1	Natural Regeneration Establishment				
1a	Regeneration and Fill Plant < 300 trees/ha	18	1,457	0	781
1b	Regeneration and Fill Plant ≥ 300 trees/ha	0	32	0	0
2a	Plantation Establishment	1,081	1,906	0	0
2b	Intensive Plantation	0	80	0	0
3	Early Competition Control	622	964	0	0
4	Density Control and Release in Plantations	1,001	1,326	0	0
5	Density Control and Release in Natural Stands	472	1,037	203	109
6	Commercial Thinning (CT)	59	958	0	26
7	Forest Quality Improvement				
7a	Crop Tree Release	0	0	0	6
7b	Crop Tree Pruning	0	0	0	0
7c	Selection Management	13	103	0	222

Another example of uneven treatment across land tenure is evident from Table 15.5. There are sizeable differences in the levels of some activities on industrial and non-industrial lands, notably regeneration and fill plant and CT being almost exclusively on non-industrial forests. There was much more density control (PCT) on non-industrial lands. Very few hectares of intensive plantations were established (Category 2b), and a look at the difference in requirements (Table 15.6), as set out in the Forest Sustainability Regulations, between a basic plantation and an intensive plantation goes a long way toward explaining that outcome. The added cost of moving from a basic to an intensive plantation ranges from at least $200/ha to $300/ha, and the Registered Buyer must wait until the trees are 1.2 m tall to retire the credits. Thus, the Registered Buyer would claim the basic plantation credits in the year of planting and then likely have to wait five to eight years to claim the additional credits for the intensive plantation. At 150 additional credits/ha, there is no real incentive in the Registry of Buyers system to create intensive plantations on private land. The concern of the Review team is that there will be a need to incentivize more-intensive plantation establishment in order to support the production forestry leg of the triad.

Table 15.6. Comparison of minimum requirements for basic and intensive plantations.

Criterion	Basic Plantation	Intensive Plantation
Minimum number of living planted or natural softwood crop trees/ha	1,500	2,000
Minimum acceptable stocking level	85% @ 2.4 x 2.4 m spacing	90% @ 2.1 x 2.1 m spacing
Average height of softwood crop tree	No requirement	1.2 m
Other	Site must contain at least 900 living planted trees/ha	Site must contain at least 1,500 softwood crop trees/ha that are released

Continuing on this observation, Figure 15.1 shows the distribution of the use of credits by activity type in 2016: 11 per cent of the credits were applied to partial harvesting, while 58 per cent were applied to tending treatments. The remaining 31 per cent of treatments were applied to stand establishment (fill planting or plantations). Approximately 3,000 ha of plantations were established, and another 2,238 ha of fill planting was done. Since the 2016 clearcut area was almost 20,000 ha, this means that some 15,000 ha of clearcut area was naturally regenerated. Harvest areas usually regenerate naturally from seed, existing regeneration, and suckering. For this reason, planting is usually not required to regenerate a forest in Nova Scotia.

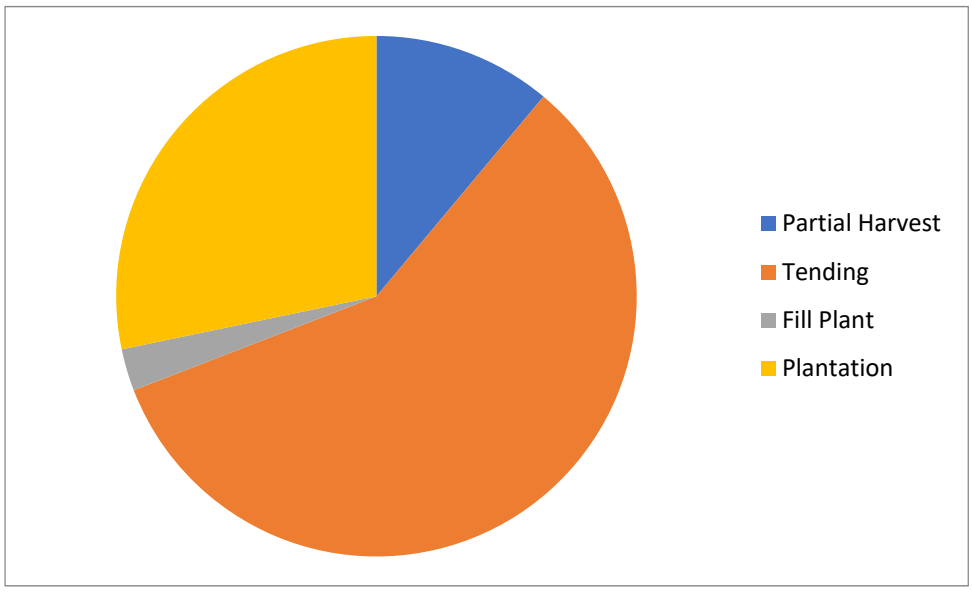


Figure 15.1. Use of silviculture credits, by percentage of activity type (2016).

The analysis indicates that the provincial silviculture funding systems appear to have been effective in providing for forest renewal and for a reasonable level of post-establishment treatments. That said, the structure of the program, which places substantial autonomy upon the licensee or Registered Buyer to conduct silviculture, results in uneven and potentially ineffective silviculture treatments being applied across all land tenures.

15.5 Conclusions

The above indicates that there are opportunities to improve Nova Scotia's silviculture programs. Nova Scotia's silviculture system for private land is unique in Canada, possibly the world. Nowhere else does the industry have such a substantial responsibility to carry out silviculture on private lands that it does not own, in proportion to the amount of wood purchased from private land. This makes it challenging for government policy makers to change the trajectory of Nova Scotia's forest sustainability.

This review of the silviculture funding systems in Nova Scotia has identified the following concerns that can be addressed through policy changes:

- A high proportion of silviculture funding has been used to support partial harvesting, much of which is commercial thinning.
- There is very little establishment of intensively managed plantations on either private or Crown land.
- On private lands, silviculture work is done at the discretion of the Registered Buyer, and harvested woodlots are not necessarily treated after harvesting, even when that would represent sound forestry.
- The private-land silviculture system generally lacks a mechanism to ensure that, beyond the informed but discretionary choices made by Registered Buyers, silviculture treatments are selected and calibrated to generate a high rate of return and regeneration.
- There is little-to-no monitoring of silvicultural effectiveness on private land beyond ensuring that the reported work was undertaken and silviculture obligations have been satisfied.
- There are no existing incentives for Crown licensees or Registered Buyers to undertake experimental or costly silviculture techniques.
- There is a lack of transparent forest management planning processes that include a plan for effectiveness monitoring on Crown land.
- The multiplicity of systems complicates the task of assessing overall silvicultural effectiveness and implementing province-wide priorities.

Potential changes as a result of this Review could also affect the existing silvicultural implementation and funding system. An example might be adjustments to encourage harvesting designed to promote multi-aged and all-aged stands on all ownerships, especially on Crown land, where such direction can be mandated. Another example could be changes to promote the use of more-intensive plantation regimes in areas identified for "production forestry" if the landscape triad model is adopted.

Any policy changes made to address the concerns identified above will need to take into account the expected impact of the recommendations of this Review on forestry systems in Nova Scotia.

16 Silviculture Reporting, Progress, and Accountability

(Prepared by Laird Van Damme and Peter Duinker)

A successful forest management program requires a strong system of 1) accountability for effectiveness of silviculture, 2) audits of treatments success, and 3) overall audits of expenditures on different categories of silviculture. In implementation of the triad, a mechanism is also needed for making adjustments in silviculture to ensure its alignment with ecological forestry.

As an oversight mechanism that broadens the participation beyond regulators, several Canadian provinces have implemented a multi-stakeholder forum, or a forest practices board, for developing advice on forest practices and related forest policy and management issues on a continuing basis, receiving reports on progress (including in limiting clearcutting to conditions in which it is consistent with ecological forestry at multiple spatial levels and meeting legislated reduction targets), and discussing all proposals for changes to the provincial forest management program.

The most critical step in reporting on progress and showing accountability to the public in ways that support institutional learning is admitting the unknowns. Acknowledgement of uncertainty is the only honest approach to setting future directions for management and policy. To summarize and quote Donald Rumsfeld:

> "There are known knowns. These are things we know that we know." [One example in forest management is implementation of approved plans.]
>
> "There are known unknowns. That is to say, there are things that we know we don't know." [One response is the adaptive management cycle as a policy and planning framework built upon an environmental assessment foundation.]
>
> "But there are also unknown unknowns. There are things we don't know we don't know." [One example response is the coarse-filter approach to biodiversity conservation, which consists of natural disturbance emulation with a dash of the precautionary principle for good measure.][7]

Nova Scotia has a publicly accessible information system showing a range of policy, research, and forest inventory publications. There are opportunities to view and comment on planned operations. These are the things we know.

The known *unknowns* are within the mandate of the Research and Information Services branch of the Department of Natural Resources. DNR research was used in developing the recently published forest management guides that provide the decision trees based on pre-treatment assessments.

The current approach to dealing with the known unknowns and the unknown unknowns is to conduct research programs as problems are identified while operations progress. Precautionary principles are in place, such as the requirement for limbing at the stump to ensure that soils are not depleted of critical nutrients. Harvests that emulate natural disturbance patterns and timings help ensure that ecosystem functions, even if not fully understood, can be maintained.

[7] http://www.brainyquote.com/quotes/authors/d/donald_rumsfeld.html#TCJZyc913HHWwmbj.99

The principal means of reporting progress in implementing ecological forestry in Nova Scotia is the state of the forest (SOF) report issued periodically in response to the province's commitment under Canada's National Forestry Accord. The most recent SOF report was published in 2017 and states: "The Department of Natural Resources is committed to advancing the practice of ecosystem-based landscape-scale management. Indicators selected for this report demonstrate this commitment, as well as progress to implement the *Code of Forest Practice (2012)*" (DNR 2017e).

A standard reporting framework for SOF uses the Canadian Council of Forest Ministers *Criteria and Indicators* (CCFM C&I 2003) for Sustainable Forest Management. This framework is also widely used across Canada for forest management planning.

The Mersey Tobeatic Research Institute (MTRI) recently completed a State of Nova Scotia Forest and Biodiversity Review. It identified many gaps and recommended, among other things, that the SOF report should "fully utilize Canada's Sustainable Forest Management Criteria and Indicators (2003) and collaboratively adapt them to a Nova Scotian context."

MTRI also completed a scan of Canadian jurisdictions and found significant gaps in planning and reporting in the Nova Scotia system relative to the other jurisdictions. Table 16.1 is modified from the MTRI report and shows a considerable lack of public transparency in planning and reporting compared to other provinces. BC and Ontario have the most extensive and legally binding planning and reporting processes.

Interactions with contributors to the Review process reveal a high level of distrust among stakeholders and between stakeholders and DNR. A more transparent process and more fully integrated planning and reporting system would be beneficial in achieving ecological forestry objectives while building trust among stakeholders.

Table 16.1. Planning and reporting (provincial comparisons).

Province	State of the Forest Report?	Publicly Transparent Annual Operating Plans (AOP)	Publicly Transparent Forest Management Plans	Publicly Transparent Crown Forest Management Agreements (licences)	Public Consultations	Criteria and Indicators
Nova Scotia	Yes. 2008 and 2016.	No. Online harvest viewer, but no AOP.	No.	No.	Limited/nil. Online harvest viewer is only option to provide input. No other regular consultation with the public.	Few. Most required by CCFM not there, or in altered forms.
Ontario	Yes. State of Ontario's Natural Resources: Forests 2016.	Yes.* Annual work schedules from 5 years' OPs.	Yes. 20-year plans contain two 5-year operational plans, renewed every 10 years.	Yes.	Yes.	Yes. Legally required.
British Columbia	Yes. The State of British Columbia's Forests 2016.	Yes.	Yes. 5-year plans.	Yes.		Yes. Legally required.
Alberta	No.	Yes.	Yes. 10-year plans.	Yes.	Yes. Form of consultations not clear, and variable across the province.	Indirectly.

* *The original report had "no." Although there are no annual operating plans, there are annual work schedules drawn from a publicly vetted 5-year operating plan.*

Berry et al. (2018) from MTRI note that the old-growth forests in Nova Scotia are less than 1 per cent in area. They suggest that Nova Scotia's Old Forest policy to achieve 8 per cent area in each ecodistrict requires regulations, or forest management plans backed by regulations, to be effective in implementing the policy. They use the BC framework as an example of a supportive regulatory framework, but the Ontario framework has similar characteristics with a more robust forest management planning and auditing framework than is found in BC.

The need for developing a transparent forest planning process on Crown land is described elsewhere in this report. The plans provide an efficient foundation for monitoring and reporting, especially if they follow the CCFM C&I, as is commonly found across Canada.

Nova Scotia has state-of-the-art forest inventory and mapping systems. Many data from these systems are made available to the public and can be found online. It also has a robust network of permanent sample plots that have been properly maintained since the mid-1960s. But data without context are simply data and not information. Informed decisions by managers that include public input require contextually rich integrated systems based on theoretical frameworks such as adaptive management and environmental assessment.

Interviews with several DNR staff included discussions on adaptive management. However, they interpret this to mean learning by your mistakes and adapting to changing environments. This understanding is reflected in the somewhat ad hoc assortment of research programs undertaken by DNR.

Adaptive management philosophy speaks to a more systematic approach to institutionalized learning (Duinker and Trevisan 2003). It starts by developing hypotheses and making predictions. These predictions are tested by a properly scaled monitoring program, which informs the institutions responsible for management, and further sets of hypotheses and predictions are made in a cycle of continual improvement and learning.

Adaptive management is a formal policy in Ontario and is used in Ontario to focus its forest research program (OMNR 2013).

The Ontario adaptive management framework operates at the stand, landscape, and forest levels. For example, silviculture ground rules (SGRs) are developed within the forest management planning process and monitored to determine if the stated objectives for a silvicultural treatment package are being met. Variances are reported in year-7 and year-10 annual reports and verified by independent forest audits (IFAs). IFAs also verify if forest-level objectives are being met and report to the public by tabling the report in the legislature and online.

Ontario SGR monitoring includes establishment surveys to determine if the program meets specified input requirements (e.g., number of trees planted). These are followed by “Free to Grow” (FTG) surveys at a year specified in the SGR to determine when no more follow-up treatments are required. When FTG status is achieved, the stand re-enters the forest inventory.

Nova Scotia does complete establishment surveys to enable payment to service suppliers from silviculture funding sources. However, there is no systematic FTG survey equivalent to test silvicultural treatment effectiveness of the investment choices made thus far. There have been well designed ad hoc regeneration surveys from time to time (Stewart and Quigley 2000), but a more systematic approach would yield efficiencies and generate public trust. Provincially scaled data collection programs, such as the network of permanent sample plots (PSPs), are helpful, but some cause-and-effect relationships will be hard to discern at this level. There is a need for forest landscape (ecoregional) scaled monitoring.

Ontario’s silvicultural effectiveness monitoring (SEM) system is theoretically sound but there are implementation issues. For example, the forest management plan requires the plan author to describe the SEM program, including the survey methods. This allows for regional adaptation and is consistent

with a professional reliance system. Some authors complete this requirement better than others, but in all cases the government uses a different sampling system to verify the reports. Hence there was significant controversy over the root causes of variance (i.e., is it the treatment or the measurement system?).

This situation may be resolved in Ontario by introducing a standardized system modelled after Alberta's SEM system (Alberta Agriculture and Forestry 2017). The Alberta system (a variant of a code-based system, as described in Chapter 17) is technically robust and reliable but will limit opportunities for efficiencies and adaptation. The only thing missing in Ontario's system was a protocol agreement with the government on specific audit procedures (e.g. plot size) to verify the results generated by the proposed system in the approved plan.

Alberta's robust SEM system was completely unknown to the public. There are no SOF reports or IFAs to report results and context to the legislature and the public. This created a lack of trust and a major finding of concern by the Alberta Office of the Auditor General in 2006. These deficiencies have since been corrected to the Auditor General's satisfaction (Auditor General of Alberta 2012).

The Ontario SEM system has a cautionary tale when recognizing the distinction between known and unknowns. Tolerant hardwoods that followed the published tree-marking guides and passed a tree-marking audit by certified tree markers were deemed automatically to be FTG and meet SGR objectives. The guides and associated practice were deemed a known known. Thirty years later, when the second harvests were being completed, it was discovered that the objectives were not being achieved in the majority of stands (KBM 2012, 13). Forests are complex systems and there are very few, if any, known knowns.

Implementing the triad approach in Nova Scotia may allow for implementation of active adaptive management and a structured stakeholder engagement decision analysis, similar to systems used in Ontario.

Active adaptive management consists of developing hypotheses as part of the planning process and testing hypotheses through monitoring programs. Hypothesis testing can be done in Nova Scotia through the existing PSP network, spatial forest inventories (soon to use enhanced technologies such as LiDAR), and problem-focused research programs. Compliance monitoring programs are in place in Nova Scotia to ensure that existing standards are being met. However, these programs, if supplemented by a properly targeted and scaled silvicultural effectiveness program, will help rationalize future silviculture programs.

IFAs and other programs help identify if the systems, even if properly implemented, are being truly effective. Thus, IFAs both test and help generate hypotheses. But most important, IFAs provide context and accessibility to forest-level performance measures within the grasp of the general public.

Many forest licensees across Canada currently have third-party forest certification. Hence, they are accustomed to audits and committed to continual improvement, with systems in place to demonstrate compliance. This is a useful environmental condition for reporting on progress in a transparent way to stakeholders/regulators using regulated audit systems such as IFAs.

IFAs have been used in Ontario for more than 30 years, and many licensees, especially those that are also third-party certified, suffer audit fatigue. Measures are being developed to improve efficiencies and

ensure continued relevance. Although the Government of Ontario is also audited to the same standard as the licensee, it is less responsive in addressing audit findings. The licensees are responsive because they can lose the licence from a failed audit, whereas there are few repercussions to the government unless citizens act.

Saskatchewan has similar allowances in the regulations for IFAs but it has only completed one audit to date. BC Forest Practices Board does random and issue-based audits. An Ontario IFA variant of a regulated auditing and reporting requirement is worth considering for Nova Scotia.

In conclusion, reporting on silvicultural progress and effectiveness is enabled through an adaptive management process where objectives are clearly established through a forest management planning process supported by monitoring and reporting programs at the appropriate scale for each objective. The CCFM criteria and indicators are useful for setting objectives and reporting results. In addition, testing and reporting on system performance can be accomplished using third-party or independent audits, either issue based or on a regular cycle.

17 Different/Better Forestry: The Role of the Forestry Profession

(Prepared by Laird Van Damme)

17.1 The Forester

The forestry profession consists of individuals with specific training in forestry practices working either as individual consultants or, more commonly, for larger organizations such as DNR, a forest products company with land management responsibilities (e.g., Northern Pulp), or a non-government organization associated with forests (e.g., the Association for Sustainable Forestry). The movement toward ecological forestry requires behavioural and attitudinal changes. Since most human behaviour is learned behaviour, education can play a significant role.

The attitudes and behaviours of forestry professionals begin forming during the post-secondary educational experience. Forestry training consists largely of natural-science-based course work, some economics, and a dash of arts (usually a course in forest policy or history). This training, particularly when delivered at the diploma and undergraduate levels tends to produce a technocratic worldview where forest problems of all kinds are reframed into technical problems.

For example, whether or not to clearcut can be decided by using a decision tree assessing site and stand characteristics. Problems are often framed to be complicated rather than complex. Complicated problems lend themselves to engineered solutions, whereas complex problems require broader systems thinking and an acknowledgement of uncertainty that can be addressed only through institutional learning enabled by active adaptive management (Duinker and Trevisan 2003).

Technocrats are notoriously bad communicators, perhaps because of a lack of education in the arts. DNR and forest industry foresters are hard-working professionals, but they have clearly lost the public trust in Nova Scotia. The issues before this Review are subtended by communication issues, and this is a common problem facing natural resources managers across North America.

One solution is to reduce the technical content in forestry undergraduate programs and instill a commitment to lifelong learning. Quite often, there is a desire to cover all the technical dimensions a forester may face within the undergraduate curriculum. This is clearly an impossible task.

A reduced curriculum could then add intelligent exposure to the arts and use some case-study-style business training. Ideally the mind (intellect), heart (empathy), and gut (intuitive/instinctive) aspects of the individual are cultivated to the fullest potential possible in two to four years. In Figure 4.1, the left diagram is a schematic of the focus of current curriculums at most forestry schools, and the right is a schematic of what a curriculum could look like to better support ecological forestry.

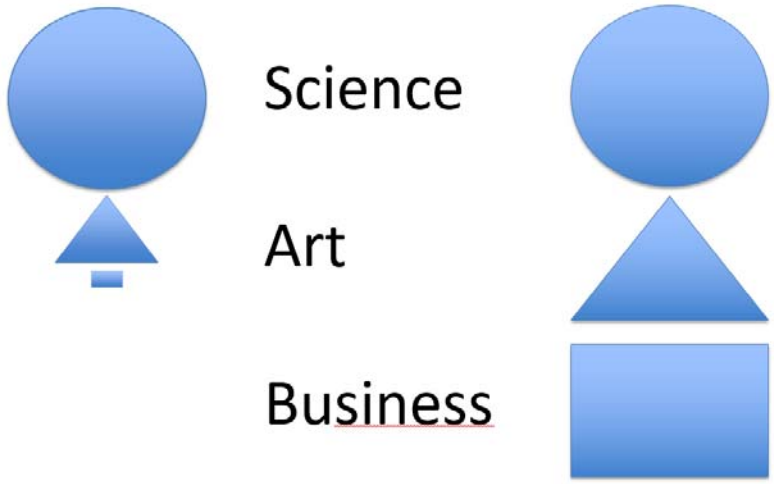


Figure 17.1. Current and modified forestry school curriculums.

Nova Scotia has a limited ability to directly influence the curriculum of foresters and technicians because most of these educational opportunities exist only outside the province. The NS Community College offers forestry technician diplomas in its "Natural Resources Environmental Technology" program. There are no professional forestry programs in Nova Scotia. However, progress can be made in the context of continuing education. Mid-career professionals would benefit from a customized educational experience to enable a faster adoption of ecological forestry.

An example of a comprehensive program is the Ontario Advanced Forestry Program (OAFP), which ran from 1991 to 1996 (Van Damme and Brown 1992).[8] All graduates now hold senior positions in government and industry (a selection bias?). The successful implementation of Ontario's Crown Forest Sustainability Act (CFSA) in 1994 was enabled in part by this program. The CFSA ushered in radical changes and set the ground work for the implementation of ecological forestry in Ontario.

The first five OAFP modules reinforced the technocratic model. But the course delivery in retreat settings by leading scientists helped embed science and management thinking through friendships and trust built upon shared experiences that lasted well after the program ended (Van Damme et al. 2008). The capstone module, and by far the most widely subscribed too, was Module 6, "The Art of Professional Practice." Case studies were used, and the content could be described as liberal arts. Module 6 helped fuse the natural sciences realm to the social science domain, as advocated many years ago by Aldo Leopold.

> "One of the anomalies of modern ecology is the creation of two groups, each of which seems barely aware of the existence of the other. The one studies the human community, almost as if it was a separate entity, and calls its findings sociology, economics, and history. The other studies the plant and animal community and comfortably relegates the hodge-podge of politics to the liberal arts. The inevitable fusion of these two lines of thought will, perhaps, constitute the outstanding advance of the present century."—Aldo Leopold

[8] Note: Jeremy Williams and Peter Duinker were instructors at OAFP.

This is not to say that technology and technocratic skills are not important. Indeed, new technology, such as LiDAR data acquisition planned to be collected for the entire province by the Government of Nova Scotia, will demand the development of new technocratic skills. These data, if accessed and understood by professionals, can greatly improve the efficiency and effectiveness of many tasks. Professionals in turn can make these data accessible to the public, thus facilitating forest management extension services and private landowner participation in forest products markets.

It is important to recognize the efforts already made in professional development by DNR staff. The pre-treatment assessment decision keys based on ecosite classification involved considerable investment in training and certifying practitioners to deliver new directed programs through public policy. The training material and hands-on field experiences were made available to Review team members. The training staff competency and materials meet a high standard of excellence.

17.2 The Professional Association

Most foresters belong to professional associations. The structure and legal position of the association will influence its role in the movement toward ecological forestry.

The purpose of most associations is to protect the public interest (as opposed to "rent seeking" to protect the incomes of foresters). By means of a stated code of ethics, an association can self-regulate the behaviour of its members through various forms of disciplinary actions. For example, the Registered Professional Foresters Association of Nova Scotia has such a code of (https://www.rpfans.ca/code_ethics.php). Professional forestry associations also include continuing education requirements and landowner outreach.

A distinguishing feature of many western democracies is the existence of civil society constructs that include environmental non-government organizations, unions, and professional associations. According to Ed Cane of the CATO institute, "There are basically two ways to organize society, voluntarily, through the private interaction of individuals, social organizations, religious institutions and businesses – what I would call civil society; or coercively, through the actions of the state – what I call political society" (Cane 2004).[9]

The current approach DNR is taking to ecological forestry can be classed as a code-based system with strong government leadership and government-issued decision keys supporting pre-treatment assessments. This may be the most efficient way to move toward ecological forestry at this time.

Although government leads the movement toward ecological forestry, many may argue that it has not been effective. The proportion of areas clearcut has declined, but only modestly. The role an organization plays in effecting change is discussed in greater detail in Section 17.3.

Across Canada, various provincial governments oscillate between code-based systems favoured by left-of-centre politics to results-based or outcomes-based systems favoured by right-of-centre politics. BC moved from a code-based system to a results-based system in 2005 (see Chapter 19) and more recently Saskatchewan has followed suit.

[9] See also Niall Ferguson's *The Greta Degeneration* (2012, Penguin) for a very good read indeed.

Professional reliance systems, if properly designed and executed, can be used to ensure accountability to the public and reduce government operating costs because, theoretically, less oversight is required (i.e., fewer "code cops"). Ontario's former Minister of Natural Resources David Ramsey proposed a private member's bill in 1998 that failed, but a subsequent bill passed, leading to the Professional Foresters Act, 2000, which is a "right to practice" act. He said the following when introducing the bill:

> We've seen over the years a growing concern by everyone in how our forests are managed. It is very important that the public have a comfort level with this and that they know that the people who are charged with managing our forests are working at the very highest standards with the very latest skills and professionalism that is available anywhere in the world. That is one of the main reasons for doing this.
>
> The key to meeting this public demand is to increase the accountability of those who manage the forest. This greater accountability can be achieved by extending the reach of the forestry profession to cover all individuals practising forestry, ensuring the educational qualifications and enforcing adequate practice standards for those individuals and defining an appropriate scope of practice for them. By vesting the professional body with the licensing power that I call for in this act, these goals can be achieved in a way that demonstrates the government's commitment to accountable forest management in Ontario. (Ontario Legislative Assembly 1998)

Professional reliance systems require robust professional associations because they play a significant role in the process. The Association of British Columbia Forestry Professionals has 5,000 members and legislated right to practice. It is of sufficient size to be effective at "self-regulating" a move to ecological forestry, or any other socially desired endpoint. It is noteworthy that the regulated directions toward a version of ecological forestry in BC require that there be no negative impacts on wood supply from Crown land.

Both the Association of Saskatchewan Forestry Professionals (fewer than 200 members, both foresters and technicians) and the Ontario Professional Foresters Association (at 550 members with no technicians) have right-to-practice legislation but lack the critical size necessary to self-regulate the profession. For example, Ontario's association recently lost a court case related to practising without a licence and nearly went broke as a result of the process.

The Foresters Association Act (1999) is the foundation for RPFANS. This act is not right-to-practice legislation; hence the role that RPFANS can play in the movement toward ecological forestry will be modest and voluntary, relying on the discretion of its board and members.

Even with right-to-practice legislation that would enable a results-based system to support ecological forestry, the current base of 90 members would face real challenges in meeting social expectations of self-regulation. There may be a role for a network of Maritimes associations, inclusion of technicians, and inclusion of allied disciplines (e.g., biologists) to develop the critical mass necessary for self-regulation to support a professional reliance system.

One consequence of the lack of right-to-practice legislation is that people certified to complete PTAs are not required to be registered professionals, and many have no formal forestry training at all. This was identified as a problem by one field practitioner.

At a more fundamental level, ecological forestry will not only require better-trained foresters (and biologists), it will require more resources. Aligning adequate human resources to support ecological forestry will be a significant challenge.

As things currently stand, Nova Scotia foresters are already spread thin. They each manage an average of 39,000 m^3 harvested annually. This is significantly higher than in other provinces.

Table 17.1. Comparison of management load on foresters in six jurisdictions.

	Registered Professional Foresters	Annual Harvest (m^3)	Annual Harvest per Forester (m^3)
NS	94	3,700,000	39,362
AB	684	23,300,000	34,064
BC	2,780	67,900,000	24,424
Maine	787	14,400,000	17,789
NB	277	9,000,000	32,491
ON	514	15,800,000	30,739

Regardless of whether code-based or results-based systems are deployed to enable ecological forestry, the association provides a space for interaction among the individual professionals, their peers, and the organizations they serve. The association also interacts with organizations in the process of change, ideally as a positive and enabling force.

For example, if the owner of a Crown timber licence or private land is driven by a short-term economic strategy rather than a balanced approach to ecological and social issues, the professional may at some point be in conflict with the code of ethics. The association allows the professional an opportunity to "push back." This force is stronger under right-to-practice legislation. For example, in fields such as law, the fact that the lawyer's employability depends on maintaining a licence is thought to potentially discourage them from doing things their firm (or employer) might want them to do to encourage productivity or profits at the expense of professional ethics.

17.3 The Organization

Most foresters work for government agencies or corporations. Both government agencies and corporations have corporate cultures that are largely shaped by leadership figures. How leadership recruits, rewards, and disciplines individuals who report to them shapes the culture. Corporate culture

has a significant impact on a professional's behaviour. The move to ecological forestry may require corporate culture change within DNR and key licensees.

Figure 17.2 shows the various facets of corporate cultural change by Mintzberg, a professor teaching Master of Business Administration programs at McGill University.[10] Significant change requires changes that are formal and informal in both the organization's strategy and the organization itself. Many failed attempts at organizational change occur when great effort is placed on a new vision, but nothing else changes within the organization's culture, structure systems, or people. Hence the vision is never realized. The whole point of this construct is that meaningful change requires changes in all facets and components of the system.

DNR has done a good job of developing the required strategic elements for change. But have the organizational elements of change been addressed? It appears not to be the case at this time.

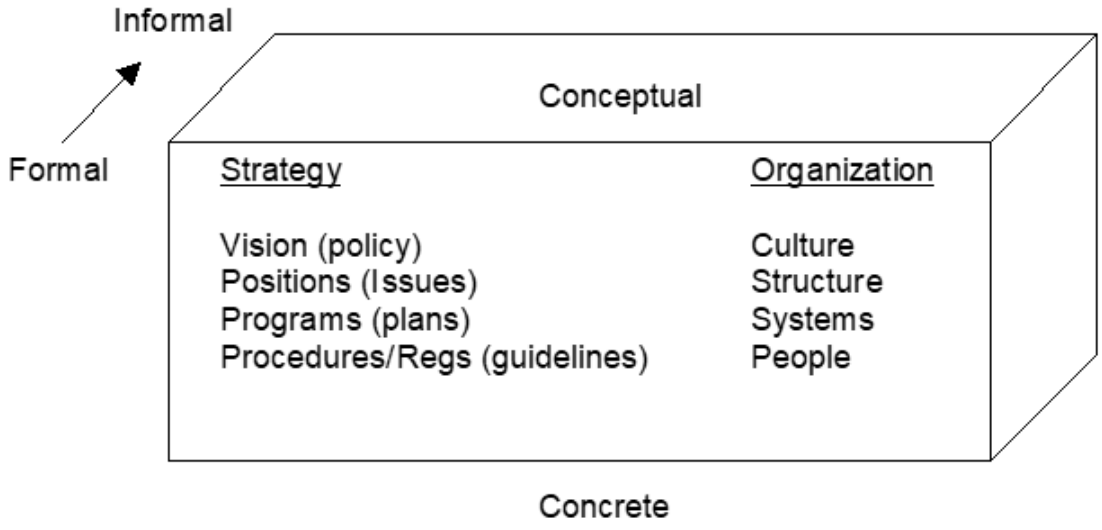


Figure 17.2. Mintzberg's change cube (words in parentheses are this author's interpretations).

The people element of an organization can be addressed by strategic hires (and reassignments) or education as described above. DNR could make changes to advance ecological forestry through its own organizational change.

Change in organizational behaviour of licensees and landowners is more problematic. Nonetheless, DNR does have influence. How much influence to exert becomes a strategic choice. The process of this Review in and of itself has an influence to some extent on the organizational cultural behaviour of licensees.

Alternatively, DNR could create entirely new licences and influence culture that way. New licences for four or more regions could be created. The terms of these licences would honour existing commitments. But the new licensees could be corporations consisting of both existing commitment holders as key

[10] http://library05.com/mintzberg-henry-business-strategy-strategy-safari-/4742-the-change-cube.html

shareholders and other stakeholders recruited as new shareholders, thus creating a robust and diverse governance structure. These entirely new organizations would develop their own culture, with a common purpose of implementing ecological forestry.

DNR could set the higher-level goals or outcomes as licence obligations, but the licensees might develop their own means of implementing ecological forestry. This diversity encourages adaptive management at many levels, including the organizational level of the implementation bodies. For example, the licence might specify, in addition to meeting wood supply commitments, a requirement for silvicultural effectiveness monitoring (Alberta has a good system), hierarchical landscape-level planning, and accountability through independent forest audits (as found in Ontario).

Currently, some licence obligations are assumed as part of wood supply agreements on Crown lands surrounding Northern Pulp and Port Hawkesbury Paper. The delivery of these forest management programs will be strongly influenced by the corporate culture of the parent pulp mill companies.

The Medway Community Forest Cooperative (2018) is an example of a novel form of organization developed to deliver a forest management program. The board members represent a cross-section of interested stakeholders, but no forest products companies are shareholders. Elsewhere, community forests that have small forest areas lacking a strong licensed mandate, or the means to charge management fees as granted by DNR or other government agencies, have not been successful over the long run.

WestFor Management Inc. (2018) is another example of a new organization in charge of delivering a forest management program on Crown land in Nova Scotia. All shareholders are forest products companies (consuming mills). Unlike cooperative licensees elsewhere, such as Westwind Forest Stewardship Inc. (2018), WestFor has no supplier shareholders or other stakeholders on its board. It seems that WestFor is all about the business, and Medway is all about the social licence – to be successful, ecological forestry requires both.

Landowner behaviour can be changed through extension, tax incentives, or regulations. This presents a significant but not insurmountable challenge. There are examples of progress using both voluntary systems in Minnesota and regulations in Maine, Oregon, and Washington.

It appears that Nova Scotia is not interested in a regulated system to influence private landowner behaviour. For this reason, Minnesota's system is useful to look at. Following an environmental assessment of forestry practices in the 1990s, the government created an implementation body called The Minnesota Forest Resources Council. The charter is as follows:

> The Minnesota Forest Resources Council (MFRC) is a 17-member board created to develop policy recommendations to the Governor and federal, state, and local governments and to encourage the adoption of sustainable forest management policies and practices. Council members represent a wide range of forest resource interests and hold public meetings every other month to discuss key issues.
>
> For over 20 years, the council has played an integral role in depoliticizing complex forest issues and helping Minnesota's citizens, lawmakers, and forest professionals make sound decisions regarding the stewardship of public and private forest lands. The council acts as a catalyst for new landscape-level cooperative models and championing long-term ecosystem integrity (MFRC 2018).

This system has worked very well. Credible independent audits show high rates of compliance for voluntary best-management practices. Should Nova Scotians act on this Review's recommendations and build new organizational and implementation structures to advance ecological forestry with or without an environmental assessment, they will have been well served.

There is surely a key role for woodlot associations. The Nova Scotia Woodlot Owners and Operators Association (NSWOOA) "believes that forest practices should mimic natural processes in the native Acadian forest, which covers most of mainland Nova Scotia and parts of Cape Breton" (NSWOOA 2018) and hence clearly supports ecological forestry. It offers many resources to landowners to encourage their participation in ecological forestry and a wood products marketplace.

In summary, effecting cultural and attitudinal change in the way forests are managed is a long-term effort that needs to be supported by appropriate social constructs, including the full range of civil society elements mentioned above. The government also needs to play a leadership role in this effort, and there are many indications that the government, and DNR specifically, needs to regain the trust of Nova Scotians.

18 Environmental Assessment of Forest Management

(Prepared by Peter Duinker)

1. Industrial forest management for timber production is an enterprise that can have profound effects on environmental, economic, and social values associated with the landscape. Across Canada, a number of processes have been used in the past four decades to reduce the undesirable effects of industrial forest management to acceptable levels, including: (a) environmental assessment (EA) processes; (b) environmental protection legislation; (c) greening of forestry professional education curricula; (d) conservation-oriented forest policy and legislation; (e) peer mechanisms such as Canada's Model Forests; (f) accords and strategies for sustainable forest management; (g) application of criteria and indicators of sustainable forest management; (h) codes of forest practice; (i) recognition of international agreements, such as the Global Convention on Biological Diversity; (j) third-party forest certification; and others.

2. Four Canadian provinces apply the provincial EA process to industrial forest management plans for Crown land. Saskatchewan and Manitoba treat each such plan as an individual undertaking. In Ontario and Newfoundland & Labrador, the class EA process was used to ensure implementation of a forest management planning process that meets basic EA standards for scientific and participatory elements. In all other provinces where industrial forest management occurs on Crown land, the forest management plans are exempt from the EA process.

3. What might be the value of calling forest management plans for Crown forests in NS into the EA process? For one thing, the forest management planning process in NS is currently lacking in open and transparent public engagement. Application of the provisions of EA would force forest managers to take a much more proactive and forthright approach to public engagement. For another, the EA process demands a thorough investigation into the full range of ecological and social effects of industrial forest management, something not now accomplished in routine forest management planning in this province.

4. Are there downsides? Indeed there are. If the NS EA process were to be applied to forest management planning as a Class-1 undertaking, both the science and the engagement requirements would be found lacking. Forest management across broad landscapes for many future decades is an undertaking that can have profound effects on the environment and society, and these effects are hardly sufficiently scrutinized without sophisticated impact forecasting tools and vigorous citizen engagement. According to the Environment NS website, "Class 1 undertakings are usually smaller in scale and may or may not cause significant environmental impacts or be of sufficient concern to the public" - this does not describe industrial forest management in NS. Secondly, one could argue that the NS EA system is already overtaxed with other kinds of projects, especially given the paltry resources assigned to the process. Is it a good thing to invite another government department into the decision-making process for industrial forest management on Crown lands?

5. Perhaps NS should adopt the class EA approach, as did ON in the 1980s and NL in the 1990s. In both these provinces, a major EA process was undertaken to assure the public that the forest management planning process was indeed implemented according to the strongest principles of impact science and citizen engagement. Under a class EA, all forest management plans are scrutinized by the environment department of the respective government, mainly to see that the principles of EA as specified in the class EA release document have been followed. No separate EA is conducted unless sufficient public

concern is raised such that the Environment Minister's discretion to call for a project EA is implemented.

6. Given the level of controversy over social and environmental effects of industrial forest management on Crown lands in Nova Scotia, it is my view that an EA process is needed for that activity. The key stakeholders associated with forested Crown lands should negotiate which approach would be most advantageous - application of a class-style EA process (which may look much like a strategic EA - see Sinclair et al. 2017), or application of the provincial class-II EA process for each iteration of a Crown forest management plan. Either way, it will be vital to implement rigorous cumulative effects assessment in the process (Sinclair et al. 2017). That will go a long way toward providing useful effects knowledge and implementing a substantive version of adaptive management (Duinker and Trevisan 2003).

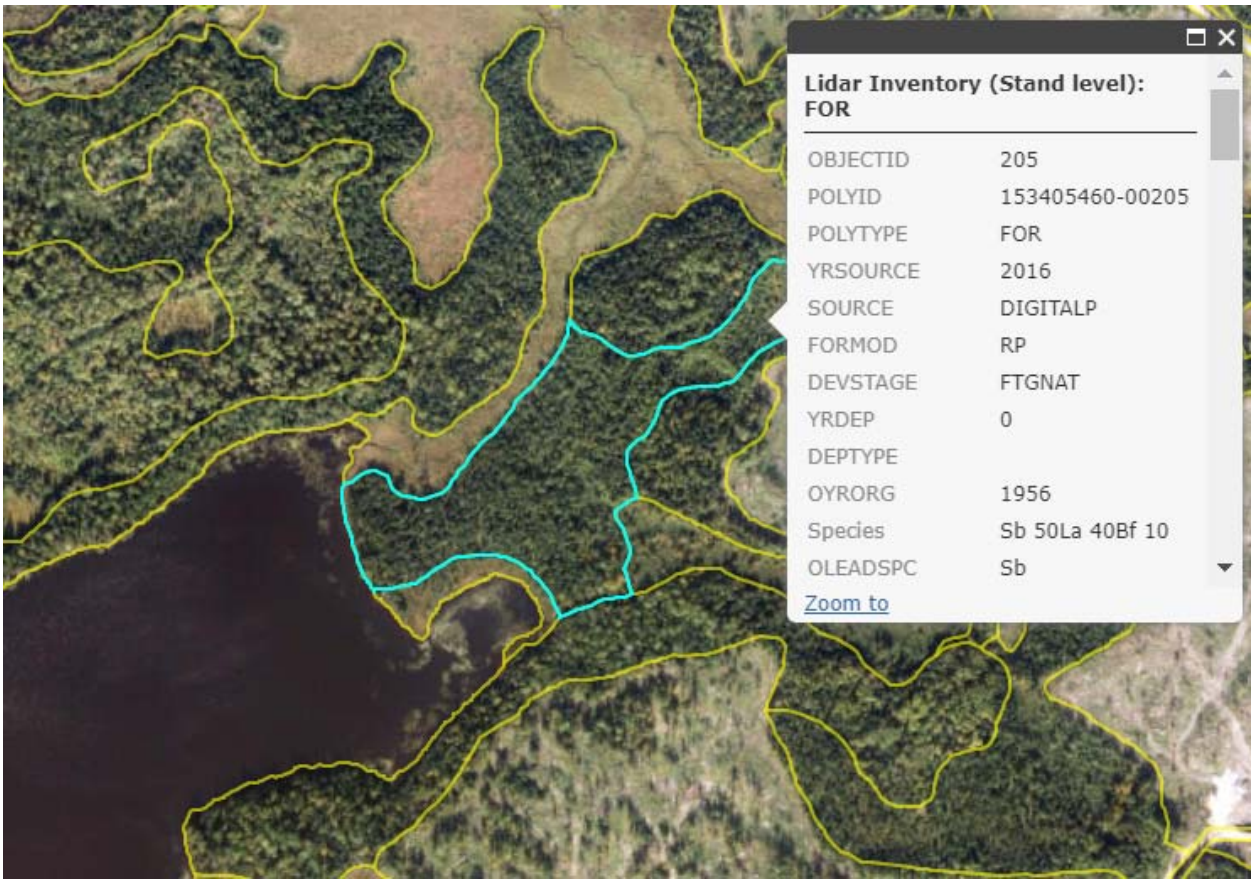
19 The Impact of Emerging Technology on Forestry Practices

(Prepared by Laird Van Damme)

The foundation to forest management planning is the forest inventory. In Europe and the USA, a grid of sample plots was used to generate statistically valid estimates of volume for an area of interest. This method was in use for 100 years or more in some cases.

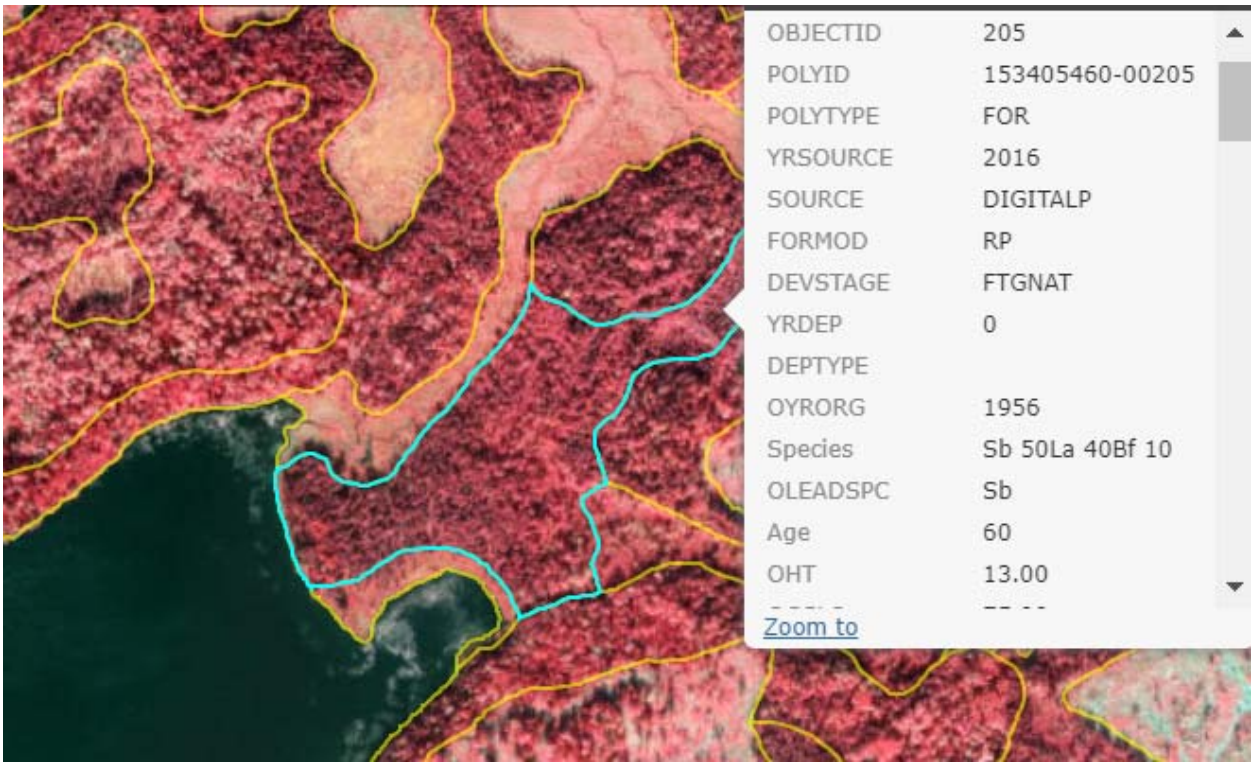
Canada has used aerial photograph interpretation to produce statistically invalid but nonetheless useful estimates of volume. The advantage of this method is that it maps out where the volume is among other important features such as lakes and streams. This has been the dominant method since the 1940s. Nova Scotia uses both sample plots and aerial photography. In fact, its network of permanent sample plots has been maintained since the 1960s. Few other provinces have maintained such a consistent and dedicated inventory program.

The smallest unit of management is a stand consisting of a homogenous group of tree species and age/sizes. Harvest blocks consist of groups of stands. This matches even-aged management planning system applications rather well.



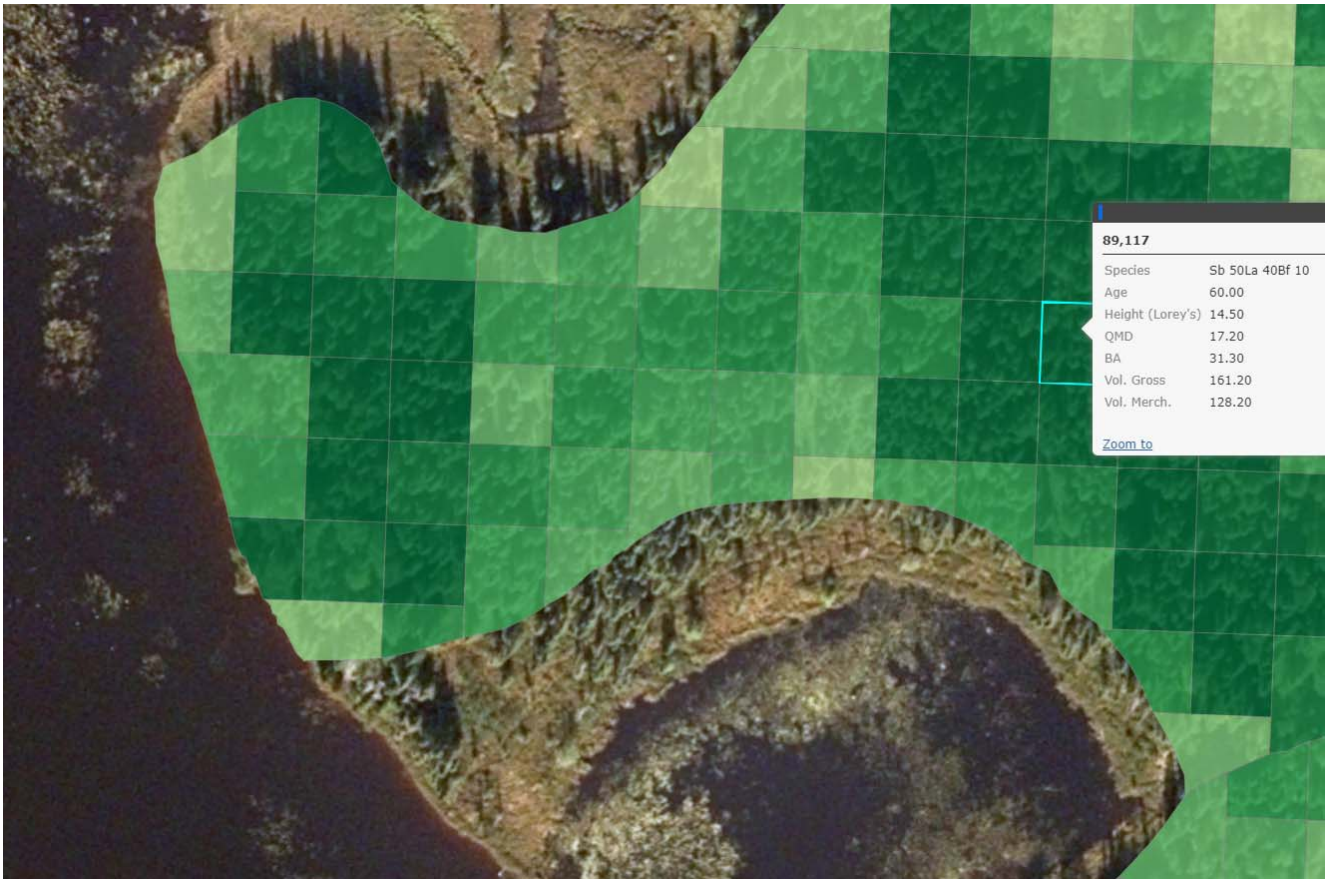
In the last ten years, digital multi-band imagery from satellite and airborne sensors has been used to better estimate tree species and volume, and to identify ecosites (vegetation and soil associations). The base unit of management remains the *stand*.

But digital data do allow for sub-stand-level information to be used. Whereas in the past a standard forest township scale map would have 1,000 stands, new maps are averaging 3,000 stands per map, reflecting a finer-scaled approach. The process still relies on photo interpretation by well-trained humans. In the case shown below, the estimated stand height of the spruce, larch, and fir was 13 m.

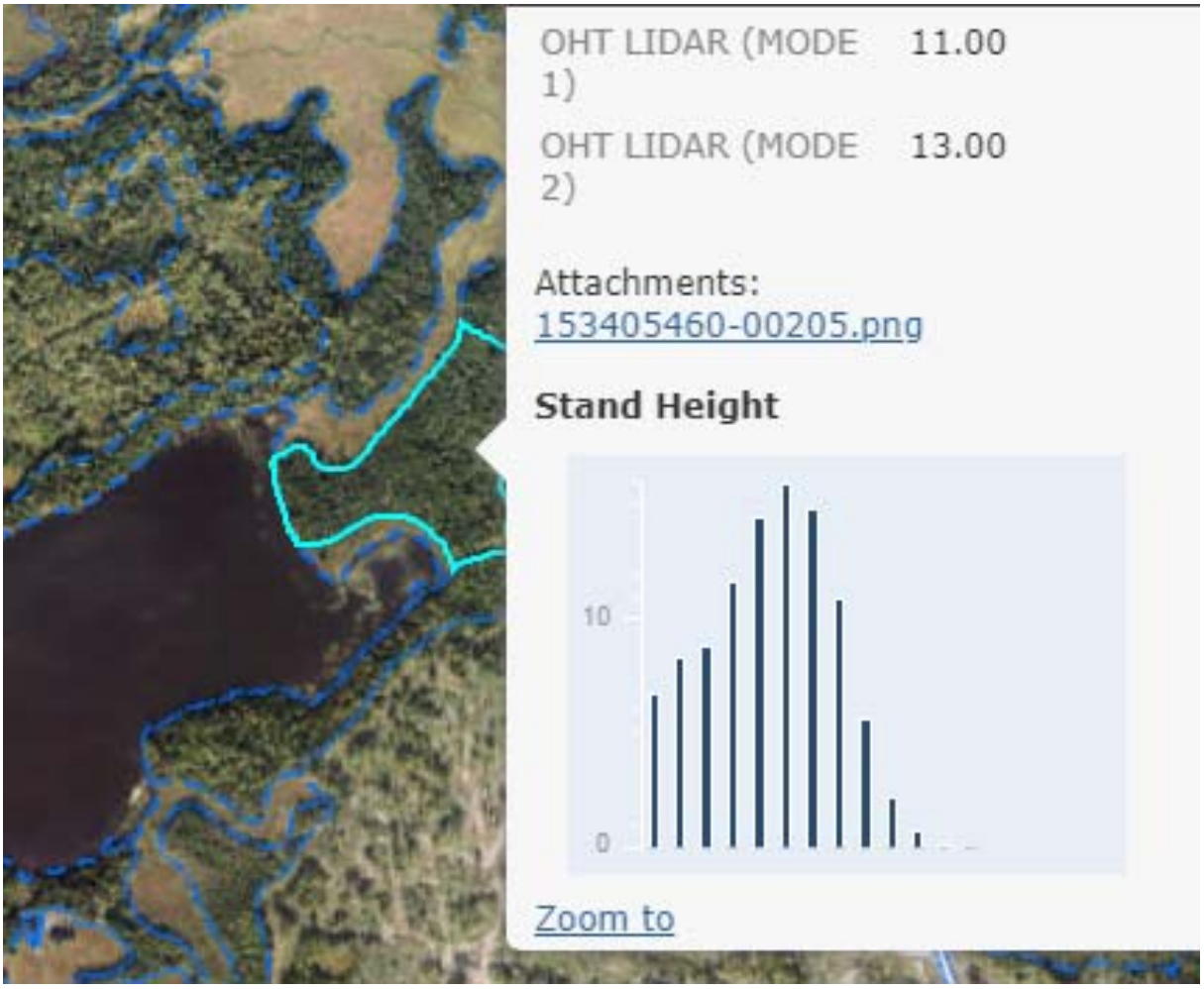


LiDAR is an active airborne sensor that emits and receives laser pulses that accurately measure terrain elevation and tree crown characteristics such as tree height. This allows for semi-automated and more-accurate classifications. In this case (see below), the calculated height is 14.6 m, and estimated volume is 110 m^3/ha. (This happens to be close to an average volume for Nova Scotia.)

LiDAR data can also be used at the sub-stand scale. In the following image, 16-m^2 pixels identify taller trees with higher volume (dark green) within the stand compared to shorter trees and lower-volume areas (light green). Rather than clearcutting this stand, an irregular shelterwood harvest could focus on the dark-green areas and retain the light-green areas for future harvest.



LiDAR data also allow for estimation of piece-size distribution. These distributions are a key factor used for determining product values and harvest costs. These data can also be used to prescribe which type of harvest pattern is most appropriate.



LiDAR can also be used to map individual tree crowns. Crown maps, in addition to estimating volume, may help predict wood quality. Now the focus of management can be individual trees, and this enables uneven-aged management and partial-cutting systems.

The remote-sensing-based data can be used for strategic and operational planning. Currently in Nova Scotia, pre-treatment assessment (PTA) data are collected using a grid of sample plots to estimate volume and piece-size distribution, among other things, at a reported cost of $2/tonne, or $200/ha. LiDAR image data and processing will cost less than $2/ha and reduce PTA costs by at least 50 per cent.

The LiDAR and associated thematic-map-products data can be viewed on phone and tablet applications by harvest machinery operators with real-time georeferencing using GPS technology. Hence, ribbon and paint are no longer required (saving $70–$100/ha) (Source http://fpsuite.ca/l_en/fpdat.html). These systems are already being deployed in Nova Scotia.

(Image source: http://www.treemetrics.com/ourtechnology/)

Having a full-tree enumeration and real-time data collection while wood is harvested enables new ways of organizing wood products inventory and supply management. These new systems can potentially save the industry nationwide billions of dollars each year (Dr. Kevin Crowe, personal communication). Furthermore, making data and support tools available online to landowners may encourage participation in a virtual marketplace. Such a marketplace may help set fair prices and encourage participation in forest management programs.

In addition to the above, LiDAR-data-derived products, such as accurate elevation models, are a form of infrastructure that can be used to attract investment. Accurate data of this nature are used by the transportation, energy, mining, and agricultural sectors. Flood mapping and other emergency response

efforts are enhanced with these data. At a reported $0.43/ha for acquisition, this will provide a good return on public investment dollars.

[*Disclosure: KBM Resources Group, owned partly and managed by Mr Van Damme, has two aerial LiDAR systems used in forestry, energy, and mining applications in Central Canada. KBM has not done any of this type of work for the Province of Nova Scotia*.]

20 Brief Overview of the Forest Policy and Implementation Framework in British Columbia

(Prepared by R.A. [Al] Gorley, RPF)

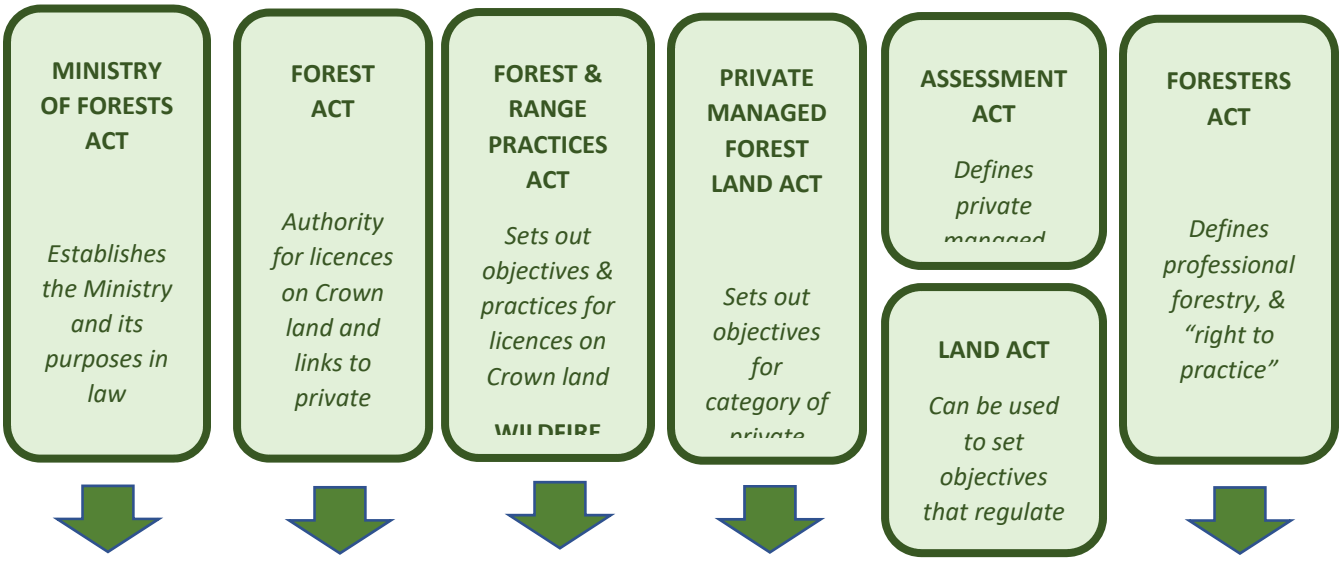
20.1 Purpose

A quick, high-level description of some forest practices policy and implementation approaches used in British Columbia, aspects of which may inform the discussion taking place in Nova Scotia.

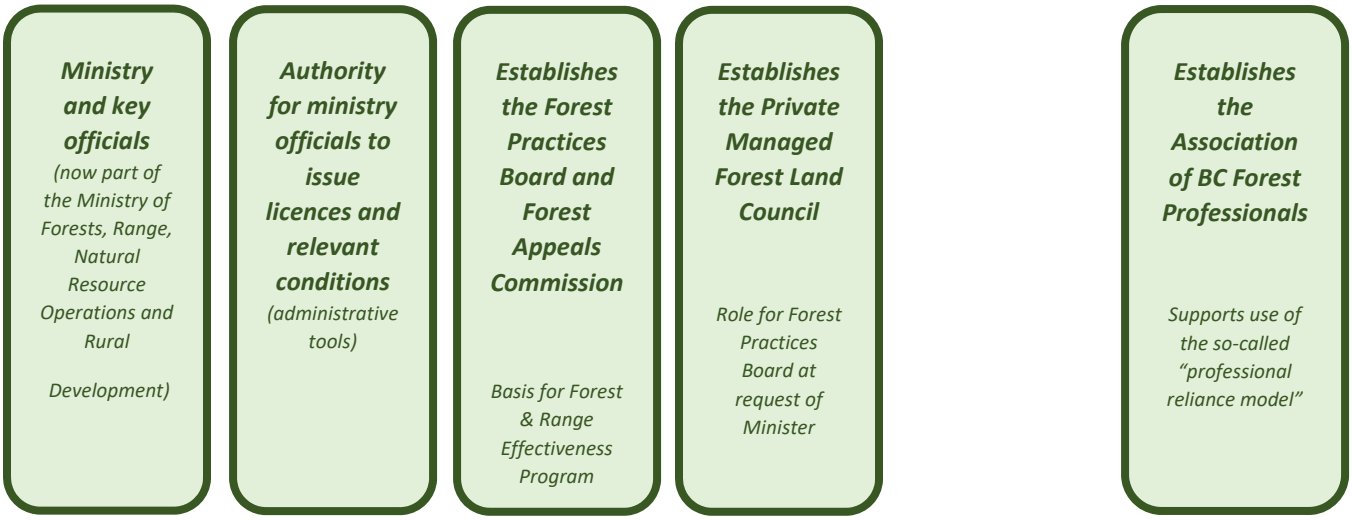
20.2 Overall Framework

The following diagram shows the major forest practices policy and implementation instruments currently in place in British Columbia.

KEY LEGISLATION (POLICIES)



KEY IMPLEMENTATION STRUCTURES



20.3 History

A major difference between BC and NS, besides the obvious ecological aspects, is the fact that about 95% of BC's forest land is Crown, whereas the majority in NS is private. While the BC experience may be instructive, NS may need to put its priority on different policy and program "levers" to achieve the public's interests. Having said that, there are parallels in public expectations and concerns regarding forest practices.

Many of the components of the BC framework have been in place for decades with only incremental change, and certainly since a Royal Commission report in the late 1970's. This is particularly true for the *Forest Act* and the *Foresters Act*. However, the policies bringing forest practices into legislation are more recent, having been brought in initially in about 1995 (*Forest Practices Code Act*), and then undergone a significant adjustment in about 2004 (*Forest and Range Practices Act* and *Wildfire Act*).

What we commonly refer to as "the war in the woods" was raging in the mid '90s. The focus of much of the public discontent was forest practices – mainly clearcutting. Of course, it was much more complicated than that. A new government decided to bring forest practices, most of which had been left to the discretion of licence holders and professional foresters, into the legal realm – essentially shifting much of the discretion to government. Even at that, the public distrust in government's will to regulate the industry was so high that an independent oversight body was created (Forest Practices Board). To protect licensees from misuse of government discretion without having to go straight to the courts, another body was established (the Forest Appeals Commission).

Although most of BC is Crown land, there are some significant blocks of private forest land on highly productive sites, especially in the south and on Vancouver Island. In an effort to balance private rights with the public's interests in private land forest practices, yet another organization was created (the Private Managed Forest Land Council).

The following commentary attempts to describes in a bit more detail the origins of key framework components, how they have evolved, some of their linkages.

20.4 Commentary

20.4.1 Ministry of Forests Act – *Ministry mandate*

This *Act* has been in place for nearly 40 years with relatively little change (even though the name of the Ministry changes frequently – currently the Ministry of Forest, Lands, Natural Resource Operations, and Rural Development). The act defines the purposes and functions of the ministry as:

Under the direction of the minister, to do the following:

- encourage maximum productivity of the forest and range resources in British Columbia;
- manage, protect, and conserve the forest and range resources of the government, having regard to the immediate and long-term economic and social benefits they may confer on British Columbia;
- plan the use of the forest and range resources of the government, so that the production of timber and forage, the harvesting of timber, the grazing of livestock and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are coordinated and integrated, in consultation and cooperation with other ministries and agencies of the government and with the private sector;

- encourage a vigorous, efficient and world competitive timber processing industry, and ranching sector in British Columbia; and
- assert the financial interest of the government in its forest and range resources in a systematic and equitable manner.

When developing policy, and as a statutory decision maker in various capacities, I often referred to this section when called upon to "balance" competing interests or perspectives.

Ministry of Forests Act: http://www.bclaws.ca/civix/document/id/complete/statreg/96300_01

20.4.2 Forest Act – *Administrative authority and direction*

This *Act* covers the administrative authority and parameters for implementation of much of the ministry's mandate. It sets out the authority for issuing various types of licences for Crown timber. It also establishes linkages to harvesting timber on private land that is managed in conjunction with public land (e.g., Tree Farm Licence, Woodlot Licence, Community Forest Licence, First Nations Woodlands Licence). Note that while these are area-based licences, a great deal of the timber in BC is harvested under volume-based (quota) licences.

Another notable aspect is that this *Act* provides the authority for the Chief Forester (or other specified officials) to set an allowable annual cut (AAC) for Crown land areas (timber supply areas) and for area-based licences. It also sets out what must be considered in the setting of an AAC. By convention, the setting of AACs has become a rigorous process with well-defined public input requirements and reasonably high transparency by publishing the analysis and the decision rationale. This convention of providing the public with written reasons for decisions is being adopted more broadly, especially for more-complex or controversial decisions.

Although it has evolved to reflect government policy changes, the structure and content of the *Act* has remained stable since it replaced the former *Act* following a Royal Commission in the late 1970's.

Forest Act: http://www.bclaws.ca/civix/document/id/lc/statreg/96157_01

20.4.3 Forest and Range Practices Act and Wildfire Act – *Practices policy and implementation structures*

Prior to 1995 government's influence over most forest practices was achieved through administrative means: contract requirements, cutting permit conditions, and operating guidelines, sometimes with little or no ability for enforcement. For the most part, practices were determined by licensees or landowners following the advice of professional foresters or engineers.

In 1995 the government brought in the *Forest Practices Code Act* through which it codified numerous standards, and many specific practices in law, making them legally enforceable. Many of the new requirements were aimed at protecting the environment and non-timber values. Despite the huge effort that went into developing the legally enforceable practices, involving government, industry and academia, there was significant push-back from the industry. One problem was expense – the new requirements involved processes, redundancy, and default standards that increased approval time and costs. A related, but different industry concern was the amount of discretion given to government officials and the lack of flexibility given to industry. This very "prescriptive" code satisfied much of the

public demand for tighter controls, but the perceived threat to industry viability convinced a new government, elected in 2001, to change it.

The industry argued that the intent of the 1995 legislation could be achieved more cost-effectively through an approach that focused on "results" and gave discretion on how to achieve them back to licensees, who would rely on the advice of professionals. This led to the new government replacing the *Forest Practices Code Act* in 2004 with the *Forest and Range Practices Act.* Around the same time, it took practices related to wildfire prevention from pre-existing regulations and created the *Wildfire Act*. The negotiations leading to the change resulted in creation of a provincial Forest and Range Evaluation Program that monitors practices for the purpose of evaluating effectiveness. The *Land Act* is not discussed here but has provisions for setting objectives that become a legal requirement (typically spatially based protection measures, e.g., for old growth).

A key aspect of the *Forest and Range Practices Act* is the *Forest Planning and Practices Regulation*. This is because it sets out the government's "objectives" for a number of identified "values" impacted by forest practices (e.g., soil, water, wildlife, visual quality, etc.). Most of these "objectives" are constrained by a requirement that they not unduly reducing the supply of timber. A licensee must submit a plan showing how it will meet these objectives as a perquisite for receiving authority to harvest timber.

Forest Planning and Practices Regulation: http://www.bclaws.ca/Recon/document/ID/freeside/14_2004

Forest and Range Practices Act:
http://www.bclaws.ca/civix/document/id/consol21/consol21/00_02069_01

Forest and Range Evaluation Program: https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/integrated-resource-monitoring/forest-range-evaluation-program

Two institutions created under the 1995 legislation were continued under the new government, and are still fully operational: The Forest Appeals Commission, and the Forest Practices Board.

FOREST APPEALS COMMISSION

- Operates independent of government.
- Full time chair and staff (legal and administrative).
- Part-time commissioners appointed by government (combination of legal and forestry expertise).
- Hears appeals by licensees against government decisions.
- Can affirm a decision, replace it, or send it back.
- Decisions of the commission can be appealed to the courts.
- Forest Practices Board can bring an appeal.

Although the number of appeals about forest practices brought to the commission seemed to decrease as the new "results-based" code took hold, the existence of the commission still provides some protection to the industry from heavy-handedness or inappropriate use of discretion by government officials.

Forest Appeals Commission: http://www.fac.gov.bc.ca/

FOREST PRACTICES BOARD

Jurisdiction extends to the activities carried out under the *Forest and Range Practices Act* and the *Wildfire Act* by persons authorized under the *Forest Act* (in other words all forestry licensees on Crown land), and to the appropriateness of government enforcement. Since the government carries out some forest practices through its timber sales program, the board can also investigate those.

- Operates independent of government.
- Full time chair and staff (auditors, investigators, legal, and administrative).
- Part-time board members appointed by government (generally a cross-section of professional expertise and perspectives).
- Carries out routine (random) audits on licensee and government timber sales operations. These are on-site field audits for compliance and soundness of practices.
- Investigates complaints from the public or organizations about industry or government practices.
- Conducts special investigations into recurring issues of compliance or effectiveness (not specific to a single party), and into the effectiveness of government enforcement.
- Provides special reports into matters of public interest related to forest practices.
- Monitors statutory determinations (e.g., significant authorizations, penalties) and may initiate or intervene in an appeal to the commission.
- Reports to the public at the same time as it reports to the parties and government.
- Cannot make an order or overturn a decision of government.
- Can audit practices on private land if requested by the Minister (no history of this occurring that I'm aware of).

Forest Practices Board: https://www.bcfpb.ca/

Example of an audit report: https://www.bcfpb.ca/wp-content/uploads/2018/02/ARC209-Downie-FL-A31102-WEB.pdf

Example of a special report: https://www.bcfpb.ca/wp-content/uploads/2016/05/SR42-NSR.pdf

Example of a complaint report: https://www.bcfpb.ca/wp-content/uploads/2016/04/IRC195_Haida_Gwaii_VQOs.pdf

20.4.4 Private Managed Forest Land Act – *Practices policy and implementation structure*

This legislation was brought in in 2003 to provide a parallel, but less restrictive regime for regulating forest practices on private managed forest land classified under the *Assessment Act.* It establishes "objectives" for protection of soil, water, fish habitat, critical wildlife, and for reforestation. The *Act* also establishes a Private Managed Forest Land Council to oversee forest practices.

PRIVATE MANAGED FOREST LAND COUNCIL

- The object of the council is to encourage forest management practices on private managed forest land, taking into account the social, environmental and economic benefits of those practices.
- Small staff, plus 2 council members each appointed by government and industry. Chair appointed jointly. All have expertise in forestry.

- Council collects information from members (power to require records and enter land) and submits an annual report to government.
- Council can require remediation or levy a penalty.
- Government can audit the council.

Private Managed Forest Land Act: http://www.bclaws.ca/Recon/document/ID/freeside/00_03080_01

Private Managed Forest Land Council: http://mfcouncil.ca/

Assessment Act – Private Forest Land:
http://www.bclaws.ca/civix/document/id/complete/statreg/96020_01#section24

20.4.5 Foresters Act – *Implementation structure*

Note: although not discussed here, other acts governing Engineers and Geoscientists, Biologists, Agrologists, and various technologists are also relevant.

In BC, Forest Professionals have "right-to-practise" legislation, meaning only they are legally allowed to practise forestry in the province. The *Act* is equally applicable on public and private land. It defines the practise of professional forestry and establishes the Association of BC Forest Professionals to regulate the profession. There are roughly 5000 members.

Although it has evolved, the *Act* has been in place for over 50 years, and so professionals have been relied upon to prescribe, implement, and evaluate appropriate forest practices. As mentioned previously, in the shift from a highly prescriptive legal code to more results-based code, it was argued that the public safety-net was in the requirement for licensees to rely on professionals to prescribe sound practices (aka "professional reliance"). Although this was not really a change from the practise of the previous 50 years, it happened concurrently with the devolution of many decisions from government officials to licensees. This created a perception, at least in the minds of some, that professionals should be making public-preference choices previously made by government officials and has drawn criticism of the "professional reliance" approach. The new government in BC is currently reviewing professional reliance, with a report due shortly. I don't think it will significantly change the role of forest professionals or their association.

Foresters Act: http://www.bclaws.ca/civix/document/id/complete/statreg/03019_01

20.5 A Few General Observations on BC's Framework

There is no overarching Natural Resources act, so planning, authorizations, and regulating occur through a variety of (usually) industry-specific policies and agencies. Several years ago, the government made a significant move to better coordinate natural resource management under "one land manager" by creating a Ministry of Forests, Lands, and Natural Resource Operations. However legislative changes do not yet reflect this approach fully, and some activities (e.g., oil and gas development) remain separate.

While the situation is workable, it creates a scenario where the same rules, standards, and oversight provisions may not apply to all operators on the land base. This is compounded in the forestry sector by the volume-based (quota) approach to licences, which can lead to several operators sharing, and having management obligations, on a common land base. One of government's responses to this has been the

development of a cumulative effects management strategy. Although still a work-in-progress, it does raise the awareness of decision makers to reduce the risk “death by a thousand cuts”.

Land use plans (zoning for priority uses and protected areas) need updating across most of the province and have varying degrees of legal standing. There continues to be a demand for better “landscape level” integrated / coordinated planning and objective setting. Of course, how this accomplished on vast areas of Crown land will be very different than on landscapes with a mix of ownership. One compelling reason for some planning that spans ownership may be fire. Our experiences in 2017 and some other recent examples suggest the trend is only going to get more challenging.

21 Market Access

(Prepared by Jeremy Williams)

21.1 Introduction

The second component of this Review is as follows:

> *Evaluate market access for private forest owners, particularly in the western region, and provide recommendations to address any identified issues.*

The inclusion of this component in the Review stemmed from the perceived difficulty that many woodlot owners, especially those in the western region, are experiencing in selling timber from their woodlots. These woodlot owners have expressed dissatisfaction with the prices that are being offered for their timber, and in some cases, the lack of a buyer for the pulpwood component of their timber. Western region woodlot owners feel that the market is not as advantageous for them because there are no major pulpwood users in the western region of the province.

In the sections that follow, the Review team sets forth an overview of the market conditions for selling standing timber in Nova Scotia. Section 21.2 provides an overview of the conditions of competition in the province for sales of standing timber. Section 21.3 considers timber supply from the different categories of forest landownership in Nova Scotia and reviews some of the recent changes in the ownership of large blocks of mostly forested land. Following that, in Section 21.4, the reductions in demand in the western region of Nova Scotia are examined in more detail, since there have been large-capacity reductions since 2007 that represent the primary reason that market accessibility has deteriorated for many woodlot owners in this region. Section 21.5 discusses the role of Crown and private timber in the market, particularly in the western region.

21.2 Background

Conifer species have long been, and continue to be, of predominant interest to Nova Scotia's forest industry. Spruce and fir, and to a minor extent red pine, constitute the spruce-pine-fir (SPF) category of timber. Provided that the wood is large enough, it is principally sawn into lumber (dimension lumber in the larger size classes and studs in the smaller sizes). Smaller dimensions of SPF are used to produce pulp and can be used for bioenergy as well. The chips that are produced by sawmills as a by-product of lumber production are typically sold to pulp mills and are preferred for pellet manufacturing over other sources of wood fibre.

White pine and eastern hemlock are also of commercial interest and are processed by specialty mills, usually for products with higher values than lumber (e.g., moulding, beams). Hardwood species such as sugar maple and yellow birch, as well as poplar and to a minor extent white birch, can yield veneer at the highest quality level. Lower on the quality scale, maple and yellow birch also provide valuable sawlogs, and below that, pulpwood. Non-veneer poplar and white birch is typically sold as wood furnish used to manufacture composite boards – there is one such plant in Nova Scotia. In the absence of such a market, fuelwood or biomass for energy are the remaining options.

Hardwood is a growing component of the overall Nova Scotia harvest – 22 per cent in 2016. However, availability of supply is not a primary concern, as the harvest remains well below the sustainable level.

Conifer is at the centre of the market access issue, especially with regard to the sale of SPF and, as we shall see, the pulpwood component of this species group in particular.

Other than Prince Edward Island, Nova Scotia has the highest proportion of privately owned land in Canada. A component of the market access issue is the principle that the Nova Scotia government has put in place that private land will be the primary source of fibre for the industry. This principle was enunciated in the "new" forest policy for Nova Scotia released in 1986 (Nova Scotia Department of Lands and Forests 1986), in response to the 1984 Royal Commission on Forestry. One of the principles of the New Policy was "Encouraging the development and management of private forest lands as the primary source of timber in Nova Scotia."

The document continued by stating, "The New Policy will respond to the needs of private owners and the requirement that they have a fair share of the available market for primary forest products and receive a fair and reasonable return for primary forest products sold." No further elaboration was provided of how this principle would translate into practice.

The New Policy principle referenced above appears with almost the exact same wording as one of the purposes and intents of the Forests Act. Again, there is no further direction provided regarding how this is to be interpreted or achieved. This lack of specificity has led to divergent interpretations; compared with most members of government and industry, private woodlot owners tend to have different views on what this principle should mean in practice.

The mid-2000s was a good time to be a private woodlot owner selling wood in Nova Scotia. However, conditions deteriorated rapidly as the 2008–2009 recession took hold. APEC (2008) describes the change in fortunes for woodlot owners at this time:

> From the perspective of private woodlot owners, the slump in market prices has been devastating. There is still a market for some of their timber at local sawmills, but the demand for residual pulp[wood] has collapsed, which discourages many woodlot owners from selling their wood. Some are exporting their goods to buyers outside the province. But many woodlot owners will choose to simply wait out the current situation until the industry restructures and prices improve, although their incentive to invest in new silviculture may be greatly diminished.

Unfortunately, these market conditions have deteriorated further, especially in western Nova Scotia, as the Bowater Mersey pulp and paper mill in Brooklyn has closed. This is the context for the Review.

21.3 Overview of Provincial Timber Supply and Demand

The provincial timber supply and demand conditions have changed significantly since 1995. Both have declined, for different reasons, with the decline in demand outpacing the decline in supply.

Timber is only supplied from that portion of the land base that is available, and one of the principal causes of the reduction in supply has been the expansion of the protected areas network in the province. Since the year 2000, the amount of protected area, including forested area, has increased significantly in the province. Thanks to additions to the provincial protected areas system, most recently those associated with the purchase of the Bowater lands in 2012, more than 12 per cent of the province is protected. In addition, the 2016 *State of the Forests* report (SOFR) reports that the area of forest in the province declined approximately 2 per cent (by 89,188 ha) since the 2008 SOFR was produced. It is

not clear from the land use figures where the lost forest area went; however, some was likely converted to agriculture and urban areas. Other area reductions may have reflected inventory reclassification.

In addition to the creation of protected areas, measures have been put in place since 2000 to protect biological diversity, species at risk, and other important values in Nova Scotia's forests. These measures primarily apply to provincial Crown land (there is generally no commercial harvesting permitted on federal Crown lands), and their impacts are difficult to assess. However, their implementation, as well as the transfer of large areas from industrial to Crown ownership, have had the effect of further lowering the available timber supply in the province.

One implication of these shifts in land use, ownership, and regulatory requirements is that the sustainable wood supply in Nova Scotia has declined from the almost 8 million m^3/y level established in 2000 (DNR 2008). The 2016 SOFR estimated that the potential harvest level, which is an estimate of the amount of timber that can be sustainably harvested in the province, is 5.74 million m^3/y, of which 4.15 million m^3/y is softwood and 1.59 million m^3/y is hardwood (DNR 2017e).

In the eastern and western regions, the hardwood harvest has since 2002 consistently been less than 50 per cent of the available amount, and in the central region, about 80 per cent. Provincially, the hardwood harvest is well below the potentially available level (the straight red line in Figure 21.1). The 2008 SOFR noted that the main issue with hardwood was the difficulty in meeting sawmill demand for high-quality sawtimber during the 1995–2006 reporting period, a challenge that has persisted.

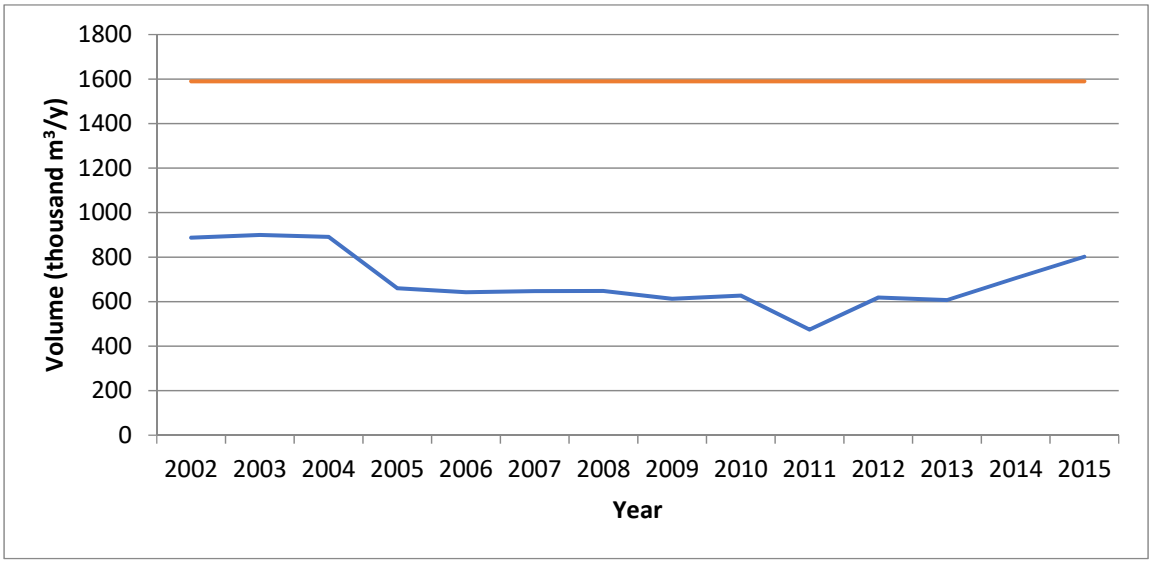


Figure 21.1. Potential (red) and actual (blue) provincial hardwood harvest volume.

In contrast, the softwood harvest in the province exceeded the 2016 level of potential supply in every year from 2002 to 2008, and this exceedance likely began in the mid-1990s. The following charts are derived from the data presented in the 2016 SOFR; Figure 21.2 shows the actual provincial softwood harvest versus the present-day estimate of the potential harvest level. The 2002 and 2003 harvests were well above the available harvest (even if the available harvest is increased by 15 per cent to account for the lower level of protected areas in existence then). The increase in harvest from the extensive salvage operations conducted in the wake of Hurricane Juan further increased the gap between available and

actual. The harvest of 2004 (6 million m^3 of softwood) was the peak; from there the decline was unabated until 2012, when the harvest reached a low point from which it has shown little recovery.

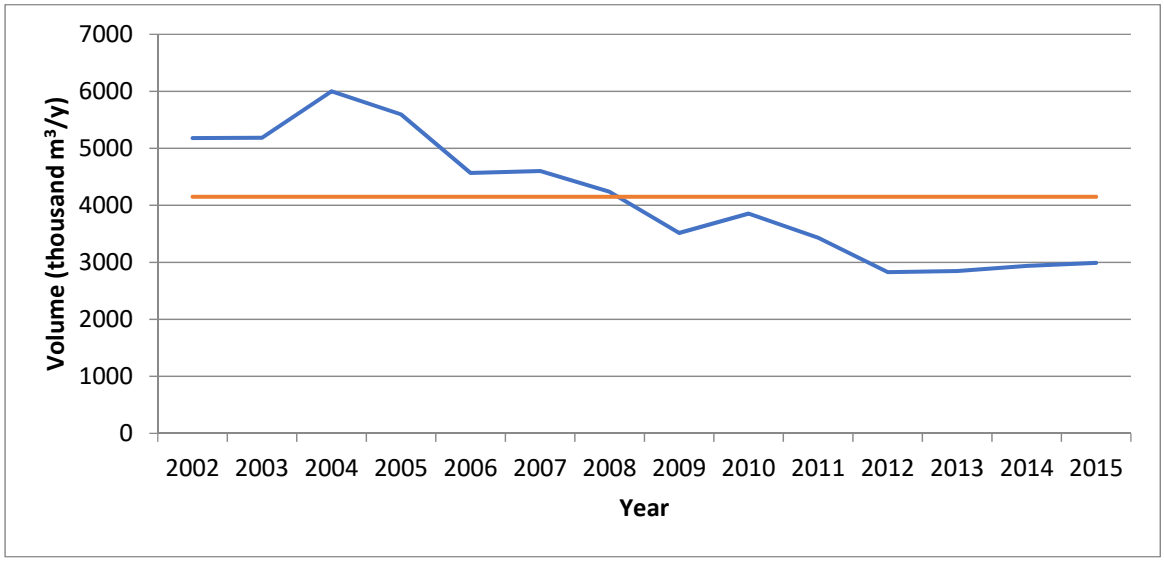


Figure 21.2. Potential and actual provincial softwood harvest volume.

In addition to timber harvested in the province, timber products are also imported as well as exported. Many of the imports are softwood, studwood, and sawlogs, as well as sawmill chips, from New Brunswick and Prince Edward Island. An average of 60 per cent of the volume of wood exported between 2012 and 2016 consisted of chips sold to Turkey, another 32 per cent of volume going to New Brunswick. Imports have gradually trended higher since 2002, reaching levels of approximately 400,000 m^3/y in 2014 and 2015.

Exports declined from post-Hurricane Juan peaks of 1.5 million m^3/y to levels in the 200,000 to 400,000 m^3/y range. While very different product types are imported and exported, the amounts are relatively low and do not have a significant impact on provincial harvest levels. The majority of imports are used by central region mills and might possibly displace some volume from western region counties such as Kings and Lunenburg. Figures 21.3, 21.4, and 21.5 show the potential and actual harvests in the central, eastern, and western regions, respectively. They show that all of the overcutting occurred in the central region – in part because Hurricane Juan's effects were concentrated there, but also because there were many mills in the region in the early 2000s, and timber prices were high, stimulating a high level of harvesting. The US housing market was still very strong at that time, driving demand for softwood lumber. It was only since 2011 that the actual harvest slipped below the estimated potential harvest.

From 2002 to 2010 the cumulative amount of conifer timber cut in the central region was 8.4 million m^3 greater than the sustainable level, equivalent to more than five years of harvest at the potentially available level. In other words, regional harvesting was more than 50 per cent above the potentially available level during much of that decade.

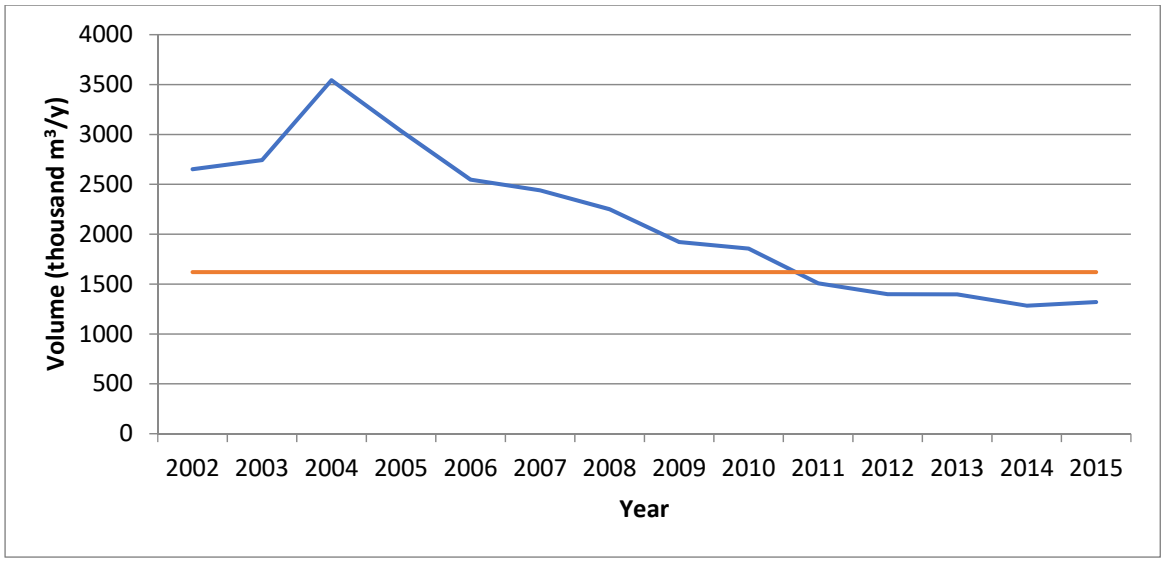


Figure 21.3. Potential and actual central region softwood harvest volume.

In contrast, the actual harvest in the eastern region only once touched the current level of the potential harvest and is now at roughly 80 per cent of the potential level (Figure 21.4). Since 2000, the ongoing operation of the Port Hawkesbury facility has led to a more stable harvest level in the region compared with the rest of the province. However, the impacts of the 2006 closure of the mill (during which time it was sold by Stora Enso to NewPage) and the closure during 2012 (when NewPage sold the mill to the current owner) affected harvesting levels, as can be seen in Figure 21.4.

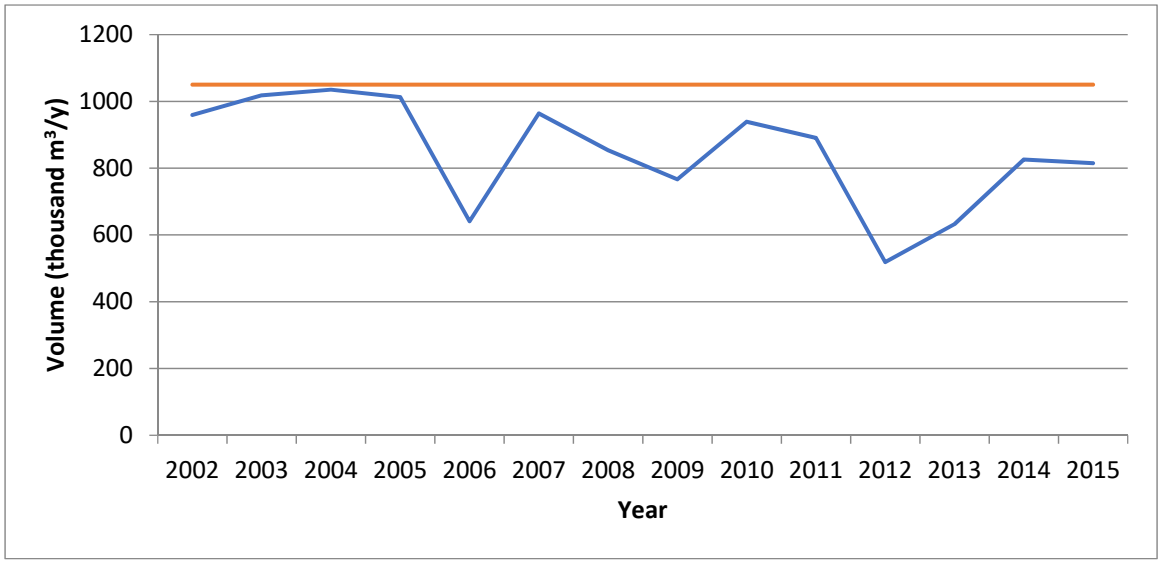


Figure 21.4. Potential and actual eastern-region softwood harvest volume.

In contrast to the central and eastern regions, the actual harvest in the western region has fallen dramatically, and it is well below the potential harvest level (Figure 21.5). The harvest in the region declined by about one-third from 2002 to 2003 and has trended downward since then. The closure of the Bowater Mersey plant and associated sawmill removed approximately 400,000 m^3 of demand, which

is visible in the chart. Although harvesting has increased from the trough in 2012, the actual harvest remains at approximately 58 per cent of the potential level. Figure 21.5 illustrates the significant deterioration in demand for timber in the western region and the low level of actual harvest compared with what is potentially available.

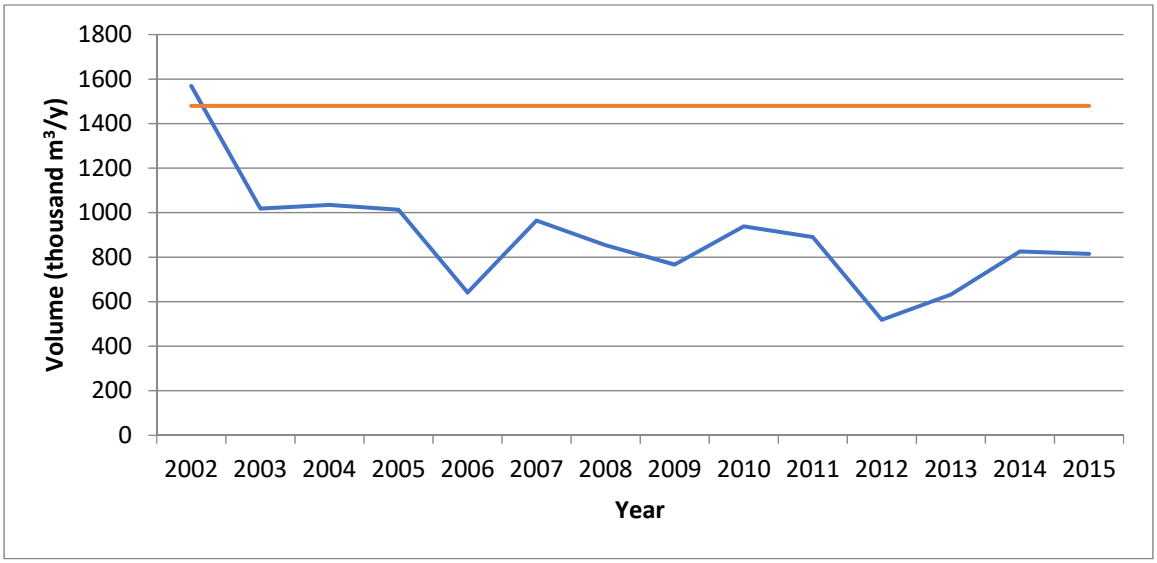


Figure 21.5. Potential and actual western region softwood harvest volume.

Figure 21.6 shows the breakdown of the provincial softwood harvest by product type. Sawlogs and veneer bolts make up the largest proportion of the harvest, averaging 59 per cent during the period shown. Pulpwood averages 39 per cent of the harvest, and fuelwood (which is primarily wood for pellets and other bioenergy) accounts for 2 per cent. The importance of fuelwood appears to have grown significantly during the period; it was a negligible part of the harvest until 2008, when it exceeded 1 per cent of the harvest for the first time, and in 2015 it was reported to have reached 8 per cent. Sawlogs and bolts routinely represented more than 60 per cent of the harvest until 2008, when the proportion fell below 50 per cent; as of 2015 it has gradually risen to 58 per cent. The trajectory of pulpwood as a fraction of the harvest has been the inverse of the sawlog pathway; the closure of the Bowater Mersey mill immediately reduced the pulpwood harvest volume (even though the mill received a good percentage of its fibre from sawmill chips), and the proportion of pulpwood in the harvest declined from 46 per cent in 2011 to 32 per cent in 2012. It has since rebounded slightly to 34 per cent.

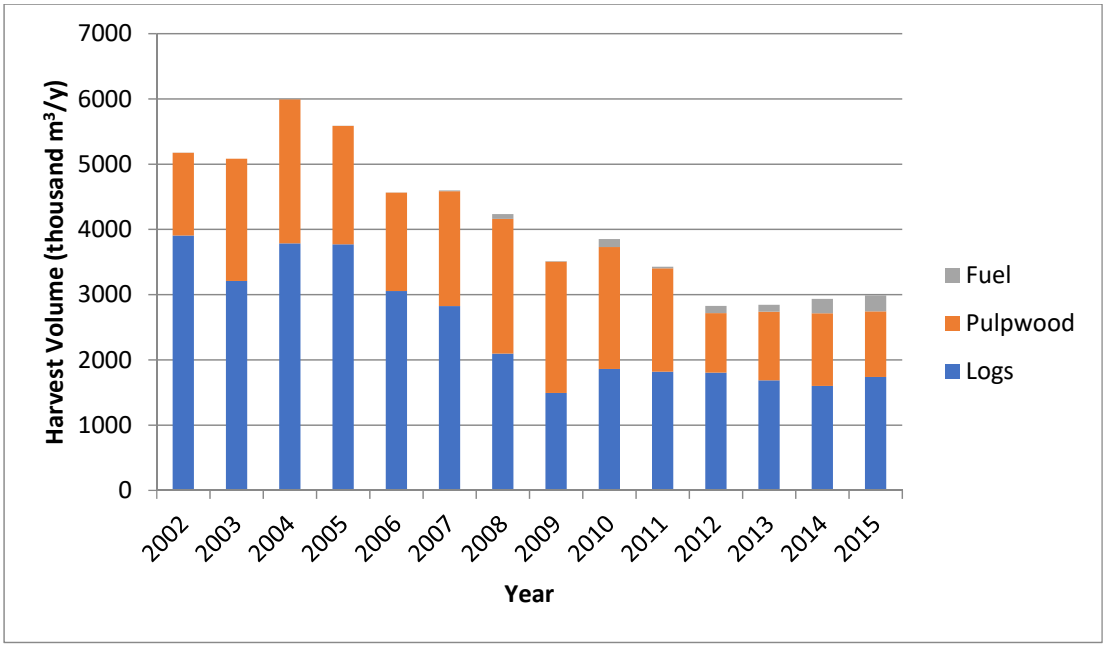


Figure 21.6. Provincial softwood harvest volume, by product type.

21.4 Timber Supply by Ownership

There are three general ownership classes relevant to the supply of timber in Nova Scotia:

1. Provincially owned Crown land that is available for timber harvesting
2. Private land owned by industrial companies
3. Private land owned by non-industrial entities

The provincial Crown land includes protected areas, lands with buffers and reserves, and areas that are generally available for timber production. The province has increased the area of protected lands significantly since 2000, from approximately 1 per cent to 12.2 per cent of the province as of December 31, 2015. This does not include an additional almost 7,000 ha protected in 2017.

A number of the mill-owning companies also own land that they harvest to provide some of the supply to their mills. This is the second category of forest landownership. This group is often referred to as "industrial landowners."

Some corporate organizations that own land and manage it to provide timber, and perhaps other goods and services, do not themselves own mills. These lands, and the woodlots that are generally owned by individuals (in some cases a woodlot might be held in a company), constitute the third category of forest landownership – the private non-industrial forests. For brevity, this group will be referred to as the "woodlot owners," as distinct from the industrial landowners.

Table 21.1 shows the number of private woodlot parcels in the province (as of 2015), with the non-industrial holdings subdivided by size class. Note that the same people might own different woodlots under different ownership names, or shared ownerships, and these types of multiple ownerships have not been reconciled. Nevertheless, it can be seen that just over half of the private forest land is in mid-sized parcels ranging from 10 to 400 ha. The table also shows that the harvest intensity is quite variable,

being very low in the smallest size class (an average harvest cycle of 457 years at the 2017 rate of harvest). The intensity generally increases with size: the largest owners (with 2,000 ha or more) are on a 115-year harvest cycle.

Table 21.1. Nova Scotia private forest ownership statistics (2015 data).

Category	Number of Parcels	Total Area (ha)	Private Land (%)	Harvested Area, 2017 (ha)	Percent Private Harvest (%)	Harvest Area / Total Area (ratio)
Industrial owner	5,170	418,626	15	3,848	22	1/109
Major owner 2000+ ha	17,680	339,266	12	2,958	17	1/115
Large owner 400–2000 ha	5,295	184,115	6	1,398	8	1/132
Medium owner 50–400 ha	32,374	958,088	34	5,335	31	1/180
Small owner 10–50 ha	42,103	759,642	27	3,428	20	1/222
Noncom owner 3–10 ha	24,340	174,271	6	381	2	1/457
Total	**126,962**	**2,834,008**	**100**	**17,348**	**100**	

Figure 21.7 shows the area of land in each of the three ownership categories as of 2016. The total area, the forested area, and the part of the forested area available for timber production (the “working area”) is shown for each ownership class. DNR estimated the working area of the forest by removing from the forest land base areas that were protected, inoperable, used as watershed or wildlife buffers, or protected under Nova Scotia’s Old Forest policy.

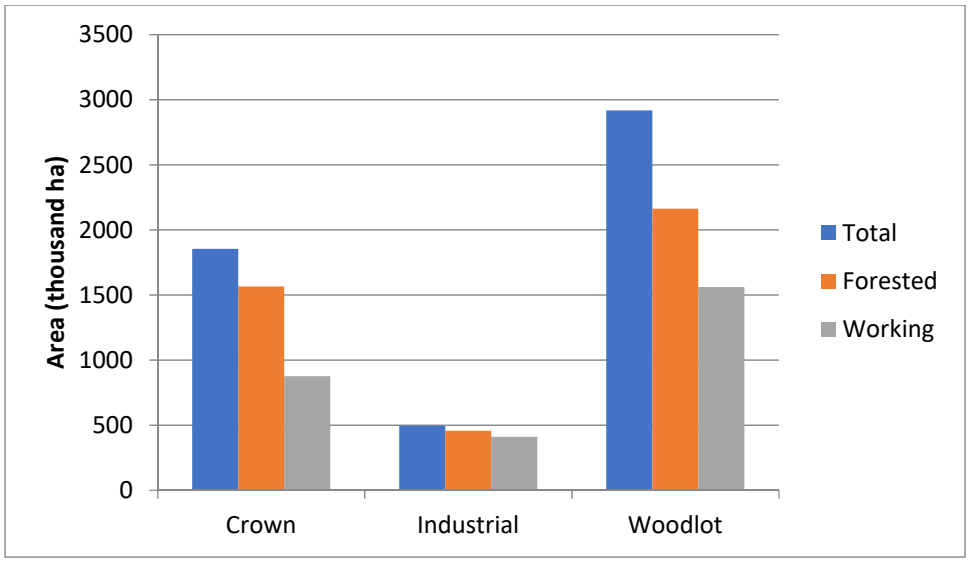


Figure 21.7. The area of total, forested, and available forested land, by ownership.

Although Crown land accounts for 35.8 per cent of Nova Scotia's land base, it accounts for only 30.8 per cent of the available forest area, largely because 540,541 ha are protected. A large portion of the private non-industrial land area is not forested (e.g., agriculture), and DNR has used woodlot owner surveys to estimate that 15 per cent of the forested area in this ownership class is not available because owners do not want any harvesting in their woodlots. DNR found that the modelled available harvest level was very sensitive to the participation rate assumption, about which there is some uncertainty. However, the department felt generally confident in the 85 per cent participation rate over the long term, since it would produce an annual rate of harvest similar to what has been observed over time. The short-term participation rate probably shifts over time; for example, it would probably increase during a period of sustained higher timber prices.

Provincially, industrial lands account for 14.4 per cent of the working forest, and non-industrial private lands account for 54.8 per cent. It is important to recognize that there have been some substantial shifts in the land base between ownership classes. Key landownership transfer events since 2000 include the following:

1. 2006: Neenah Paper sells 202,000 ha to Wagner (industrial land changed to private land).
2. 2008: In June, Neenah Paper sells Pictou mill to Atlas/Blue Wolf but retains 195,000 ha woodlands in June (industrial land changed to private land).
3. 2010: In May, Neenah Paper sells 172,000 ha to Northern Pulp (private land that had previously been industrial land changed back to industrial land) and 23,000 ha to Crown (private land changed to Crown land). Province completes purchases of: (a) 1,620 ha from J.D. Irving in Yarmouth, Shelburne & Annapolis Counties; (b) approximately 4,050 ha from NewPage in Antigonish, Guysborough, Pictou, Inverness & Victoria Counties; and (c) 26,300 ha from J.D. Irving in Yarmouth, Annapolis, Digby & Cumberland Counties (changing private land to Crown land).
4. 2012: Province buys Bowater lands in December (approx. 220 000 ha changed from industrial lands to Crown lands, some of which became protected Crown land).

The net result of these changes was a 524,000 ha reduction in the area of industrial land, an increase of 324,000 ha of Crown land, and a 200,000 ha increase in private non-industrial land.

Figure 21.8 shows the provincial timber harvest volume by ownership class, and Figure 21.9 shows the proportion of the provincial timber harvest that came from each ownership class. The volume of harvest has declined on both of the two private ownership classes and risen on Crown land; however, a key factor was the purchase of the Bowater lands by the province in 2012, which shows up clearly in both figures. The net increase in industrial land in 2010, as well as the reduction in industrial land in 2008 (explained above), also show up in the figures.

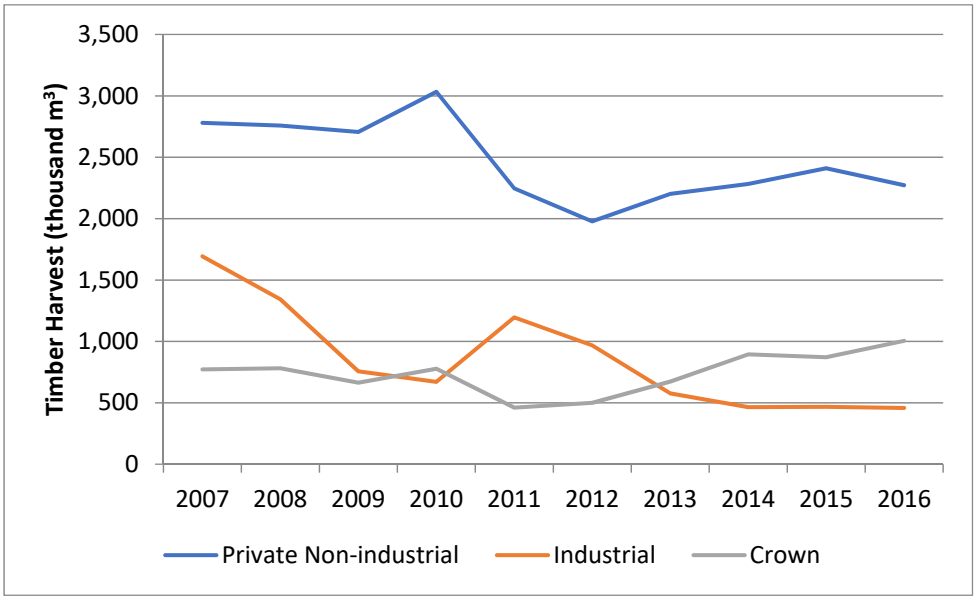


Figure 21.8. Provincial timber harvest, by ownership class.

Figure 21.9 shows most clearly that the non-industrial private lands have maintained and slightly increased their share of the provincial harvest, while the wood supply shares from Crown and industrial land have essentially been flipped between the two ownership classes.

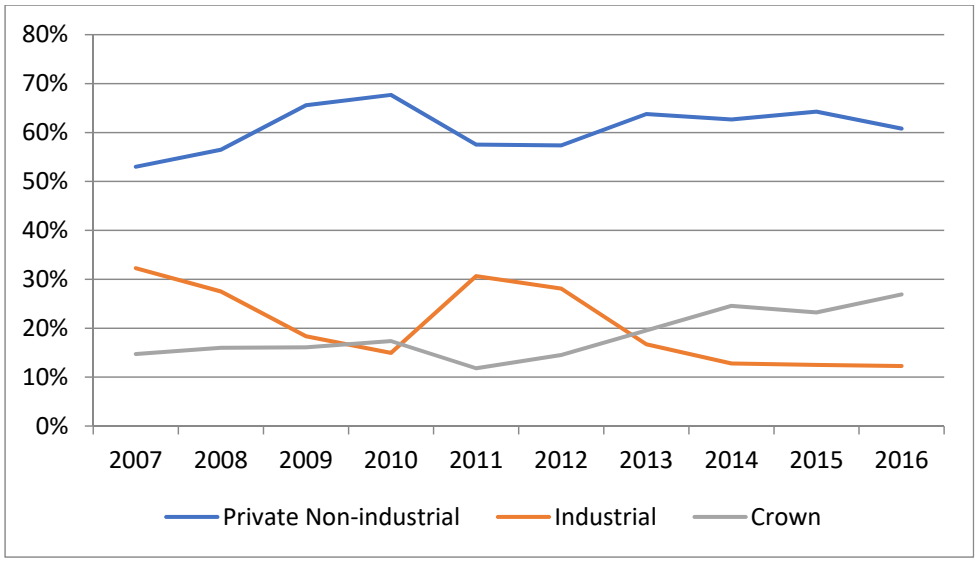


Figure 21.9. Percentage of provincial timber harvest, by ownership class.

21.5 Changes to Western Region Timber Harvest Levels

We will now take a closer look at the composition of supply and demand in the western region, where the majority of the perceived market access issues have been reported.

One of the challenges of characterizing the timber market in the western region is being able to separate factors that have operated province-wide from those that are specific to the region. Figure 21.10 shows that between 2007 and 2016 the trend in harvest volume in the western region was very similar to the provincial trend.

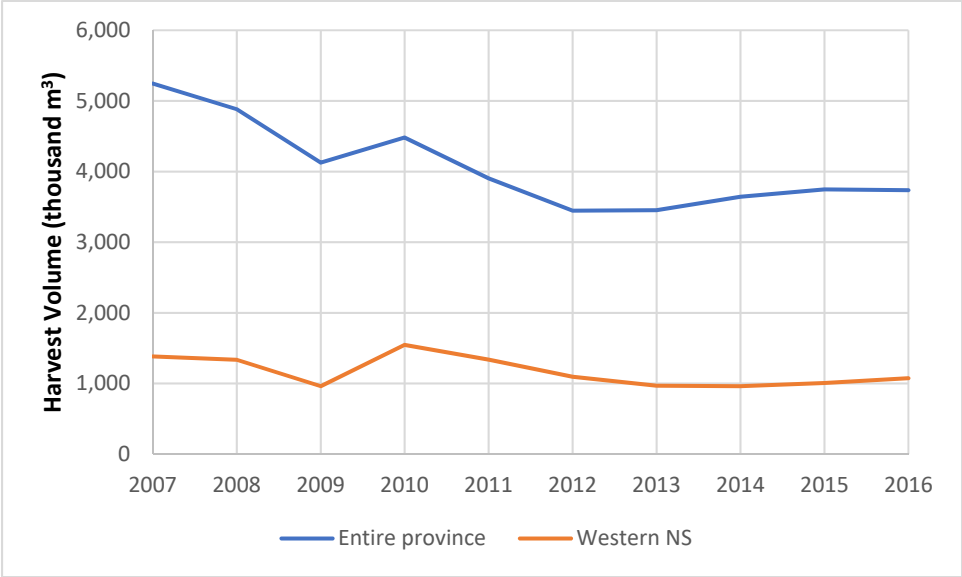


Figure 21.10. Timber harvest volume – all species.

The trends in the non-industrial private harvest in each region are shown in Figure 21.11. The eastern and western regions show similar trends, while the central region has a more pronounced early decline and avoids the dip in 2012. This figure does not indicate that the western region is losing market share provincially.

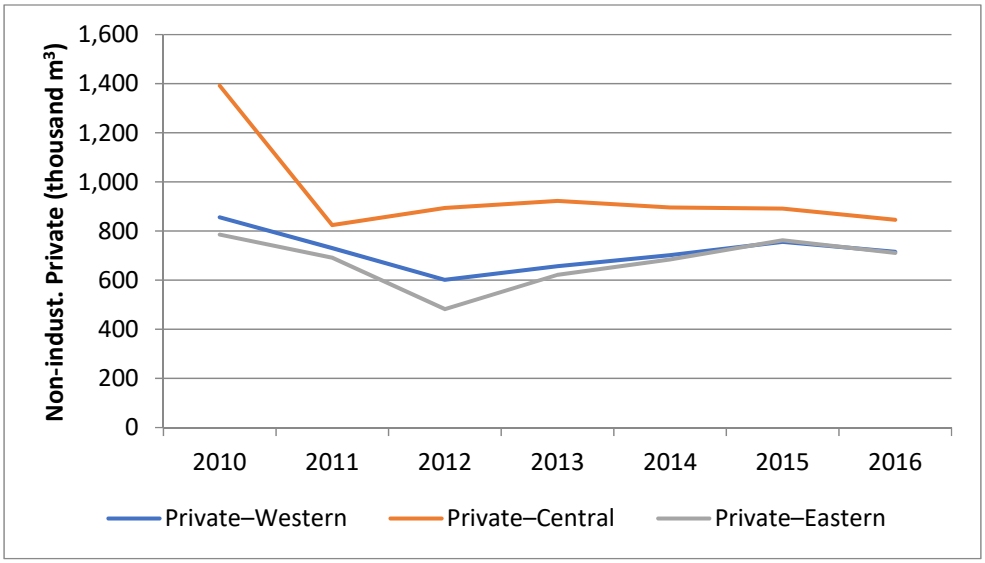


Figure 21.11. Timber non-industrial private harvest volume – all species, by region.

Figure 21.12 shows that the industrial share of the regional harvest has declined significantly, while the Crown harvest has expanded, but this is attributable to the purchase of the Bowater Mersey private land by the province. The share of the harvest provided by the woodlot owners has actually increased into the 70 per cent range in recent years, declining slightly to 65 per cent in 2016, which coincides with the start-up of WestFor operations. The private non-industrial volume has been fairly steady during the 2013–2016 period at 650,000–750,000 m^3/y.

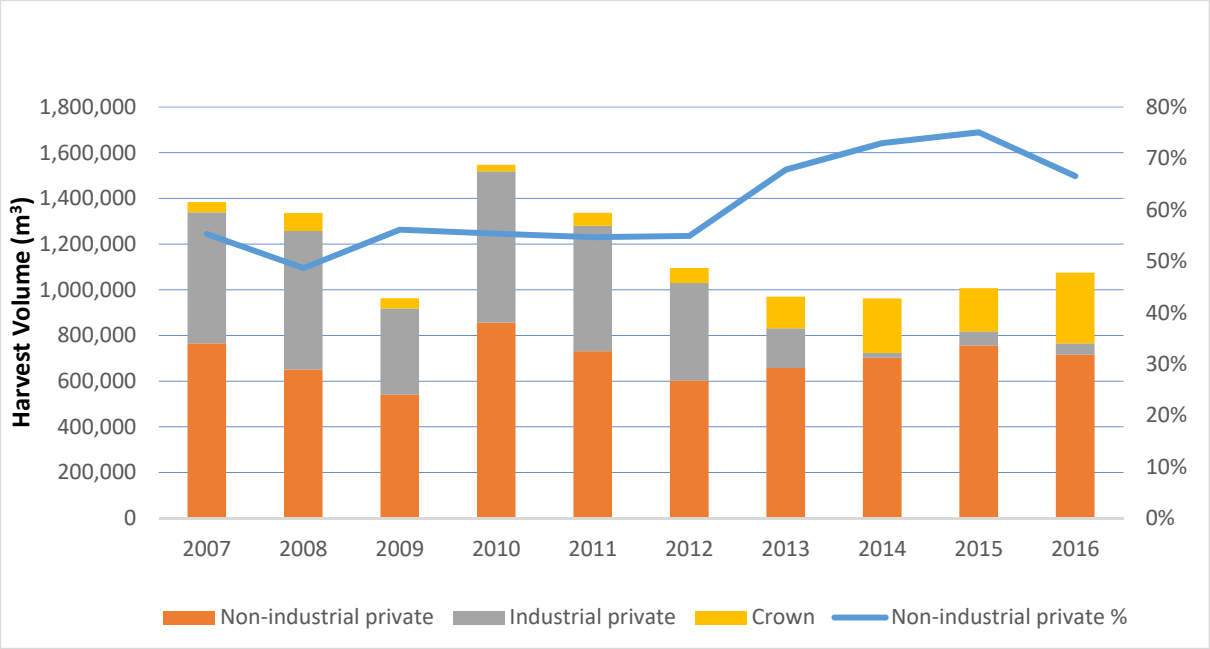


Figure 21.12. Western region harvest volume, by ownership.

Figures 21.10–21.12 do not provide any evidence that woodlot owners in the western region are disadvantaged relative to woodlot owners elsewhere in the province.

A review of harvest volumes by county in the western region also does not reveal any dramatic losses in harvest volume in any particular county during the past decade. Figure 21.13 shows that the harvest in Shelburne County has remained steady while Queens and Yarmouth have experienced declines from 2006 but have recovered fairly strongly since the nadir reached in 2008–2009.

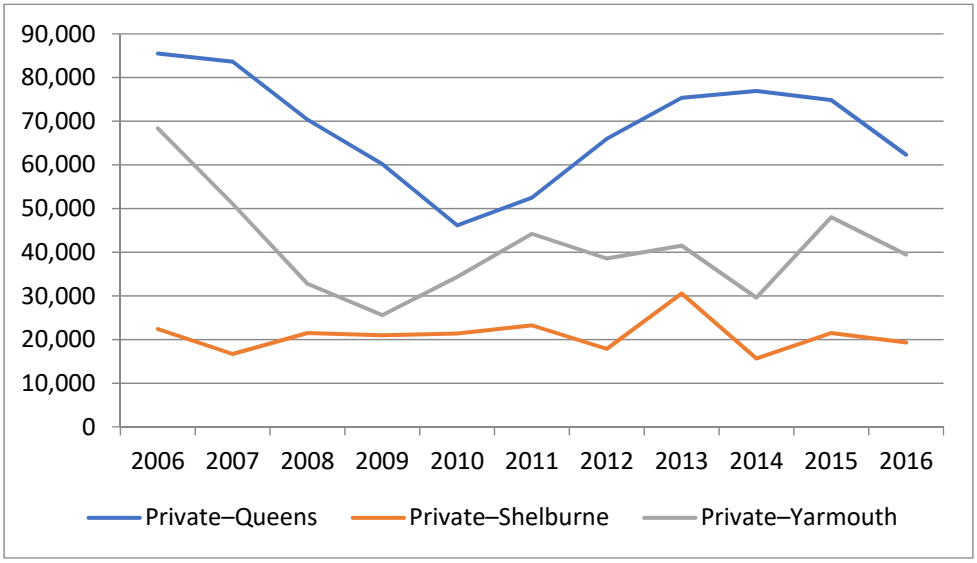


Figure 21.13. Non-industrial private harvest volume (m^3) in Queens, Shelburne, and Yarmouth Counties.

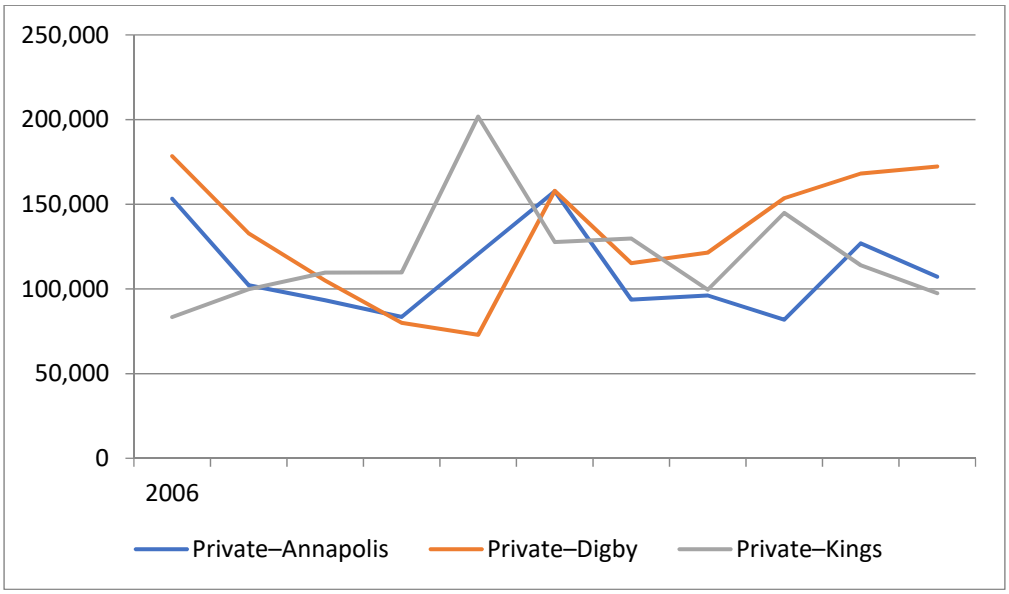


Figure 21.14. Non-industrial private harvest volume (m^3) in Annapolis, Digby, and Kings Counties.

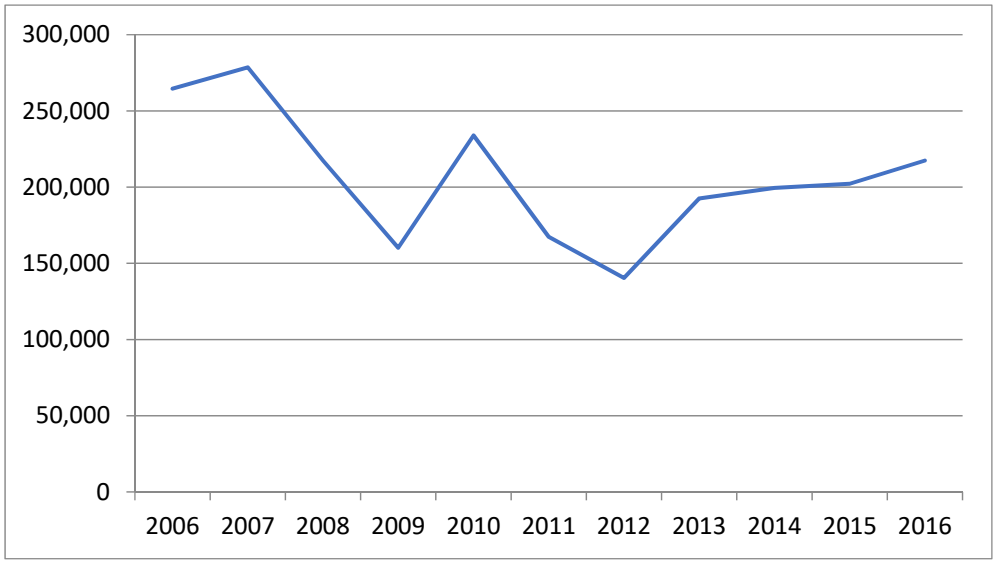


Figure 21.15. Non-industrial private harvest volume (m^3) in Lunenburg County.

The non-industrial private harvest in Annapolis, Digby, and Kings Counties has fluctuated within a range, not showing any discernable trend (Figure21.14), while the harvest in Lunenburg County (Figure21.15) shows a pattern similar to that in Queens and Shelburne.

21.6 What Accounts for the Reported Market Access Issue in Western Nova Scotia?

The market access issues reported in western Nova Scotia are not evident from the harvest data over the past 10 years. However, this does not necessarily mean that these perceived issues do not exist.

The greatest imbalance within the province between supply and demand exists in the western region, as evidenced by the very low level of harvest in the region compared with the sustainable available harvest (see Figure 21.5). The loss of industrial capacity since 2008, which has been greatest in the western region, has contributed to this situation.

The gap between supply and demand suggests that woodlot owners will generally have weaker pricing power in the west and purchasers can be choosier about which woodlots they will purchase wood from. This pressure intensified with the closure of the Bowater Mersey pulp mill, which removed the major user of low-grade timber from the regional market, leaving Northern Pulp as the next closest major user. (The Brooklyn power plant, now owned by Emera, has been very uneven in its use of wood sourced directly from the forest.) The Review heard on numerous occasions that the break-even distance for sales of pulpwood is 150 km. Accordingly, to the extent the western woodlots are located beyond that distance from a low-grade user, they may be challenged to sell their timber. If they have a high proportion of pulpwood in their woodlots, they won't get much revenue at all, and if they have a high percentage of sawlogs, they can get their woodlots cut, but their return will be limited due to little revenue from the pulp component. Thus, certain woodlot owners in western Nova Scotia face an economic choice that is different from other woodlot owners in the province.

The two pulp mills left in Nova Scotia drive the demand for pulpwood. Northern Pulp essentially represents demand for pulpwood in the west and central part of the province through its purchasing and its presence in WestFor. Port Hawkesbury Paper represents demand for the eastern-region pulp market. To be sure, there is a zone overlapping between the mills where head-to-head competition occurs, and the chip exporter out of Sheet Harbour does create some alternative demand. However, demand conditions in western Nova Scotia are not nearly as robust for pulpwood as they are for sawlogs and studwood. With respect to softwood sawable products, competition is more widespread across the province, and sawmills have a demand footprint in all regions.

The commencement of harvesting by WestFor in 2016 brought back online a significant timber volume that had been removed from the market due to Bowater's closure in 2012. The 2012–2016 hiatus in supply from the Bowater lands was a temporary condition that cushioned the private non-industrial woodlot owners from the full impact of Bowater's closure. The start-up of WestFor caused a temporary supply imbalance that has since been factored into the market. Notwithstanding all of the above, average stumpage prices in Nova Scotia are the highest in all of Canada and remain so.

21.7 Options for Improving Market Conditions

The province places primary emphasis on private wood supply being the preferred source of timber for mills, and the province sets Crown stumpage rates at prevailing private market prices through surveys and indexing. This ensures that private land stumpage is available and competitive. However, reductions in demand and increases in supply affect regional timber pricing and sales volumes. The closure of the Bowater Mersey mill in 2012 resulted in the loss of a key source of demand for timber, especially pulpwood. Private landowners were shielded from the full impacts of this closure, as harvesting was

suspended for several years on the land owned by Bowater. The purchase of the Bowater lands by the provincial government and the establishment of WestFor enabled the resumption of harvesting on the former Bowater lands in 2016. As one would expect from the basic laws of supply and demand, WestFor's start-up added to the supply of timber in the market and temporarily increased the challenge for private woodlot owners to get a favourable price for timber in the western region until markets adjusted to the change in conditions.

Since pulpwood markets were considered to be poor well before Bowater closed, as indicated in the excerpt from the 2008 APEC report, the Bowater closure exacerbated an already difficult situation. Private non-industrial woodlot owners with a high proportion of pulp were most strongly affected by this situation, and they had to choose between not harvesting and accepting a low price, if they could sell their timber. Moreover, woodlot owners found that the choice was bleaker the farther they are from pulp mills.

Woodlot owners would benefit from the emergence of new markets for low-grade wood. In the mid to long term, wood for energy represents the most obvious new use for low-grade timber. Just during the period of this Review, the level of interest in wood-based heating and power appears to have grown in Nova Scotia, and the Review was frequently told that PEI has numerous wood-fed district heating plants in operation, while Nova Scotia had very few. If the province is able to attract new users of low-grade wood, it would be beneficial for the entire forest sector, although using wood for commercial energy is controversial. Reports of old-growth timber being harvested and chipped for bioenergy are indicative of weaknesses in wood markets and in the planning system.

Growing demand for low-grade fibre would help to balance the overall timber market in the west. However, in the meantime, the options available to the province to assist landowners have negative distributional impacts within the sector. How the costs and benefits of decisions regarding wood supply are distributed is a political decision.

A shift toward more partial harvesting and less clearcutting on Crown land, while providing ecological benefits, could also support private timber sales.

In addition, revising the governance of Crown forest management in western Nova Scotia to include broader stakeholder representation would allow fuller consideration of the social, economic, and ecological implications of Crown land forest operations.

Appendix A: Review of Nova Scotia Forest Practices: Terms of Reference

Introduction

Recognizing a wide diversity of interests related to forestry, the Government of Nova Scotia is undertaking an independent review of forest practices in Nova Scotia. Professor William Lahey, President of the University of King's College, has been retained as Project Lead for the review and to provide recommendations to government.

Scope

The review will examine current practices, including strengths and weaknesses, and provide recommendations for improvement regarding how Nova Scotia balances long-term environmental, social and economic interests in managing the province's forests. In particular, the review has the mandate to examine the following components:

1. Evaluate the effectiveness and identify opportunities to improve the legislation, regulations, policies and guidelines, as well as the science-based tools that determine whether and where harvesting occurs, as well as the harvesting methods (e.g.: clear cut, partial harvest) that can or should be used.
2. Evaluate market access for private forest owners, particularly in the western region, and provide recommendations to address any identified issues.

Technical Experts

Under the direction of Professor Lahey, DNR will retain experts to advise him on technical aspects of the review. This may include experts on forest ecology, resource supply modelling, integrated resource management, forestry operations, and wood markets.

Stakeholder, Mi'kmaq and Public Input

The review will build on and not duplicate the stakeholder, Mi'kmaq and public engagement that has occurred on the issue of forestry in recent years, including *The Path We Share, A Natural Resources Strategy for Nova Scotia 2011-2020*, and the Western Crown Land Planning Process. In order to inform the review, additional opportunities for input will be provided, designed by and under the direction of Professor Lahey.

Support

The review will receive secretariat support from staff within the Department of Natural Resources Policy Planning and Support Services Branch. This will include retaining technical experts as needed, general administrative, logistical and research support (including hiring of students), and assistance with planning and coordinating additional public, stakeholder and Mi'kmaq input that may be required. Wherever possible, and consistent with the effective discharge of the mandate, Professor Lahey will make use of the available support resources of DNR.

Delivery of Report

Professor Lahey will deliver an interim draft report followed by a final report to the Minister of Natural Resources. The report will include:

- A description of the methodology, including meetings held, documents reviewed, and analyses conducted;
- A summary of the issues examined and the perspectives of the public and interested parties on those issues based on submissions received in this review or in prior processes;
- A summary of key findings that form the basis of the key conclusions and recommendations on forestry practices policy, regulation and management and on market access for private forest owners;
- Rationale, conclusions and recommendations regarding the issues examined, including what currently works well and areas for improvement.

The final report will be public.

Time Frame

The final report will be delivered no later than February 28, 2018 and the work will be conducted in the following phases:

1. Preparatory Phase (September-December)
    - Assemble and review background material
    - Retain independent experts, commission background paper(s)
2. Issue Identification and Review (December-January)
    - Identify major issues
    - Mi'kmaq engagement
    - Stakeholder, and public Input
3. Analysis and Report Preparation (January-February)

Appendix B: Review of Forestry Practices in Nova Scotia: Discussion Questions from January 2018 Workshop of the Review's Experts

Introductory Note

The following is a list of questions developed and refined through a workshop that Professor Lahey held with most of the Review's experts in early January. Most of the experts will be providing Professor Lahey with their ideas about how these questions might be answered in the course of the completion of this Review.

The questions reflect many but not all of the issues raised in the consultations Professor Lahey has conducted as of the end of December as well as the collective expertise and experience of the participants in the workshop. They are also drawn naturally from the mandate given to the Review by Minister Miller – certain questions and issues arise unavoidably from that mandate.

The list of questions, while extensive, is not intended to be comprehensive of all of the questions the Review may eventually address. Even though many of the questions are deliberately framed broadly to cover as many issues and topics as possible in how they could be answered, it is recognized that some issues or topics already raised in consultations and research may have been missed in the formulation of the questions. Additional issues, topics or questions may arise from the answers the experts give to these questions and from the further work of the team of experts in light of how they have each answered these questions. Additional issues, topics or questions may also arise from continuing consultations with stakeholders or from the ongoing literature research that the Review may conduct.

Likewise, it is important to recognize that the Review may not address or try to answer all of the questions on this list or to address all of the issues or topics which are covered by the questions on this list. This could be for a number of reasons, including the limited time and other resources the Review has to work with. Perhaps most importantly, it could also be because the further work of the Review, including with the Review's experts, indicates that some of the issues or topics covered by this list of questions are not as important to the work of the Review as other issues or topics. In addition, further work and deliberation may lead to the conclusion that some of the matters covered by some of the questions are outside of the mandate of the Review or beyond its capacity to deal with for reasons other than the limits of time and other resources the Review is working with.

Finally, it should be noted that developing and answering these questions is only one of the ways in which the Review's experts, individually and collectively, are providing advice and support to the Review. For example, members of the team are preparing short papers on specific topics that cut across or are outside this list of questions. Others are being consulted through ongoing discussions on specific topics within their particular areas of expertise. Collectively, the team will also be working together in subsequent meetings to develop advice on the conclusions and recommendations that will be included in the Professor Lahey's report to Minister Miller.

A. General Questions about Forestry Practices

1. For the purposes of this review, how should "forestry practices" be defined?
2. In Nova Scotia, what are the current and potential impacts of forestry practices on economic, social and environmental values? What role do forestry practices play and can they play in (a) balancing

these values or (b) combining these values in an approach to forestry that aspires to protect and advance all three sets of values?

3. What, in contrast, are the economic, social and environmental factors that influence or determine what forestry practices are followed?
4. What are the characteristics that Nova Scotia forests should have if Nova Scotia is to have balanced enjoyment of economic, social and environmental values from its forests now and in the future?
5. To achieve optimal/better/acceptable alignment between forestry practices and economic, social and environmental values, how should forestry be practised in Nova Scotia? In other words, what forestry practices should be considered as acceptable or as good forestry practices in Nova Scotia from economic, social and environmental perspectives? Specifically, what forestry practices, should be
   - Always used, followed and adhered to;
   - Sometimes used or followed depending on specified conditions or criteria;
   - Subject to limitations or restrictions; or
   - Never used and followed?
6. What are the scales (temporal and spatial) at which questions about forestry practices and their impact on and contribution to economic, social and environmental values should be asked?
7. What are different approaches, and their respective strengths and weaknesses, for aligning economic and biodiversity objectives with respect to forestry?
8. How much forest land would have to be used for forestry to meet the needs of the current industry?

B. Questions about Specific Forestry Practices

9. How should clearcutting be defined?
10. What, in general terms, are the strengths and weaknesses of each of the following forestry practices, separately and in combination, to economic, social and environmental values?
    - Clearcutting;
    - Herbicide spraying;
    - Whole-tree harvesting; and
    - Harvesting for biomass (wood to be used as energy).
11. What are the conditions or circumstances under which clearcutting, herbicide spraying, whole-tree harvesting, and harvesting for biomass are or could be
    - Unacceptable forestry practices;
    - Acceptable forestry practices;
    - Preferred forestry practices?

    In each case, and for each practice, what are the applicable conditions or circumstances?

    In rough terms, what proportion of harvesting – relative to the amount of current harvesting and/or to the current percentage of harvesting that is clearcutting - would be by clearcutting if clearcutting only happened where it was an acceptable or preferred forestry practice?

    What, roughly speaking, would be the economic, social and environmental impact of clearcutting if it only happened where it was an acceptable or preferred forestry practice?

In rough terms, how widespread would the use of herbicide spraying be if herbicide spraying only happened where it was an acceptable or preferred forestry practice?

12. In what circumstances and under what conditions, if any, is harvesting for wood energy an acceptable forestry practice?
13. What forestry practices should be used or not used when harvesting wood as energy fuel?
14. What would be the costs of implementing restrictions on clearcutting, herbicide applications and whole-tree harvesting for Nova Scotia's existing forestry industry?

C. Implementation Questions on Forestry Practices

15. To what extent and on what basis are forestry practices on private land a matter for public policy? Can forestry practices and economic, social and environmental values be aligned in Nova Scotia without attention to them on private as well as on Crown land? What would be the implications and consequences of limiting government policy on forestry practices to Crown land? How can government influence forestry practices on private lands while respecting the ownership rights of landholders?
16. What are the actions or combinations of actions the NS government can take to have forestry practices that align with economic, social and environmental values in the short and longer term?
17. Specifically, on the question of implementation, what role can be played by options that have been proposed or raised for discussion, such as:
    a. Amending the Crown Lands and Forest Acts to specify that Crown lands and forests are to be managed for all values;
    b. Establishing timber supply and biodiversity goals and objectives in a way that makes it clear they are of equal importance in DNR decision making and in Nova Scotia's forestry policy;
    c. Establishing timber supply targets that meet the needs of industry while protecting other values and planning harvesting and silviculture accordingly.
    d. Implementing the triad approach that includes zones of intensive forest management to meet timber supply objectives thereby creating greater "room" for protected areas and for ecological-based forestry.
    e. Making diversity in forests structure a specific objective of DNR's mandate;
    f. Conducting a strategic environmental assessment to forestry;
    g. Applying environmental assessment processes (or a forest-specific alternative) to FULAs and/or forestry management plans (with or without relaxation of other regulatory processes and requirements currently in place), possibly in combination with reduction and elimination of stand-level micro-management;
    h. Improving science capacity of DNR and breaking down the walls between DNR science and scientists and the broader scientific community;
    i. Identifying and filling the data gaps which limit the capacity of DNR to engage in evidence-based decision making on a holistic basis and which limit public understanding of forestry and its effects on the environment (including biodiversity) and its importance to the economy;
    j. Dealing with concerns about the impacts of forestry on soil in the western region;
    k. Addressing the back-log of management plans required for designated species at risks;

l. More broadly, developing and implementing a comprehensively ecological approach to forestry that, among other things, emphasizes protection for wildlife and wildlife habitat;

m. Implementing the forestry management guidelines and processes being developed by DNR, including those that would shift decision making to the level of ecodistricts and landscapes, either as written or with amendments to align them with ecological conditions and biodiversity objectives;

n. Adopting measures to recognize and deal with cumulative effect issues and concerns;

o. Managing Crown lands to set an example for owners of private woodlots and industrial lands privately held;

p. Implementing (restoring) targets/goals for limiting clearcutting on Crown lands;

q. Restoring objectives for limiting clearcutting established by the forestry strategy;

r. Requiring those licensed to harvest on Crown lands to manage their own lands to the same or similar standards;

s. Regulating forest practices on private land (perhaps with exemptions for small parcels);

t. Implementing a ban on whole-tree harvesting on Crown lands;

u. Taking measures to support development of "responsible" wood energy projects and markets such as in schools, hospitals, municipal buildings, etc., both as a means to deal with market access for low-grade product but also as a means of making forest improvement through responsible forest management more financially viable;

v. Making silviculture funding available on a broader basis to owners of private land to improve the financial viability of alternatives to clearcutting;

w. Along the same lines, considering options for utilizing the Registry of Buyers, with or independently of assigning a role to registered foresters in the development and approval of management plans, as a mechanism for encouraging owners of private land to responsibly manage their forests;

x. Implementing province-wide FSC certification or restoring FSC certification for western Crown lands that were previously FSC certified, and/or supporting FSC certification initiatives of organizations such as woodlot management services organizations such as Cape Breton Private Partnership;

y. Supporting the work of the four regional woodlot/landowners service organizations to increase the number of participating owners and to improve the viability, through cooperation, of "responsible" forest management practices on private lands;

z. Supporting the Mi'kmaq Forest Initiative as well as other opportunities to increase Mi'kmaq participation in forestry;

aa. Ensuring the community forest is given a full and fair opportunity to show what it can accomplish;

bb. Considering some kind of pilot project on the potential role of municipalities in forestry management;

cc. More broadly, making resiliency of forests and forestry, including in light of impact of climate change, overriding policy objectives in Nova Scotia;

dd. Within that context (or with another framing), work with all stakeholders to develop a widely shared vision of the importance of forests and of forestry to Nova Scotia that is in equal measure about economic opportunity and ecological well-being and that (1) supports the value of the forests to the current economy, including the existing forestry industry and tourism industries and (2) supports the value the forests can have to the industries and economic opportunities of the future.

18. What other ideas (options, actions or combination of actions) should be considered by this Review?

D. Questions about Market Access

19. What factors affect the marketability of wood for private woodlot owners?
20. Should private woodlot owners be guaranteed a share of the timber market and if so, how could this be accomplished/administered?
21. If there is a market access issue, what are the scale and dimensions of this problem? What are the causes of this problem? Specifically, to what extent and in what ways is the problem caused by:
    a. A general (world) drop in demand;
    b. A drop in demand within Nova Scotia, specifically from the closure of Bowater paper mill and Oakhill sawmill;
    c. The availability of wood from Crown lands in relation to the demand for timber/wood/fibre;
    d. The allocation of Crown land in the western region;
    e. Transportation costs;
    f. The unavailability of a market for low quality wood;
    g. Other factors; or
    h. The combined effect of some or all of these factors?
22. To the extent there is a market access issue, can anything be done about it? Should anything be done about it? What are the things that can be done about it or that would have to be done about it if government was of the view that it should do something about it? Which, if any, of the following options should be considered?
    - Encouraging and supporting regional and local wood energy projects;
    - Encouraging and supporting proposed biodiesel facility;
    - Continuing/expanding existing biomass initiatives within the electricity system;
    - Supporting the development of other kinds of markets for wood;
    - Adjusting the amount of wood available from Crown lands to better reflect market conditions and the statutory principle that Crown supply is not to be primary supply; and/or
    - Working with industry (the mills), especially WestFor, to ensure equitable access to the market is being made available to private woodlot owners.
23. Does the market access issue call for fundamental rethinking of how Crown land harvesting should be controlled or managed, or about how the interaction between Crown and private supply should be managed, to ensure market fairness (and transparency) in Nova Scotia? Does it suggest the need for an alternative mechanism for ensuring stability of supply for the industry?

24. Are there connections of interest and importance between the market access issue and the forest practices question?

E. Questions about Completion of this Review

25. What other or different questions should or could be asked to complete the mandated review? In other words, what issues are missed or understated by this list of questions?
26. What are the challenges to answering the questions posed by the Review's mandate? What can realistically be accomplished by this Review in the prescribed timeframe?
27. How should the review factor in and build on the Natural Resources Strategy, including the reports of the steering panel and of the expert panels, and the public input that was received under that process?
28. What work is needed – and what work can be completed - to complete the Review? Specifically
    - What additional information is needed?
    - What additional analysis is needed?
    - What additional consultations – or other kinds of processes – are needed?
29. What, if anything, can this Review do, in its report or otherwise, to contribute to a less polarized discussion about forestry in Nova Scotia?
30. How can recommendations on forestry practices be equally grounded in ecological stewardship that aligns with provincial legislation (including the Environmental Goals and Sustainable Prosperity Act and the promised Biodiversity Act) and an economic vision for Nova Scotia that aligns with provincial economic strategy (including as outlined in the One Nova Scotia report and its follow-up)? If so, how?

Appendix C: Forest Management in Nova Scotia: A Summary and Reflection on Provincial Forest Policy from 1980 to 2017

(Prepared by Nathan Ayer)

For the full report, please see the 53 pages following page 166 (after the References).

Appendix D: State of Nova Scotia Forest and Biodiversity Review (2017)

(Produced by Mersey Tobeatic Research Institute)

For the full report, please see the 29 pages following the text of Appendix C after the References.

Appendix E: Workshop Notes: Opportunities for Consensus and Conflict Resolution in Forestry

Forestry Gathering
February 20, 2018, 9:00am – 3:30pm
Fairbanks Centre, Dartmouth

Notes compiled by Sera Thompson, New Leaf Communications and Amanda Lavers, Mersey Tobeatic Research Institute

Summary

Twenty-five participants met on February 20, 2018. The meeting was opened with remarks from Bill Lahey about the independent forestry review which he is leading. Despite the opportunities that exist for change, Dr. Lahey suggested that polarization is holding back the sector from greater success. Peter Duinker, Amanda Lavers, and Sera Thompson reviewed some of the recent forums for collaboration within NS's forestry sector. Tim Merry provided examples from his work facilitating systems change along a spectrum of government enforced to citizen-led change. All participants were given a chance to speak about how they perceived a path forward to better cooperation. Apparent themes in this discussion included the social licence and significant investment needed to implement real change with questions around the role of DNR and the process needed. In the afternoon, participants were asked to bring forward solutions and to break into smaller groups to discuss these in detail and bring them back to the larger group for consideration. The strongest agreement was expressed for promoting local forest products and developing a forest strategy process design where

participants formally sign on to process and commit to stand by the process. The most contentious solution included the proposal that service areas administer silviculture and road subsidies.

Workshop Purpose

To bring together a small group of diverse leaders in the forestry sector to identify areas of consensus and explore how to resolve the conflict and build trust.

Context for the Workshop

Perspective from the Forestry Review so far:

There is an encouraging opportunity, directed from the Premier, to make things better. But as an outsider, a major theme that has become apparent in Dr. Lahey's review, so far, is polarization. Many parties are independently trying to influence government but there is not a lot of conversation between camps. This will likely lead to less than optimal situation for decision making and an unstable environment for forest policy. There is a strong desire for alternatives. Balance and integration is an ongoing process. It is not necessary that Dr. Lahey's review make suggestions about a forum for ongoing dialogue but he thinks it should be part of his review. While disagreement can be healthy, there is more cohesion in other jurisdictions within forestry sectors. Forests and forestry are so important culturally, societally, economically, and environmentally to Nova Scotia.

Conclusions coming out of recent processes including the Natural Resource Strategy, Private Landowners Forum, the Forestry Lab, and others:

Forests in Nova Scotia are the backbone of the economy, rural life, and the environment. Forestry in Nova Scotia is ubiquitous across the province but very contentious regarding how to do it right. Some of the recent processes include the Voluntary Planning Economic Strategy in 1991 which stated that NS was at a crossroads and needs major socioeconomic change to finance our standard of living; the Natural Resource Strategy with a divided expert panel in forestry completed in 2011; the Ivany One Nova Scotia report in 2014 which suggested that a shared vision and commitment to economic growth and renewal was needed among key institutions and stakeholders; and the Forestry Lab to work together to tackle concrete challenges, end the culture of conflict, and address complex economic, environmental, and social policy issues within NS's forestry sector which concluded in 2017. Dr. Duinker noted numerous forestry forums including the Nova Forest Alliance, Colin Stewart Forest Forum, and Small Private Landowners forum which have been concluded and left a vacuum in advance of the next ten year cycle for a natural resource strategy.

The Nova Scotia Forestry Lab assessed the current reality of the forest sector and summarized these major challenges:

- Polarization, no middle ground, no shared truth
- Competence of DNR
- Rapid pace of change
- Scarcity of leaders who can work across divides and stretched capacity of those leaders

One of the strong conclusions and points of agreement within the Forestry Lab was that all parts of the sector need to be successful for overall success and that connections and collaboration across the sector would be key to success regardless of market forces. The strategies identified included the following:

- Finding neutral ground
- Mobilizing landowners
- Improving the image of forestry through improved public perception, social licence, and attracting workers, and
- Imagining the Forestry Sector we want and adapting elements of the Finnish Model for NS

Tools and processes for systems change / conditions for success

How can we overcome territorialism so we are not merely managing the collapse of a sector? How do we achieve genuine engagement so that large membership organizations or industries are not merely protecting their role and existing power? This can become so critical to successful transitional changes. Tim Merry is working across a spectrum of examples of system change from government enforced initiatives (which can create stability but be divisive) to those that are citizen-led (which may be less stable or predictable but galvanize support). Tim discussed work including Swedish municipal reform and efforts in Sweden to reduce child poverty, Now Lunenburg County, and Transforming Sport in

Nova Scotia. In Nova Scotia, municipalities were modernized using structural reform. Is it possible to legislate a container for collaborative processes for 2-3 years? Sera discussed the provincial school review process.

Open-ended engagement without enforcement of outcomes or political will to carry-through is too expensive for some parts of the sector and may bias participation toward those with the deepest pockets who can sustain long processes. Why do we hope or believe that if we follow the same path that the outcomes will be different? We may not need full agreement, but we need to know if any gravitational pull exists within Nova Scotia's forestry sector to suggest that the polarization can be resolved from people within the sector.

Reflection Circle: What are you seeing? What is the path forward?

- **Optimism**
  Long-term vision is possible
  If we could agree on a shared vision we should all be successful (workers and forests)
  Exciting opportunity to learn from Finland

  Encouraged that the sector includes young leaders and women

- **Investment/Financial Model**
  Industry needs to be sustainable
  Transition to better forestry requires different gear in the woods
  Incentives are important but tricky
  Farmers are good at fostering local consumer support

- **Reality**
  Need to adapt to reality and stay real
  Get beyond flavour of the month to root causes
  There are real structural schisms within the sector
  Can we agree about the value of big trees? Can sawmills adapt to larger log sizes? What are the costs and benefits of increasing tree size?

  Public participation even in the Medway Community Forests has been difficult
  We have the instrument and support for it: Service Areas
  Knitting together players through certification

- **Implementation**
  Transition Team needed to focus on results
  How can we survive on the ground without society paying for the changes that are needed?
  How can we transition to better forestry with better gear and better operators?

  We need honest partners at the table

- **Process**
  Balance between government mandate and citizenship engagement
  Uneven power
  A lot of processes have fallen short in the past
  We need to include marketing board and collective bargaining
  Modeling scenarios, e.g. in NB, the Erdle task force had 8 scenarios with 32 indicators
  In Finland, laudable results in terms of value-added and good quality jobs
  "Don't re-invent the wheels but make sure they are inflated!"

- **Social Licence**
  Change the message: communicate complex message
  How do we monetize social values?
  We need to engage the public and consumers
  How do we get society to feel better about using natural resources?
  Apathy from public- real investment is needed

- **DNR**
  DNR is impoverished and understaffed: we need to do it on our own
  DNR needs to foster innovation, entrepreneurial spirit, and flexibility in the sector
  Lack of support from DNR
  Lack of frameworks from DNR to allow for innovation and entrepreneurship

Breakout groups - **Defining key messages and recommendations**

In the afternoon participants were invited to bring forward ideas and proposals that "*will help the sector to resolve conflict and build collaboration and trust".* While this request was repeated multiple times, the participants initially seemed to gather around a more fragmented set of ideas for forestry solutions for which they were passionate and already committed to advocating. Groups were asked to

report back and express their level of support and concerning questions for each solution. The conversations in the afternoon were as follows:

1. **Title**: Forest Strategy Process Design

   Who Came: Kingsley Brown, Marcus Zwicker, Kari Easthouse, Peter Duinker

   Ideas: Quantitative, technical scenario analysis that features an explicit proposal for forest strategy. Quantitative indicators developed in public forums (e.g. wood volume, clearcutting rates, silviculture rates, and value-added and economic impacts). Public input on the range of scenarios on both Crown and private land (replete with forest practices such as which landbases? Which field practices? Levels of protection?). Public vetting of scenario outcomes. Independent modelling. Use some elements of Erdle task force. Explicitly describe tradeoffs so that it is very transparent and clear to the public how decisions are made and what values are emphasized. The participants should demonstrate credibility with clear lines of accountability to their constituents.

   Questions: Who is responsible for the work? Who are the constituents? Can there be more than one person representing each constituency? How to influence ultimate outcomes? Who decides? How to finance? If there is a third party, what is the time frame?

   Key recommendation: Get it done in 2 years. Participation should be funded (like municipal strategic plans). There may need to be more than one person per constituency.

   Level of support: 9 supporters, 2 have questions, no nay-sayers

   Key recommendation: The process could be a compensated advisory board with a consultant.

   Level of support: 11 supporters, none have questions, no nay-sayers

   Key recommendation: People formally sign on to process and commit to stand by the process. Engagement from start to finish.

   Level of support: 16 supporters, none have questions, 1 nay-sayer

2. **Title**: Centre of Excellence

   Who Came: Andrew Fedora & Andy Kekacs

   Ideas: An overarching structure to build trust run by a stewardship council. Everyone is invited and it would include industry in some way. Respect, value, proper incentives. Create social licence by honest attempts to find real answers and set priorities. Recommended by Finland study tour. Flexible and responsive. Accept reality. Find effective incentives. Share power, funds, and decision making. Access federal funds through ACOA and NRCan.

   Questions: How do we discover answers? What are the priorities? How do we bring in many viewpoints? How do we create an overarching vessel for collaboration and targeted areas of investigation? How will industry participate? How will the mission, mandate, and participants compare to the Nova Forest Alliance?

Key recommendation: Accept an invitation to a stewardship council to collectively advocate for funding.

Level of support: 15 supporters, 2 have questions, no nay-sayers

3. **Title**: How do we motivate all Nova Scotians to support and have pride in local forest products?

   Who Came: Stacie Carroll, Cassie Turple, Amanda Lavers

   Ideas: Using "Field to Fork" regime. Put faces on posters in wood product isles. Labelling is needed to make it easier to buy Nova Scotia lumber first. "Select Nova Scotia" should also include this commodity (already a government initiative with all the necessary infrastructure) before importing forest products. The effort should include both timber and non-timber forest products. "Atlantic Woodworks" procurement of wood is a good link between architects and building suppliers. There is potential to bring in enviro side with industry and woodlot owners especially because of the potential to reduce Carbon Footprint. We need to better understand how forest products are long-term carbon sinks. By implementing a more personalized supply chain we can bring support of land owners by creating pride and contribute to creating a community within the sector by breaking down walls. Make links between the trees and the products they become: Circle of Life. Local procurement through societal pressure. There is a need for agriculture to recognize forest products.

   Questions: Forest NS video - did it work? Why do people not care about forest products like they do about food? Why are forest products not considered more "green?" How do we get the stories heard of the people working within the industry? Are there anti-competitive clauses in trade agreements?

   Key recommendation: Make more effort to promote local forest products

   Level of support: 14 supporters, 1 has questions, no nay-sayers

   Key recommendation: Local promotion (such as Dal Agriculture Campus pilot for small private producers and Wood First initiatives) and procurement of local wood products should help unite industry-woodlot owners-environmentalists.
   Level of support: 17 supporters, 1 has questions, no nay-sayers

4. **Title**: What does good forest management look like? What will the forest look like in 7 generations?
   Who Came: Debbie Reeves, Patricia Amero, Mary Jane Rodger, Greg Watson, Rick Archibald, Jane Barker

   Ideas: Manage for current markets and reflect the ecosystem diversity that supports long- term sustainability and future opportunities. Focus on developing the highest value (economic and ecologically) possible. All operations and prescriptions are ecosystem based (regenerating and tending). Diversity, resilience, and adaptability. Healthy, diverse, productive forests. Achieve consensus on natural disturbance regimes. It's expensive to invest silviculture funds at all stages of

stand development; we should target certain stand types on productive land. DNR create committee process with landowners and facilities to review practices and programs.

Questions: How do we manage our differing long-term goals? How can we move toward high value forests? What is our shared vision?

Key recommendations: Targeted silviculture funding for long-term stand tending and machine operator training. Longer term agreements through Association for Sustainable Forestry - Silviculture programs and Crown land licences.

Level of support: 13 supporters, 0 have questions, no nay-sayers

5. **Title**: What tools are available to influence landowner harvesting behaviour?

Who Came: Matt Miller & Mike Lancaster

Ideas: 1. Market forces: cyclical commodity markets, Non-Timber Forest Products, Carbon.
2 Silviculture funds.
3. Property taxes. Culture vs strategy.
4. Regulations: most unregulated jurisdiction with regard to harvesting in North America or Europe. Agent capture/ how well do different structures achieve landowner goals? Co-op vs certification.
5. Education + outreach (ASF). Culture of mistrust of government and landowners "sovereignty." Focus on economic values (incentives).

Questions: Is NS's laissez-faire approach best serving industry and environmental well-being? Do we have the capacity to deliver what landowners want? What are landowner's rights and responsibilities?

Key messages:

- Past forest policy initiatives to regulate landowners have failed (unintended consequences, no compliance, poor regulations)
- Carrots › sticks.
- Expanding focus of incentives beyond commodities will increase landowners' engagement.
- Engaging stakeholders in design of carrots will increase uptake.

6. **Title**: Learning from Finland

Who Came: Dale Prest, Harold Alexander

Ideas: We need more organized woodlot sector (50% of our forests). Cooperation between industry, government, woodlot owners exists in Finland where it is mandated to belong in Forest Management Areas (compare to NS max 3% participation provincially; in past group ventures have achieved 25%-30% participation in smaller regions like Sissibo and Tatamagouche). Silviculture funding move from registered buyers to Service Areas Co-op. Road subsidies vs municipal taxes or regulation. Carbon/proportional to volume. Service area co-ops to administer road and silviculture

subsidies. New market opportunities for an aggregated landbase for carbon offsets would be part of the long-term plan. Nova Scotia should adopt the Finland Framework for the organization of small private forest owners with full service coverage across Nova Scotia through the Service Area Model. Local 'Forest Management Areas' providing county level services similar to North Nova Forest Owners.

Key recommendations: Support the operation of at least three regional service area co-ops to deliver/administer across the whole province silviculture and management on private lands to achieve the outcomes in Kari's strategy and explore new opportunities.

Level of support: 9 supporters, 5 have questions, no nay-sayers

Key recommendations: Service areas administer silviculture and road subsidy for one stop shop.

Level of support: 10 supporters, 2 have questions, 4 nay-sayers

Appendix F: Input from Nova Scotia Forest Science Advisory Committee

Response of the NS Forest Biodiversity Science Advisory Committee to an Information Request from Prof. William Lahey, Leader, NS Forest Practices Review

Notes prepared by Dr. Peter Bush, Chair, on behalf of the entire Committee membership (Dr. Peter Duinker, Dr. Thom Erdle, Dr. Graham Forbes, and Dr. Tom Herman)

Prof. Lahey posed the following information requests to the Committee:

> The biodiversity issues or questions that my review of forestry practices should address or consider as it formulates conclusions and recommendations on forestry practices with the intent, in accordance with my terms of reference, of balancing economic, social and environmental values relative to forests and forestry?
>
> The conclusions or recommendations on forestry practices I should consider in addressing or considering these biodiversity issues or questions.

In this document, the Committee provides its advice on the first request. The Committee feels ill-equipped at this time to develop proposals for conclusions or recommendations on the second request.

Building on its work to date, the Committee has developed the following list of proposed biodiversity priority themes that the Forest Practices Review should consider in developing its recommendations to the Government of NS.

Climate change. How might we expect a changing climate to influence various elements of forest biodiversity, and how might such influences modify our current expectations for the future viability of particular species? The scientific consensus that dramatic climatic change will occur over the 21st century is sufficiently strong (as per the work of the Intergovernmental Panel on Climate Change) that such change must be factored into all initiatives to conserve biodiversity. On the premise that forest practices significantly influence biodiversity, in often complex and undesirable ways, it is clear that a changing climate must be factored into any understanding of how future forest practices in NS may influence biodiversity at multiple spatial scales (*e.g.*, operational, landscape). This presents an opportunity to investigate the cumulative effects of climate change and forest practices on the future condition and state of NS forest biodiversity. One of the greatest challenges will be to design and promote forest practices that encourage growth of tree species projected to thrive under new climate regimes and discourage establishment of those projected to decline.

Forest landscapes. Understanding how forest management activities and patterns across the landscape influence biodiversity is essential. In recent decades, landscape ecology has advanced considerably as a discipline. This emerging science can be better incorporated into forest management planning in Nova Scotia. We urgently need the planning insights anticipated from the NSDNR's landscape planning pilot project. The coarse-filter approach to conservation of forest biodiversity (used in the pilot project) is as yet untested in NS. We believe that a first-approximation assessment of landscape-level biodiversity responses to alternative forest

management strategies is within reach with available data and reasonable assumptions. First results should indicate timings and locations where choices about forest practices are least and most important from a biodiversity perspective.

Land use change and forest biodiversity. Forest practices for timber production are doubtless a major influence on forest biodiversity. However, other human activities on the land cannot be discounted as additional potential threats to biodiversity - minerals extraction, oil and gas development, wind farms, urban expansion, new and expanded highway corridors, agriculture (including blueberry production), aggregate extraction, and others. It is important for the Government of NS to know how the full range of human activities in and on the forest landscape may cumulatively affect key elements of forest biodiversity. The critical starting point in cumulative effects assessments is to define the full range of human activities that are key drivers of biodiversity conditions, including analysis of the potential spatial extent of such activities across several decades into the future across the landscapes of the province. This is appropriately accomplished using participatory scenario construction. Then, it is necessary to determine how the individual effects of each driver interact with those of other drivers, in potentially complex ways, to produce integrated effects on forest biodiversity. Only then can appropriate management and policy directions be defined and refined to conserve native forest biodiversity.

Role of private forest land in biodiversity conservation. Only about one-third of NS's forest land is in public ownership; the rest is private. The pattern of ownership in the province varies widely across regions and forest types. Thus, it is highly challenging, if not impossible, to conserve the province's forest biodiversity on public lands alone. Land use can isolate and fragment forest and thereby alter the amount, configuration, and function of habitat. Ownership patterns have tremendous potential to influence metapopulation dynamics and gene flow of forest biodiversity. The ecological scales at which species operate often diverge significantly from the scales of ownership and forest management. As a result, mechanisms are needed to encourage or even oblige biodiversity conservation measures on private forest land, and to integrate forest practices across land ownerships on larger areas. Private land can be crucial to biodiversity conservation, both in maintaining landscape connectivity and protecting 'biodiversity and species-at-risk hotspots'. Such landscape-level management issues might even necessitate changes in ownership patterns through land exchange, etc.

Natural disturbance regime (NDR). It is time to revisit NSDNR's characterization of the NDR of forest ecosystems across NS. It is also important to clarify DNR's approach to mapping NDRs across the province on one hand, and on the other hand, the role of NDR at the site level when FEC (Forest Ecosystem Classification) calls are made and PTAs (Pre-Treatment Assessments) are prepared. Thorough peer review is needed to ensure that the NDR understandings of the Government are firmly based on the best scientific evidence and expertise. Additionally, better communication and discussion of how this science should be applied is needed with all key forest stakeholders. It is important to critically assess the role and value of historical natural disturbance regimes in guiding management decisions given that future climatic conditions will vary from the past ones which strongly shaped the nature of those historical regimes. Analysis and dialogue are urgently needed to determine the appropriateness of a restoration approach to forest management based on putative natural conditions. The full range of forest practices options available to build resilient forests in the face of increased climatic instability should be

considered these could include shortened periods between timber harvests on a site, alternative gene pools in forest regeneration, and others.

Forest-dependent species at risk. Conservation or recovery plans are needed for all such species as soon as possible. Those plans should be supported with cumulative effects assessments that try to ascertain the degree to which on-the-ground forest practices contribute to stress on the species at risk. It is also imperative that species-specific recovery teams include experts in forest management and forest wildlife habitat relationships. Collaboration among recovery teams, when possible and appropriate, should be strongly encouraged in order to realize synergies, reduce duplication of effort, and minimize contradictory management actions. Coordination also is needed among managers to minimize the potential conflict in forest habitat objectives for species at risk and other priority species, such as harvested wildlife.

Invasive alien species and irruptive native species. Two major forces are driving potentially massive changes in the biodiversity complexion of the world's ecosystems: climate change, and globalization (i.e. economic, cultural and ecological globalization). Both of these drivers facilitate movement of species around the world to ecosystems in which they are novel, and sometimes, if invasive, to the serious detriment of native species. Numerous examples pertinent to Nova Scotia's forests exist: brown spruce long-horned beetle, emerald ash borer, and hemlock woolly adelgid. Climate change is expected to alter species relationships sufficiently among native species themselves to modify "normal" forest dynamics. The mountain pine beetle serves as a noteworthy Canadian example; this insect is indigenous to the lodgepole-pine forests of western Canada but became seriously irruptive with the loss of long and deep winter cold periods in central BC. Both invasive alien species and irruptive native species are potentially highly disruptive to the conservation of native biodiversity in Nova Scotia's forests. Their negative or positive effects on native biodiversity should be considered during the design of forest practices.

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Forest Management in Nova Scotia: A Summary and Reflection on Provincial Forest Policy from 1980 to 2017

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1. Introduction

Canada's forest industry is undergoing major changes due to shifting global demand for traditional forest products (e.g. paper, newsprint) and increasing interest in using wood fibre to produce bioenergy and biomaterials (Natural Resources Canada 2017). These trends are reflected clearly in Nova Scotia's forest sector, as pulp and paper production has declined significantly in recent years, overall harvesting levels have declined, wood fibre is increasingly being used for electricity generation and production of wood pellets, and research and development is ongoing to develop technologies for production of biofuels and biomaterials (FPInnovations 2017).

As the Nova Scotia forest industry goes through this period of uncertainty and change, there is also uncertainty about the effectiveness of the provincial government's forest management policies. Despite the release of a new forest policy in 2011 that was formulated on the basis of 3 years of public and expert consultations and intended to direct forest management to the year 2020, the government has launched a new third-party review of the effectiveness of its legislation and policies that support forest management practices (Government of Nova Scotia 2017). This review comes amid public concerns about the sustainability of continued clearcutting and use of wood for bioenergy (Bancroft & Crossland 2010), and a continuing evolution of government forest management priorities. For example, while in the 2011 forestry policy the government committed to reducing clearcutting to 50% of all harvesting activities, in 2016 the government withdrew this commitment and stated that clearcutting can be a beneficial component of an ecosystem-based, landscape-scale approach to forest management and policies should not be so prescriptive.

The forest industry in Nova Scotia has a long history, and this is not the first time that the industry has faced significant challenges, nor is it the first time that government has been forced to reevaluate its forest management policies. In the late 1970's and early 1980's, Nova Scotia's forest was described as being in a crisis, and government forestry managers were faced with many options for addressing the crisis and guiding the industry over the long-term (NSRCF 1984). Several issues being faced at that time are issues that are still being considered in 2018, such as the role of private woodlot owners in forest management, the risks and opportunities of using wood fibre for energy, and the need to balance the economic productivity of provincial forests with the protection of wildlife habitat and forest ecosystems.

In this time of uncertainty about the future of the industry and the need to identify appropriate forest management policies, there is great value in reflecting on the history of forest policy in Nova Scotia. How did government forest policy respond to the crisis in the early 1980's? What were the key forest management priorities? How have these priorities evolved over time? Developing an understanding of these and other policy questions could contribute valuable information to the current forest policy debate. In an effort to contribute to these discussions, this report provides a summary of key developments in Nova Scotia forest policy between 1980 and 2017, and a brief reflection on the evolution of forest policy as it relates to several underlying management issues.

1.1 Background and Objectives

The starting point for this historical review and reflection is a journal article published in 1980 by F. B. Goldsmith, in which he examined the ecology of Nova Scotia's forests and how the forests have changed since European settlement as a result of human use and management (Goldsmith 1980). He assessed a

number of forest attributes, including soil and nutrient characteristics, species composition, tree height and girth, growth rates, and impacts from fire and disease. Although not intended to be a direct commentary on Nova Scotia forest policy, Goldsmith reflected in some detail on the history of exploitation of the Nova Scotia forest and the impacts of this exploitation on the health of the forest, starting from European settlement through to the late 1970's when pulp and paper had come to dominate the forest sector in the province. He concluded that the Nova Scotia forest had deteriorated over time in terms of tree height, girth, species composition, fire barrens, nutrients, and a shortage of timber for sawmills and pulp and paper. He attributed a large share of the blame for the deteriorating conditions in the forest to historical harvest practices of "high-grading" for sawlogs and more recently, clearcutting for pulp and paper production. If these practices were not improved, Goldsmith predicted that future options for the Nova Scotia forest sector in terms of variety, quantity, and quality of products available from the forest would be greatly reduced.

Goldsmith's concept of managing the forest to support "future options" seems particularly relevant in the current period of global transition in the forest industry. In this period of major transition, it is critical that the forest be maintained in a condition that will allow for a wide range of options for deriving value from the forest. Policy-makers should therefore not be tied to trying to impose the necessary conditions to support a single dominant aspect of the industry, for example, trying to continuously salvage the pulp and paper industry. Instead, policy should direct the management of forests to maximize the options for deriving value from the forest, either through a variety of industrial activities that yield direct economic benefit (e.g. lumber, wood products, bioenergy), or through the preservation of wildlife habitat and other ecosystem services that yield indirect social, economic, and environmental value. The other element of this "future options" approach is that policy-makers must have good inventory information and ecosystem and habitat information for the forests they manage, as well as stakeholder input and an understanding of evolving market conditions for forest products. This style of management must be supported by well-researched quantitative information on the state of the forest and an understanding of what values are most desired by stakeholders and society in general. This allows for the identification of what the Nova Scotia forest can provide, versus what is desired.

The conclusions drawn in Goldsmith's assessment of the Nova Scotia forest in 1980 indicate that these types of forest management principles were not being used at the time, and therefore the forest was deteriorating and increasingly limited in its ability to support a strong forest industry. One of the primary objectives of this paper is to examine changes in forest policy and forest management in the context of Goldsmith's conclusions from 1980 in order to understand how policy has evolved since that time. More specifically, the objectives for this report were to:

1. Document important milestones in Nova Scotia forest policy between 1980 and 2017;
2. Summarize the key policy objectives and management approaches within each new forest policy; and
3. Provide a brief reflection on the evolution of forest policy, in particular with respect to key underlying forest management issues that have persisted over the study period.

The overall objective of this report is to summarize and reflect, but not to provide a quantitative assessment of the health of the NS forest, and not to provide critical policy analysis and recommendations.

The initial conception of this paper was during a directed studies course at the School for Resource and Environmental Studies in 2011-2012. The research and preliminary report from 2012 have been revised and updated with information on new policy developments between 2011 and 2017, as well as new reflections on key policy issues. This revised report is being submitted to inform the Independent Review of Forestry Practices being chaired by Dr. William Lahey.

1.2 Methods

The primary method used for this report was a qualitative literature review of key government policy documents and related governmental and non-governmental reports that provided additional insights on policy developments. Federal forest policy documents were also reviewed to understand the potential influence of federal forest policy on the direction of provincial policy, although this material is covered in limited detail. A small number of journal articles and books were also reviewed to provide additional context and insight around forest policy developments.

Given the broad spectrum of forest policy issues that have arisen in the last 40 years, there is no attempt here to be comprehensive in this review. The scope of the review was designed to highlight key issues more broadly. In particular, policy documents were reviewed with a primary focus on identifying:

1. Key forest management objectives for the given policy framework;
2. Background information on the context/rationale for new policy developments; and
3. Specific strategies or policy tools implemented to achieve forest policy objectives.

Non-policy documents were then reviewed to develop additional insight related to the policy developments where appropriate.

While some quantitative information is provided on Nova Scotia forest characteristics (age class, harvest volumes, etc.), a detailed quantitative analysis of changes in the forest was beyond the scope of this report. In an effort to avoid the politicized and polarized views that can often characterize forest policy debates, no interviews or consultations with industry or government experts were carried out, allowing for a more neutral, unbiased view of the literature and policy developments.

1.3 Study Boundaries and Limitations

The scope of the historical review included:

1. A broad overview of the state of the forest (i.e. age class, forest cover), the forest industry (i.e. harvest levels, key products), and forest policy at the outset of the study period; and
2. A detailed chronological review of provincial policy developments between 1980 and 2017;

The temporal scope of the review is generally from the publication of Goldsmith's review of the Nova Scotia forest resource in 1980 until the end of 2017 when the independent review of forestry practices was initiated by the government. Geographically, the scope of the review is limited to documents published on Nova Scotia's forests and forest policy, with some consideration of national forest policy as it relates to the Nova Scotia situation where appropriate. Discussion of policy developments in other Canadian provinces or other international jurisdictions was outside the scope of this report.

2. State of the Forest in 1980

The following sections provide a broad description of the state of the forest and the forest products sector in Nova Scotia in the early 1980's, as well as a description of the existing forest policy regime and key policy-related issues occurring at the time. This is a summary of documented information about the forest and forest industry at the time to provide context for the policy review, and is not reflective of any critical analysis by the author.

2.1 State of Nova Scotia Forests in 1980

In 1980, Nova Scotia forest lands covered 84% of the land surface of the province, totaling approximately 4.37 million hectares of forest land (Goldsmith 1980), of which 53% were softwood stands, 30% were mixed stands, and 17% were hardwood stands (NSDLF 1980). The gross merchantable stock was estimated at around 280,000,000 m^3, of which 69% was softwood and 31% was hardwood. The most prevalent softwood species were red and black spruce (27% of total stock, respectively), balsam fir (25%), and white spruce (7%). The most common hardwoods were red maple (12% of total stock), yellow birch (6%) and sugar maple (4%). Nearly 40% of the forest area was of age 41-60 years, and over 30% was of age 61-80 years. Of particular concern was that the 0-20 years age class made up just over 5% of the forest area, and only about 11% was in the 21-40 age class, indicating that a great deal of the forest was moving into older age classes with little new growth coming along to replace it (NSDLF 1980).

Reports on the state of Nova Scotia's forests around 1980 describe unhealthy and unproductive forests that had been mismanaged and subject to tremendous stress since European settlement, and that barely resembled the characteristic forests of the Acadian Forest Ecoregion in which they reside (May 2005). This bleak description was echoed in both academic and government documents at the time. In his ecological assessment of the forests in the province, Goldsmith (1980) noted that even in the absence of poor management, Nova Scotia's forests have several natural constraints to tree growth, including a relatively cool climate, shallow nutrient-poor soils, high precipitation, and locally impeded drainage. These natural constraints were only exacerbated by a long history of intensive industrial cutting, and the result was a forest with a vastly changed species composition and historically poor growth rates. White pine was the major species used by industry up until 1860, and once heavily depleted, it was replaced by red spruce, which around 1980 was also decreasing in volume and the forest industry had shifted again to focus on balsam fir, white spruce, and black spruce. Goldsmith noted there was strong evidence to suggest that repeated cutting of softwoods from mixed stands encouraged the regeneration of hardwoods of lesser commercial value, since natural succession in Nova Scotia is first to colonizing hardwoods. With respect to productivity, Goldsmith pointed out that in terms of height and girth, all sources at the time suggested that the dimensions of hardwood and softwood trees had decreased since colonial time, and samples from various parts of the province indicated that the annual increment was about 46% of what it was in the previous best 10 years of growth. Furthermore, poorly managed forest harvesting had served to further deplete the already low nutrient content of NS soils (Goldsmith 1980).

In a provincial manual of forest practices published in 1980 (NSDLF 1980), a similar description was provided of a forest on the verge of being overharvested with very little new growth ready to replace what was being removed. Echoing the concerns expressed by Goldsmith about forest growth rates, this government report noted that an average acre of NS forest land was producing 20-25 cubic feet per acre per year under good forest practice, but was capable of producing at least 70 cubic feet per acre per year.

In 1984, The Royal Commission on Forestry in Nova Scotia did not mince words when it described the Nova Scotia forest as being in crisis. According to the Royal Commission, the forest had been ravaged by fire, insects, weeds, and wind, and continued "high-grading" by forest harvesters, a method known as "take the best, leave the rest" (NSRCF 1984). In addition to being subject to intensive harvesting, very little effort had been invested in forest renewal, which is quite evident when looking at age class data from the early 1980's. The Royal Commission suggested that if forest practices at the time were continued, by 2005 there would not be enough raw material to meet the needs of industry in the seven eastern counties on a sustained yield basis. The Royal Commission noted that much of the softwood forest was mature to over-mature and extremely susceptible to damage from insects and disease. This was one of the contributing factors to the spruce budworm outbreak in Cape Breton in the 1970's, where ultimately 22,000,000 m^3 of forest had been lost as of 1984 (NSRCF 1984). The Royal Commission echoed comments from Goldsmith and the provincial government with respect to the low growth rates exhibited in Nova Scotia forests, where growth of mature softwood stands was below 2.1 m^3/ha/year although the land base in Nova Scotia is capable of 8.4 m^3/ha/year.

2.2 Nova Scotia Forest Products Industry in 1980

The annual output of the Nova Scotia forest industry was valued at approximately $500 million in 1984, including the provision of 8,000 direct jobs and an estimated 16,000 indirect jobs (NSRCF 1984). The annual average requirement for wood fibre in the early 1980's was 3,300,000 m^3 of softwood and 413,000 m^3 of hardwood. The total harvest in 1980 was 4,270,683 m^3, which was used primarily to provide feedstock to over 350 sawmills and 5 pulp and paper mills (NSRCF 1984). Provincial Crown land produced 26% of the harvest, while large industrial lands accounted for 30% and small private woodlots produced 44% of the harvest (NSRCF 1984). Of the 350 sawmills, approximately 40 mills accounted for over 80% of total sawmill production. In terms of markets for Nova Scotia forest products, the majority of sawmill products were sold in local markets (approximately 80%) while nearly all of the outputs from the pulp and paper sector were exported. Overall, there was a sense of optimism about global demand for wood fibre in the early 1980's, as world markets for wood fibre were strong and predicted to grow. It was thought that if Nova Scotia could maintain a secure supply of high quality fibre products, its prospects on the global market would be excellent (NSRCF 1984).

The industry had undergone several changes in recent years, most notably a rapid replacement of labour by technology which favoured the larger, more integrated forest companies, and the emergence of pulp and paper as the dominant player in the Nova Scotia forest sector. Sawmill production had declined steadily, with 1977 having a volume of less than 200 million board feet, including only 10 million board feet of hardwood (down from 350 million board feet and 40 million board feet of hardwood in 1950). During the same period, the number of sawmills decreased from 800 to 300, but there was a marked increase in the volume of pulpwood production. In 1961, pulpwood was 30% of the annual harvest. Since that time, two new mills had opened, as well as a hardwood plant in 1967. Total pulpwood requirements increased to nearly 80% of the total harvest by the late 1970's. Overall, there was a 60% decrease in sawlog harvest and a 500% increase in pulpwood harvest in the years leading up to 1980.

Overall, Nova Scotia was thought to be overharvesting softwood with very little effort to renew softwood stands, and under harvesting hardwoods (Goldsmith 1980, NSRCF 1984). Up until the 1970's, wood fibre had always been readily available, so that little thought was given to renewing the forest resource after harvesting. This lack of forest rehabilitation coupled with losses from the spruce budworm outbreak in

Cape Breton was leading to concern about shortages in supply in the near future (Goldsmith 1980, NSRCF 1984), with sawmills in the east already experiencing shortages of quality sawlogs in 1984 (NSRCF 1984).

2.3 Nova Scotia Forest Policy Context in 1980

Nova Scotia forests were managed by the Department of Lands and Forests in 1980, primarily under the Lands and Forests Act. The province was also signatory to several federal/provincial economic agreements to support forest management on private lands in the early 1980's. The primary concern in the early 1980's was that the forests were in poor health which resulted in low productivity. The forest had been highgraded for centuries and softwood had generally been overcut with very little effort to renew the forest after harvest. In general, a lack of a clear long-term strategy meant that the province could soon be facing losses in the forest sector and missed opportunities on the global markets. It is also interesting to note that, similarly to the present dialogue in Nova Scotia on bioenergy, there was discussion about the use of wood biomass as an energy feedstock. The oil price shocks of the 1970's had spurred fear over energy affordability and energy security, and industry and government alike were exploring the feasibility of burning wood biomass as a substitute for fossil fuels in heating and electricity generation applications (NSRCF 1984).

One of the long-term challenges of managing the forests in Nova Scotia is that unlike most other Canadian provinces, the majority of productive forest lands in Nova Scotia are privately owned. In 1980, approximately 73% of Nova Scotia forest land was privately owned, with 52% of that land consisting of smaller private woodlots, and 21% held by large industrial owners. The Crown owned just 21% of the forest lands of the province in 1980, and only 22% of the gross merchantable volume (NSDLF 1980). Maintaining the active involvement of private forest land owners in managing their lands and supplying adequate wood fibre was a key policy objective in the early 1980's.

3. Summary of Nova Scotia Forest Policy Development 1980-2017

The following sections provide an overview of key developments related to forest policy and forest management between 1980 and 2017. The primary focus of the discussion is on the contents of each government policy document, and when available, some additional details are provided from other government documents to give context and highlight possible motivations and observed outcomes related to particular policy objectives. The policy developments are organized generally by decade, which is a somewhat arbitrary boundary used to provide structure to this lengthy summary. An overview of the chronology of key policy developments is provided in Table 1.

3.1 Forest Policy Developments 1980 - 1989

1984 – Forestry: Report of the Nova Scotia Royal Commission on Forestry

At the outset of the 1980's, Nova Scotia lacked a long-term forest management policy (NSRCF 1984). This fact, coupled with serious concerns about the health of the forest and the ability of the forest to supply an increasing demand for wood fibre prompted the Department of Lands and Forests to initiate the Royal Commission on Forestry in 1982 (NSDLF 1983). Through consultation with the public, the forest industry, and various forestry experts, the three-person commission was asked to report on:

1. The present and projected forest inventory, its quantity, quality, distribution, value, and availability, and the sustainable harvest levels for products of the forests in relation to present and future industrial and other demands.
2. The most appropriate forest management procedures, including protection and the utilization of the forest resources of Nova Scotia, to ensure maximum future benefits.
3. The impact of land ownership and tenure, competing uses and forest management practices on the future supply of forest products, fish and wildlife population, and recreational opportunities in Nova Scotia.
4. The role of Governments, at all levels, in relation to all aspects of the use and management of the resources of the forests of Nova Scotia, including taxation, and the most appropriate regulatory framework for the Province.

In a detailed report published in 1984, the Royal Commission stated that based on their consultations and information reviewed, if current forest practices were maintained, by the year 2005 there would not be enough raw material available to meet the needs of industry in the seven Eastern counties of the province, and that continuation of current forest practices would lead to an erosion of the resource which would preclude Nova Scotia from the benefits of increasing worldwide demand for wood fibre (NSRCF 1984). This impending forest crisis was blamed on a history of poor management, including high-grading and a lack of effort to restore forest losses due to harvest, fire, insects, and disease. The Royal Commission did conclude, however, that the forest land base of the province was more than capable of sustaining the requirements of the existing forest industry and providing wildlife and recreational needs if subject to proper forest management practices.

The notion of proper forest management practices was explored in detail in the Royal Commission report, and ultimately the commission presented six potential management approaches that could be pursued, including:

1. **Laissez-Faire** – An approach involving very little active forest management which would ultimately lead to raw material shortages and negative impacts to wildlife and forest health and aesthetic.
2. **Status Quo** – Maintain current level of silviculture investment and do not promote new hardwood uses or try to involve small private woodlot owners in softwood management. Forest productivity would remain around 1.5 m^3/ha/year, well below its capability which is 2-3 times this level of productivity. Softwood harvest would peak at 4,000,000 m^3 in 2040.
3. **Conservancy** – Increase the volume of wood fibre available to at least 7,700,000 m^3 per year by 2030/2040 (5,500,000 m^3 of softwood, 2,270,000 m^3 of hardwood) through an active program of forest restoration, conservation, and improvement, funded by initial expenditures of $20 million per year.
4. **The Sawlog Forest** – Maximize sawlog production, which would create a better quality and more aesthetically pleasing forest, and boost rural economies. Substantial silviculture activities would be required, and the use of sawmill co-products (chips, sawdust, etc.) would need to be maximized by maintaining complimentary industries such as pulp and paper.
5. **Industrial Biomass** – Manage the forest to maximize production of low-grade fibre for biomass industries, such as manufacture of cellulose and rayon, feedstock for wood-alcohol and chemical plants, and biomass for energy. Substantial capital investment would be required.

6. **Species Selection** – Eliminate budworm-susceptible species (balsam fir and white spruce). This would involve a period of intense harvesting and processing of existing stands, followed by sufficient replanting to maintain stands of more desirable species.

In examining the advantages and disadvantages of each of these potential paths forward, the commission recommended what they referred to as the "Conservancy Policy", which specified that the Conservancy option (#3) and the "best elements" of options 4, 5, and 6 be adopted and implemented as soon as possible (NSRCF 1984). This new policy would focus on restoration, conservation, and improvement of the forest, with a primary objective of greatly increasing productivity and the annual allowable cut (AAC). This would be achieved by developing a policy centered around the following essential elements:

1. Scheduling – a timetabled harvesting of the forest so the most appropriate wood is cut at the optimum time.
2. Allocation – ensure that the best end use is achieved for each tree removed.
3. Marketing – a monitoring and assistance of the commercial facets of the resource to maintain the efficiency of all participants.
4. Silviculture – forest cultivation, including planting, thinning, fertilizing, and drainage.
5. Protection – prepare for, take action to counteract or minimize, any avoidable forest hazard, including fire, insects, weeds, wind, and diseases.

The Royal Commission noted that all five components described above were equally essential and could not be pursued in isolation, arguing that "good forestry is the skillful orchestration of these components toward the goal of a healthy forest and an increased, sustainable harvest." (pg.19). It was also noted that the success of this policy would depend heavily on the participation of private woodlot owners, who at the time owned a significant portion of the best forest land. The commission recommended that private woodlot owners should be brought into the policy via cooperation and financial incentives, rather than through legislated means. More specifically, private woodlot owners should be encouraged to enter into management plans and be compensated for an abatement of property taxes, silviculture assistance in cash payments, technical and professional expertise, and ensuring markets for their wood. The Province should also monitor insect, disease, and fire hazard conditions and provide protection for private lands. Non-participants should be taxed as speculative landowners.

If this policy was pursued, the Royal Commission projected that the expected annual volume of fibre available would increase to 4,070,000 m^3 of softwood and 1,850,000 m^3 of hardwood by 1990, and 4,620,000 m^3 of softwood and 2,100,000 m^3 of hardwood by 2020. Successful application of the Conservancy Policy would also lead to a substantial increase in abundance of all forms of wildlife, to the point that some species could become pests and hunting seasons would have to be expanded.

Table 1. Chronology of Key Developments in Nova Scotia Forest Policy 1980-2017

Year	Policy Development	Context/Contributing Factors	Highlights
1984	Forestry: Report of the Nova Scotia Royal Commission on Forestry	Expert panel review commissioned by the Department of Lands and Forests to address the lack of a long-term forest management policy, and address more specific concerns about a potential lack of wood fibre supply to meet future forest industry demands.	Panel recommended a new policy to focus on restoration, conservation, and improvement of the forest, including: • Increasing the volume of wood fibre available to at least 7,700,000 m3 per year by 2040 • A long-term strategic program of harvest scheduling, allocation, marketing, silviculture, and protection
1986	Forestry: A New Policy for Nova Scotia	A new forest policy for Nova Scotia, developed as a direct response to recommendations from the Royal Commission on Forestry. The policy was designed to address most of the key issues and suggested approaches from the 1984 Royal Commission report.	The new policy included directives to: • Double forest production by the year 2025 • Establish a formal program to work with private woodlot owners • Protect wildlife habitat and watercourses • Establish forest management practices for Crown land • Development of a GIS-based forest inventory • Enact the Lands and Forests Act, the Pulpwood Marketing Act, and the Forest Improvement Act
1989	Forest/Wildlife Guidelines and Standards for Nova Scotia	These guidelines were developed to achieve some of the objectives stated in the 1986 Forest Policy and the 1987 Wildlife Policy.	These standards were to be implemented on Crown land and incorporated into forest management plans on private land. Areas of focus included standards to establish: • Forest diversity (including clearcut specifications) • Edges and wildlife corridors • Special management zones near watercourses • Cavity trees, snags and downed trees • Deer wintering areas • Habitat for birds of prey and heron colonies
1994	Nova Scotia's Forest Management Strategy	This strategy was developed as part of the federal/provincial Cooperation Agreement for Forestry Development 1991-1995. It also reflected Nova Scotia's commitment to the Canadian Council of Forest Ministers 1992 Forest Accord: Sustainable Forests – A Canadian Commitment.	An intensive forest management strategy was adopted to pursue the 1986 Forest Policy objective of doubling forest production by 2025. This included plans to: • Use intensive silviculture to push softwood harvest from 3.75 to 5.3 million m^3 and hardwood from 1.5 to 2.0 million m^3 by 2025. • Apply commercial thinning, shelterwood, salvage and site clearing treatments to reduce forest mortality and losses to insects and disease • Increase quality of wood for sawlogs and studwood • Increase restoration of Budworm-killed stands in Cape Breton

Table 1. Chronology of Key Developments in Nova Scotia Forest Policy 1980-2017

Year	Policy Development	Context/Contributing Factors	Highlights
			• Achieve a more balanced age class distribution by 2061-2065 The plan also highlighted the emerging concept of sustainable development in forestry, and the need for integrated resource management.
1997	Toward Sustainable Forestry: A Position Paper	Federal/provincial forestry programs expired in 1995 and coupled with an unprecedented increase in harvesting (exceeded 5,000,000 m^3 in 1996) led to concerns about the sustainability of current management and harvesting. This position paper was heavily informed by a report commissioned from the Coalition of Nova Scotia Forest Interests (1996) and a public response to that report prepared by Voluntary Planning (1996). This change in policy was also noted to incorporate sustainable development principles and a generally evolving set of values and concerns in society with respect to forests.	Overall approach was to shift the responsibility for maintenance of the forest resource onto those creating the demand for wood fibre in the industry. This included plans to promote: • Sustainable harvests – establish a registry of buyers of wood fibre to enter into stewardship and silviculture arrangements • Sustainable forest practices – develop a code of forest practices required on Crown lands and encouraged on private lands • Collection and reporting of data – require prompt reporting of wood volumes acquired, publish a "State of the Forest" report every 3-5 years • Stakeholder participation and input – establish a provincial forum and advisory committees to work with the Department of Natural Resources
1998	Registry of Buyers	Provincial program established in line with the proposed approach in the 1997 policy to place greater emphasis on industry to account for the demand of wood fibre and collection of information on harvesting.	Provides a means of collecting data on the acquisition of primary forest products, export/import of primary forest products, and generation of secondary forest products. Highlights of the Registry of Buyers include: • Applies to all entities that purchase more than 1,000 m^3 of primary forest product • Data is broken down by species, geographic origin, land ownership, and processing location/destination, and is summarized in an Annual Report • Would ultimately become a key component of the Forest Sustainability Regulations
1999	Interim Old Forest Policy	A policy intended to clarify and consolidate DNR efforts to maintain old forests. Acted as a precursor to a more formal policy which would be released in 2012.	Primary objective was for DNR to set aside 8% of forest land as old growth in each of the 39 forested eco-districts of the province. The policy provided a definition of "old growth" and "old forest", and documented guidelines for selecting and setting aside old forests and identifying old forest sites.

Table 1. Chronology of Key Developments in Nova Scotia Forest Policy 1980-2017

Year	Policy Development	Context/Contributing Factors	Highlights
2000	Forest Sustainability Regulations	Provided another mechanism to implement policy from the 1997 discussion paper related to silviculture. Enacted under the Forests Act and designed in relation to the Registry of Buyers that was previously established.	The regulations require Registered Buyers who acquire more than 5,000 m^3 of wood from industrial or private lands to submit a Wood Acquisition Plan (WAP) and to either conduct a silviculture program or contribute to the Sustainable Forestry Fund based on silviculture credits calculated by the Department. Technical standards for softwood and hardwood silviculture are defined in Schedule 1 of the regulations.
2002	Wildlife Habitat and Watercourses Protection Regulations	Some elements of the 1989 Forest/Wildlife Guidelines and Standards were enacted into regulations under the Forests Act.	The regulations apply to forestry operations on Crown land and private land, and provide specifications to: • Ensure legacy trees and habitat structure are maintained on forest land • Establish special management zones around watercourses that prohibit certain forestry activities and include vegetative buffer zones
2004	Nova Scotia's Code of Forest Practice: A Framework for the Implementation of Sustainable Forest Management	Development of a Code of Forest Practice was initiated with the 1997 position paper on sustainable forestry. The Framework Document for the code was published in 2004, with subsequent updates in 2008 and 2012.	The code was designed to emphasize the shift from managing forests primarily to maximize productivity for industrial harvests to more sustainable forest management which recognizes non-timber values provided by forests. Principles of the code include: • Forest ecosystems – sustain or restore natural patterns and attributes • Forest products – improve growth, value and quality of products • Wildlife habitat – maintain and enhance natural forest conditions required for wildlife • Integrated Forest Use – need to sustain multiple forest uses, local communities, and forest environment
2008	State of the Forest Report 1995-2005: Nova Scotia Forests in Transition	The concept of a regular State of the Forest report was introduced in the 1997 position paper on sustainable forestry. The first such report was slated to be in 1998, followed by a new report every 3-5 years; however, this	The report includes a summary of key forest statistics such as changes in merchantable volume, species composition, age class distribution, land ownership, etc. It also contains data on the economic contributions of the industry, harvest levels, and exports.

Table 1. Chronology of Key Developments in Nova Scotia Forest Policy 1980-2017

Year	Policy Development	Context/Contributing Factors	Highlights
		report in 2008 was the first one issued, and the next report would not be issued until 2017.	The report also includes summaries of changes in government policies and programs for forest management, silviculture, and the evolving ecosystem-based management system.
2009	Our Common Ground: The Future of Nova Scotia's Natural Resources	The Environmental Goals and Sustainable Prosperity Act (EGSPA 2007) committed the Department of Natural Resources to develop a new Natural Resources Strategy by 2010. Voluntary Planning was commissioned to engage Nova Scotians in 2008 for input towards development of this new policy. This was Phase I of the new policy development strategy.	Phase I included 27 public meetings attended by over 2,000 people and submission of over 600 written statements. The emerging themes from these consultations were that a new policy should be based on: • Sustainability • Diversity • Collaboration • Transparency • Informed Decision-Making
2010	Phase II Expert Panel Reports for the new Natural Resources Strategy	As part of Phase II of the development of a new Natural Resources Policy for Nova Scotia, expert panels were commissioned to prepare research reports to provide input to the process, and the Steering Panel provided a summary of strategic recommendations.	Reports prepared and submitted during Phase II included: • Restoring the Health of NS Forests (Bancroft & Crosland 2010) • The Roots of Sustainable Prosperity in NS (Porter 2010) • A Natural Balance: Working Toward Nova Scotia's Natural Resources Strategy (Glube et al. 2010) • Review of Reports and Recommendations Relating to Forests/Forestry (Wagner 2010) • Comments on the Natural Resources Strategy Phase II Recommendations (Patriquin 2010) These expert reports were somewhat polarizing on many of the key issues.
2010	A Policy Framework for the Future of Nova Scotia's Forestry	This policy statement was released by the Department of Natural Resources during preparations for the new Natural Resources Strategy. It was posted to the department website and described as "strategic directions".	Strategic directions listed in the framework included: • Reduce clear cutting by 50% in 5 years • Prohibit whole-tree harvesting • Eliminate public funds for herbicide spraying • Private land owners not required to have management plants to harvest for non-commercial energy use • Undertake an analysis of having an Annual Allowable Cut for NS • Incorporate harvesting of forest biomass for energy in the Code of Forest Practices, and include commercial users of biomass for energy or fuel in the Registry of Buyers

Table 1. Chronology of Key Developments in Nova Scotia Forest Policy 1980-2017

Year	Policy Development	Context/Contributing Factors	Highlights
2011	The Path We Share: A Natural Resources Strategy for Nova Scotia 2011-2020	After three years of public and expert consultations, the Department of Natural Resources released a new Natural Resources Strategy for Nova Scotia, including a new forest policy section. In addition to the main policy document, this also included publication of From Strategy to Action, a brief document outlining the specific policy objectives in the new policy and a timeline for action on each objective.	Overarching goals of the new policy were to promote: • Collaborative leadership • Sustainable resource development • Research and knowledge sharing; • Good governance Within each of these broad objectives, specific actions related to forestry were defined. Some highlights include: • Implementation of ecosystem-based approach to forest management • Report regularly on the state of Nova Scotia's forests • Expand research and knowledge in key areas (e.g. forest carbon, pests and disease) • Establish working community forests on Crown land • Reduce clearcutting to 50% of harvests • Eliminate public funding for herbicides • Evaluate potential of having an Annual Allowable Cut (AAC) • Various initiatives to work with private woodlot owners
2012	Nova Scotia's Code of Forest Practice: A Framework for the Implementation of Sustainable Forest Management – Guidelines for Crown Land	Development of a Code of Forest Practice was initiated with the 1997 position paper on sustainable forestry. The framework for the code was published in 2004, followed by a set of interim guidelines for Crown land in 2008. Part of the 2011 Natural Resources Strategy included application of the Code of Forest Practice on all Crown lands and to encourage use on private lands.	In addition to the framework of principles, the Code of Forest Practice now includes guidebooks with specific direction for each of the four principles.
2012	Nova Scotia's Old Forest Policy	A policy to consolidate DNR efforts to maintain old forests and associated	The policy is focused on public lands and emphasizes lands currently under protection. Provides a definition of "old growth" and "old forests". Objectives include:

Table 1. Chronology of Key Developments in Nova Scotia Forest Policy 1980-2017

Year	Policy Development	Context/Contributing Factors	Highlights
		biodiversity. Builds on the Interim Old Forest Policy of 1999.	• Identify and conserve old growth forests and the best old forest restoration opportunities on public land • Establish and sustain an ecologically representative network of old forest • Provide social, recreational, and educational opportunities for public use of representative old forests • Provide direction and procedures for integrated resource management decisions involving old forest values • Establish a spatial database for storing and tracking old forest identified under the policy
2016	The Path We Share: A Natural Resources Strategy for Nova Scotia 2011-2020 Five-Year Progress Report	Interim updates on progress related to objectives in the Natural Resources Strategy were provided after 12 months (2012), 18 months (2013), and 2 years (2013). The five-year update consolidated most of the reported progress from those interim updates, and provided updates on the status of important commitments related to clearcutting and an AAC.	The 12-month update gave limited progress updates and pointed out actions for which work was ongoing and/or deadlines had been extended. This included clarification of the use of forest biomass for energy, and the establishment of rules for whole-tree harvesting. Highlights of the 2-year update were that the issue of biomass harvesting for energy had been clarified, public funding had been discontinued for herbicide use, and whole-tree harvesting was now banned. In the 5-year update, the department withdrew their commitment to reduce clearcutting to less than 50% of harvesting, citing an increased understanding of how clearcutting can be incorporated into an ecosystem-based management approach. It was also noted that an AAC would not be pursued for all forest lands due to challenges with the extent of private land ownership.
2017	State of the Forest 2016	The concept of a regular State of the Forest report was introduced in the 1997 position paper on sustainable forestry. The first such report was slated to be in 1998, followed by a new report every 3-5 years; however, the first report was only released in 2008, and this latest report was not issued until 2017.	The report was framed around the guiding principles in the Code of Forest Practice. In addition to reporting on key forest statistics (age class, species composition, harvest levels, economic value, etc.), the report also included assessments of indicators related to the ecosystem-based management approach adopted by the province (e.g. biodiversity, soils and water, forest carbon). For some of these elements that have not been assessed to-date there was minimal or no data available for a proper assessment.

Table 1. Chronology of Key Developments in Nova Scotia Forest Policy 1980-2017

Year	Policy Development	Context/Contributing Factors	Highlights
2017	Independent Review of Forest Practices	During the 2017 provincial election, the Liberal party's platform included a commitment to commission a third-party, independent review of forest practices in Nova Scotia. Several months after winning the election, the Liberal government initiated this review in the summer of 2017.	Dr. William Lahey, President of the University of King's College, was retained as Project Lead. His mandate was to: • Evaluate the effectiveness and identify opportunities to improve the legislation, regulations, policies and guidelines, as well as the science-based tools that determine whether and where harvesting occurs, as well as harvesting methods. • Evaluate market access for private forest owners, particularly in the Western region, and provide recommendations to address any identified issues. During this process, Dr. Lahey would accepted written submissions from the general public and meet with individuals and representatives of groups and organizations that wanted to contribute. All of this while working with a team of expert advisors selected by Dr. Lahey upon initiation of the review process.

1986 - Forestry: A New Policy for Nova Scotia

Following on the Royal Commission on Forestry report in 1984, the Department of Lands and Forests issued three new natural resource policies in the mid-1980's, including Forestry (1986), Wildlife (1987), and Parks (1988). Focus in this report is on the Forestry Policy of 1986, although elements of the Wildlife and Parks policies certainly would have contributed to guiding forest management practices in the subsequent years. Some specific examples of this are provided elsewhere in this report, but detailed analysis of these policies is beyond the scope of the present study.

The 1986 forest policy was heavily based on the recommendations from the Royal Commission on Forestry in 1984, which recommended that the province should adopt their "Conservancy Policy". Many of the key recommendations made by the commission were directly included in the new policy, including the overall governing approach of the policy, which was to maximize efforts towards cooperation, education, extension and incentive programs as opposed to punitive taxation, legislation, or regulation. Although not explicitly stated, this approach would appear to be one of the only options for a province like Nova Scotia where up to 70% of the forest land was privately owned at the time and not subject to Crown management.

The primary objectives of the new forest policy were directed towards (NSDLF 1986):

- A healthier more productive forest capable of yielding increased volumes of high quality products.
- Encouraging the development and management of private forest lands as the primary source of timber for industry in NS.
- Supporting private landowners to make the most productive use of their forest lands.
- More effective management of all Crown lands.
- The maintenance or enhancement of fish and wildlife habitats, water quality, recreational opportunities and associated resources of the forest.
- Enhancing the viability of forest-based manufacturing industries.
- A doubling of forest production by 2025.
- Creation of more jobs, both immediately and in the long term through improved forest productivity.

These objectives would be achieved by implementing the general forest management principles outlined in the 1984 Royal Commission report, including:

- The use of scheduling for appropriate harvesting.
- Allocation of forest stands to best end use.
- More effective marketing of forest products.
- A continuing, vigorous silviculture program.
- Protection of the forest from fire, insects, diseases, and competing vegetation.

Based on these guiding principles, a range of forest management policy elements would be utilized to achieve the province's objectives. Highlights of these policy elements include:

- Private Lands – Private woodlot owners should have fair market share and receive fair and reasonable return for primary forest products, enjoy traditional rights and responsibilities of private ownership, and continue to receive incentive assistance for management.

- Crown Lands – Crown lands will be used more effectively, including enhanced productivity and increased harvest of better quality products, improved leasing and licensing arrangements, and integration of wildlife and outdoor recreation considerations in the forest management planning process.
- Forest Protection – Protection will be a key priority with enhanced forest fire detection and suppression, continued efforts against the spruce budworm, the use of chemicals registered with the Government of Canada, and the protection of selected stands against competing vegetation.
- Forest Industry – Support and encourage the forest products sector by developing a Forestry Trade Development Strategy and encouraging and assisting in the development of new markets and production of higher-value products.
- Wildlife and Environmental Considerations – Will maintain or enhance conditions for fish and wildlife by the protection of significant wildlife habitats and maintenance of the long-term productivity, diversity, and stability of forest ecosystems, and respecting the integrity of watersheds, fish habitats and the aquatic environment, special places, ecological reserves and significant outdoor recreational opportunities.

These elements of the policy were further expanded upon with more specific strategies that would be taken in the coming years to achieve the objectives of the policy. It is noted in the description of proposed forest management strategies that private lands and private landowners were the key to attaining the goals and objectives of this policy, since private lands were the most productive and most accessible in the province. The future success and the future viability of the forest industry would depend on the interest of private landowners in managing their lands for forest production. The proposed forest management strategies included:

- Adoption of a new forest management planning process to guide decision-making, involving the prediction of the effects of various forest management alternatives on wood supply.
- Preparation of operational forest management plans for Crown lands and the development and implementation of compatible forest management programs for private lands in cooperation with private landowners.
- Establishment of a Private Lands Directorate to assist private landowners in managing their lands, including financial incentives and the continued support of the Group Management Venture organizations.
- Increased efforts in marketing and market development for primary forest products.
- Increased forest research, including research on growth and yield predictions, refining ecological methods of land classification, and the impacts of forestry operations on wildlife.
- Develop a geographic information system (GIS) to manage the province's forest inventory program.
- Develop suitable guidelines and standards to minimize the impacts of various forest management practices on fish and wildlife habitats and the forest environment.

This policy would ultimately be the guiding document for forest management in the province well into the mid-1990's. Elements of the policy certainly reflect the lingering concerns about insect and disease resulting from the spruce budworm outbreak in Cape Breton. It is noted in the policy that "Protection is the keystone of sound forest management" The policy was implemented by three Acts passed by the

Legislature in 1987, including the Forest Act, the Forest Enhancement Act, and the Primary Forest Products Marketing Board Act (NSDLF 1987).

1989 - Forest/Wildlife Guidelines and Standards for Nova Scotia

Following on one of the specific strategies outlined in the 1986 Forest Policy, the Forest/Wildlife Guidelines and Standards for Nova Scotia were published by the Department of Lands and Forests in 1989 (NSDLF 1989). These guidelines and standards were also in keeping with the new Wildlife Policy published in 1987. Although not supported by legally binding legislation, these guidelines and standards were to be implemented on Crown lands and incorporated into forest management programs for private lands when possible.

The guidelines document was designed to be an aid for foresters which provided techniques to preserve wildlife habitat during forest harvesting activities. Techniques and guidelines were described within a set of key areas of concern for wildlife habitat, including:

- Forest Diversity – maintenance of diverse tree species composition and management of forest succession after harvest.
- Edges and Wildlife Corridors – maintenance of "edge" areas where wildlife and habitat are richest, and maintenance of wildlife corridors connecting harvested areas with unharvested areas.
- Special Management Zones Near Watercourses – maintenance of buffer zones and management zones around watercourses (lakes, rivers, streams) where certain forest harvest activities are to be restricted and particular ecosystem characteristics are to be maintained.
- Cavity Trees, Snags, and Downed Trees – maintenance of wildlife habitat by leaving behind appropriate amounts and types of dead trees.
- Deer Wintering Areas – maintenance of deer habitat by altering cutting practices and scheduling within known wintering areas.
- Birds of Prey and Heron Colonies – maintenance of their sensitive habitats by being aware of nests and colonies and scheduling harvests around mating periods.

Within these key areas, some very specific guidelines were provided, such as specifications for the size and nature of clearcuts, buffer zones, and special management zones. Of particular note in this document were specific guidelines for clearcutting, which is a forestry practice under significant public scrutiny in 2018. These guidelines stated that:

- Areas to be clearcut should not exceed 50 hectares (125 acres). Where it is necessary to cut large areas because of insects, disease blowdown and/or extensive old growth stands, leave corridors for wildlife.
- Where an area planned for clearcutting exceeds 50 hectares (125 acres), leave one or more wildlife corridors to conform with the guidelines regarding maximum clearcut size.
- Where the total area would exceed 50 hectares, avoid clearcutting stands adjoining a clearcut area until the regeneration in the original clearcut is at least two metres (six feet) tall or else provide appropriate wildlife corridors.
- Forest managers are encouraged to prescribe irregular borders (such as stand boundaries) for clearcuts because they provide more edge for wildlife than do straight borders.

Promotion and development of the guidelines were primary activities in 1989 and presentations were given to industry, government, and private agencies to explain and develop procedures to implement the guidelines. (NSDLF 1990). These guidelines and standards would later be formally brought into legislation as legally binding regulations in the early 2000's.

3.2 Forest Policy Developments 1990-1999

On September 16, 1991, the former department of Lands and Forests was merged with the department of Mines and Energy to form the new Department of Natural Resources. Forestry would now be managed under this larger department, and more specifically under the "Forestry Branch" of the department (NSDNR 1992).

Despite this organizational change, several forest management initiatives that carried over from the 1980's continued to be priorities for provincial forestry managers and progress was made on several fronts. Work continued in the early 1990's on the province's forest inventory, including the addition of 49 new permanent sample plots (PSP) and completion of the GIS inventory for 2 additional counties in the province (NSDNR 1992). Data collected from PSPs was used to determine the effect of various management operations, including cleaning, trimming, shelterwoods, fertilization, and planting on timber production and natural regeneration. The results were used to update growth, yield, and wood supply models and provide information to develop similar models for hardwoods. These PSPs, in addition to new PSPs put in place over the years, continue to be used in 2018.

In 1991, the Canada/Nova Scotia Cooperation Agreement for Forestry Development (CAFD) expired after having supported the development of 5,104 forest management plans covering over 800,000 acres of private forest land in Nova Scotia (excluding Group Venture programs). Upon expiry of the agreement, a new financial agreement was reached with the federal government that would see $98 million in funding for forest management, silviculture, and education between 1991 and 1995. This funding was used to fund silviculture and the development of forest management plans on private forest lands. Seven large landowners and 4 pulp and paper companies participated in silviculture under the CAFD agreements during 1991 alone (NSDNR 1992).

In terms of forest management on Crown lands, efforts were continued by provincial staff to develop an integrated resource management (IRM) plan for Crown lands, as suggested in the 1986 Forest Policy document. In 1993, a committee was formed in the Department of Natural Resources to devise an integrated management planning process that would be used on all Crown lands (NSDNR 1993), and in 1994 the committee selected a location for a pilot project to test the plan in Colchester and Cumberland counties (NSDNR 1994).

1994 - Nova Scotia Forest Management Strategy

In 1994, the Department of Natural Resources released the Nova Scotia Forest Management Strategy (DNR 1994). This strategy was developed to be a framework for achieving the objectives in the 1991-1995 Canada/Nova Scotia Cooperation Agreement for Forestry Development, as well as the forest management objectives in the 1986 Forest Policy. The primary focus of this management strategy was to identify ways of increasing forest volume available for harvest and improving wood quality through an intensive management approach (DNR 1994).

The introduction to the strategy revisited a lot of the key themes that were discussed in the 1984 Royal Commission report, including the importance of forest protection, the state of the forest products industry, and general concerns about wood supply relative to demand. It was reiterated that the overall impact of the spruce budworm damage on the province's forests during the 1970's and the legacy of poor management practices going back to European settlement had left the forest in poor condition and forced the government to change the emphasis of forest management policies in the 1980's. This change towards a more active management and renewal approach was reflected both in the 1986 Forest Policy and in the federal-provincial economic agreements to co-operate on forestry issues.

According to the strategy document, DNR forest inventories indicated there were considerable opportunities for improving the productivity of NS forests and increasing sustainable wood supply. According to the data provided, poor forest conditions meant that softwood stands were yielding only $1/5^{th}$ of their potential (98 m^3/ha, but productivity could be as high as 500-650 m^3/ha). To address the lack of productivity in the forest, a new forest management approach was needed. The government used forest inventory models to evaluate the impacts of three possible approaches to forest management on the potential yield from the province's forests, including:

1. **Passive Management -** Existing silviculture would be discontinued in 1991 while maintaining pest and fire protection programs. Only natural regeneration would be used, and it was predicted that this would result in a decline in the sustainable annual harvest for softwoods (from 3.7 million m^3 to 2.5 million m^3). This would result in a 33% reduction in the annual allowable softwood harvest. If demand continued to increase by about 5% per decade, there would be a 44% shortage of softwood supply by 2025. Such a decline in wood supply would jeopardize the economic viability of the industry.
2. **Basic Management -** Under this management program, the Crown and the pulp and paper companies would be responsible for ensuring that all harvested areas on their own lands were regenerated within several years. There would be no management program for small woodlots. The sustainable annual harvest for softwood would increase from 2.5 million m^3 to 2.7 million m^3. By 2025, there would be a 36% shortage of wood supply relative to projected demand. By 2021, hardwood supply would be 21% less than projected demand.
3. **Intensive Management -** This approach would allow the province to meet the 1986 Forest Policy's objective of doubling forest production by 2025. This would require an intensive program of stand renewal and tending on all ownerships, and also the reclamation and renewal of low-volume, low-quality stands which could not be salvaged economically. Advantages of this approach included: meets long-term expanded demand for wood fibre (softwood would increase from 3.75 million m^3 to 5.3 million m^3 and hardwood from 1.5 million m^3 to 2.0 million m^3 by 2025); reduced forest mortality; reduced losses to insects and diseases (due to increased salvage of dead or dying stands and high risk overmature forest); increased quality (sawlog and studwood would increase substantially); and increased restoration of budworm-killed stands.

These three forest management options are very similar to those presented in the 1981 National Forest Sector Strategy (Environment Canada 1981), where it was argued clearly that the intensive management option would yield the greatest increase in productivity, and not surprisingly this approach is what was selected by the Nova Scotia government as the best approach. The province adopted an intensive forest management approach, which promoted the use of silviculture to sustain harvest levels. The result was

projected to be a younger, healthier forest with a more balanced age-class distribution, and a forest that was less susceptible to insect and disease damage. Carbon storage in the forest would also increase.

Trees would be harvested at or near their biological maturity, and weak or under-developed trees would be removed early in stand growth. Higher stocking levels would be reached due to more active silviculture, weeding and thinning, allowing trees space to grow. In addition, more trees would remain or become old growth forest, while cover type would remain generally steady (% of hardwood, softwood, mixed stands).

Intensive management practices would include:

- Planting – One third of harvested areas did not meet the stocking objective of 60 per cent preferred commercial species through natural regeneration.
- Stand Tending Treatments
    - Precommercial Thinning
    - Commercial Thinning
    - Regeneration Release
- Harvesting Treatments
    - Clearcutting – properly conducted, it is both ecologically sounds and cost-effective. Clearcut areas normally regenerate naturally within 5 years
    - Seed Tree Harvesting
    - Shelterwood Harvesting
    - Selection Cutting

As with other forest policy documents in the 1980's and early 1990's, the new forest management strategy was heavily based on promoting the use of more intensive forest management strategies to increase the productivity of the forest. This would improve the quality of the wood and would allow the province to reap the economic benefits of a growing global demand for wood fibre. Despite this heavy emphasis on increasing forest productivity, the new strategy also included initial discussion on sustainable development, noting that Nova Scotia was committed to the goals of the National Forest Strategy and the national Forest Accord. In line with these commitments, Nova Scotia would develop and implement a series of action plans to stimulate progress in:

- Conserving the natural diversity of the forests
- Improving the ability to plan and practice sustainable forestry
- Increasing public participation in the allocation and management of forest lands
- Assisting private owners to manage their lands
- Increasing research and technology efforts

It is also noted in this forest strategy document that global demand for wood products that have been produced in accordance with internationally accepted principles of sustainable forest management would influence forest management in the future and this must be recognized; however, no particular actions were prescribed along this front.

In reflecting back on the 1986 Forest Policy, it is noted that the policy stressed the need for integrated resource management. As of 1994, Nova Scotia had been working towards this object as exemplified by the following programs:

- Introduced Forest/Wildlife Guidelines and Standards.
- Developed IRM for Crown lands.
- Released for review a Proposed Parks and Protected Areas Systems Plan.
- Passed a Conservation Easement Act.

It was also noted that completion of the GIS inventory and the better understanding of the relationship between wildlife, the forest, and human needs would facilitate management of the forest on an ecosystem basis and the implementation of IRM. This is noted despite the fact that the primary objective of the 1994 forest strategy was to maximize forest productivity, and is indicative of where forest policy approaches were going to go in the late 1990's and early 2000's.

1996 - A New Forest Strategy for NS

It is unclear what impact, if any, the 1994 forest management strategy had on the forest or the forest sector, as only 2 years after its release, the province was launched back into discussions about the need for a new forest policy. In 1993, the Minister of Natural Resources invited a group of forest industry stakeholders to come together to develop a discussion document on a new forest strategy for Nova Scotia. The Coalition of Nova Scotia Forest Interests, as it was known, held a two-day workshop and then produced a discussion paper called "A New Forest Strategy for Nova Scotia" (CNSFI 1996).

The motivation for starting a new discussion on a new approach to forest management in the province was concern about an unprecedented demand for wood fibre resulting in a recent surge in harvesting, and the expiry of the federal/provincial forestry development agreement and the termination of federal support for such purposes. The fear was that without the federal funding for silviculture and forest management plans, the increased harvesting being undertaken to meet demand would not be followed up with sufficient forest renewal and would not be harvested in an appropriate manner.

In the discussion document, the group summarized their key recommendations as follows:

1. Better Information/Reporting of Data – Present data collection is inadequate, and the Coalition proposed the establishment of a registry of buyers requiring annual reporting on harvesting by all buyers of the volumes of primary and secondary forest products acquired for processing or export.
2. Forest Practices – proposed the establishment of a code of forest practices for use on all lands being managed as a forest resource. Code should be required on all Crown lands and made a condition for wood fibre buyers. Essential elements of the code were outlined in the appendix to the discussion document. It was also proposed that the Forest/Wildlife Guidelines and Standards be upgraded to regulations.
3. Funding – recommended that Resource Enhancement Fund type funding be continued. Provide funding for silviculture on private land based on a range of conditions.
4. Sustainable Forestry Board – Create a board consisting of industry and landowners to provide advice on the forest practices code and sustainable forestry.
5. Reporting – publish and distribute a state of the forest report at least every 3 years
6. Education/Extension – there will be a need for a well-planned education effort to support use of the code of forest practices.
7. Consultation – Voluntary Planning should conduct public consultation on development of a forest strategy, starting with commentary from the public on this discussion document.

Following release of the discussion document, Voluntary Planning did conduct a consultation and review process of the discussion document and the comments were summarized in a report submitted to government in 1996 (Voluntary Planning 1996). Many of the comments from the public revolved around concerns that the heavy industry presence on the Coalition of Nova Scotia Forest Interests would have too much influence on the new strategy, and that it would be done behind closed doors. Some additional topics that would be important for a strategy were also raised, including the need to promote integrated resource use, protection of biodiversity, and promotion of ecotourism.

1997 - Toward Sustainable Forestry: A Position Paper

Following on the discussion paper from the Coalition of Nova Scotia Forest Interests, the Department of Natural Resources released its second new forest strategy in three years, called "Toward Sustainable Forestry: A Position Paper". Clearly this new strategy was heavily influenced by the recommendations in the 1996 discussion paper by the Coalition of Nova Scotia Forest Interests, as every one of their major recommendations was adopted in this new strategy.

In the introduction to the new strategy it was noted that in the most recent five-year period, softwood harvests had exceeded the sustainable supply level. This overcutting coupled with expiry of federal government funding for silviculture led to concerns that forest lands would not be able to sustain present and future harvest levels (on private lands in particular) and that forest stands may be harvested while still immature. It was estimated that the province's forests were capable of sustaining an annual harvest of 3.8 million m^3 of softwood and 1.5 million m^3 of hardwood. These estimates were predicated on the federal/provincial funding for silviculture. Termination of this program meant that silviculture programs on private lands between 1996 and 2000 may not be capable of supporting an annual harvest of 3.8 million m^3 in the future. In the early 1980's, the annual harvest of softwood averaged 2.7 million m^3, followed by 3.7 million m^3 between 1986 and 1990, and 4 million m^3 from 1991-1995. The annual harvest of hardwoods average 0.5 million m^3 in 1981-1985, 0.7 million m^3 in 1986-1990, and 0.7 million m^3 in 1991-1995. Exports from the forest industry increased from 3.5% of the harvest in 1981-85 to 7.5% in 1986-1990 and stood at 14.1% in 1995. The average industrial harvest, mostly softwood, increased 43% between 1981 and 1995. Most of this increase occurred on private lands where the annual average harvest doubled in this time period. Crown harvests remained relatively unchanged.

It was argued in the document that the average annual softwood harvest in 1991-95 was 0.2 million m^3 over the estimated sustainable limit of 3.8 million m^3, and that the 1995 harvest of 4.8 million m^3 suggested that overharvesting on private lands was a potentially serious problem demanding immediate action. It was also noted that since the federal funding for silviculture expired in 1995, the incentive approach for encouraging proper forest management on private lands no longer seemed viable. Further highlighting these potential issues, the 1996 National Roundtable on the Environment and the Economy (NRTEE) initiated a regional project on the issue of overcutting on private woodlots in the Maritimes.

It was argued, then, that these fundamental issues necessitated a change in the NS policy approach to private land forestry. This new strategy was designed to:

1. Outline measures to ensure forest harvesting, especially on private lands, does not exceed the capacity of NS forests.
2. Ensure that forest management practices are in keeping with commitments to maintain, protect, and enhance biodiversity and other forest values and uses.

It is also noted in the introduction to the new strategy that the 1986 Forest Policy was produced before sustainable development became a priority, and that many changes since then needed to be addressed in forest policy, such as the commitments agreed to when Nova Scotia signed on the Canada Forest Accord under the National Forest Strategy of 1992 (CCFM 1992), as well as the Convention on Biological Diversity. A new policy must reflect evolving values and concerns, as well as society's changing needs and expectations with respect to forests.

Solutions to these issues were further complicated by the fact that harvesting and scheduling decisions were thought by most to be the decision of private land owners, not government. There was a need to come up with a solution that respected traditional rights of ownership. In light of this, the decision was made to put the onus for silviculture on those generating the demand (industry). Key recommendations of the new forest strategy included:

1. **Sustainable Harvests**
    - Establish the Registry of Buyers which would require all buyers of forest products above a certain threshold to register annually and comply with management requirements;
        - Require buyers of over 1,000 cubic metres to submit a Wood Acquisition Plan, including details of planned silviculture on any lands from which fibre was sourced. Silviculture requirements could be met via three options:
            - Stewardship or contract arrangement;
            - Silviculture payment arrangement;
            - Contribution to a silviculture fund (similar to Stora/NS Landowners and Forest Fibre Producers Association joint management plan)
        - Province to offer financial and technical assistance to those on the Registry of Buyers.
2. **Sustainable Forest Practices**
    - Update the Forest/Wildlife Guidelines and Standards and amend the Forests Act to legislate elements of the guidelines that are amenable to regulation.
    - Develop a Code of Forest Practice that would be mandatory on Crown lands and encouraged on private lands.
    - Require all harvests over 2 hectares to be registered with DNR prior to being carried out.
    - Support sustainable forest practices via education and extension programs.

In addition, DNR would support the development of voluntary certification processes provided they meet Canadian Council of Ministers of Environment (CCME) sustainability criteria and the National Forest Strategy.

3. **Collection and Reporting of Data**
    - Require buyers of forest products to report promptly on wood volumes acquired, and the government will report these statistics annually.
    - The Department will prepare and publish a State of the Forest report every 3-5 years, with the first to be published in the 1997-98 fiscal year.
4. **Stakeholder Participation and Input**
    - Establish a provincial forum, either a reconstituted Coalition of Nova Scotia Forest Interests, or a Forestry Sector Committee.
    - Establish advisory committees to work with DNR on local needs.

This new forest strategy would ultimately form the basis on which most DNR activities were based for the rest of the 1990's and well into the 2000's.

In other forestry matters towards the end of the 1990's, the province's GIS forest inventory system was completed in January of 1997 (NSDNR 1997), an important achievement with respect to supplying policy-makers with data about the NS forest. Two key pieces of legislation were passed at the end of 1998; the Wilderness Areas Protection Act and the Endangered Species Act. The Wilderness Areas Protection Act allowed for the formal protection of 31 designated wilderness areas, increasing the percentage of the province within protected areas from 2.9% to 8% (May 2005). The Act allowed for the protection of these lands, with specific allowances for such activities as ecosystem management, research and education, wilderness recreation and nature-based tourism. The designations encompassed 285 000 hectares (almost 20%) of Crown forest land and transferred authority for the lands from the Minister of Natural Resources to the Minister of the Environment. Under the new Act, a management plan would be prepared for each area, the development of which would include public consultation (NRCAN 1996). This was an example of protecting other values that forests provide beyond just the supply of wood fibre. On a related note, DNR staff continued to develop an ecological land classification system for the province in the late 1990's to assist in planning, managing, monitoring, and reporting on forest resources (NSDNR 1997).

The CAFD joint funding program ran through its final year in 1995, paying out $4,585,668 for silviculture on private forest lands. The province funded the Resource Enhancement Fund-Forest (REFF) and paid out $1,998,861 for silviculture for 81 Registered Cooperators, including 18 Group Ventures (NSDNR 1996). This was followed by additional REFF funding in 1996/97, of approximately $6,495,486 to fund silviculture operations on private lands (13,197 ha affected) (NSDNR 1997). The end of these types of federal-provincial funding programs for forest management and silviculture on private lands was a key development in the 1990s which had immediate impacts on forest management and policy development.

1998 – Registry of Buyers

Following on the objectives of the 1997 Toward Sustainable Forestry policy document, the Registry of Buyers was established officially in 1998. It was established to compile reliable and accurate data on the volume of products harvested and the sustainability of harvest levels in the province, and to act as a link among many of the initiatives in the 1997 strategy (NSDNR 2017a). The Registry of Buyers was designed to:

- Identify persons or businesses that process primary forest products into secondary forest products in NS, acquire primary forest products for processing into energy (electricity), to sell as a fuel to the consumer (when greater than 1,000 m^3 of primary forest product), import primary forest products into NS for processing into secondary products, or export primary forest products in unprocessed form.
- Compile annual data on the amount of primary forest products acquired by Registered Buyers according to species, geographic origin, tenure of land, processing location or destination.
- Compile information on secondary forest products generated in NS by each registered buyer.
- Report annually on the data and information compiled through the registry.

Annual reports on activity in the Registry of Buyers are compiled and provided on the DNR website. This program quickly became a central component of the Forest Sustainability Regulations that were in development at the time and that would be passed in 2000.

1999 - Interim Old Forest Policy

One of the troubling statistics discussed by the Royal Commission on Forestry in 1984 was the small amount of old growth forest remaining in the province. Preservation of old growth forest was not mentioned in detail in any of the new forest policy documents since 1980; however, in 1999, the Department of Natural Resources issued the "Interim Old Forest Policy" as a means to begin the identification and protection of old forests on Crown land.

The primary objective of the interim policy was to set aside the best remaining old forests and old forest restoration opportunities while a more comprehensive old forest policy was developed. The overall target for the policy was to have departmental staff set aside 8% of Crown land as old growth in each landscape that would be maintained in the oldest forest available, where possible in climax forest types representative of the landscape (NSDNR 1999). Ultimately the objective was to set aside 8% as old growth in each of the 39 forested eco-districts of the province as defined in the Nova Scotia Ecological Land Classification (NSDNR 2008). Old Growth was defined as any forest stand with a minimum of 30% crown closure, 50% basal area as climax species and 30% of basal area as 125 years old. Mature climax is anywhere that 30% of basal area is above 80 years old. Old Forest was defined as any stand or collection of stands containing old growth or mature climax forests.

The policy document provided guidelines for selecting and setting aside old forests and tools for identification of possible old forest sites. Areas selected by the Ecological Technical Committee would be set aside and would be excluded from any forestry development. It was noted that a more comprehensive old forest policy should include area and distribution objectives based on the ecological land classification while considering socio-economic conditions, goals and objectives

3.3 Provincial Policy Developments 2000-2010

The development of forest management programs by the Department of Natural Resources in the early 2000's (up until about 2007) was driven primarily by the recommendations in the 1997 policy statement. This includes passing of the Forest Sustainability Regulations, passing of the Wildlife/Watercourse Regulations, development and publication of the Nova Scotia Code of Forest Practice, and continuation of the Registry of Buyers, which was implemented via an amendment to the Forests Act in 1998. This period also saw significant progress on development of the ecological land classification system, and implementation of an integrated resource management approach on Crown lands. Towards the latter half of this decade, the province would embark on the development of yet another new forest policy.

2000 - Forest Sustainability Regulations

The Forest Sustainability Regulations were introduced in 1999 and passed as legislation in early 2000. These regulations were the mechanism by which several of the commitments in the 1997 forest policy were implemented. These regulations would also serve to put in place a silviculture funding program designed to put the onus on the forest industry in the wake of federal funding for silviculture expiring in

1995. At the core of the Forest Sustainability Regulations was the Registry of Buyers, which was recommended in the 1997 forest policy and which was implemented via the Forests Act in 1998.

The Forest Sustainability Regulations were passed under Section 40 of the Forests Act and require Registered Buyers who acquire more than 5,000 m^3 solid per year of wood from private lands to: 1) submit a wood acquisition plan (WAP) and year-end report to NSDNR by February 28 of each year; or 2) conduct a silviculture program or contribute to the Sustainable Forestry Fund in lieu of a program, or a combination of both. Registered Buyers who choose to conduct a silviculture program must ensure the silviculture work is done to specified standards and they must provide an annual report to NSDNR regarding completed silviculture work. A summary of each year's silviculture work is provided in the Registry of Buyers Annual Reports, along with statistics on forest harvest and production of primary and secondary wood products. A technical advisory committee was struck by the Department of Natural Resources (NSDNR 2001) and technical standards for silviculture were specified in the regulations, as well as details on what should be included in wood acquisition plans.

The Forest Sustainability Regulations (FSRs) require forestry companies, businesses, and individuals acquiring over 5,000 m^3 of wood annually from private lands to invest in silviculture in proportion to the amount of wood they acquire. Within the first two months of each year, every buyer must submit a Wood Acquisition Plan to DNR. The plan must include an estimate of the wood volume that the buyer intends to acquire in the upcoming year. That estimate is fed into a formula established in the regulations to calculate the number of silviculture credits that the buyer is obligated to redeem. The more wood a buyer obtains, the more silviculture credits they accumulate, and the greater their obligation to offset credits. Over the next year, the buyer must redeem all their credits through either an in-house silviculture program or a monetary contribution to a government-established silviculture fund (called the "Sustainable Forestry Fund"), or a mixture of both. A credit schedule prepared by DNR specifies how various silviculture activities on the ground translate into credits toward meeting a registered buyer's obligation. Monies contributed to the Sustainable Forestry Fund in lieu of an in-house silviculture program are directed to the Association for Sustainable Forestry (ASF). ASF, which is an arms-length entity separate from the Province, reinvests money from the Fund into silviculture work on small private woodlots. Landowners and forestry contractors can apply to ASF for silviculture funding. The vast majority of silviculture done under the regulations, however, is through the registered buyers' own programs. To ensure that silviculture investments under the regulations are effective in promoting tree growth, the regulations include a set of technical standards. The standards prescribe conditions such as the range of stocking, species composition, and other measures of stand condition that must be satisfied.

In 2001 it was noted that DNR had reorganized internally to accommodate these new programs, in particular to ensure standards of silviculture treatments were being met, providing information, and monitoring for compliance with the new Forest Sustainability Regulations. The 2000-2001 year was the first year for full compliance under these new Regulations. A new Forest Technical Advisory Committee, established to review and recommend necessary changes, met monthly through the year and made several recommendations for future changes. Department staff received training in the new roles and began the task of assessments and communicating directly with local industries. Work at DNR also progressed during 2001 on the remaining elements of the 1997 forest strategy, including the Code of Forest Practice (DNR Accountability Report 2001). In 2002, DNR completed strategic land use plans which were approved by the Minister in February 2002. These plans included a database of attributes of Crown land,

a broad land classification system that separated Crown land into three groups, and established regional goals and objectives for the department's management of Crown land (DNR Accountability Report 2002).

2002 - Wildlife Habitat and Watercourses Protection Regulations

The Wildlife Habitat and Watercourses Protection Regulations came into effect under the Forest Act on January 14, 2002. These regulations were based in-part on the 1989 Forest/Wildlife Guidelines and Standards, which up until this time had been mandatory on Crown lands and recommended for voluntary use on private forest lands. The conversion of these guidelines into regulations was recommended in the 1997 forest strategy document.

Although based on the 1989 guidelines, the regulations that came in to effect in 2002 were a greatly streamlined version and did not bring forward many of the guidelines in the 1989 document. The regulations were focused on the protection of watercourses and the maintenance of wildlife habitat structure, while leaving out many of the more specific guidelines on clearcuts and protection of wildlife that were included in the 1989 guidelines.

Highlights of the regulations include requirements related to:

- Legacy Trees and Habitat Structure – On any harvest site comprising an area greater than 3 hectares of forest land, the forestry operator shall ensure that at least 10 living, or partially living, trees are left standing for each hectare of forest land cut (specific requirements for these trees are provided in the regulations).
- Special Management Zones – Where the average width of a watercourse situated on or adjacent to forest land on which a forestry operation is carried on is equal to or greater than 50 cm, a forestry operator shall establish or ensure the establishment of a special management zone of at least 20 m in width along all boundaries of the watercourse.
- Watercourse – A forestry operator shall ensure that understory vegetation and non-commercial trees within 20 m of the edge of any watercourse are retained to the fullest extent possible. No forestry operator shall conduct any activity within 20 m of the edge of any watercourse that would result in sediment being deposited in the watercourse.

Overall the regulations were designed to maintain water quality and protect wildlife habitat on forest harvest sites, and were deemed mandatory on all Crown and private lands.

2004 - Nova Scotia's Code of Forest Practice: A Framework for the Implementation of Sustainable Forest Management

The notion of developing a code of forest practice was raised in the 1996 Coalition of Nova Scotia Forest Interests discussion document, and committed to in the 1997 sustainable forestry strategy. In 2004, a first draft of the Code of Forest Practice was released publicly for discussion, and was to be implemented on Crown lands via the Integrated Resource Management planning process (NSDNR 2005).

In the introduction to the 2004 Code of Forest Practice, it was noted that a shift had occurred in Nova Scotia's forest management approach, from managing forests simply to maximize harvest levels toward sustainable forest management which recognized the important non-timber values that forests provide (NSDNR 2004). Certainly, this shift in approach was becoming more evident with the adoption of the Integrated Resource Management Land Use Strategy in 2002, and the ongoing work on the Ecosystem

Classification System and the Forest Classification System (NSDNR 2004). The Code of Forest Practice was designed to provide direction and practical guidance for managing a range of forest uses and values that would benefit current and future generations.

Administration of the Code of Forest Practice would include a mandatory adoption of the code on Crown lands within the IRM planning process, and voluntary application of the code on private lands, although some of the management practices in the code were currently required on private lands via the Registry of Buyers program. Each part of the Code of Forest Practice was to be reviewed every 5 years.

The Code of Forest Practice was organized into four themes of management principles which reflected a much more diversified view of the forest than traditional forest policy in the province. These principles included (NSDNR 2004):

- Forest Ecosystems – Focus on managing forest ecosystems to sustain or restore their natural patterns and attributes. Forest management principles are specified, including the need to manage for carbon sinks/climate change.
- Forest Products – Despite increased pressure for non-timber values of forests, production of timber-related products will remain a key part of NS economy. Practices will improve growth, quality, and value of forest products.
- Wildlife Habitat – Forest practices must maintain and enhance natural forest conditions required for wildlife.
- Integrated Forest Use – must sustain multiple forest uses, local communities, and the forest environment.

The Code of Forest Practice would be updated and finalized in 2008 and 2012.

2008 – State of the Forest Report

In 2008 DNR finally released the first State of the Forest Report, which had been promised ever since the 1994 forest management strategy. This report covered the period of 1995 – 2005 and was titled "Nova Scotia Forests in Transition" (NSDNR 2008a). The opening sections of the report highlighted key policy and industry developments that had occurred during the study period. Some noteworthy topics included:

- Adoption of the new forest strategy in 1997, along with subsequent amendments to the Forests Act and passing of the Forest Sustainability Regulations and the Wildlife Habitat and Watercourse Protection Regulations.
- Development of the Framework for Implementing Sustainable Forest Management in Nova Scotia, i.e. the principles of the Code of Forest Practice.
- The new requirements for regulated silviculture programs on private lands, adopted to replace the former federal-provincial cooperative agreements and funding programs.
- Establishment of the Nova Forest Alliance and a Model Forest located between Halifax and Truro to be used for research on best management practices and ecological classification systems.
- Dramatic increases in the harvesting of hardwoods for export of pulp chip products and firewood led to provisions in the Forest Sustainability Regulations to ensure that $0.60 per cubic metre of hardwood must go to silviculture for hardwoods on private lands.

- Advancement of an ecosystem-based approach to managing forests on Crown land with the development of the Ecological Land Classification (ELC) and the Forest Ecosystem Classification (FEC) tools.
- Shifts in the NS forest industry from primarily a pulpwood market to a studwood and log market that produced wood chips for the pulp and paper sector. This led to increased sawmill activity, although due to a shift toward larger, higher technology mills, the number of sawmills declined from 322 in 1995 to 235 in 2005.
- There was a large increase in forest companies seeking international certification for their forest practices, including the Canadian Standards Association (CSA), the Sustainable Forestry Initiative (SFI), and the Forest Stewardship Council (FSC).

The report also included updates on a number of key forest statistics. As of 2005, Nova Scotia contained 4.3 million hectares of forested land, an increase from 4.1 million hectares reported in 1994, although there is uncertainty in this value and this may not represent a true increase. The majority of this forest land was identified as privately owned, with 51% owned by small private owners, and 18% owned by large private industrial firms. The Crown increased its land ownership to 28%, and the Federal Crown continued to own 3% of forested lands in the province. Forest age class data for 2003 showed a notable increase in the 0-20 and 21-40 years age classes compared to 1998, and decreases in the 61-80, 81-100, and 100+ age classes. This was attributed to increased harvesting on private land during this period which resulted in many older stands being replaced by young natural stands and plantations.

Harvest levels generally increased over the study period, with a notable shift in the origin of harvests on private lands. Harvesting on small private lands was shown to be declining and being replaced by wood from larger industrial lands. The economic value of the NS forest industry increased over the study period, and as of 2004 was contributing $700 million to the provincial GDP while employing approximately 11,000 people and generating exports in excess of $1 billion.

2009 - Our Common Ground: Consultations for a New Natural Resources Strategy

Around the mid-2000's, work was still underway by the Department of Natural Resources to implement programs from the 1997 sustainable forest strategy, including the Code of Forest Practice, which as of 2008 still contained interim guidelines; however, as early as 2005, discussions began on yet another provincial forest policy, as approval was received from the Minister for staff to go ahead with renewal of the provincial forest strategy, as well as preparation of a provincial biodiversity strategy (NSDNR 2005). Two years later, DNR began what was planned as a three-year process to develop a new strategy to govern Nova Scotia's natural resources, including forests, minerals, parks, and biodiversity. This was in response to a commitment to a new natural resources strategy in the Environmental Goals and Sustainable Prosperity Act, which was passed in 2007. It was decided that there would a major effort put towards open and inclusive public consultations to inform development of the policy, and this process was initiated in 2007 (NSDNR 2007). Work on many other DNR initiatives was postponed in order to free up staff to work on the new strategy. This included the continued work on developing long-range management frameworks for the Integrated Resource Management planning for Crown lands. Work did, however, finally get underway on preparing a State of the Forest report, which had been committed to in 1997 but had yet to be undertaken. The intent was to have the State of the Forest report act as a supporting document for development of the new forest strategy (NSDNR 2008a).

Natural Resources Strategy Phase I: Citizen Engagement

On behalf of the Department of Natural Resources, Voluntary Planning carried out an extensive public engagement process to help inform development of the new natural resources strategy. This process included 27 public meetings which attracted over 2,000 people, and the receipt of over 600 written submissions (Voluntary Planning 2009). The results of the public consultation process were summarized and delivered to the steering panel which was overseeing the development of the natural resources strategy.

The comments received were organized into five key values or themes which emerged during the consultations as being what citizens wanted to see in a new natural resources strategy. These included (Voluntary Planning 2009):

1. Sustainability – The current approach to managing natural resources is not sustainable. Citizens want a natural resources strategy than can provide for rural economies today without compromising the culture, society, environment, and economy of generations to come.
2. Diversity – Citizens want a more diverse, flexible forest industry, and want to see a more diverse Acadian forest recaptured instead of the present landscape of monoculture plantations.
3. Collaboration – Citizens want the government to bring together opposing viewpoints, and they want to continue to have a strong say in policy development.
4. Transparency – Citizens want a more open, clear, easily understood decision-making process.
5. Informed Decision-Making – Nova Scotians want the department to use the best available information that incorporates science, economics, citizen values, and locally based community knowledge when making resource management decisions.

The level of inclusion of public input in Phase I of the developing the new natural resources strategy was already a significant change from previous policy development processes carried out by the department. More strikingly, these core values expressed in the citizen consultations would ultimately form the core of the strategy itself.

2010 - Natural Resources Strategy Phase II – Independent Panels of Expertise

Upon completion of the public consultations, the Department of Natural Resources initiated the second phase of the policy development process in which several independent panels of expertise were struck to provide technical guidance on what is needed for the new natural resources strategy. Two of these panels were focused entirely on forestry issues, while panels such as the one on biodiversity were intended to span all of the natural resources being managed. The following is a brief summary of the key insights that emerged from these detailed expert reports, both of which included a large number of recommendations which are too numerous to include fully in this report.

Biodiversity Panel Report – 2010

The biodiversity panel produced 31 recommendations on biodiversity for the Steering Panel to consider. Two of the key recommendations were that the province should create a Biodiversity Act, and a Nova Scotia biodiversity information management system which could be used to better inform Nova Scotians on the need to protect biodiversity. The panel also noted that the Environmental Goals and Sustainable Prosperity Act of 2007 specifically stated that “natural capital” should be protected in the province, which encompasses more than simple trees or minerals. Ultimately, the biodiversity panel hoped their

recommendations would lead to healthy and diverse ecosystems, viable populations of species, genetic resources and adaptive potential, and sustainable use of biologic resources (Drysdale *et al*. 2010).

Restoring the Health of Nova Scotia Forests (Bancroft and Crossland) – 2010

The description of the current state of Nova Scotia's forests by Bancroft and Crossland (2010) was very reminiscent of talk in the early 1980's about a forest in crisis. Bancroft and Crossland argued that Nova Scotia has already surpassed the threshold of ecologically sustainable forest harvesting and is now faced with resolving major restoration issues to sustain many forest species. Overall, this panel on forests called for the new natural resources strategy to plot a path away from yield-based forestry, which has dominated provincial policy for most of the last 30+ years, to an ecologically-based, multi-age management approach.

Bancroft and Crossland made 132 recommendations, some of which included:

- Adopt an ecologically-based multi-age forest management paradigm.
- Implement the Integrated Resource Management process on Crown lands.
- Take a balanced approach between harvesting and ecosystem services.
- Promote stewardship and education for Nova Scotia citizens to increase their connection to forests.
- Stop whole-tree harvesting and phase out clearcutting.

It is also interesting to note that Bancroft and Crossland referred back to the 1986 Forest Policy and noted that it contained several good recommendations for transitioning from an industrial forest model to a more ecologically-balanced forest model that were never implemented and should be revisited. In particular, they highlighted the following recommendations from the 1986 policy (Bancroft & Crossland 2010):

- Wildlife & Environmental Considerations: Protection of significant wildlife habitats and maintenance of the long-term productivity, diversity, and stability of the forest ecosystems.
- Forest Management Planning: Full consideration of wildlife conservation requirements, potential ecological impacts, and outdoor recreation opportunities and needs.
- Forest Management Practices: Forest management techniques to be used on Crown land and recommended on private land will be designed to facilitate suitable natural regeneration wherever practical. This will involve selection cutting, or the harvesting of individual trees or groups of trees within a stand, and the shelterwood harvest system, involving one or more partial cuts carried out a decade or two before the final harvest.

Given all of the forest policy changes that have occurred in Nova Scotia since 1986, it is interesting that a panel of experts was able to go back 25 years and find recommendations that were never implemented for issues that are still relevant today.

The Roots of Sustainable Prosperity in Nova Scotia (Porter 2010)

Porter (2010) made 62 recommendations on forests and provided somewhat of a counterpoint to the arguments made by Bancroft and Crossland. The emphasis of Porter's recommendations was on the need to include private woodlot owners in any change to forest management, since they own the majority of productive forest land in the province. Some of Porter's more notable recommendations include:

1. Complete and implement the Code of Forest Practice on Crown land.

2. Improve forest management on private lands without using a command and control approach.
3. Support a range of management practices that includes clearcutting and herbicide use.
4. Implement an enhanced extension effort.
5. Improve compliance with existing regulations and conduct a regulatory review.

Porter also recommended that the provincial government should support all internationally-recognized forest certification programs (do not choose one over the other) and encourage their adoption on Crown and private land.

A Natural Balance: Working Toward Nova Scotia's Natural Resources Strategy (Steering Panel Report – 2010)

The natural resources steering panel pulled together all of the information gathered in Phase I and Phase II of the policy development process and produced a summary report to guide Phase III, in which the actual policy would be drafted based on the results of Phase I and II. Relative to the expert panel reports, the steering panel report was very high-level and did not offer any new information beyond a synthesis of what had already been done.

The panel recommended six strategic priorities for the new natural resources strategy, including (Glube et al. 2010):

- Leadership readiness.
- Citizen engagement.
- Legislative renewal and compliance improvement.
- Research capacity and knowledge sharing.
- Education.
- Collaboration/cooperation/coordination.

With respect to forests, the steering panel made a number of specific recommendations, including:

- Fully adopt the Code of Forest Practice and Integrated Resource Management on Crown lands and private lands.
- Require management plans prior to cutting on all public and private lands.
- Allow clearcutting by permit only.
- Allow pesticide and herbicide use by permit only.
- Exercise great caution on biomass and use the proposed biomass boiler at the NewPage pulp and paper mill as a pilot to learn from.
- Stop whole-tree harvesting.

In a sense, these recommendations showed a lack of knowledge on the part of the steering panel about forest ownership and the limitations of the provincial government in terms of regulation what happens on private lands. Due to the lack of control that the provincial government has over forest management on private lands, several of these recommendations were not feasible as they were worded (e.g. fully adopt the Code of Forest Practice on private lands). Ultimately the Department of Natural Resources would have to work with these recommendations in the context of the limitations of their power over private forest management.

Further to the expert panel reports and the Steering Committee report, the Forest Products Association of Nova Scotia (FPANS) commissioned Dr. Robert Wagner, Director of the School of Forest Resources at

the University of Maine, to critique the expert panel reports and the recommendations of the Steering Committee. In his review (Wagner 2010), Dr. Wagner was highly critical of the Bancroft & Crossland report, in particular their recommendations to discontinue clearcutting, herbicide use, and whole-tree harvesting. In reviewing the Porter report, Dr. Wagner was more supportive, although still critical of the lack of supportive analysis behind the recommendations.

These reports by Bancroft and Crossland, Porter, and Wagner, have not been reviewed in great detail here as they were quite polarizing on many of the key issues. It is interesting to note, however, that ultimately Dr. Wagner was highly critical of the Steering Panel's recommendations, noting that "Overly simplistic regulations based on unfounded assumptions can yield unpredictable and possibly undesirable results" (Wagner 2010, as cited in Foster 2017).

2010 - A Policy Framework for Forestry

Upon completion of Phases I and II of the new natural resources strategy development, the Department of Natural Resources began to work internally to draft the new strategy. This process would ultimately take over a year to complete, and in the interim, the department released an interim policy statement to set out some strategic priorities for the future. Key recommendations on forests in this policy statement included:

- Reduce clearcutting by 50% over 5 years.
- Prohibit whole-tree harvesting.
- End public funding for herbicide spraying.
- Private woodlots don't need management plans to harvest for non-commercial energy.
- Analyze options for an annual allowable cut (AAC).
- Incorporate biomass harvesting guidelines into the code of forest practice and the Forest Act.

This interim policy statement would be the final release by the Department of Natural Resources prior to publication of the full natural resources strategy in 2011.

3.4 Provincial Policy Developments 2011-2017

2011 - The Path We Share: A Natural Resources Strategy for Nova Scotia 2011-2020

After several years of planning and consultation, the new natural resources strategy was released in August of 2011. Called "The Path We Share", the strategy marked a significant departure from traditional natural resource policy in Nova Scotia (NSDNR 2011a). Development of this strategy fulfilled a commitment under the Environmental Goals and Sustainable Prosperity Act, and the policy was also closely related to a number of other provincial policies, including the Climate Change Action Plan and the Renewable Electricity Plan. Broadly speaking, the strategy set 23 policy goals with specific actions that must be completed to achieve them, and was based on the overarching goals put forth by Nova Scotians during the stakeholder consultations in Phase I of the policy development process. These were refined somewhat and listed in the new policy as:

- Collaborative leadership.
- Sustainable resource development.
- Research and knowledge sharing.
- Good governance.

Some of the broader policy recommendations that impact on forestry included a commitment to ecosystem based management of resources, which would include a redesign of the Integrated Resource Management process for Crown land, and to teach private land owners about this process, as well as to move forward on a biodiversity policy.

With respect to forest policy specifically, the new strategy was based on the premise that forests provide many benefits beyond timber supply, including a number of other ecosystem services such as carbon sequestration and habitat for wildlife. The new forest policy was based on five key principles, and within each principle a set of specific policy actions was outlined. Some of the key recommendations are summarized below:

- **Ecosystem approach**
    - Fully implement an ecosystem approach to forest management.
    - Apply the Code of Forest Practice on publicly and privately-owned woodlands.
    - Help private land owners understand and use an ecosystem approach to manage their woodlands.
    - Develop comprehensive risk management strategies to support healthy forests.
    - Align Nova Scotia's forest principles and actions with national strategies.
    - Report regularly on the state of Nova Scotia's forests.
- **Research and knowledge sharing**
    - Expand research and knowledge in key areas (e.g., forest carbon, controlling pests and disease)
    - Develop standards, and collect, use and share information about forest resources.
- **Shared stewardship**
    - Involve interested groups and individuals in developing policies about Nova Scotia's forests.
    - Provide support to owners of small private woodlots, particularly through their organizations.
    - Focus education and outreach programs on shared stewardship.
    - Explore ways to establish and operate working community forests on Crown land.
- **Sustainable resource development**
    - Encourage innovative ways to increase the value of harvested timber by turning it into higher-end products.
    - Revise the way forest resources on provincial Crown land are allocated and managed in order to improve the economic, environmental, and social benefits to Nova Scotians.
    - Support the promotion and marketing of forest resources and resource development.
- **Good governance**
    - Reduce clearcutting and establish a harvest tracking system.
    - Review and redesign silviculture programs.
    - Limit herbicide use.
    - Clarify the use of forest biomass for energy.
    - Establish the rules for whole-tree harvesting, and incorporate this into the Code of Forest Practice.

- Evaluate the effects of implementing an Annual Allowable Cut (AAC)—the amount of wood permitted to be harvested—to ensure the sustainability and productivity of Nova Scotia's forests.

The new natural resources strategy was accompanied by a document called "From Strategy to Action" in which the Department of Natural Resources listed out specified objectives and timelines for completion for elements of the new strategy (NSDNR 2011b). In addition to several actions that would influence management of all natural resources, seven specific actions were outlined for forest management, including projected timelines to completion. These included:

- Focus forest-related education and outreach programs.
- Reduce clearcutting to 50 per cent of all harvests.
- Apply the Code of Forest Practice beginning with Crown lands.
- Discontinue public funding for herbicide use.
- Clarify the use of forest biomass to generate electricity.
- Encourage the use of forest management plans.
- Establish rules for whole-tree harvesting.
- Evaluate effects of implementing an Annual Allowable Cut (AAC).
- Implement an ecosystem approach to forest management.
- Improve harvest tracking and silviculture programs.
- Expand research and knowledge sharing.

This new strategy for forests was substantially different than most provincial forest policy documents of the last 30 years. Of note was that there was very little emphasis on increasing harvest rates or setting any particular objectives for harvest levels or the productivity of forest stands. The emphasis was placed on the ecosystem approach to managing forests, where harvesting for timber is only one of the values provided by the forest. It is also notable to see action taken to reduce clearcutting and the use of herbicides, which are two practices that were recognized as being essential in previous forest policy documents. Lastly, the element of public consultation and participation in the forest management process reached an all-time high with this new forest policy.

2012 – Nova Scotia's Code of Forest Practice: A Framework for the Implementation of Sustainable Forest Management – Guidelines for Crown Land

The Nova Scotia Code of Forest Practice was initiated in the 1997 Towards Sustainable Forestry policy document, and in 2004 the guiding principles for the code were released for review by DNR. In 2008, the Code of Forest Practice was expanded to include specific direction for each of the principles in the 2004 framework document under the heading of Interim Guidelines for Crown Land. This guidance was provided within a set of Guidebooks that were appended to the Code of Forest Practice framework document (NSDNR 2008). A more detailed breakdown of the code principles is summarized in Table 2. In the 2008 document, it was noted that while the 2004 principles set the overall framework, these guidelines would provide more practical direction that can be applied at both the landscape or stand level in forest management. These guidelines were mandatory on all Crown lands and would be implemented in the planning and design process for Integrated Resource Management (IRM) plans for each of the Eco-districts in Nova Scotia. Private forest land owners would be encouraged to follow the guidelines but were not compelled by any regulatory force.

A review of the forest management principles in the Code of Forest Practice reveals that the idea of managing forests for both timber and non-timber values had become a key part of the provincial government's approach toward forestry. The Code of Forest Practice as it emerged in 2008 was closely linked to several other provincial government programs that had been underway throughout the late 1990's and early 2000's which served to move the policy focus to a broader range of forest values. This includes the Ecological Land Classification, the Forest Classification System, the Wildlife and Watercourses Protection Regulations, the Integrated Resource Management program on Crown Lands, and the Wilderness Areas Protection Act. All of these provincial programs together signified that a major shift had occurred in provincial policy as it pertains to forests. This shift would culminate in the new natural resources strategy that would be released in 2011, and which was described in the preceding section.

Table 2. Principles in the 2008 Nova Scotia Code of Forest Practice

Principle	Description
Guidebook I – Forest Ecosystems	
1.1	Forest Management Practices will be designed and conducted to conserve and enhance the health and natural diversity of NS forest ecosystems
1.2	Forest Management Practices will be planned and conducted according to Ecological Land Classification for NS (2003)
1.3	Forest Management Practices will be planned and conducted to protect habitat for species at risk
1.4	Forest Management Practices will be designed and conducted to conserve and enhance habitat for Nova Scotia's wildlife species
1.5	Forest management practices will recognize the contribution of protected and wilderness areas in preserving the natural forest heritage within NS
1.6	Forest management practices will be designed and conducted in a manner that maintains and enhances the quality of air, water, and soil in NS
1.7	Forest management practices will be designed and conducted with consideration of the potential effects of climate change, and opportunities to maintain and enhance forest carbon sinks
Guidebook II: Forest Products	
2.1	Forest management practices will be designed and conducted to secure a sustainable long-term harvest of forest products
2.2	Forest management practices will be designed and conducted to improve productivity, quality and value of forests and forest products
2.3	Forest management practices will incorporate the best available knowledge of local ecological conditions, including soil, climate, water, terrain, vegetation and wildlife habitat, in the planning process for roads, harvesting systems and silviculture activities
Guidebook III: Wildlife Habitat	
3.1	Forest management practices will be designed and conducted to maintain or restore the natural range and structure of forest communities to benefit the wildlife species of NS
3.2	Forest management practices will be planned and conducted to respect significant wildlife habitats in NS forests
Guidebook IV: Integrated Forest Use	
4.1	Forest management practices will be designed and conducted to balance the economic, cultural, social, and environmental interests and values of all NS
4.2	Forest management practices will be designed and conducted to consider structure and diversity elements required for the integration of public interests

Within each of the code principles, more specific sub-principles are outlined, as well as forest management guidance suited for landscape level management, and stand level management, where appropriate.

In 2012, the final version of the Code of Forest Practice was released under the title of Guidelines for Crown Land (no longer interim) and the 2011 Natural Resources Strategy committed to making the Code of Forest Practice mandatory on Crown lands and included in the IRM plans, while remaining voluntary on private forest land. Since introduction of the Code of Forest Practice in 2004, DNR has released a number of technical manuals to assist in implementation of the code, including technical manuals on Forest Ecosystem Classification (Neily et al., 2013), Tolerant Hardwood Management (McGrath, 2007), Tolerant Softwood and Mixedwood Management (McGrath, 2010), and most recently Nova Scotia's Forest Management Guide (McGrath 2018). The latter is a significant and detailed technical document that covers practical guidance for pretreatment assessment, different management prescriptions (e.g. selection cutting, tending, natural regeneration, etc.), and guides for management of specific tree species (e.g. spruce) and types (e.g. wet coniferous).

2012 – Nova Scotia's Old Forest Policy

This policy document builds on the 1999 Interim Old Forest Policy and is intended to guide conservation of remaining old growth forests on public land by establishing procedures for selecting and evaluating old forests within the IRM system on Crown lands. The policy defines Old Growth as a forest stand where 30% or more of the basal area is in trees 125 years or older, at least half of the basal area is composed of climax species (i.e. species which typically dominate stand composition during the late stages of natural succession), and total crown closure is a minimum of 30%. A more generalized focus is on Old Forest, which is defined as any stand or collection of stands containing old growth and/or mature climax conditions.

The objectives of the policy are to:

- Identify and conserve old growth forests and the best old forest restoration opportunities on public land.
- Establish and sustain an ecologically representative network of old forest.
- Provide social, recreational, and educational opportunities for public use of representative old forests.
- Provide direction and procedures for integrated resource management decisions involving old forest values.
- Establish a spatial database for storing and tracking old forest identified under the policy.

Directives in the policy provide actions that DNR staff will take for:

- Selection, designation, and mapping of Old Forests.
- Data management, including updating of the GIS inventory and scoring of Old Forest to evaluate old forest conditions and provide a basis for stand selection.
- Integration of the Old Forest Policy with IRM procedures.
- Development of public communications on old forests.
- Appointment of a Provincial Old Forest Coordinator.

The policy also provides more specific procedures and guidelines for selecting and conserving old forests.

2013 – The Path We Share 2-Year Progress Report

In the 2011 Natural Resources Strategy, the government committed to timelines for a number of the forest management objectives proposed. In an effort to follow-through on these commitments, the government began issuing periodic updates on their progress. Leading up to the 2-year progress report on the new Natural Resources Strategy that was published in 2013, DNR released two interim updates at 12 months and 18 months. In the 12-month progress report, it was noted that the target date for two of the forestry commitments had been extended, including the clarification of the use of forest biomass to generate electricity, and the establishment of rules for whole-tree harvesting. In terms of legislation, it was noted that the Forest Sustainability Regulations would be amended to make biomass users subject to the same rules that currently apply to the forestry industry, and that consultations on this would begin in the fall of 2012. It was noted that a State of the Forest Report was scheduled to be released in 2013. The 12-month update included a reflection on the transformation of the forest industry at a global scale, perhaps most starkly illustrated in the closure of the NewPage Port Hawkesbury and Bowater Mersey pulp and paper mills in Nova Scotia, and noted that some delays in forestry actions from the new policy were due to efforts to work with the difficulties that arose from these closures.

Within the first 12 months of the new strategy, the government invested funds and resources into educating and networking with private woodlot owners, including the development of educational materials, encouraging programs such as the Forest Stewardship Council (FSC), and providing training and silviculture assistance.

With respect to clearcutting, the department established a technical definition of a clearcut as "An area is considered a clearcut when less than 60 per cent is sufficiently occupied with trees taller than 1.3 metres." Beyond this definition, no progress was reported on the target to reduce clearcutting to 50% of provincial harvests. With respect to the use of forest biomass to generate electricity, draft amendments to the Forest Sustainability Regulations were underway to ensure that rules for biomass use in the forest industry would also apply to other biomass users (i.e. biomass for energy users would become part of the Registry of Buyers). It was also noted that DNR intended to update the Code of Forest Practice to include rules for the use of biomass for energy. Two other key policy commitments with respect to whole tree harvesting and exploring the use of an Annual Allowable Cut (AAC) were noted as being ongoing and still commitments.

The 2-year progress report provided further updates on the specific actions that were committed to in the 2011 Natural Resources Strategy (NSDNR 2013). This was a critical update, as some of the priority actions listed for forestry in The Path We Share were due to be completed within 24 months. Overall the report noted that 3 of the 2011 commitments were completed, including the clarification of use of forest biomass for electricity generation, the establishment of rules for whole-tree harvesting, and the discontinuing of public funding for herbicide use. Two of the commitments that were due to be complete within 24 months were extended, including the evaluation of using an AAC (out to 3 years) and the improvement of harvest tracking and silviculture programs (out to 2.5 years). The State of the Forest report was mentioned and said to be forthcoming by fall/winter of 2013/2014.

In the 2 years since the new strategy was released, the province continued to invest resources in silviculture and education/outreach to private woodlot owners. On clearcutting, it was noted that clearcut

harvests decreased to 89% of total harvests based on 2011 data using traditional tracking methods. Whole-tree harvesting was prohibited on Crown or private lands, including amendment to the Wildlife Habitat and Watercourses Protection Regulations and including these in the Code of Forest Practice.

In these years after release of the new forest strategy, DNR's approach placed increasing emphasis on use of the Code of Forest Practice to guide management decisions such as efforts to reduce clearcutting, requiring all new forest licenses to adhere to the code, and training forestry workers on application of the code. In other developments, DNR began developing a discussion paper to examine options for implementing an AAC and the relevant impacts. They also developed a Crown timber supply analysis and intended to expand to timber supply analyses for private and industrial land. Pilot projects to evaluate two harvest tracking methods were also developed by the department.

2016 – The Path We Share 5-Year Progress Report

The 5-year progress report (NSDNR 2016) on forest management commitments included a restatement of many of the updates in the 1-year and 2-year updates. Some new updates indicated that DNR was:

- Working toward a Forest Operating Agreement with Mi'kmaq of NS to give them responsibility for managing certain forests on Crown lands in central and western areas of the province.
- Working with private industry and the federal government to develop and expand opportunities in the emerging low-carbon bio-resource economy. This included establishment of the Forestry Innovation Hub to set up a bio-economy-based industrial cluster to provide the processing and/or manufacturing capacity to produce products with a lower carbon footprint and target domestic and export markets.
- Implemented a Harvest Map Plan Viewer, which is an interactive web-based application that maps all planned harvesting on Crown lands in the province.
- Began the development for a nutrient budget model for NS forests.

Significant updates were provided on the province's commitments to reduce clearcutting and explore use an AAC. With respect to clearcutting, DNR withdrew the commitment to reduce clearcutting to 50% of all provincial harvests. It was noted that (pg. 20):

"We understand now that the decision to clearcut (or not) has to be made in a larger context. In some areas, clearcutting will not have an impact on the total health of the forest – it may even improve it. In others, clearcutting could have a negative impact. We have now developed tools that ensure all the harvest treatments are aligned with the nature-based requirements of Nova Scotia's lands. We will continue to share the best practices, such as our Code of Forest Practice, and our ecosystem-based tools, such as mapping technology and pre-treatment assessments, that can help private landowners reach the right decisions about what to do on their lands."

With respect to using an AAC, the department noted that after exploring this option, it was determined that due to the high percentage of private land and the rights of small woodlot owners, the department would not implement a province-wide AAC. Instead, the department would continue with their shift to an ecosystem-based management approach and set timber objectives for Crown land that would ensure a long-term sustainable wood supply.

2017 – State of the Forest 2016

The latest State of the Forest Report was issued in 2017 (NSDNR 2017b), the first since 2008 and only the second such report to ever be produced by the NS government. This release came several years late relative to commitments made in the 2011 forest strategy which promised a new state of the forest report every 3-5 years. It is unclear why the government has committed to producing these reports in multiple policy documents over the years yet struggles to produce them in a timely fashion.

The report covers a study period from 2006 to 2015, following on the 2008 state of the forest report which covered 1995 to 2005. The opening of the report refers to the global transition occurring in the forest industry, the idling and closure of pulp and paper mills in the province, the new markets emerging for wood fibre, and the government's continued commitment to pursuing ecosystem-based landscape scale management of the forest. While reporting on many key forest statistics that are tracked over time and which appeared in the 2008 report (e.g. age class, species distribution, economic value), the 2017 report also introduced new indicators and a new qualitative scoring system used to characterize trends for each indicator (e.g. increase, decrease, baseline, undetermined, etc.). Each indicator "score" was also ranked by confidence in the available data (e.g. high, medium, low).

The report indicates that as of 2015, there were 4.2 million hectares of forest land in Nova Scotia, a slight decline from 2005, although clearly there is some uncertainty in determining this value so it is not clear if this represents a trend. Ownership of these forest lands has shifted slightly in recent years, due largely to the acquisition of the Bowater Mersey forest lands by the province in 2012, however, over 59% of NS forest lands continue to be owned by private citizens and businesses. The species composition of the forest showed a slight increasing trend towards hardwood in terms of merchantable volume and growth. This was due primarily to intense softwood harvesting in the mid-2000's and subsequent natural regeneration. The age class structure of the forest showed increases in upper age classes between 1998 and 2012, including the 61-80, 81-100, and 100+ age categories. The younger age classes (0-20 and 21-40 years) make up approximately 30% of the forest, which is twice as high as estimates by the Royal Commission on Forestry in 1984 which showed that these age classes were dangerously low in the early 1980's in terms of supporting future harvesting. From an economic perspective, a decreasing trend was observed between 2002 and 2015 for export revenue and direct jobs provided by the forest industry. Total export value declined from over $1 billion in 2002 to approximately $700 million in 2015, and direct jobs declined from over 11,000 in 2002 to less than 7,000 in 2015. These declines were attributed to pulp and paper mill closures and temporary shut-downs, and the global economic downturn in 2008.

Beyond these basic statistics, the report also provided updates on a number of ecological indicators related to forest ecosystem health, including an Ecological Emphasis Index, status and risks of forest pests and fires, protected areas, species at risk, soils and water, and forest carbon. For some of these new ecological indicators it is noted that little or no data is available to establish trends.

2017 – Independent Review of Forest Practices

Citing a need to "recognize the wide diversity of interests related to forestry", the NS government launched an independent review of forest practices in Nova Scotia in the summer of 2017 (Government of Nova Scotia 2017). The mandate for the review is to:

- Evaluate the effectiveness and identify opportunities to improve the legislation, regulations, policies and guidelines, as well as the science-based tools that determine whether and where

harvesting occurs, as well as the harvesting methods (e.g. clearcut, partial harvest) that can or should be used.

- Evaluate market access for private forest owners, particularly in the Western region, and provide recommendations to address any identified issues.

The panel is led by Dr. William Lahey, President of the University of King's College, with support from a panel of expert advisors consisting primarily of academic experts and industry consultants. The review will consist of consultations with key stakeholders and experts and the acceptance of public input via written submissions. A final report is to be provided at the end of February 2018 and will include conclusions and recommendations related to objectives outlined above.

This policy review document has been submitted to Dr. Lahey to inform the independent review.

4. Reflection and Conclusions on Key Issues and Developments

The objective of this report was not to provide critical analysis and recommendations related to forest policy in Nova Scotia, but rather to provide a chronological summary of key policy developments; however, in this concluding section, a brief summary of observations and reflections is provided on some of the underlying forest management issues that persisted over the course of the study period, and that remain relevant to the current Independent Review of Forest Practices.

4.1 Evolving Forest Management Objectives

Perhaps the most notable contrast between the Forest Policy from 1986 and the most recent policy in 2011is the change in management objectives expressed by the provincial government. Although policy documents in the 1980's referenced the need to protect wildlife habitat and recreation areas to some degree, it was clear that the primary objective of forest policy was to promote practices that would increase the productivity of Nova Scotia forests to supply wood fibre to forest product manufacturers for economic gain, in particular pulp and paper producers. Specific quantitative targets were cited for harvest levels and merchantable volumes, and a longer-term planning for productivity and harvesting was shown, with the 1986 Forest Policy projecting out 60 years to desired harvesting outcomes in the year 2040. In the mid-1990's policy documents, harvest levels and productivity were still clear priorities and quantitative targets were provided, as well as objectives for longer-term changes in age class structure and species composition that would be required to support policy objectives. During these years, the pulp and paper industry was still the dominating force in the NS forest industry, and there was an increasing demand for sawlogs, so there was a significant increase in demand for wood fibre. In addition, up until 1995, significant federal funding was being provided to support silviculture and forest management on private lands to increase productivity.

In contrast, the 2011 forest policy does not include any quantitative information on expected or desired harvest levels, or targets for future merchantable volume levels needed to support industry objectives. In fact, there are essentially no specific objectives provided for the forest industry in terms of the amount and form of wood fibre needed to support the industry in the future. The policy objectives reflected a much broader view of forest management and focused on actions to track and modify harvesting practices, limit ecological impacts through education and forest management planning, and continue implementing an ecosystem-based management approach in the province. The policy was also directed

toward management over a much shorter timeframe of 8 years (until 2020). These approaches stand in marked contrast to earlier forest policies in the province.

The shift toward this broader set of forest management objectives began in the mid-1990's as sustainable development principles began to inform both federal and provincial government policies. This shift was notable in the 1997 Toward Sustainable Forestry policy document, and perhaps best expressed in the first iteration of the NS Code of Forest Practice in 2004. The principles for forest management in the Code of Forest Practice include the protection and conservation of forest ecosystems, sustainable harvest practices, protection and enhancement of wildlife habitat, and a management of the forest for a wide range of economic, cultural, social, and environmental interests and values.

The shift towards managing the forest for a broader set of values also included an increased emphasis on public consultation to inform policy development. Whereas the 1986, 1994, and 1997 forest policy documents were largely informed by consultations with expert panels, the 2011 forest policy was based on several years of public and expert consultations, and a number of the policy objectives were focused on addressing issues raised during public consultations (e.g. the commitment to reduce clearcutting).

This shift in policy approach to managing the forest for a broader set of objectives, both timber-related and forest ecosystem-related, is certainly not unique to Nova Scotia. It was very much in line with the shift in federal forest management policy, and a global shift in environment and resource management that began more broadly in the early 1990's. What is notable about this shift from a forest management perspective is that at least in the case of Nova Scotia, the focus on managing the forest for a wide range of values seemed to have pushed more specific planning and objectives for wood supply and required/expected harvest levels to the margins.

What is not clear in the 2011 forest policy is what are the expected markets for wood products and the required amounts and form of wood fibre that must be obtained for the forest industry to succeed in those markets? What are potential thresholds for sustainable harvest levels in Nova Scotia for the upcoming decades? This is not to suggest that such planning has not taken place within DNR; however, historically this type of information has been included in forest policy documents.

4.2 Availability of Information on the Forest

It was noted in Section 1.2 that an important element of good forest management is to have good inventory information and ecosystem and habitat information for the forests being managed, as well as adequate stakeholder input and an understanding of evolving market conditions for forest products. Since the beginning of the study period (1980), the provincial government has set out and achieved a number of objectives for collecting and organizing important data on the Nova Scotia forest and its ecosystems. Major achievements in this regard include the development of the GIS forest inventory, increasing the number of PSPs for data collection and forest management trials, and identification and classification of the diverse ecosystems, habitat, and forest classifications across the province. These have all contributed to an increased knowledge and understanding of the Nova Scotia forest, and have enabled programs such as the IRM program on Crown lands. They also form the basis of the government's ecosystem-based management approach, and development of the Code of Forest Practice. With respect to stakeholder input, the consultations undertaken to inform the development of the 2011 Natural Resources Strategy were among the most extensive to-date, and the policy itself reflected a number of the priorities expressed by Nova Scotians.

What is not clear at present is whether this significant increase in available information about the forest has been translated to more effective policy or to a healthier forest. How can the use of this information be maximized to inform practical forest policy decisions? Answering these questions is beyond the scope of this review, but are worth pursuing in further research.

4.3 Forest Management on Private Lands

One of the most fundamental challenges in directing appropriate forest management practices in Nova Scotia is that the majority of forest land in the province is privately owned. The government has tried to ensure that private forest land owners have full and free rights to use their land as they see fit, while also encouraging them to use appropriate forest management and harvesting practices via several non-regulatory approaches. In short, although the government has made significant progress in developing and implementing its desired forest management practices on Crown lands over the study period, there still remain significant challenges in getting private forest land owners to adopt approaches consistent with the government policy of the day, and at an even more basic level, to get them to participate in the forest sector and to actively manage their lands at all.

In 1980, approximately 73% of Nova Scotia's 4.37 million hectares of forest land was privately owned, a notable contrast to the general ownership pattern in Canada at that time, in which 92% of all productive forest was Crown land. Of the privately-owned land in Nova Scotia, 52% was considered small private ownership (less than 1,000 acres), while the remaining 21% of private land was considered large industrial ownership. Provincial Crown land made up 24% of Nova Scotia forest land in 1980, with the remaining 3% owned by the federal government. (NSDLF 1980). In the 1986 forest policy, the issue of privately owned forest land was raised immediately on page 1 where it was noted that the government policy would be to cooperate with private forest land owners via education, extension, and incentive programs rather than using punitive taxation, legislation or regulation. Elsewhere in the 1986 forest policy, it is noted that private forest lands will be the primary source of supply for the forest industry, and that a primary focus of the new policy will be to encourage and assist private landowners to make the best use possible of their forested lands. The tone in the policy was that particular objectives or forest management practices "would be implemented" on Crown land and "recommended" on private land. The general policy was to "encourage and assist" private land owners, and there was a particular objective to increase productivity and wood supply coming from private lands.

The primary tool used to work with private forest landowners in the 1980's through to the mid-1990's was federal/provincial cooperation agreements which brought significant federal government investment in silviculture and forest management activities on private lands. In 1977, the first of a series of cost-sharing agreements was reached between the provincial and federal governments in order to enhance forest quality and productivity through intensive management practices. Subsequent agreements were signed in 1982, 1984, 1989, and 1991. Overall these programs amounted to over $250 million of shared financial support for forest management activities in Nova Scotia on both Crown and private lands. As part of the Cooperation Agreement for Forestry Development 1991-1995, a new Forest Management Strategy was released by the Department of Natural Resources. In that strategy it was noted that 69% of the province's forest land was privately-owned at that time, including 47% small private and 22% large private. Provincial Crown land had grown to 28% of forest land, up 4% since 1980. This strategy was based on an assumed continuation of federal/provincial programs for intensive management on private lands, noting that in their wood supply forecasts for the strategy, modelers assumed that 85% of the small

private woodlot holdings in the Eastern region and 70% in the Central and Western regions would participate in forest harvesting or management.

In the mid 1990's these federal/provincial programs came to an end, at the same time as Nova Scotia saw a significant increase in demand for wood fibre, raising concerns that the province's forest lands might not be able to sustain current and future harvest levels. This period marked a shift from an "incentive" approach that had been used by the government to encourage good management practices on private land, and reinforced the concept that the traditional rights of private forest land ownership should be respected, and that it is not perceived to be an appropriate role for government to be involved in the decision-making process on private land (NSDNR 1994). Therefore, in the 1997 policy change, the provincial government shifted the onus onto those demanding the wood fibre, and established the Registry of Buyers through which those acquiring wood fibre paid for silviculture treatments. The NS Code of Forest Practice would also be encouraged for use on private lands.

In the 2008 State of the Forest report, it was noted that the provincial Crown still owned 28% of forest land in Nova Scotia, while small private landowners held 51% and industrial private owners held 18% (NSDNR 2008a). In the 2017 State of the Forest report, it was shown that primarily as a result of acquiring the Bowater Mersey Paper Company Limited forest lands in Western Nova Scotia, the provincial Crown now owns nearly 34% of provincial forest lands (NSDNR 2017b). In the 2011 Natural Resources Strategy, the discussion of private forest land is much less direct. It is noted in several instances that specific programs will be "applied" to private lands, for example "Apply the Code of Forest Practice on publicly and privately-owned woodlands", although it is not clear how this will be accomplished. The general discussion is around encouraging and supporting private forest land owners, and continuing to work with them via the Forest Sustainability Regulations.

Although the vast majority of wood harvested in Nova Scotia continues to be from private land, the general trends are not encouraging for private woodlot owners. In 2011 it was noted that participation rates for private woodlot owners were steadily declining, since a peak harvest level from 1996-97, only 64% of those who harvested during that time were currently participating in the forest industry in 2009 (Woodbridge Associates 2011). Harvests from non-industrial private woodlands have also been steadily declining, and the area of private land subject to silviculture treatments has also been declining, with 2015 area down almost 50% from 2002 area treated (NSDNR 2017b).

4.4 Clearcutting

In the 2011 policy it was stated that the province would reduce clearcutting from over 96% of harvesting down to 50% of harvesting within 5 years. This is a notable diversion from any previous policy statements on clearcutting since 1980. In the 1994 forest management strategy, it was noted that clearcutting is the most common harvesting method in Nova Scotia, and is ecologically sound and cost-effective if done properly. It was also noted that clearcut areas usually regenerate naturally within 5 years (NSDNR 1994). In the 1989 Wildlife guidelines and standards, it was suggested that clearcuts should not exceed 50 ha, that 3-8% of an area should be left as old growth, and if a clearcut is to exceed 50 ha, harvesters must leave one or more wildlife corridors and should avoid clearcutting adjacent to other clearcuts until they are 2 metres high (NSDLF 1989). In the 2012 Code of Forest Practice, it is noted that where scenic vistas are important, forests will be managed for diverse canopy structures without large visible clearcut harvest areas. Otherwise there is no other mention of clearcutting in the Code of Forest

Policy, which at present is the primary guidance document on desired forest management practices in Nova Scotia.

Clearcuts were raised in the 2009 Voluntary Planning public engagement work, where participants noted concerns that clear cuts were not ecologically or economically sustainable and should be reduced (Voluntary Planning 2009). Others feel it is necessary and environmentally appropriate under specific conditions. The issue was raised frequently in these consultations and generally in negative terms and in the context of needing to reduce the practice. In their 2010 expert panel report, Bancroft and Crosland recommended phasing out clearcutting and promote uneven-aged management and discussed the negative impacts from clearcutting in the Acadian forest at-length. In his expert panel report, Porter recommended the inclusion of clearcutting among a range of management practices that should be used. His rationale was that if good forest management practices are encouraged and used, that clearcutting will naturally be reduced in favour of other practices, and therefore prohibition should not be required even though this practice may currently be overused (Porter 2010). The steering panel for the Natural Resources Strategy recommended clearcutting only be allowed by permit, which is generally not a feasible approach when so much of the harvesting is occurring on private land where the province exerts little control over harvest methods.

Ultimately, the government put this target of 50% in 5 years in the 2010 policy framework and then in the 2011 policy and action plans. Shortly after release of the policy, a clarifying statement was issued by DNR on the definition of a clearcut. In the 2-year progress report, it was noted that this definition was produced, and that the department was undertaking testing to see about using the Code of Forest Practice as a means to reduce clearcutting. Finally, in the 5-year progress report released in 2016, DNR indicated that based on research they've done since the policy was put in place, clearcutting may not have an impact when used in some areas, and may in fact improve forest health depending on the context, while in others it could have a negative impact. In light of that, they are no longer pursuing the direct objective of reducing clearcutting to 50%, but instead using ecosystem-based management and the Code of Forest Practice to encourage appropriate harvest methods where needed, and clearcutting remains a part of that harvesting method toolbox.

On the surface it would appear that the objective to reduce clearcutting down to 50% was a somewhat arbitrary policy decision made largely to address strong public concern. No specific rationale was provided from the department on why this objective was set, or how they arrived at 50%, other than they looked at it and "existing ecosystem-based forest management analysis of Nova Scotia's forests identifies approximately 50% of the land is appropriate for uneven-aged management" (NSDNR 2011a). Now that they have backed off this objective, public opposition is growing again, and it is unclear whether this was a strategic move by the department, or an attempt to appease the public and ultimately a policy mistake.

4.5 Bioenergy and Biomaterials

It was noted in the introduction to this policy review that the global forest industry is undergoing major changes, and that use of wood fibre to produce bioenergy and biomaterials is increasingly being identified as an innovative way to grow the forest industry in Canada. This is also the case in Nova Scotia, where wood fibre is already being used to produce electricity and wood pellets for heating, and where research and development is underway by a number of organizations on the use of NS wood fibre to produce biofuels for the transportation market (Cellufuel 2015, FPInnovations 2017). Despite efforts by the

provincial government to salvage the pulp and paper industry in recent years, it was made clear in DNR's 2015 Business Plan that this will no longer be the case:

"The province and the world are adapting to the transition of the sector. Our government has initiated a significant shift in policy in forest sector development. Instead of large corporate handouts to specific companies, our focus is on innovation and solutions for the entire sector." (NSDNR 2014)

Despite this clear statement, at the time of developing the 2011 forest policy, the future of the pulp and paper industry in the province was still in flux, and it seems that as a result, the 2011 policy lacked clear objectives related to the "focus on innovation and solutions" that was stated in 2015. Going forward, it is essential that the provincial government undertake planning and consultations on how to navigate this shift in the industry. Will provincial policy ultimately encourage the use of wood fibre, either primary forest products or wastes and co-products, to support the production of biofuels and biomaterials? Will the cautious approach to biomass electricity generation be maintained, and under what conditions might the approach become more supportive? What are the implications for the forest in terms of the amounts and forms of wood fibre that must be harvested to support these types of emerging sectors in the industry? What are potential thresholds in terms of sustainable harvests from the current or future NS forest to support these types of activities? How does the management of the forest for these emerging sectors relate to other forest policy objectives within the ecosystem-based management approach? These are questions that must be addressed in the next iteration of forest policy development in Nova Scotia.

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State of Nova Scotia Forest and Biodiversity Review

Executive Summary

This review of Nova Scotia's State of Forest Report (2017) and biodiversity modules about invasive species and species at risk addresses four objectives: (i) identifying gaps, reviewing assumptions and reference points, (ii) identifying data sources, (iii) identifying research priorities, and (iv) summarizing reports from other jurisdictions.

Gaps were identified when comparing the Nova Scotia State of Forest report to the national report and those from Ontario and British Columbia; these included consistent reporting of trends, data confidence, data sources, targets, and thresholds. An adaptive, globally respected, and science-based framework of Criteria and Indicators for sustainable forest management in Canada has been available since 2003. It should be fully utilized in a collaborative, transparent, and locally relevant process to develop better criteria and indicators for the state of Nova Scotia's forest and biodiversity. In particular, several widely accepted social and economic indicators are missing from the 2016 State of Forest Report including the following: contribution of timber and non-timber forest products as well as forest-based services to the GDP, value of secondary manufacturing of timber products per volume harvested, return on capital employed, roadside log and pulp prices, employment rate in forest-based communities, number of active sawmills, and numbers of injuries and fatalities. Missing ecological indicators include landscape connectivity indicators, compliance rates with Wildlife Habitat and Watercourses Protection regulations, and non-compliances reported by third party certification auditors.

There are numerous technical considerations in the choice of reference points for data presented for each indicator. Efforts should be made, however, to provide data with the longest time series available for each indicator, and clear explanations must be provided to justify the choice of years provided. To be clear to the public, consistent with CCFM, and comparable with other disturbance factors such as fire and insects, indicators about forest disturbance from harvesting should report area harvested rather than volume harvested. Data from 1975-2015 are provided from several sources (National Forestry Database, GPI Atlantic, and Global ForestWatch) with detailed data about forest harvest area by harvest method and tenure.

Recommended research priorities include the following: collaborative development of locally relevant criteria and indicators from the national framework; data collection for social indicators; forest ecosystem carbon storage by forest type and age class. Other jurisdictions outside of Canada were also considered and exemplary criteria and indicators from the United States and Australia are provided.

1. Objectives

- Review assumptions, reference points, and key gaps in DNR State of Forest Report April 2016 and State of Biodiversity modules March 2017: Introduction to Biodiversity, Invasive Alien Species, and Species at Risk
- Identify and annotate available data sources and/or expertise not included in DNR State of Forest Report
- Identify research priorities for ecological & economic state of forest indicators
- Summarize scientifically defensible reporting methods / monitoring frameworks / state of forest reports from other jurisdictions (with input from panel experts)

2. Methodology

Three staff of MTRI were allotted a total of 25 person days to achieve the objectives outlined above. This was undertaken by reviewing the key documents and websites listed in Appendix 1. There was not sufficient time for direct personal communications with experts to verify currency of online documents for interprovincial comparisons of State of Forest reports. A series of questions were provided to NSDNR staff at the Forestry and Wildlife divisions; responses to these questions were considered as background information. Data from other sources including the National Forestry Database, Statistics Canada, Nova Scotia Registry of Buyers, and Global Forest Watch were downloaded and analyzed.

3. Identified Gaps

3.1 Gaps: Trends, data confidence, data sources, targets, and thresholds

In both the national State of Forest and Ontario State of Forest reports trends and data confidence are clear and consistently reported and discussed. This is also the case in Nova Scotia's Species at Risk and Invasive Species Biodiversity modules. In those four reports as well as State of Forest reports from British Columbia, Saskatchewan, and New Brunswick, methodology and data sources were provided. In Parks Canada's State of Park reporting, targets and thresholds are also estimated for each indicator. DNR staff emphasized in their answers to our questions that the State of the Forest 2016 report was meant to be a "straight forward and easily understood" publically accessible and non-technical document and that it does not undertake statistical analyses or attempt to explain the driving factors behind indicator trends. As reports from other jurisdictions have demonstrated, it is not necessary for full details to be provided about statistical analysis but it is in the public interest that indicators are presented clearly and that their analysis is scientifically defensible and referenced. Throughout the report explanations about why a trend is increasing or decreasing (e.g. major market changes or mill closures) are needed *in order* for the document to be straight forward and easily understood.

To improve clarity for Nova Scotians, we recommend that NSDNR adopt the best elements from these model documents in its State of Forest reporting; symbology should be provided to indicate a summary of trends and data confidence, data sources should be directly provided, trends should be discussed fully, and where possible targets and thresholds should be determined and explained.

3.2 Gaps: Criteria and Indicators

In the State of Forest 2016 report, few details are provided about their methodology for choosing criteria and indicators, but the Executive Summary suggests that "indicators of key principles from the Code of Forest Practice (2012) are reported". In a written response to our questions for this review about methodology, DNR staff explained that "criteria and indicators were developed in consultation with experts within the Department". Many workers, however, recommend that the development of criteria and indicators should be collaborative and that local methods to define and generate them are required (Sherry *et al* 2005; Sheppard & Meitner 2005; BC State of Forest 2010). An adaptive, globally respected, and science-based framework of Criteria and Indicators for sustainable forest management in Canada exists but as of 2008, Nova Scotia was among the four or five provinces not drawing on it in their State of Forest or State of Environment reports (CCFM 2008; Table 1). Despite the considerable resources spent to develop frameworks, the full potential of criteria and indicators remains untapped for sustainable forest management and has yet to be integrated in prospective analyses in the development of forest policy (Duinker 2011).

Nova Scotia's State of Forest 2016 report includes discussion and data for 12 of the 46 indicators recommended by the Canadian Council of Forest Ministers (CCFM) (Appendix 2). Nova Scotia's State of Forest report is particularly lacking in social and economic indicators and makes very little reference to climate change. Data appear to be readily available from Stats Canada for CCFM indicators such as 5.1.1 contribution of timber products to the GDP, 5.1.2 value of secondary manufacturing of timber products per volume harvested, 5.3.2 return on capital employed, and 5.3.6 average income. Other indicators, which may be difficult but not impossible to quantify, and are of great public interest, include: 2.4 area of forest with impaired function due to acid rain; 3.2 rate of compliance with locally applicable road construction, stream crossing, and riparian zone management standards; 6.1.2 area of forest land owned by Aboriginal peoples; 6.3.3 employment rate in forest-based communities; and 6.3.4 incidence of low income in forest-based communities. Other jurisdictions, including Prince Edward Island, Northwest Territories, and Saskatchewan include criteria for which no data are currently available.

To live up to its commitments under the Canada Forest Accord signed by Nova Scotia's Minister of Natural Resources in 1998 and the Montréal Process (1995, 2003, 2009), we recommend that Nova Scotia fully utilize Canada's Sustainable Forest Management Criteria and Indicators (2003) and collaboratively adapt them to a Nova Scotian context.

3.3 Gaps: Biodiversity indicators

There are no indicators from the CCFM about landscape connectivity but Ontario's State of Forest Report includes three metrics (total core area index, edge density, mean nearest neighbour) for an indicator they call "Levels of fragmentation and connectedness of forest ecosystem components". They also report on an indicator called "Anthropogenic corridors such as roads, utility corridors and railways". British Columbia's State of Forest report includes the following specific landscape connectivity indicators: road density, number of stream crossings, and field-truthed assessments of fish passage at stream crossings.

Other progressive indicators included in Ontario's State of Forest Report include Structural legacy following harvest (compliance), downed woody debris (study plots), compliance with forest management guidelines for protecting water quality and fish habitat, economic benefits from selected wildlife species, and old growth (amount by forest type). Other progressive indicators in British Columbia's State of Forest report consider tree genetic diversity, ground level ozone, and air pollution from wildfires.

In the spirit of Resolution 40-3 at the 40th Conference of New England Governors and Eastern Canadian Premiers Conference (2016), and given the Nova Scotia Old Forest Policy (2012), we recommend that NSDNR include landscape connectivity and old forest indicators in future State of Forest reporting.

3.4 Gaps: Forest Ecosystem Carbon Indicators

The Nova Scotia State of Forest 2016 report does not account for carbon stored in forest products or in mineral soil, it does not quantify forest sector carbon emissions, and it does not account for the effect of stand development on carbon storage. In DNR staff responses to our questions, they recognized the importance of carbon and climate change modeling and state that they are currently in the process of filling a forest resource analyst position that specializes in forest carbon and climate change. A 2006 study on carbon storage in Red spruce forests in Central Nova Scotia indicated that total site carbon storage increases throughout stand development. Carbon peaked in the 81 to 100 year age class indicating that rotations in this time frame maximize carbon storage (Taylor *et al.* 2007). There have also been recent studies in Nova Scotia and the northeastern United States that indicate that harvesting frequency and structural retention significantly affect mean carbon storage within the soil, particularly within soil depths greater than 20 cm (Prest *et al.* 2014, Diochon *et al* 2008, and Nunery & Keeton 2010).

Simply reporting on annual net change in forest ecosystem carbon based on harvesting levels is not a true reflection of carbon storage and release. Ontario's State of Forest report uses forested wetland carbon as an indicator, and British Columbia's State of Forest report uses the following indicators to assess greenhouse gas emissions and sinks: fire, insects, logging, and reforestation; retention of older forests (aged > 80 years); and management responses to address short-term mitigation targets including prompt reforestation, planting trees on previously non-forested land, controlling fire and pests, longer rotations, and reducing fossil fuel use.

3.5 Gaps: Soil and Water Indicators

NSDNR has shown commitment to these core indicators by investing considerable staff time and resources in soil nutrient budget modeling since 2008 and the incorporation of the Forest Ecosystem classification guides into the Pre-Treatment Assessment Program and new Management Guides. Although there is a short section on ground disturbance in the State of Forest 2016 report, the report excludes any of the Department's own nutrient budget modeling, and does not discuss how it will be incorporated into long term management planning. NSDNR staff suggest that this will be included in future State of Forest reporting.

There are no reported data on compliance auditing for ground disturbance and road construction, stream crossings or riparian zone regulations (CCFM core indicators 3.1 and 3.2). A significant amount of Nova Scotia's crown and private land is certified to SFI or FSC standards, for which third-party audits are conducted annually. Non-compliances are noted and made publicly available so data limitation is not a problem. Crown land management also requires both pre-and post treatment assessments for which data should be available. NSDNR has its own research paper on soil disturbance: "Post-Harvest Soil Disturbance and Permanent Structure Survey - Pockwock-Bowater Watershed Project" McCurdy et al. (2004) which could be discussed.

Other progressive indicators in British Columbia's State of Forest report include i) number of soil disturbance enforcement actions on crown land 1995-2007, from the Ministry's random sampling-based resource stewardship monitoring program, and ii) number of streams in four stream condition classes, based on province-wide assessments of stream-riparian condition conducted between 2005 and 2007.

In harvested areas in British Columbia, a total of 1,022 riparian site assessments were completed between 2005 and 2007. Key physical and biological attributes of streams and adjacent riparian areas were assessed after logging and compared to reference conditions found in mature, undisturbed forest stands.

We recommend that future State of Forest reports should describe current soil nutrient modelling, and provide available data even if they are just from pilot study sites. We recommend that any non-compliances regarding Wildlife Habitat and Watercourses Protection regulations, or rutting and ground disturbance reports from internal audits, or FSC/SFI audits should be reported.

3.5 Gaps: Economic Indicators

Contribution of timber products to the gross domestic product (GDP) is a core CCFM indicator but it is absent from the Nova Scotia State of Forest 2016 report. Gardner Pinfold (2015) reported from Statistics Canada data that the contribution of forestry to Nova Scotia's GDP was $800m. According to Statistics Canada, Nova Scotia's overall GDP was $41,726 million in 2016. In terms of contributions to GDP, forest products in Nova Scotia are fifth among goods-producing sectors but the highest contributing sector was Fishing, Hunting, and Trapping (Gardner Pinfold 2015).

Value of secondary manufacturing of timber products per volume harvested is a core CCFM indicator but it is absent from the Nova Scotia State of Forest report. In GPI Atlantic's 2008 report, they summarized Statistic Canada data which reported that in 1998 and 2004 Nova Scotia was below the national average in terms of value-added per cubic metre of wood harvested, and that between the two time periods, the value declined from $127/m3 of wood harvested in 1998 to $107/m3 of wood harvested in 2004. Provinces such as Manitoba, which had an increasing trend in adding value to forest products, had an explicit commitment by the provincial government to promote value-added industries (Manitoba 2006 cited in GPI).

Although non-timber forest product (NTFP) markets in Nova Scotia are not well developed or promoted, they do exist (*e.g.*, maple syrup production) and often involve subtle management or manipulation of the forest environment for their production. Contribution of non-timber forest products and forest-based services to the gross domestic product is a core CCFM indicator but it is absent from the Nova Scotia State of Forest 2016 report. Nova Scotia exported an average of $247,944 per year worth of Maple Products between 2008 and 2012 (Figure 1; Agriculture and Agri-Food Canada January 2014). Forest-based services such as guiding, hunting, fishing, and tourism also contribute significantly to the economy, and as noted above (Gardner Pinfold 2015; Stats Canada 2016) make significant contributions to Nova Scotia's GDP. In Nova Scotia, an estimated $87 million is spent annually on hunting and trapping (Government of Canada 2012) and $56 million on sportfishing (NSDFA 2018). Nature-related expenditures by residents of Nova Scotia on these and other nature related activities, including recreation, education, fishing and photography, totaled an estimated $973m in 2012 (Federal, Provincial, and Territorial Governments of Canada, 2012 p.113).

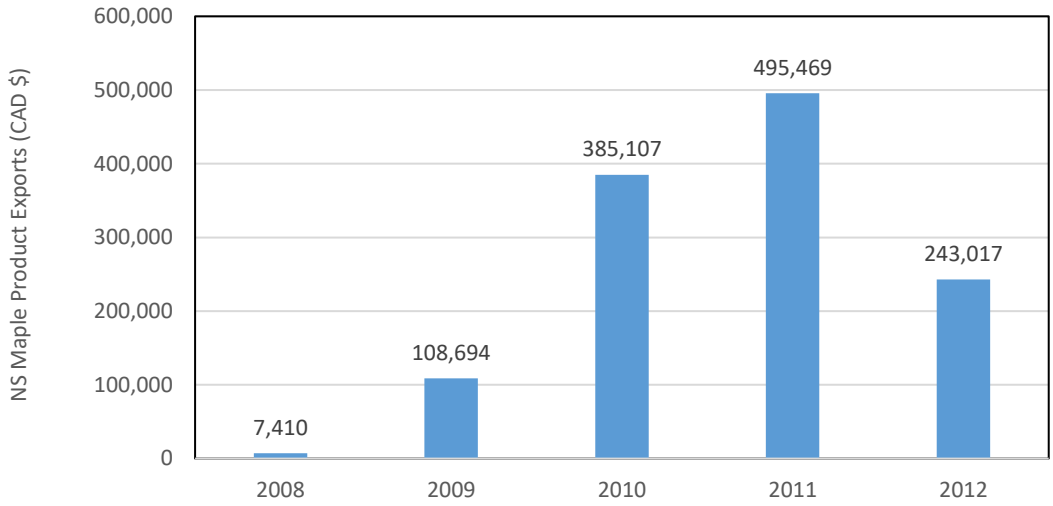


Figure 1. Nova Scotia Maple Products Export Revenue from Agriculture and Agri-Food Canada January 2014.

Many private landowners consider price to be an important factor driving participation in the forestry sector. Data on forest product prices may be available from the Registry of Buyers but they are not presented in annual reports. Natural Resources Canada archives weekly lumber prices online. With the time and resources we had available, we were able to present data from Digby County from 1998-2017 showing that prices have remained fairly constant (Figure 2). It would be informative to compare prices to costs associated with forest harvesting. Anecdotally, it is well understood that operational costs increased between 1998 and 2017. If data could be provided on roadside log and pulp prices as well as operational costs, this could help inform CCFM core indicator 5.2.2: distribution of financial benefits from the timber products industry between landowners, contractors, and mills.

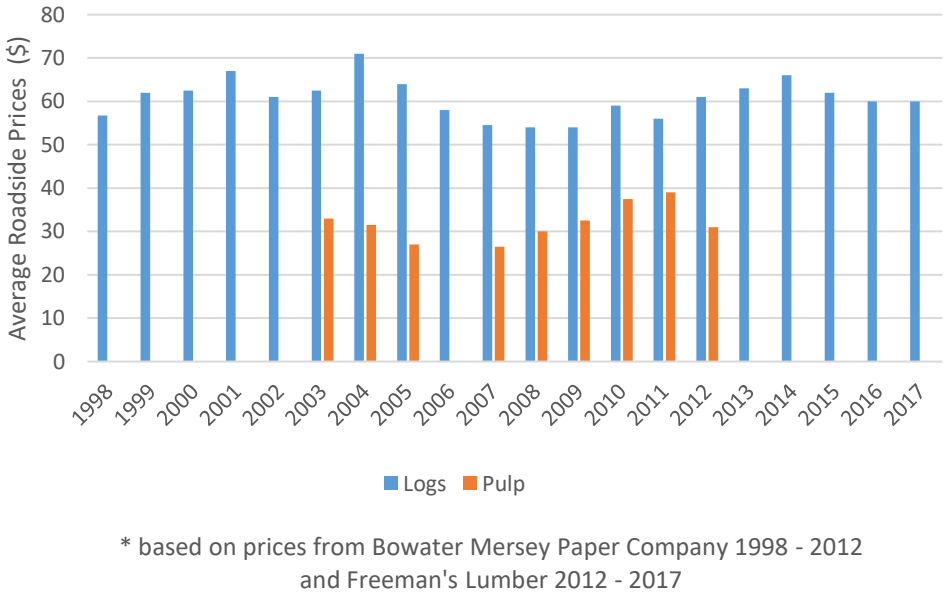


Figure 2. Roadside logs/pulps (Canadian dollars not adjusted for inflation) paid by Bowater Mersey Paper Company (1998-2012) and Harry Freeman & Son Limited (2012-2017) to woodlot owners in Digby County. Data were provided to MTRI and Western Woodlot Services Co-operative by la Foret Acadienne.

Investment in forest research and timber products as well as industry research and development are core CCFM indicators but are absent from the Nova Scotia State of Forest 2016 report. Other progressive indicators included in Ontario's State of Forest Report include use of recycled versus virgin fibre, and forest biomass utilization for fossil fuel substitution. Other progressive indicators in British Columbia's State of Forest report include volume gain expected from silviculture.

We recommend that NSDNR include indicators pertaining to contribution of timber and non-timber forest products as well as forest-based services to the GDP, value of secondary manufacturing of timber products per volume harvested, return on capital employed, and roadside log and pulp prices in future State of Forest reporting.

3.6 Gaps: Social indicators

Time series data were provided in the State of the Forest 2016 report for direct jobs in the forest sector but not indirect jobs. According to the Gardner-Pinfold report (2016), there were 6100 direct and 5400 spinoff jobs in the forestry sector suggesting that indirect jobs are may be as important as direct jobs and should be presented. Within direct forestry sector jobs, declining trends were reported for wood product jobs, pulp and paper jobs, and forestry jobs but between 2001 and 2015, the direct "support activity" jobs fluctuated but did not decline (including timber cruising, forest fire fighting, log hauling, reforestation, and pest control). More research is needed to understand why the trends for support activities differ from the other direct forestry sector jobs. CCFM suggests employment rate in forest-based communities as an indicator. Ontario identifies Communities of Concern based on three measures of resiliency and forest dependency (socioeconomic, lifestyle, and economic) and then calculates trends in their number through time. In the State of Canada's Forests report (2017), statistics are provided about the number of Indigenous people working in the forestry sector and also about average earnings for forestry and logging, wood product manufacturing, and pulp and paper product manufacturing from 2006-2016.

The number of active sawmills, which has declined dramatically, is another relevant social indicator about the distribution of benefits for which data are available in Nova Scotia (Registry of Buyers). The most recent data suggest that there were 85 active sawmills and 2 active pulp and paper mills in Nova Scotia in 2016 compared to 267 active sawmills and 3 active pulp and paper mills in 2000 (Registry of Buyers 2016). Sawmill production increased quickly during the 1990s and stayed high until 2005 but then decreased quickly for ten years until 2015 (Figure 3).

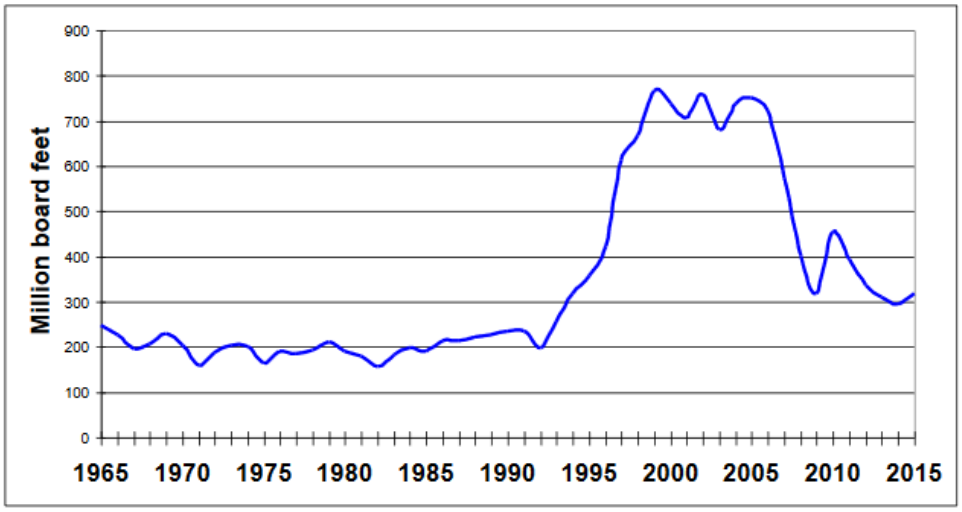


Figure 3. Sawmill production Nova Scotia 1965-2015 from Registry of Buyers of Primary Forest Products 2015 Calendar Year (June 2016).

In addition to the silviculture programs reported in the State of the Forest 2016 report, some consideration could be given to reporting other programs. Road programs have been administered by Forests Nova Scotia for the last fifty years to private landowners. The NSDNR has also administered outreach and extension programs for many years to support private woodlot management, training, and certification. All these programs, as well as those that could benefit sawmills, pulp mills, and other industry players could be reported as an indicator. As an example, in New York's Forest Resource Assessment, time series data are provided about total program funding to the state forestry agency.

Other progressive social indicators in British Columbia's 2010 State of Forest report include the following:

- Allocation of timber harvesting rights by type of licence (short, med, long)
- Share of the right to harvest crown timber s held by large forest companies 1975-2009
- Several forest-recreation indicators including map of visually sensitive landscapes and visual quality objectives
- Map of regional sensitivity to forest sector economic downturn
- Injuries and fatalities in forest sector
- Number of First Nation forestry agreements
- Timber volume licensed to First Nations
- Public satisfaction with the quality of forest resource management in B.C., 1999–2009 and results of public opinion polls commissioned by the ABCFP
- Compliance trends in # of inspections AND # of corrective measures
- Number of professionals involved in managing forestry by professional associations; number of practicing professionals provides an indication of the recruitment and attrition rates, level of training, and specialized knowledge available to pursue sustainable forest and range management.
- Investment in forest research in British Columbia
- Not quantified but "Is the Knowledge Accessible?" is an indicator that is discussed
- Tenure volume and area by each certification standard

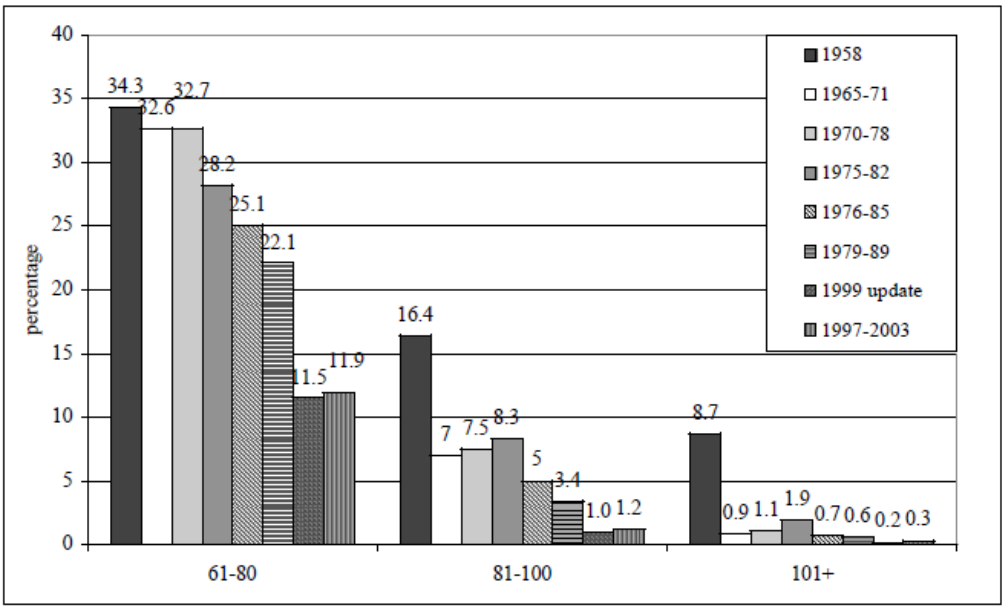
We recommend that NSDNR include indicators pertaining to indirect jobs in the forestry sector, employment rate in forest-based communities, number of active sawmills, subsidization and support programs, and numbers of injuries and fatalities in future State of Forest reporting.

4. Reference Points and Available Data Sources

Many elements of the forest have been tracked for over 50 years (NSDNR 2017), but the earliest data presented in the Nova Scotia State of the Forest Report were 30 years old (1986). NSDNR staff informed us that earlier data will be incorporated in updates to future State of Forest reporting. In Prince Edward Island forest area data presented in their State of the Forest report extend from 1900 to 2010 and in British Columbia, annual timber harvest are reported from 1910-2008 and AAC are reported from 1945-2008.

4.1 Reference Points & Available Data: Area of forest by age class

Using PSP data from 2002, 2007, and 2012 in Figure 2.6 of the State of Forest 2016 report, there appears to be an increase in older age categories of forests (61-100+ years). Other data based on DNR's aerial photography, however, suggest a dramatic decline in forests in these same age categories between 1958 and 2003 (Figure 4). A longer time series of data should be presented to understand the trend in age class distribution; PSP data date back to 1965 but according to GPI Atlantic, have never been made public. In their response to our questions, DNR staff confirm that data confidence for PSP data is high but that the number of PSP plots almost doubled in 1998. The way that PSP plots are included or excluded in the State of Forest 2016 report must be more transparent, and differences between PSP and aerial photography for this indicator must be more carefully described. There are likely statistical tools available to accommodate changes in sample size that occurred after 1998. If PSP data cannot be used to look at long-term trends, an explanation is required as to why aerial photography interpretation of height class and species is not being used in the State of Forest 2016 report to describe longer term trends in age classes.



Sources: The Forest Resources of Nova Scotia (1958); Nova Scotia Forest Inventory Provincial Summary 1965-1971, 1970-1978, 1975-1982, 1976-1985, 1979-1989; DNR GIS 1995 Inventory Data (September 1999 update); DNR GIS Unpublished Inventory Data (1997-2003). Note: Figures have been rounded.

Figure 4. Provincial forest area by age classes over 61 years as percentage of total forest area from 1958-2003. Sourced from GPI Atlantic (2008).

We recommend that NSDNR conduct the necessary analyses to include longer time series data for indicators such as Area of Forest by Age Class, Volume Growth and Loss, and Non-clearcut Harvesting. Efforts should be made to provide data with the longest time series available for each indicator and clear explanations must be provided to explain the years of data that are provided.

4.2 Reference Points & Available Data: Area of forest disturbance

Data available for this indicator exist earlier than the 2002 data that are presented in the State of Forest 2016 report; the choice of time frame greatly influences whether a trend appears to be increasing, decreasing, or is stable. Historic harvest level data exist for Nova Scotia since at least 1935 (Figure 5). In CCFM Key Trends 2005 and in current NRCan and Ontario State of Forest reports, forest harvest indicators are reported as *area* harvested, but in Nova Scotia's State of Forest it is reported in 8.3.1 as *volume*. It is more difficult for the public to understand harvest volume than harvest area. Data on area harvested since 1994 are readily available in the National Forestry Database (Figure 6), and show an overall declining trend when all land tenures are summed. In the CCFM 2005 Key Trends and Conditions report, under Criterion 2, they present the area disturbed by fire, harvesting, and selected insects on the same graph so it is easy to understand the relative impact of each type of disturbance over time. British Columbia does the same on page 54 of its State of Forest report.

We recommend that NSDNR use area of disturbance (including forest harvest, wildfire, and insect defoliation) as well as harvest area and type by tenure as indicators in future State of Forest reporting.

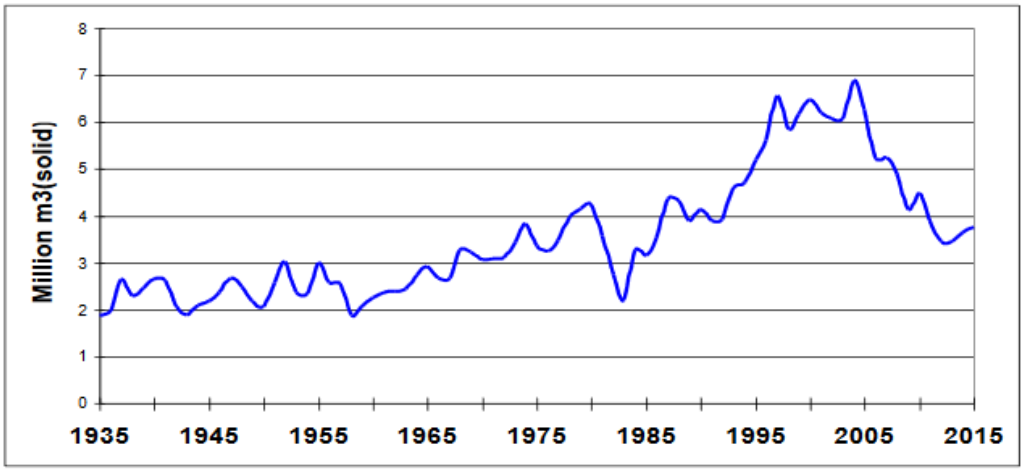


Figure 5. Historical Harvest Levels for Nova Scotia 1935-2015 from Registry of Buyers of Primary Forest Products 2015 Calendar Year (June 2016).

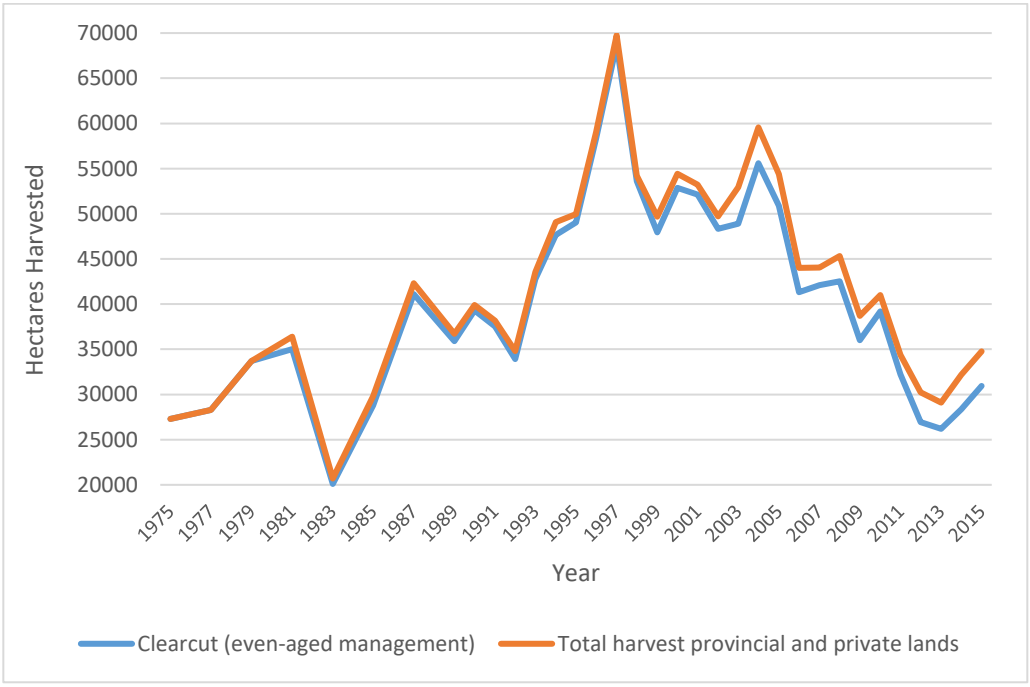


Figure 6. GPI data from 1975-2005 from National Forestry Database with data 2005-2015 accessed directly from National Forestry Database online February 2018.

When we compared data on forest area harvested from the National Forestry Database (based on DNR data likely derived from air photos but the source is not explicit) and Global ForestWatch (based on satellite imagery with 30 m resolution) we found Global Forest Watch tree cover loss estimates to be lower than harvest area estimates from the National Forestry Database which may be their factor for forest growth added to harvest to determine tree cover loss. Both data sources show a declining trend in the area harvested since 1994 (Figure 7).

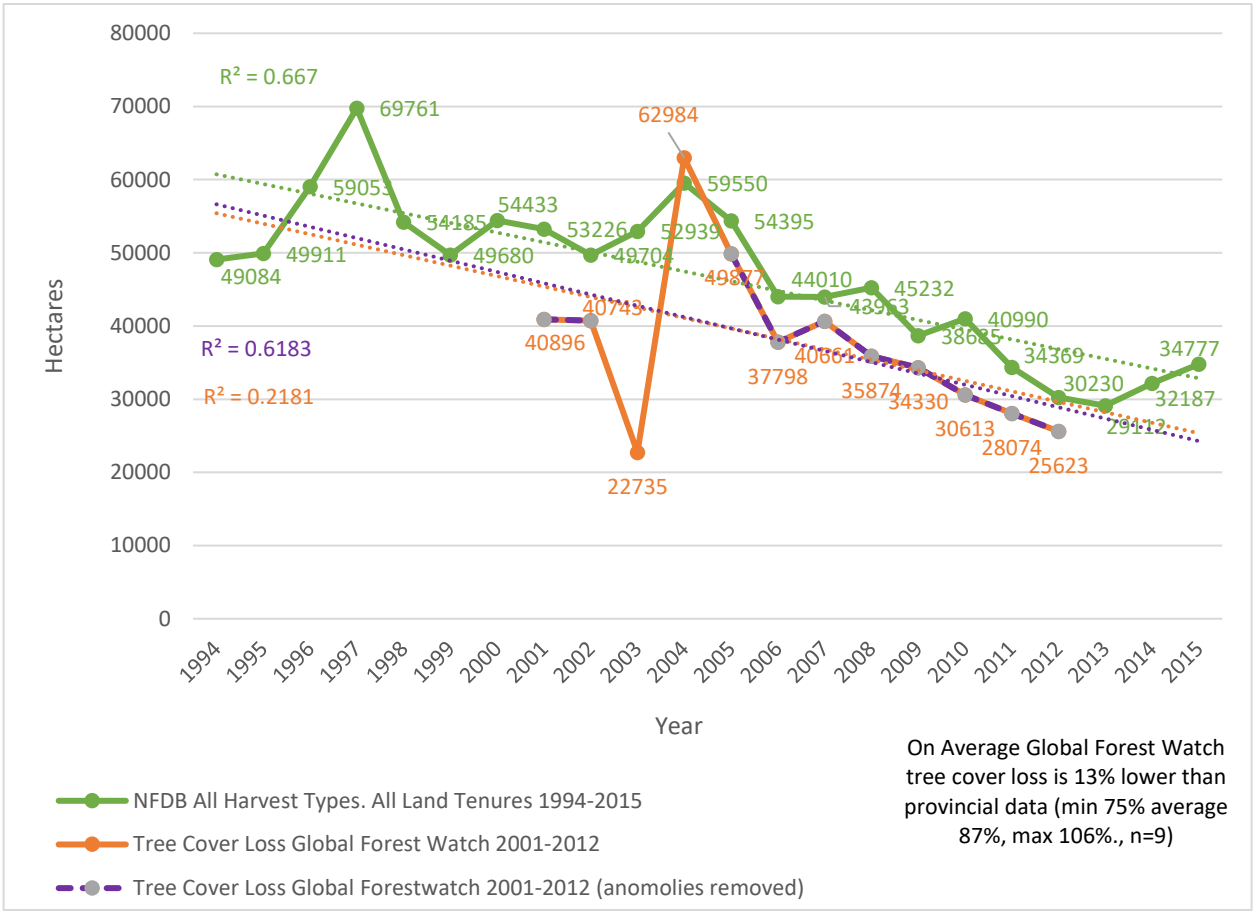


Figure 7. Harvest area estimates from two sources: National Forest Database and Global Forest Watch from 1994 to 2015.

Despite a declining trend in total area harvested from 1994 to 2015, when crown land is considered separately from private land, the trend for the same period is an increasing one (Figure 8). Between 2012 and 2015, the area of crown land harvest increased by 85%, with the highest amount occurring in the most recent year – 2015.

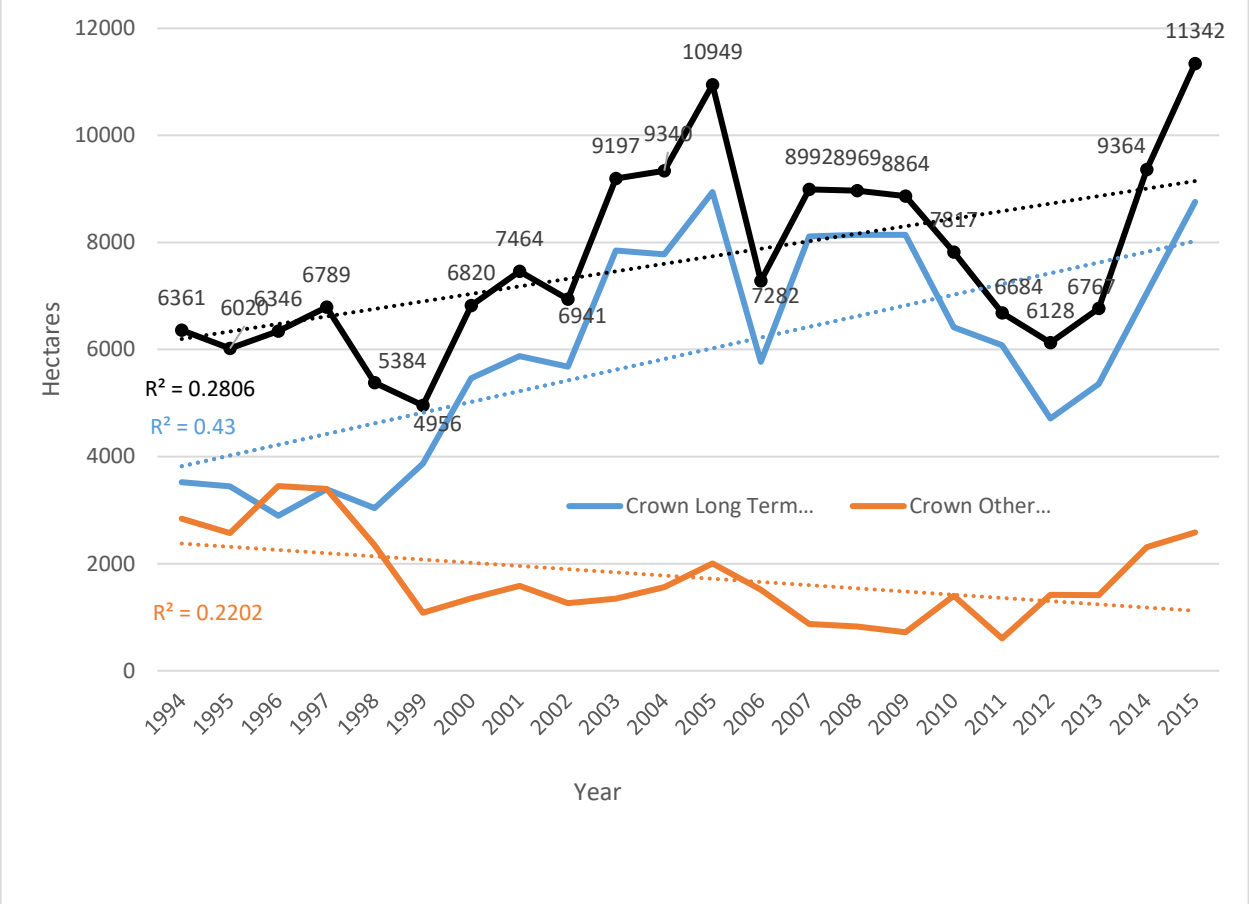


Figure 8. All cutting types on crown land from National Forestry Database NS accessed February 2018.

4.3 Reference Points & Available Data: Harvesting methods

In Nova Scotia's State of Forest 2016 Report, Harvesting Methods are provided as an indicator and the data are presented as the percentage of non-clearcut harvesting on crown lands from 2006-2015. This presentation may have been chosen because of the non clear-cutting objectives that were stated as a proportion of total harvesting in the Natural Resources Strategy (2010). Earlier data, however, are available from the National Forestry Database (Figures 9 and 10). In their response to our questions, NSDNR staff suggest that the selection of only recent data for harvesting methods was an oversight and that earlier data will be incorporated in future reporting. They also suggested that additional figures covering harvest methods will be added to the State of the Forest updates online.

We recommend, particularly given the public interest in clearcut harvesting, that long-term trends in harvest method which include data about land tenure should be included for future State of the Forest reports in Nova Scotia.

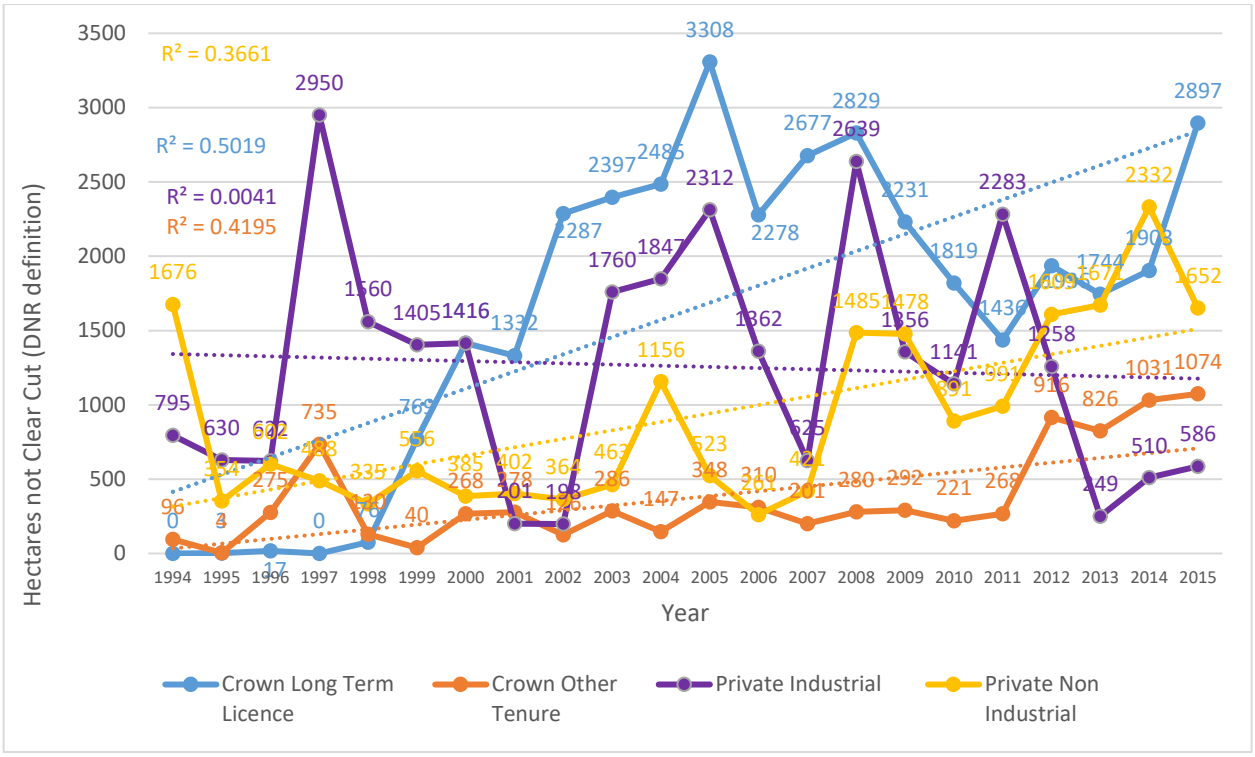


Figure 9. Area of clear cut harvest by tenure from 1994 to 2015 from National Forestry Database accessed online February 2018.

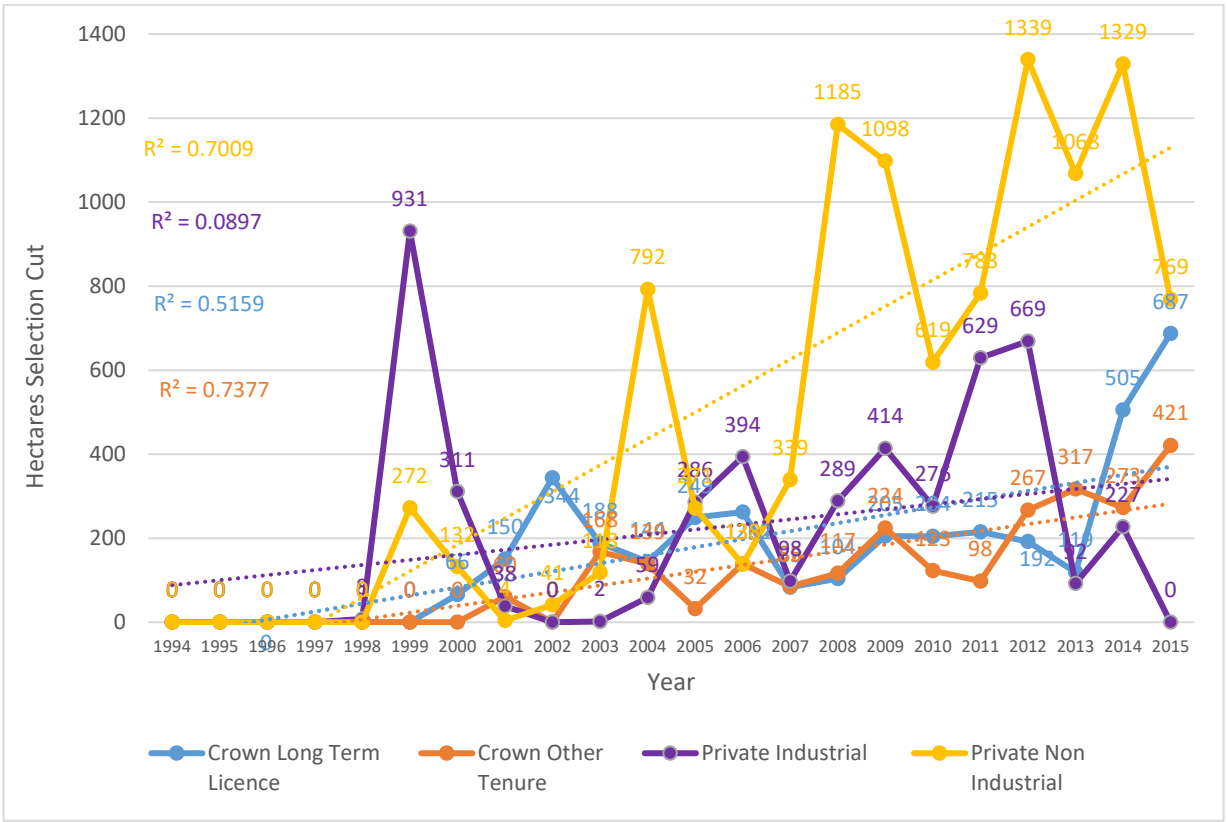


Figure 10. Area of selection harvest by tenure from 1994 to 2015 from National Forestry Database accessed online February 2018.

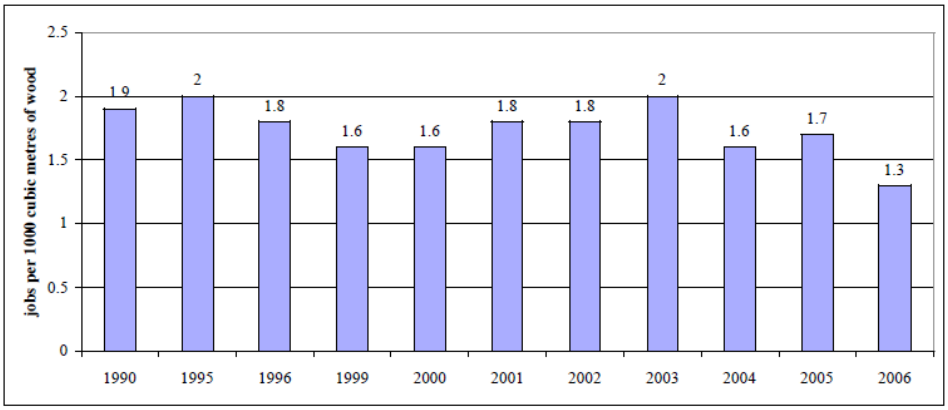
4.4 Reference Points & Available Data: Forest dependent species

Experts provided input in the determination of forest-dependent species for GPI's 2008 report and they were detailed on p. 23. We were unable to compare designations in this report to those in the Biodiversity Module to determine if there were discrepancies, because insufficient detail was provided in the report and in the answer to our question to the Wildlife Division. In their response, DNR explained that internal staff determined forest and wetland dependent species in the Biodiversity Module.

We recommend that DNR use and credit outside scientific expertise whenever possible for State of Forest and State of Biodiversity reporting.

4.5 Reference Points & Available Data: Direct jobs

Data for jobs in Nova Scotia's forestry sector appear to be available for at least ten more years than those presented in the State of Forest 2016 report (GPI 2008). Another informative way to look at trends in employment within the forestry sector is to look at the number of full-time jobs per 1000 cubic metres of wood harvested (Figure 11).



Source: Harvest volume data from NSDNR, 1997, Toward Sustainable Forestry: A Position Paper and NSDNR Registry of Buyers Annual Reports. Employment data from Statistics Canada's Labour Force Survey for 1990 to 2006 were provided to GPI*Atlantic* by Patrick Brannon, Research Analyst, Atlantic Provinces Economic Council, October 16, 2007.

Figure 11. Number of full-time jobs per 1000 cubic metres of wood harvested in Nova Scotia from 1990-2006. From GPI Atlantic 2008.

We recommend that longer time series data are provided about direct jobs in future State of Forest reporting and that an indicator be included to track trends in the number of jobs per unit of wood harvested.

4.6 Reference Points & Available Data: Roads

Road data are only provided in the State of the Forest 2016 report for 2006. Like other indicators, it would be more informative if data trends as well as targets and/or thresholds were provided. In their response to our questions, DNR staff said that the road index tool they developed ~2005 will not be used to recalculate new roads until the completion of landscape planning pilot project is completed. Unpublished data from Prakash (2006) which were discussed in Colville and Prakash (2010) are

presented in Figure 12 to illustrate how some local researchers have digitized Landsat images to show trends in road development.

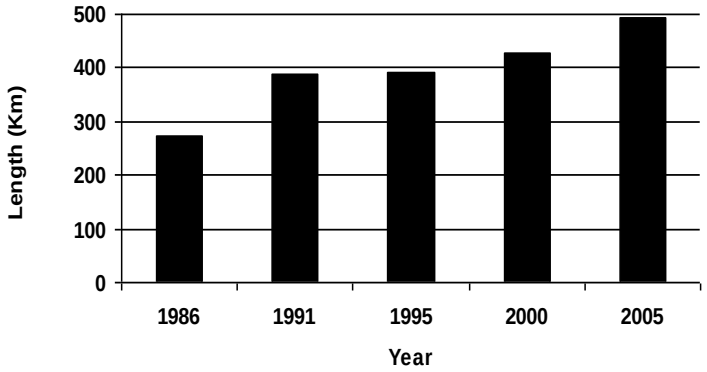


Figure 12. Road development in Upper Mersey Watershed calculated by digitizing Landsat images from 1986-2005 by MTRI and NSCC intern Sandeep Prakash supervised by David Colville in 2006.

There is a lot of literature about road density thresholds for large mammals and other wildlife which could be considered. Thresholds reported in the literature, however, (e.g. 0.6 km/km^2 for large mammals reviewed in Beazley *et al.* 2004) are not comparable to the road index values presented in the State of Forest 2016 report because the road index values are proportions of ecoregions for each road index category rather than the more widely used unit: linear kms of roads per km^2.

We recommend that existing data for road development - either the DNR Road Index tool and/or Landsat imagery be analyzed and compared to thresholds for wildlife published in the literature.

5. Research Priorities

There is much work to do, as proposed above, to fill the identified gaps and improve reference points and data sources. It may be unrealistic to add to this an ambitious list of research priorities. At the very least, local research is needed to develop collaborative and locally customized criteria and indicators.

Research may also be needed to improve data confidence for the following CCFM indicators that are likely of high public interest: 2.4 area of forest with impaired function due to acid rain, 3.2 rate of compliance with locally applicable road construction, stream crossing, and riparian zone management standards, 6.1.2 area of forest land owned by Aboriginal peoples, 6.3.3 employment rate in forest-based communities, and 6.3.4 incidence of low income in forest-based communities.

Research may be needed to quantify local data for six indicators under these criteria: 6.4 fair and effective decision making, and 6.5 informed decision making. Good examples are provided in Ontario's State of Forest report which has an indicator called Resilience of forest-based communities using Statistics Canada census data. Ontario also has an indicator called "fairness, effectiveness, and public satisfaction with decision-making process outcomes which relies on survey results on 5-year intervals from Local Citizens' Committees". If resources were available for this work, these could all provide informative content for future State of Forest reporting in Nova Scotia.

6. Other jurisdictions

Within Canada, there are a number of useful examples that can help inform Nova Scotia's State of Forest reporting. Several examples have been given throughout this review from Ontario, British Columbia, and the National database which could be used to improve Nova Scotia's reporting. A summary is also provided in Table 1 to overview State of Forest and State of Environment reporting by province.

Other lessons can be taken from the United States. In Wisconsin they include pertaining to legal and institutional frameworks for sustainable forest management; effects of climate change, agents of tree mortality, and fragmentation on forests; trends in outdoor recreation; and very detailed statistics about forest industry wages, jobs, and professional support. In Maine and New York trends in the size of private forest holdings are reported as an indicator. New York provides details about funds invested in forest health, management, wood processing, and research. Funding for university forestry research and USDA Forest Service research is also provided in detail in New York's Forest Resource Assessment. For two time periods, capital expenditures by manufacturers of wood-related products are provided. For private landowner stewardship, the annual number of forest management plans and number of acres they cover, as well as the amount of land under certification are reported as indicators.

Around the world, 12 member countries participate in the Montreal Process Working Group. Some countries like Australia and Canada have produced easily accessible State of the Forest reports. Australia has progressive indicators about Indigenous values with quantified data such as the following: extent to which Indigenous values are protected, maintained, and enhanced through Indigenous participation in forest management; and the area of forest to which Indigenous people have use and rights formally and informally recognized; resilience of forest-dependent Indigenous communities and forestry workers. In Australia's State of the Forest reporting, the degree of recycling of forest products is an indicator and trends for wages as well as injuries within the sector are reported. The importance of forests to people is a criterion and as such time series data are reported showing changes in perceptions of wood and other building materials (Fig. 13) as well as attitudes about the acceptability of cutting trees and the quality of Australia's forests management. Criteria and indicators are included for legal, institutional, and economic frameworks for forest conservation and sustainable management. In Japan, there is also careful tracking of trends in how the public values the forest and a number of indicators about research and development.

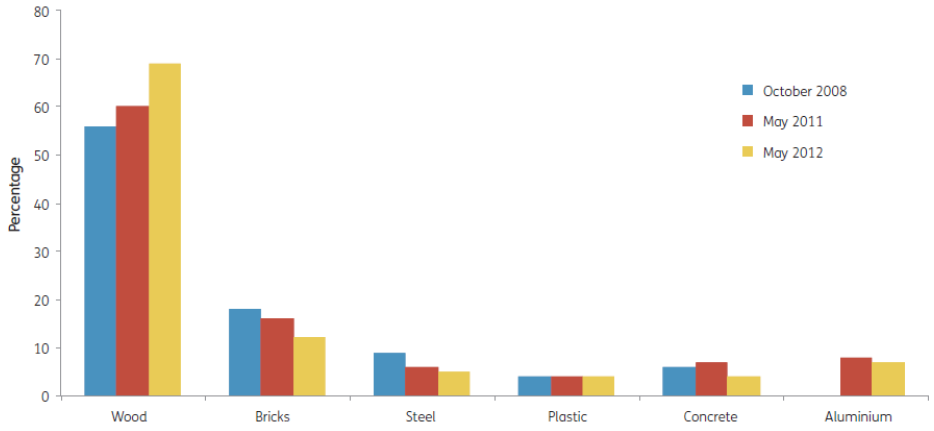


Figure 13. Perceptions of materials as environmentally friendly according to national market research surveys conducted in Australia with more than 1000 respondents per survey between 2008 and 2012 from Australia State of Forest Report 2013.

Table 1. Summary of Canadian Provinces and their activities with respect to the National Forest Accord.

Province	**State of the Forest Report?**	**Publicly Transparent Annual Operating Plans**	**Publicly Transparent Forest Management Plans**	**Publicly Transparent Crown Forest Management Agreements (licenses)**	**Public Consultations**	**Criteria and Indicators**
Alberta	No Closest approximation are detailed Regional Landscape Assessments which are more detailed than NS State of Forest 2016 report; they encompass all activities licensed on crown land as well as harvesting and wood volumes.	Yes	Yes 10 year plans	Yes	Yes Form of consultations not clear "inform and invite public comment" "provide for ongoing dialogue with the public concerning day-to-day harvesting and renewal operations, resource impacts and potential conflicts"	Indirect
British Columbia	Yes The State of British Columbia's Forests 2004, 2010, 2016. Produced by Department of Environment along with "State of the Environment" reports.	Yes	Yes 5 Year plans	Yes	Yes 60 day comment period. First nations consultation Made public after consultations	Yes Legally required
Manitoba	No	No	Yes?	Yes	Yes Posted on public registry in concert with environmental assessment act.	Indirect
New Brunswick	Yes The Public Forest 2008 State of the Forest Report: Being Responsible.	Yes Required but not found	No	No except for First Nations agreements	No	No Very little alignment with CCFM and no specific mention of C & I
Newfoundland and Labrador	Yes Provincial Sustainable Forest Management Strategy: Growing our renewable and sustainable forest economy 2014-2024	No	Yes	No	No	Yes Legally Required (CCFM doc); uses Activities, Goals, and Indicators instead of CCFM wording

Province	State of the Forest Report?	Publicly Transparent Annual Operating Plans	Publicly Transparent Forest Management Plans	Publicly Transparent Crown Forest Management Agreements (licenses)	Public Consultations	Criteria and Indicators
Northwest Territories	Yes Forests of Northwest Territories	No	No	Y	No but the only timber management licenses are with aboriginal led corporations and involve community consultation	No Major themes highlighted but criteria and indicators not presented
Nova Scotia	Yes State of the Forest 2008 and 2016	No Online harvest viewer but no AOP	No	No	Online Harvest viewer is only option to provide input. No other regular consultation with the public.	No Most required by CCFM not there or indirect
Nunavut	-	-	-	-	-	-
Ontario	Yes State of Ontario's Natural Resources: Forests 2016	No	Yes	Yes	Yes	Yes Legally Required
Prince Edward Island	Yes State of the Forest Report 2010	No	Yes	No	Yes	Yes Criteria and indicators not explicit. Some matching
Quebec	No	Yes	Yes	No	Yes	No
Saskatchewan	Yes 2017 State of the Environment Report	No	Yes	No	Yes	Does not fully align with CCFM
Yukon	No	No	No	No	No. Interactive personal fuelwood areas map	Indirect

7. Summary of recommendations

- Adopt the best elements from model documents; symbology should be provided to indicate a summary of trends and data confidence, data sources should be directly provided, trends should be discussed fully, and where possible targets and thresholds should be determined and explained.

-Fully utilize Canada's Sustainable Forest Management Criteria and Indicators (2003) and collaboratively adapt them to a Nova Scotian context.

- Include landscape connectivity and old forest indicators in future State of Forest reporting.

- Describe soil nutrient modelling and provide available data even if they are just from pilot study sites. Report any non-compliances regarding Wildlife Habitat and Watercourses Protection regulations, or rutting and ground disturbance reports from internal audits or FSC/SFI certification audits.

-Include indicators pertaining to contribution of timber and non-timber forest products as well as forest-based services to the GDP, value of secondary manufacturing of timber products per volume harvested, return on capital employed, and roadside log and pulp prices.

- Include indicators pertaining to indirect jobs in the forestry sector, employment rate in forest-based communities, number of active sawmills, subsidization and support, numbers of injuries and fatalities, and number of jobs per unit of wood harvested.

- Conduct the necessary analyses to include longer time series data for indicators such as Area of Forest by Age Class, Volume Growth and Loss, Harvesting Method by Land Tenure, and Number of Direct Jobs. Efforts should be made to provide data with the longest time series available for each indicator and clear explanations must be provided to explain the years of data that are provided.

- Use area of disturbance (including forest harvest, wildfire, and insect defoliation) as well as harvest area and type by tenure.

-Use and credit outside scientific expertise whenever possible.

-Analyze and compare existing data for road development - either the DNR Road Index tool and/or Landsat imagery to thresholds for wildlife published in the literature.

Appendix 1. Information Sources

Agriculture and Agri-Food Canada. 2016. Statistical Overview of the Canadian Maple Industry. http://www.agr.gc.ca/eng/industry-markets-and-trade/market-information-by-sector/horticulture/horticulture-sector-reports/statistical-overview-of-the-canadian-maple-industry-2016/?id=1509039990148

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Northwest Territories Forest Management Agreement website accessed 2018. http://www.enr.gov.nt.ca/en/services/forest-resources/forest-management-agreements

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Saskatchewan Public Engagement Plan. http://publications.gov.sk.ca/documents/66/86843-Forest%20Management%20Planning%20Standard.pdf

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Appendix 2. Overview of Canadian Council of Forest Minister Criteria and Indicators as they relate to Nova Scotia State of Forest 2016 Report

CCFM Criteria	**CCFM Indicator**	**Corresponding NS State of Forest indicator**	**What is missing**
Biological Diversity 1.1 Ecosystem Diversity	1.1.1 Area of forest by type and age class and wetlands in each ecozone	Fig 2.1 – area by covertype Fig 2.6 - % PSP plots by age category	Fig 2.1 not by ecozone
Biological Diversity 1.1 Ecosystem Diversity	1.1.2 Area of forest by type and age class, wetlands, soil types, and geomorphological feature types **in protected areas** in each ecozone	Fig. 4.1.1	This data should be available from NSE - PA
Biological Diversity 1.2 Species Diversity	1.2.1 Status of forest-associated species at risk	Fig 5.1.1 and Biodiversity Module: SAR in NS	
Biological Diversity 1.2 Species Diversity	1.2.2 Population levels of selected forest-associated species	Not discussed	Wildlife Division species ranks may be relevant here
Biological Diversity 1.2 Species Diversity	1.2.3 Distribution of selected forest-associated species	Not discussed	
Biological Diversity 1.2 Species Diversity	1.2.4 Number of invasive, alien forest-associated species	Biodiversity module: invasive alien species in NS	
Biological Diversity 1.3 Genetic Diversity	1.3.1 Genetic diversity of reforestation seed lots	Not discussed	
Biological Diversity 1.3 Genetic Diversity	1.3.2 Status of in situ and ex situ conservation efforts for native tree species in each ecozone	Not discussed	
Ecosystem Condition and Productivity	2.1 Total growing stock of both merchantable and nonmerchantable tree species on forest land	Not discussed	
Ecosystem Condition and Productivity	2.2 Additions and deletions of forest area by cause	Not discussed	
Ecosystem Condition and Productivity	2.3 Area of forest disturbed by fire, insects, disease, and timber harvest	Figs 3.2.1, 8.1.1, 8.1.2, 8.3.1 (presented as volume of harvest rather than area)	Needs area of forest disturbed by timber harvest – data available from NFD; Needs a single graph with relative impact of

CCFM Criteria	CCFM Indicator	Corresponding NS State of Forest indicator	What is missing
			each forest disturbance
Ecosystem Condition and Productivity	2.4 Area of forest with impaired function due to ozone and acid rain	Not discussed	See Fig 2.4b p.67 2005 C&I - CCFM
Ecosystem Condition and Productivity	2.5 Proportion of timber harvest area successfully regenerated	Fig. 7.3.1, area of silviculture by land ownership; 7.3.2 area of silviculture by treatment including planting	No data to indicate success of silviculture treatments
Soil and Water	3.1 Rate of compliance with locally applicable soil disturbance standards	Not discussed	Certification audits, DNR research
Soil and Water	3.2 Rate of compliance with locally applicable road construction, stream crossing, and riparian zone management standards	Not discussed	Certification audits, DNR research
Soil and Water	3.3 Proportion of watersheds with substantial stand-replacing disturbance in the last 20 years	Fig 6.2.1 five year harvested area % of designated water supply areas	This is presented as a 5 year period (between 1999-2005) rather than 20 years
Role in Global Ecological Cycles 4.1 Carbon Cycle	4.1.1 Net change in forest ecosystem carbon	Fig 8.2.1	Model assumes no impact from harvesting on carbon on soil but local data are increasingly available for this (see refs in 3.4)
Role in Global Ecological Cycles 4.1 Carbon Cycle	4.1.2 Forest ecosystem carbon storage by forest type and age class	Not discussed	
Role in Global Ecological Cycles 4.1 Carbon Cycle	4.1.3 Net change in forest products carbon	Not discussed	The province has detailed information on harvest volumes, damage by fire and insects, old forests, production of primary products, secondary manufacturing, and an analysis of the percentage wood used for long-term forest products

CCFM Criteria	CCFM Indicator	Corresponding NS State of Forest indicator	What is missing
Role in Global Ecological Cycles 4.1 Carbon Cycle	4.1.4 Forest sector carbon emissions	Not discussed	Data for emissions from wood products and paper production industries are reported annually to the Department of Environment and Climate Change Canada
Economic and Social Benefits 5.1 Economic Benefits	5.1.1 Contribution of timber products to the gross domestic product	Only export revenue from pulp and paper, wood fabricated material and primary wood products are shown	Contribution of timber products to the gross domestic product is available from Stats Canada but needs to be parsed out from agriculture, fishing, and hunting
Economic and Social Benefits 5.1 Economic Benefits	5.1.2 Value of secondary manufacturing of timber products per volume harvested	Not discussed	Some information on forest products in the Goods Producing Sector in the Gardner Pinfold report
Economic and Social Benefits 5.1 Economic Benefits	5.1.3 Production, consumption, imports, and exports of timber products	Fig. 7.1.1 export revenue, Fig. 7.2.1 acquired volume, Fig 7.2.2 import & export volumes	No discussion of consumption except small firewood business production data not collected but estimated at 450,000m3 annually, assume local consumption?
Economic and Social Benefits 5.1 Economic Benefits	5.1.4 Contribution of non-timber forest products and forest-based services to the gross domestic product	Not discussed	Statistical Overview of the Canadian Maple Industry (2012) 2012 Canadian Nature Survey, there may be data in future for mushroom exports
Economic and Social Benefits	5.1.5 Value of unmarketed nontimber	Not discussed	Some indirect info in the 2012

CCFM Criteria	CCFM Indicator	Corresponding NS State of Forest indicator	What is missing
5.1 Economic Benefits	forest products and forest-based services		Canadian Nature Survey
Economic and Social Benefits 5.2 Distribution of Benefits	5.2.1 Forest area by timber tenure	Fig. 1.2	
Economic and Social Benefits 5.2 Distribution of Benefits	5.2.2 Distribution of financial benefits from the timber products industry	Not discussed	Price could be an element of this indicator. Some data are provided in Fig. 2 and may be available from Natural Resources Canada and/or Registry of Buyers
Economic and Social Benefits 5.3 Sustainability of Benefits	5.3.1 Annual harvest of timber relative to the level of harvest deemed to be sustainable	Fig 8.3.1	
Economic and Social Benefits 5.3 Sustainability of Benefits	5.3.2 Annual harvest of nontimber forest products relative to the level of harvest deemed to be sustainable	Not discussed	Ontario State of Forest report includes Canada yew data but only mentions maple syrup
Economic and Social Benefits 5.3 Sustainability of Benefits	5.3.3 Return on capital employed	Not discussed	
Economic and Social Benefits 5.3 Sustainability of Benefits	5.3.4 Productivity index	Fig 7.2.1	
Economic and Social Benefits 5.3 Sustainability of Benefits	5.3.5 Direct, indirect, and induced employment	Fig 7.1.2 direct jobs	Stats Can also has time series data for forest sector "spinoff", jobs; Gardner Pinfold report
Economic and Social Benefits 5.3 Sustainability of Benefits	5.3.6 Average income in major employment categories	Not discussed	

CCFM Criteria	CCFM Indicator	Corresponding NS State of Forest indicator	What is missing
Society's Responsibility 6.1 Aboriginal and Treaty Rights	6.1.1 Extent of consultation with Aboriginals in forest management planning and in the development of policies and legislation related to forest management	Not discussed	
Society's Responsibility 6.1 Aboriginal and Treaty Rights	6.1.2 Area of forest land owned by Aboriginal peoples	Not discussed	These data should be available
Society's Responsibility 6.2 Aboriginal Traditional Land Use and Forest-based Ecological Knowledge	6.2.1 Area of crown forest land with traditional land use studies	Not discussed	
Society's Responsibility 6.3 Forest Community Well-being and Resilience	6.3.1 Economic diversity index of forest-based communities	Not discussed	
Society's Responsibility 6.3 Forest Community Well-being and Resilience	6.3.2 Education attainment levels in forest-based communities	Not discussed	
Society's Responsibility 6.3 Forest Community Well-being and Resilience	6.3.3 Employment rate in forest-based communities	Not discussed	Could forest-based communities be defined in NS? Are Stats Can figures separate by communities?
Society's Responsibility 6.3 Forest Community Well-being and Resilience	6.3.4 Incidence of low income in forest-based communities	Not discussed	
Society's Responsibility 6.4 Fair and Effective Decision Making	6.4.1 Proportion of participants who are satisfied with public involvement processes in forest management in Canada	Not discussed	Lauren Miller's papers and thesis about crown land management may be relevant here
Society's Responsibility 6.4 Fair and Effective Decision Making	6.4.2 Rate of compliance with sustainable forest management laws and regulations	Not discussed	These data should be available

CCFM Criteria	CCFM Indicator	Corresponding NS State of Forest indicator	What is missing
Society's Responsibility 6.5 Informed Decision Making	6.5.1 Coverage, attributes, frequency, and statistical reliability of forest inventories	Not discussed	
Society's Responsibility 6.5 Informed Decision Making	6.5.2 Availability of forest inventory information to the public	Not discussed	Online harvest viewer stats could be used
Society's Responsibility 6.5 Informed Decision Making	6.5.3 Investment in forest research, timber products industry research and development, and education	Not discussed	Ontario State of Forest data source is FP Innovations, this may also be available in NS
Society's Responsibility 6.5 Informed Decision Making	6.5.4 Status of new or updated forest management guidelines and standards related to ecological issues		FEC and PTA management guides could be used