Algonquin Park Forest

Wood Supply Analysis Evaluation

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Table of Contents

List of Figures and Tables

1. Introduction

The Ontario Parks Board of Directors' Algonquin Park Subcommittee (the Board) has proposed changing land use designations on about 15% of the forest area within the Algonquin Park Forest (the Forest) to enhance ecological and recreational values. Historically, the actual forest area utilization of the timber resource has been below planned levels. This suggests that surplus area is available to allow the land use changes proposed by the Board without negatively impacting the forest industry that relies upon the wood supply from the park. However, the Algonquin Forest Authority (AFA) and the OMNR Southern Region Planning Unit (MNR) contend that the change in land use designation will have negative effects on the forest industry.

KBM Forestry Consultants Inc. (KBM) was asked to provide an independent evaluation of MNR's analysis. The MNR wood supply analysis report dated October 2, 2006 was the principle source of our evaluation. We also examined Strategic Forest Management Model (SFMM) case files, recent Independent Forest Audits, Annual Reports, Recreation Assessment and Ecological Assessment reports. In addition, Joe Yaraskavitch, Peter Henry, and Ric Symmes were interviewed by phone during the period of October 9 to October 17, 2006.

Our evaluation report is organized to mirror the MNR wood supply's report structure where practical, to facilitate cross referencing.

2. Wood Supply Analysis

The MNR wood supply analysis uses the base assumptions of the current plan, less the proposed reserve area. Currently the model contains limitations on values such as the area and stability of harvest by forest unit. While these limitations confine the solution space, they do provide a solution which can be practically implemented and achieves the objectives of the forest management plan.

Overall, the model inputs appear reasonable and historically the Forest has demonstrated sensible model configuration[1]. Although the analysis approach of simply reducing the landbase while maintaining all other model parameters is prudent and rational, there may be opportunities to find acceptable trade-offs through further analyses and sensitivity tests using SFMM to explore a larger solution space.

A broader sensitivity exercise could include investigating alterations to silviculture limits, as well as to yield and product assumptions. This sensitivity analysis would ideally encompass a reasonable range of expected values and would provide greater insight into the potential impacts from land withdrawals. In addition, a more focused analysis could investigate ways to lessen the impact of land withdrawals on wood supply (e.g. near-term volume targets, term weighting). The current analysis provides one possible set of impacts to wood supply, but does not investigate ways in which these impacts could be mitigated.

The MNR Wood Supply Report also describes the need to maintain higher than utilized harvest areas to ensure the availability of certain products, such as grade 1 sawlogs and veneer that are found in heterogeneous stands of lower grade material. In addition, transportation and localized use patterns within the Forest vary from one section to another. A more detailed analysis of

[1] KBM Forestry Consultants Inc. 1998. Algonquin Park Forest Independent Forest Audit 1997-2002. 38 pp + App.

expected product flows and partitioning the Forest into management subunits could be undertaken with SFMM to examine these factors in greater detail.

Other models such as Patchworks[2] might be better suited for further analysis. Patchworks is capable of integrating operational and strategic analyses, as spatially explicit harvest allocations can be developed over long-term planning horizons. One of the benefits of a spatially explicit analysis is that it can allow for various weights to be placed on operating areas. For example, a win-win scenario may be found by assigning different weights in the harvest scheduling process to areas with high recreation and/or ecological value. These weightings would mean that harvest is avoided as much as possible, but not fully prohibited, within these areas. This could reveal opportunities for protecting recreational and ecological values while maintaining an economically viable wood supply.

If warranted, the framework and extent of further analysis should form part of the negotiation and discussion process. It should be noted that analyses are costly and time consuming and cannot fully eliminate uncertainty. However, further analysis can reduce uncertainty and explicitly define the trade-offs. Above all, the usefulness of computer simulation is in decision support not decision making.

2.1 Planned and Actual Yields

The historic planned and actual yields for Algonquin Park Forest are within the range of values observed in surrounding forests. While planned yields for the Forest are conservative when compared to other forests in the region, they remain within the range of values reported within the surrounding area (Figure 1). Similarly, actual yields for the Forest have also been lower than the average reported for the surrounding forests (Figure 2). The historic planned yield for the Forest is well below that of the surrounding forests and the observed actual is just below average, suggesting an extra cautious approach that may be sensible given the Forest's setting.

[2] *See* www.spatial.ca

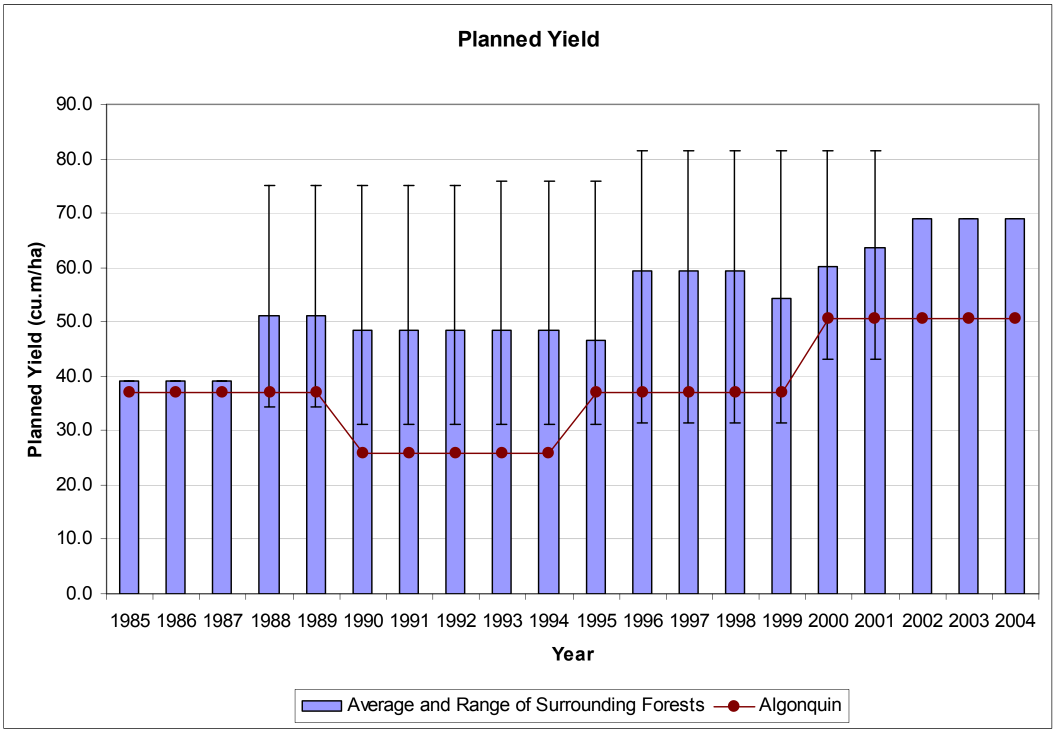

Figure 1. Planned yields for Algonquin Park Forest and surrounding forests (Minden, Bancroft, French-Severn, Mazinaw-Lanark, and Ottawa Valley).

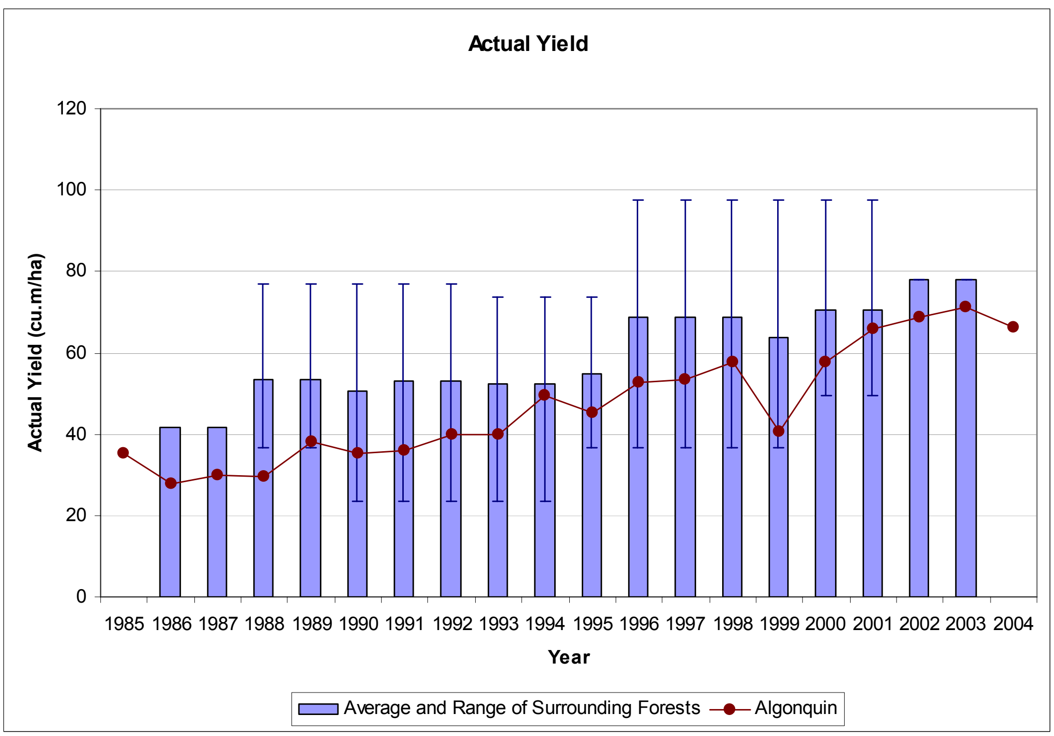

Figure 2. Actual yields for Algonquin Park Forest and surrounding forests (Minden, Bancroft, French-Severn, Mazinaw-Lanark, and Ottawa Valley).

A comparison of planned versus actual yields for the Forest indicates that actual yields have surpassed planned yields by approximately 30-35% during the previous two terms (Table 1). The current 2005-2010 forest management plan (FMP) maintains total planned yields of approximately 50 m^3/ha, which is only moderately conservative when compared to the average of 57 m^3/ha actually achieved during the previous 10-year period (1995-2005).

Table 1. Planned versus actual yields for Algonquin Park Forest.

Term	Planned Yield (cu.m/ha)	Actual Yield (cu.m/ha)
1985-1990	36.9	32.1
1990-1995	25.9	40.2
1995-2000	37.0	49.9
2000-2005	50.6	65.9
2005-2010	50.4	-

The MNR report provides logical rationale as to the high yields observed during the previous term. In addition, while planned yield estimates may appear conservative, this practice is common and prudent in Ontario to deal with the following issues:

1. **Uncertainty related to the Forest Resource Inventory (FRI):** Ontario's FRI system would rank in the lower quartile of the ten Provinces in terms of photo scale, cost and update frequency. This problem is evident as the most recent FRI for the Algonquin Park Forest was conducted in 1987. Although our studies in other projects have found the FRI to estimate total growing stock and lead species reasonably well at the forest level, it is often poor at estimating age, height and full species composition. Consequently, errors can be large at the township, block and stand levels. Thus, the base data in all wood supply analyses need to be judged with awareness that the assessments are simply estimates and not factual.

2. **Uncertainty related to yield forecasts:** Ontario's growth and yield data base is growing, but most estimates of growth and yield are still based upon expert opinion rather than empirical evidence. Therefore, estimated changes to the forest over time also have a large measure of conjecture built into the forecasts. Even where empirical evidence exists, yield estimates based on broad strata and age rarely illustrate a strong correlation to the data (Figures 3 and 4). Irrespective of the methodology used to formulate growth predictions, our forecasts are always restricted by our incomplete knowledge of the current and future states of the ecosystem.

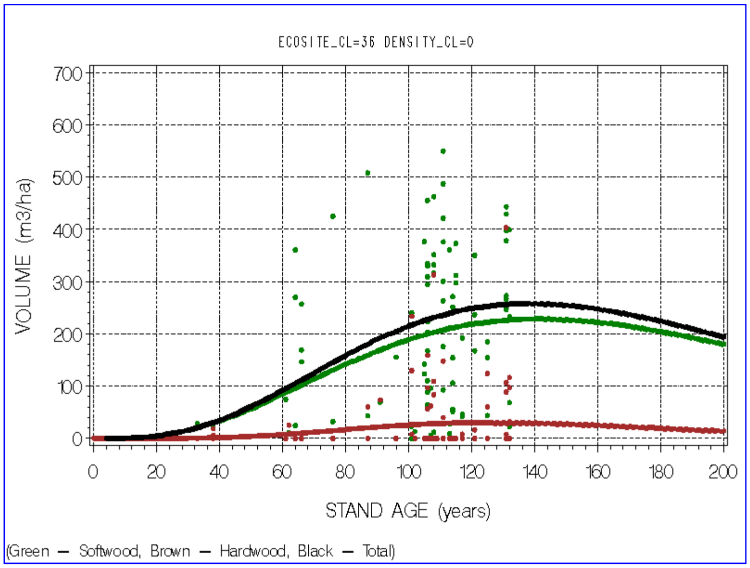

Figure 3. **Example of an empirical yield curve developed using ecosite, canopy density and age for the Louisiana-Pacific 2006-2026 Sustainable Forest Management Plan. *Courtesy of Louisiana-Pacific Canada Ltd*.**

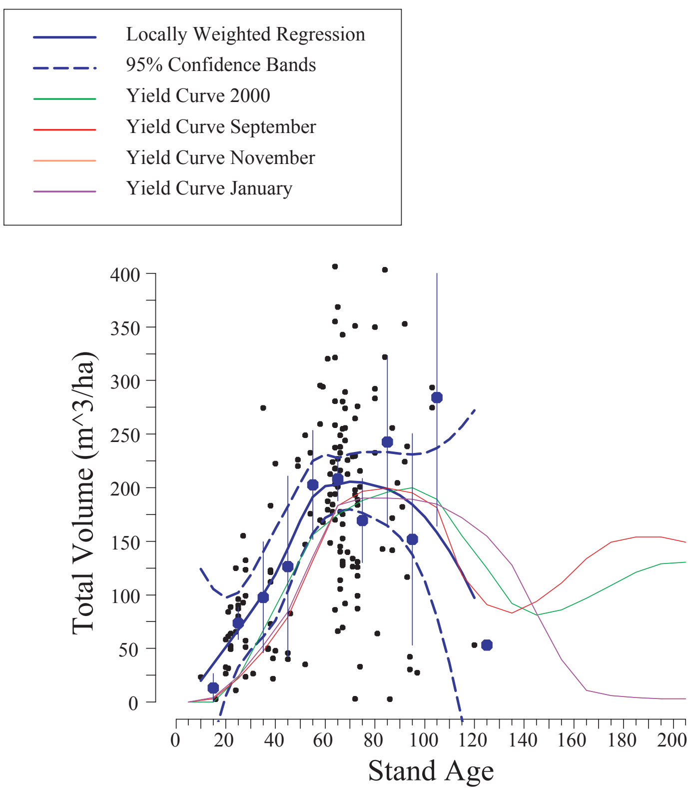

Figure 4. **Example of an empirical yield curve and confidence bands developed for the 2005-2025 Dog River-Matawin Forest Management Plan. (Source: Appendix 6 - Yield Curve Documentation for the 2005-2025 Dog River-Matawin Forest Management Plan).**

3. **Economically viable wood:** SFMM is not well designed to account for spatial constraints (geographic arrangement of features). Spatial constraints often contribute to the gap between economically viable wood supply and the available harvest area (AHA). Economically viable wood supply is typically 20-30% lower than the available aspatial supply estimated as the AHA. The gap in planned versus actual volumes harvested in the Forest is consistent with many Sustainable Forest Licenses (SFLs) that show the same trend with no declared surpluses. The difference in product yields (e.g. sawlogs) is also connected to market cycles, as described in the MNR report.

4. **Forest Projections of Future Forest Conditions:** The forecasts in SFMM assume changes are deterministic. Forest succession is forecasted to follow proportional outcomes. In nature, many changes are stochastic (random). Empirical evidence to support model inputs is not able to reduce uncertainties about the current and future forest conditions due to natural variability and stochastic disturbance events.

   In addition, SFMM creates an optimal solution based on the selected objective function (e.g. greatest value of timber over the entire planning horizon). To remain optimal, this solution and all of its parameters (e.g. area and paths of forest succession, fire disturbance) must be precisely realized in the real world. However, planned outputs from the model are never implemented with this precision (e.g. harvest area by age-class, silviculture treatments, etc.), creating a divergence between the optimal predictions of the model and what will actually be achievable.

   Patchworks is a deterministic model, but it develops a harvest schedule solution using a different method than is employed by SFMM. Spatial constraints can be fully accounted for and different weights can be assigned to each objective.

   Probabilistic statistics, models and decision analyses are beneficial in that they forecast predictions while explicitly stating the probabilities associated with them (e.g. FORESTRAP and FIDME). While these methodologies have been promoted for use within adaptive management[3], environmental policy[4] and forest management realms[5,6,7], their application in forest management planning remains sparse at this time. Their use would help reinforce the principle that data analysis and computer simulation form a decision support system and not a decision making system. Describing outcomes in terms of probabilities helps to make uncertainty explicit and aids in the development of risk management strategies.

5. **Timber scaling methodologies:** Annual reports of actual volumes can also have significant variances over time due to changes in scaling methods. Although most annual reports are based upon weight scaling over the last ten years, there is significant

[3] Prato, T. 2005. Bayesian adaptive management of ecosystems. Ecological Modelling 183: 147-156.
[4] Wolfson, L.J., J.B. Kadane, and M.J. Small. 1996. Bayesian environmental policy decisions: two case studies. Ecological Applications 6(4): 1056-1066.
[5] Thompson, E.F. 1968. The theory of decision under uncertainty and possible applications in forest management. Forest Science 14(2): 156-163.
[6] Nystrom, K. and G. Stahl. 2001. Forecasting probability distributions of forest yield allowing for a Bayesian approach to management planning. Silva Fennica 35(2): 185-201.
[7] Peterman, R.M., and C.N. Peters. 1998. Decision analysis: taking uncertainties into account in forest resource management. In Sit, V., and B. Taylor (eds). Statistical methods for adaptive management studies. B.C. Ministry of Forests Research Branch, Victoria, B.C., Land Management Handbook No.42, 148 pp.

variation in weight to volume ratios depending upon water content, which changes significantly depending upon when, where and how the trees are processed. Thus, annual report volumes are not as "factual/actual" as they appear.

2.2 Harvest Volume and Utilization

Historically, the available harvest area of Algonquin Park has not been fully utilized (Table 2). The underachievement of planned harvest levels is ubiquitous throughout Ontario and exists for many of the same reasons that rationalize conservative yield estimates as stated above (i.e. FRI uncertainties, economical vs. biological available wood, forecasting change). The spatial distribution of timber products and the variability of market conditions are also major contributors to the discrepancy between planned and actual harvest levels.

Table 2. Algonquin Park Forest Planned versus Actual Harvest Area.

FMP Plan Term	FMP Planned Area (ha/yr)	Actual Cut Area (ha/yr)	% of Planned Area Harvested
1975-1980	n/a	11,175	
1980-1985	15,007	12,742	85%
1985-1990	16,591	13,844	83%
1990-1995	16,688	7,982	48%
1995-2000	15,020	7,812	52%
2000-2005	12,264	8,429	69%
2005-2010	13,444	n/a	

3. Investments and Impacts Assessment

3.1 Silviculture Investment

The proposed zones include approximately 10,000 ha of area that has received some form of silvicultural treatment in the past 20 years. This investment will further the reluctance of AFA to agree to expanded reserves.

Forestland creates a mixture of public and private goods. Private goods accrue benefit to a single user or users. Public goods accrue benefits that cannot be assigned to a specific user (e.g. national defence). Timber is a private good while clean air is a public good. Wildlife habitat is a mix of public and private goods. Trappers can benefit from habitat, but biodiversity and existence values are public goods.

These mixtures create a challenging environment for silviculture investment rationalization. The forest industry pays for silviculture and from their point of view it is an investment in a private good (current and future wood supply). MNR sees forest renewal charges as a cost of doing business.

Renewal charges can also be seen as a form of land rent or stumpage. In this view, the Crown as landowner is investing in silviculture to produce both private and public benefits. Unfortunately, these choices are implied and not dealt with in a direct and transparent manner in terms of MNR's relationship to the forest industry. Hence there is a gap in expectations.

The Forest Accord and Room to Grow suggest that gains in growth and yield from silviculture will be shared equally among parks and the industry. This makes the forest industry reluctant to invest in silviculture above the minimum required to meet plan objectives.

Until some new form of private-public investment in forest renewal is developed to address the above gaps in expectations, the current form of tenure is the basis for decision making. In this circumstance, forest renewal is a sunken cost in terms of establishing the reserve components suggested by the Board.

3.2 Projected Impacts

The impact of imposing all four reserve components is forecasted as a 16-23% reduction in total volume through the near-term (first five terms). At first glance, these reductions are within the levels of underachievement of planned harvest levels (e.g. 30% underachievement of planned harvest areas in the 2000-2005 term) and it may appear that these reductions are simply removing surplus area. However, the current SMA forecast illustrates future declines in timber supply (from 658,000 m^3/yr to 555,000 m^3/yr at Term 4). This suggests that current commitment levels (538,000 m^3/yr) may be economically challenging to achieve through the near term, irrespective of land withdrawals.

Given the wood supply scenarios present in the MNR report, volumes from the Forest would not be able to achieve total commitment levels past Term 1. Combined with this are limitations on product supply, which is not uniformly distributed across the Forest. In part, reductions in wood supply from the Forest can be mitigated by surplus volume from surrounding forests and open market sales. The economic impact of these solutions is difficult to quantify.

Of course there are environmental impacts associated with harvesting in the reserve system that are not discussed in the MNR wood supply analysis. For example, road networks, although controlled, provide access to sensitive trout ponds and streams. These environmental benefits are equally as elusive to quantify as is wood supply and are equally important. We did not examine the impacts on these other benefits from the Board's proposal, but many of the ecological and recreational impacts/effects will be seen as beneficial.

3.3 Opportunities to Offset Wood Supply Reduction

The MNR/AFA contends that the other forests surrounding the Park do not have sufficient surpluses to offset the losses of wood supply that may follow the Board's proposal. Recent Independent Forest Audits indicate that historic actual harvest areas in surrounding forests are in the range of 50-75% (Table 3). However, these forests use data and methods similar to the AFA in Algonquin Park. Hence, all of the elements of uncertainty described above apply to these forest areas as well.

Table 3. Planned versus Actual Harvest Area and Volume of Surrounding Forests.

Forest and Term	Actual Harvest Area (% of Planned)	Actual Harvest Volume (% of Planned)
Ottawa Valley (1996-2001)	75%	72%
French Severn (1994-1999)	46%	54%
Bancroft (1996-2000)	57%	76%
Minden (1996-2000)	74%	111%

The surrounding region also contains private land holdings which augment the SFL wood supply. The utilization and availability of this resource should be considered in the larger context of what the regional wood supply can produce. Ontario does have FRI data for private land, but excludes private land from AHA estimates in FMPs. Reasonable assumptions of private landowner behaviour could be used to estimate private wood supply with a reasonable degree of confidence.

It is likely given the forest use history, that the lower than planned utilization levels in Crown forests reflect a margin of error needed to assure an economically viable wood supply. The important point for negotiation is that uncertainty works for and against both negotiating parties. In other words, the MNR/AFA position is credible, but so is the Board's position. Unfortunately, the current planning and reporting system works in absolute terms and fails to encourage the role of professional judgement and structured debate among stakeholders, which can lead to better understanding of uncertainty and subsequent risk management strategies.

4. Conclusion

The MNR wood supply analysis uses the base assumptions of the current plan, less the proposed reserve area. Although this approach is prudent and rational, there may be opportunities to find acceptable trade-offs through further analyses and sensitivity tests using SFMM to explore a larger solution space. This sensitivity analysis and broader scoping would ideally encompass a reasonable range of expected values for key inputs and would provide greater insight into the potential impacts from land withdrawals. The current analysis provides one possible set of impacts to wood supply, but does not investigate ways in which these impacts may be mitigated. Alternatively, other models such as Patchworks might be better suited for the analysis and could reveal opportunities for protecting recreational and ecological values while maintaining an economically viable wood supply.

A tool like Patchworks may help find a win-win scenario. Theoretically, a scenario may be found by assigning different weights in the harvest scheduling process to areas with high recreation and ecological value. These weightings would mean that harvest is avoided as much as possible, but not fully prohibited, within these areas. This solution would be spatially visible and allow for forecasted forest management within the proposed components to be observable/quantifiable throughout the planning horizon.

Analyses are costly and time consuming and cannot fully eliminate uncertainty. However, further analysis can reduce uncertainty and explicitly define the trade-offs. Above all, the usefulness of computer simulation and other models (the FRI is a model of the forest) is in decision support, not decision making. Strategic models are tools for strategic insight and cannot provide policy solutions. Fair negotiations are as important as technical analysis. Science and politics are equally important voices in debate.

The wood supply estimates are on the conservative side, a common practice in Ontario as part of an implicit risk management strategy. Although the proposed reserves may not negatively impact the wood supply, there is a real risk that they may. Once reserves are created, it will be difficult, if not impossible, to change the status to allow forest harvesting should wood supply shortfalls be realized in the future. Alternatives to no-cut reserves might be a negotiating point worthy of consideration. Although we cannot support one side or the other in the current negotiations from a purely technically perspective, it is hoped that our evaluation enhances the understanding of the complexities in wood supply forecasting, to assist the various groups involved in negotiation and decision making.