BC Environment

A Review of Potential Benefits and Costs Associated with Proposed Rules for Forest Practices in British Columbia

Developed for
Ministry of Environment, Lands and Parks

Developed by
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I. Executive Summary

This report provides a reconnaissance level review of potential benefits and costs to timber, ecology-dependent recreation and tourism, and government sectors from implementation of the proposed new Forest Practices Rules for British Columbia.

Direct business benefits to the recreation and tourism sector due to improvements in ecological diversity resulting from the proposed Forest Practices Rules will accumulate at a rate approximately equivalent to the progression of timber harvest activity in B.C.'s forests. In the first year, benefits will approximate $18 million. They will grow to approximately $1.3 billion per year by the end of an 80 year forest rotation. Non-market values will provide additional benefits, and are not included in these figures.

Costs to the timber industry from meeting the proposed standards are estimated to begin at approximately $75 million per year, and to decline to $39 million per year over a 15 year period.

Government program costs to reach the new standards are estimated at $18 million per year.

Under our most reasonable set of assumptions, benefits associated with the forest standards will grow to exceed costs within five years from program start-up, and will greatly exceed them thereafter.

Ecological effects from provisions for silviculture systems and forest regeneration in the proposed rules cannot be estimated from existing information. They are excluded from this analysis.

Staff in the Ministry of Environment, Lands and Parks believe that enhanced information will permit review of forest development plans and cutblock provisions to reduce road costs for industry, while maintaining targeted levels of ecological protection.

II. Organization of the Report

The overall objective of this report is to identify benefits and costs associated with the proposed new Rules included in the Draft British Columbia Forest Practices Code (November, 1993) - as they compare to present forest practices in the province. Rates of compliance are assumed similar for present and proposed future forest standards in this analysis. This regulatory assessment groups Rules within the Draft Code to identify those which are significantly beneficial or costly - from an ecological, forest industry and government perspective. Analysis of these groupings is provided in following Sections IV, V and VI. Section VII provides an integrated assessment of the proposed Rules from all three perspectives.

III. Sources of Information

We depended primarily on Saunders (1993) to assess impact on industry of moving from present forest practices to the newly proposed Rules[1]. That information is supplemented by other sources as indicated in notes to this report. Similar estimated costs to government are also provided in the Saunders report. These are, in essence, estimates by Ministry of Forests personnel.

Saunders also provided estimates of the cost of complying with existing regulations. Changing rates of compliance with respect to required forest practices is **not** a necessary condition for improved regulation to protect forests. Consequently, that component of the Saunders (1993) analysis may be of interest with respect to compliance issues, but is not directly relevant to the regulatory comparison conducted here[2].

Estimates of ecological impact were developed for this report in conjunction with staff in the Ministry of Environment, Lands and Parks (MELP). Those impact estimates were applied to Ministry of Forestry (MOF) data on values of forest recreation and preservation[3].

The ecological impacts of programs implementing proposed silviculture systems and forest regeneration rules are not estimated in this report. Experts from MELP and MOF do not agree on whether, on balance, these effects will be positive or negative for ecology. Given the important role that silviculture systems and forest regeneration play in the proposed Rules, the two Ministries should initiate a further joint examination of this issue at the earliest possible date.

The estimates of impact in this report are "reconnaissance level estimates". This means that analysis is broad reaching, but most often depends on "expert judgement" rather than extensive research and calculation. More detailed calculation will undoubtedly alter the estimates provided. However, no information available at this time indicates that more detailed estimation would alter the positive benefit-cost conclusion reached here.

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[1] Ibid.

[2] Saunders (1993)' compliance analysis relies exclusively on a narrow command and control approach, which would appear to have only limited relevance with respect to compliance issues in British Columbia.

[3] Ministry of Forests, 1991. Outdoor Recreation Survey 1989/90. Recreation Branch Technical Report 1991-1.

IV. Ecological Impacts of the Proposed Rules[4]

The Proposed Code presents a mosaic of measures specific to the concerns of forestry, ecology and the general public - spread over thirteen report sections and 98 report pages. Our strategy with respect to assessing potential ecological impact is as follows:

*Identify key ecological attributes of the forest.

*Specify proposed Rules which significantly alter impacts on each ecological attribute.

*Select indicator measures of ecological impact for each attribute.

*Integrate indicator measurements to obtain estimates of total impact.

1. Ecological Attributes of the Forest

Ecological attributes of the forest are, by definition, interrelated. At the same time, specific biological concepts can provide focus for the analyst. In this first cut assessment, ecological impact is displayed as the sum of impacts on ecological **integrity**, **diversity** and **productivity**. We define these attributes as follows:

Integrity: linking of key elements of floral and faunal systems in the forests through designated areas, leave strips, protected areas and other protective zoning, to maintain ecological function at a landscape level.

Diversity: variation of plants, animals and other living organisms, both within species and between species.

Productivity: the abundance of given species or species groupings produced within a forest area.

2. Ecological Attributes and Forest Code Sections

Many proposed Code Rules will impact upon all three key ecological attributes. However, we consider that some proposed measures particularly contribute to individual attributes. These particular linkages provide the framework for the quantification of ecological impacts presented here - and are outlined in Table 1.

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[4] The contribution to this section of Mike Fenger, Ministry of Environment, Lands and Parks is particularly acknowledged.

Table 1

Linkages Between Ecological Attributes and Proposed Forest Practices Rules

Ecological Attribute	Key Rule No.	Rule Name	Linkage
Integrity	3.3	Designated areas.	The designated area concept, discussed on pages 12-15 of the Code, is considered the key measure supporting integrity objectives. Supporting measures include 5.1 and 5.2 (soil conservation); 6.6 (wilderness); and 10.5 (timber harvesting - designated areas).
Diversity	10.1	Forest harvest planning.	Long-term harvest planning [10.1.(9,10,11,12)], landscape and stand level design are key measures to improve forest diversity. Other planning measures (10.1.4, 3.1, 3.2, 3.5, 3.6); 3.4 (watershed assess.); 6 (recreation); 6.5 (visual landscape); support the diversity objective.
Productivity	5	Soils protection.	Rules restricting actions taken during road building and timber harvesting are viewed in this analysis as primarily benefiting ecological productivity, as compared to integrity or diversity.
	9	Forest road engineering.	
	10.2	Timber harvesting.	

3. Quantitative Measures of Impact

i) Forest Areas in British Columbia

The economic data base we use in this analysis refers to the forest as a whole. The impact indicator analysis of this section references specified forest areas. It is therefore necessary to establish basic referent forest areas. These areas are taken from Ministry of Forests data for 1984, and are identified in Table 2. The term "productive" refers to timber harvest.

Table 2
Provincial Forest Area in British Columbia

Category of Area	No. of Hectares --thousands--
Total Area	88,908
Area excluding Crown Grants & Parks	81,970
Forest Land	43,265
Available Forest Land (excluding ESA's and land withdrawals)	40,881
Potentially Productive Available Forest Land	26,167
Presently Productive Available & Suitable	22,607

Source: Ministry of Forests, 1984 Forest and Range Resource Analysis.

The 43.3 million hectare **Forest Land** estimate will be used to identify the scope of recreational forest use. Land areas incorporated in subsequent ecological impact analyses are specified, by impact, on pages 11-12[5].

ii) Estimate of Impact on Ecological Integrity in B.C.'s Forests

This analysis equates impact on ecological integrity of the forest with **establishment of hectares of designated zones or similar protective areas.** Saunders[6] estimates that allowable annual cut (AAC) will decline by between 10 and 20 percent if all proposed forest standards are implemented. Nelson[7] estimates permanent withdrawals from the forest landscape at approximately 10 to 12 percent.

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[5] The presently available and suitable forest is estimated at 21.3 million hectares. Since the scope of these impacts will be considered over future years, the 26.2 million hectare figure is judged more appropriate for this analysis.

[6] Saunders (1993). Op. cit. pp 41-42.

[7] Nelson, J.D. 1993. The Effect of Harvesting Guidelines on Timber Supply and Delivered Wood Costs. A Report to the Ministry of Forests. p. 6.

This report takes the lower bound 10 percent figure of these authors as a proxy for increased ecological integrity in the forest resulting from establishment of designated zones (Section 3.3 and related sections). It is further assumed that these designations will occur proportionately from "Available Forest Land" and from "Potentially Productive Available Forest Land" (Table 2).

iii) Estimate of Impacts on Ecological Diversity in B.C.'s Forests

This analysis assumes linkage between floral and faunal species, and relies on "forest indicator data" to develop a diversity indicator estimate.

Projections of average forest age were examined to identify anticipated trends in British Columbia's forests. Average forest age is considered a more conservative indicator of declining age-based diversity than estimates of change in old growth alone[8]. Ministry of Forests (1984)[9] estimates that the average age of B.C.'s Net Productive and Suitable Forests will experience a straight line decline of approximately 0.5 percent per year for the next 80 years. Discussion with MELP's forest ecologist suggests that benefits for ecological diversity from the proposed standards may have an approximately countervailing rate of impact. We will assume an improvement of 0.5 percent per year in forest ecological diversity from implementation of Rule 10.1 (and related sections) for this analysis[10].

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[8] It is recognized that average age is only one indicator of ecological diversity. Further, some specific watersheds will exhibit bimodal age distributions that may not be indicated by age averages. On a Province-wide basis, however, we consider average forest age a useful diversity indicator.

[9] Ministry of Forests, 1984. Forest and Range Resource Analysis. p. B-23.

[10] These ecological effects will not result entirely from a slowing of the decline in average age of forests, which would imply rapid evolution to a steady state forest. Rather, they will also result from other elements of the proposed code which benefit ecological diversity. No implication with respect to the broader debate on old growth forests necessarily follows from choice of this impact indicator.

iv) Estimate of the Impact on Ecological Productivity in B.C.'s Forests

This final set of impact indicators focuses on forest Code sections that regulate how timber harvesting and related road and landing construction/operations shall take place. These regulations are primarily contained in Sections 9 (forest road engineering), 10.2 (timber harvesting operations), and 5 (soil conservation) of the proposed forest Code.

Our quantitative estimates of improved ecological productivity in the forest are taken as the sum of four impact indicators, each suitably weighted by the forest area affected. These are:

- improved road construction practices (Sections 9.3, 9.4, 9.5, 9.6 and 9.7).
- improved road maintenance practices (Section 9.8).
- road revegetation (Sections 5.6 and 9.7.6, and deactivation (Section 9.9).
- stream protection (Section 10.2).

a) Improved Road Construction

We use Saunders (1993) assumption of 10,000 km of roads constructed each year[11]. The adjacent land base affected is assumed to be 6,000 hectares (at 6 metres of adjacent width[12]).

b) Improved Road Maintenance

We assume 36,000 km of Ministry of Forests road and 100,000 km of industry road are maintained each year[13]. At 6 metres of average adjacent width, this suggests 81,600 hectares of forested area affected each year.

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[11] Saunders (1993). Op. cit., p. 38.

[12] Adjusted upward to 3 metres per side, from an MELP estimate of 2.5 metres per side.

[13] M. Fenger, personal communication. Based on information from R. Davis, MOF.

c) Deactivated and Revegetated Roads

The Saunders (1993) assumption of 5,000 km of roads deactivated each year is employed[14]. Assuming an estimated affected width of 10 metres, it is estimated that 50,000 hectares of forested area would be affected each year.

d) Improved Stream Protection

The portion of the forest land base affected by improved stream protection is assumed equivalent to forest riparian area[15]. We assume that riparian area accounts for 7.5% of British Columbia's operable forest[16]. On this basis, we estimate there are 1,971,260 hectares of potentially affected riparian area in the operable forest.

Finally, MELP's forest ecologist provided estimates of relative ecological productivity associated with improved road construction and maintenance, and stream protection, standards[17]. These are displayed in Table 3.

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[14] Saunders (1993). Op. cit., p.38.

[15] Improved stream protection will also occur beyond the riparian zone, rendering this assumption conservative.

[16] MELP experts employed the following procedure to develop this estimate. The physiography of the area from the Washington border to northern California is sufficiently similar to allow comparison between this area and British Columbia. Stream densities and proportion of forested area in riparian habitat would be comparable - and reference to the "Draft Environmental Impact Statement on Management of Habitat for Late Successional and Old-Growth related Forest Species within the range of the Northern Spotted Owl" is useful to this analysis. Required riparian reserves identified in that report ranged from 3% to 12% of operable land base, with an average of 8.5 percent. A slightly lower figure of 7.5% was considered likely for British Columbia, and was chosen for use in this analysis.

[17] Productivity estimates for Benchmark III - partial compliance with the proposed rules - are calculated by multiplying the productivity estimate under Benchmark IV by the ratio of the productivity estimate for Benchmark I to that for Benchmark II.

Table 3

Estimated Forest Ecological Productivity Under Selected Elements of the Proposed Forest Practices Rules

Code Element	Percentage Improvement in Productivity --in percent--
9.3 - 9.7 Improved road construction.	67
9.8 Improved road maintenance.	67
10.2 Improved stream protection.	45

*To hold rate of compliance constant for this analysis, estimated ecological impacts associated with the new rules were discounted by the estimated shortfall in forest ecological protection that MELP staff associate with under-compliance under presently existing forest standards.

4. Integrated Assessment of Impact of Key Elements of the Proposed Forest Practices Rules on Forest Ecology

Estimates of ecological impact developed in the previous section are integrated by expressing them as a function of the forest land base, and by phasing each impact into the analysis over an appropriate time period. Our assumptions with respect to phase-in of each impact are outlined in Table 4. Calculations for each impact element are then specified under separate sub-headings.

Table 4

Assumptions re. Phase-in of Forest Ecological Impacts

Principal Code Element	Indicator	Phase in of Impacts
3.3 Designated areas.	Percent of working forest designated.	Phased in in equal increments over an 80 year rotation.
10.1 Forest harvest planning.	Average forest age.	Impact calculation is across potential working forest, so that impact is fully accounted from Year 1 forward.
9 Forest road construction.	Percentage gain in productivity.	Incremental gain each year based on 10,000 km of road constructed.
9.8 Forest road maintenance.	Percentage gain in productivity.	Based on 136,000 km of road maintained in base year, plus 5,000 km increment in each subsequent year.
9.9 Forest road deactivation.	Percentage gain in productivity.	Based on 5,000 km of road deactivated.
10.2 Stream Protection.	Percentage gain in productivity.	Stream protection will largely be related to harvest activities, which occur over harvest rotation. At the same time, stream blockage, siltation, etc. often cause impacts more extensive in location and time than causal activities. We assume 5 percent of impacts occur cumulatively in each Year 1 through 5, and the remaining 75 percent of impacts occur in even increments over the following 75 years of the rotation.

i) Designated Area Impact Calculations

(1) Hectares Designated = .10 (Available Forest Land)
= .10 (40,881,000)
= 4,088,000 hectares.

(2) Percent of Forest Land = 4,088,000/43,265,000 X 100,
= 9.45 percent.

(3) Annual Increment Designated/ Year = 9.45/80
= 0.118 percent per year.

ii) Average Forest Age Impact Calculations

(1) Annual Percentage Change in Age = .5 $\left(\frac{\text{Pot. Productive Forest}}{\text{Forest Land}}\right)$

= .5 $\left(\frac{26,167,000 - 2,617,000^*}{43,265,000}\right)$

= .27 percent.

* Reduction re. designated area withdrawals.

iii) Forest Road Construction Calculations

(1) Forest Area Affected = (km of road constr.)(side width)
= (10,000km)(6 metres)
= 6,000 hectares.

(2) Annual Percentage Improvement = 67 $\left(\frac{6,000}{43,265,000}\right)$
= .009 percent.

v) Forest Road Maintenance Calculations

(1) Forest Area Affected = (km of road maint.)(side width)
= (136,000km)(6 meters)
= 81,600 hectares.

(2) Annual Percent Improvement = 67 $\left(\frac{81,600}{43,265,000}\right)$
= .126 percent.

vi) Forest Road Deactivation Calculations

(1) Forest Area Affected
= (km of road deact.)(width)
= (5,000 km)(10 meters)
= 5,000 hectares.

(2) Annual Percentage
= (hectares deact.)/(Forest Land)
= (5,000/43,265,000) X 100,
= .012 percent.

vii) Stream Protection Calculations
First Five Years:

(1) Forest Area Affected - Each of first five years.
= (total area affect.)(.25)(.2),
= (1,971,000)(.25)(.2)
= 98,550 hectares.

(2) Annual Percentage Improvement
$$= \frac{(98{,}550)(45)}{43{,}265{,}000}$$
= .103 percent.

Following Seventy-Five Years:

(1) Forest Area Affected - Each of remaining 75 years.
= (total area affect.)(.75)(.013)
= (1,971,000)(.75)(.013)
= 19,217 hectares.

(2) Annual Percentage Improvement
$$= \frac{(19{,}217)(45)}{43{,}265{,}000}$$
= .020 percent.

The individual impact assessments provided previously are integrated in Table 5. Expert advice to improve the accuracy of impact estimating parameters is welcomed.

Adding these assessments of ecological impact raises the issue of double counting. Impacts of designated areas are assessed first - and then subtracted from subsequent average forest age calculations. Assessments of impact from road construction, maintenance and deactivation are area specific, and should not double count. If road adverse construction impacts do not last through a full rotation, there may be some overestimate toward the end of the rotation period. Stream protection benefits could also have some overlap with other indicators, although said benefits constitute only a small portion of our total impact estimates.

With respect to underestimation, MELP ecological experts feel that crediting of ecological benefits to designated areas on a hectare for hectare basis likely understates the importance of these key linking zones in providing ecological integrity in the forest. Further, said experts have attempted to be consistently conservative in providing initial impact judgements to this analysis. Finally, our use of 80 years as the full implementation period for some ecological benefits may prove too long.

Table 5

Estimated Percentage Improvement in Ecological Health of B.C.s Forests Due to the Proposed Forest Practices Rules

Principal Code No.	Description of Standard	Improvement in Forest Ecological Wellbeing Year 1	Year 5	Year 10	Year 25	Year 80
		----------in percent----------				
3.3	Designated areas.	0.12	0.59	1.18	2.95	9.44
10.1	Forest harvest planning.	0.27	1.35	2.70	6.75	21.60
9.0	Road Construction	0.01	0.04	0.09	0.22	0.72
9.8	Road Maintenance	0.13	0.63	1.26	3.15	10.08
9.9	Road Deactivation	0.01	0.06	0.12	0.30	0.96
10.2	Stream Protection	0.10	0.52	0.62	0.92	2.02
Total Estimated Ecological Impacts		0.64	3.19	5.97	14.29	44.82

5. Economic Benefits Associated with Improved Forest Ecology

British Columbia's forests generate recreation and tourism expenditures by both provincial residents and outside visitors. As recreation areas and forest ecological diversity increase, the capacity of our forest to support such activities and the enjoyment of present recreation and tourism users will also increase. In this initial reconnaissance assessment we assume that forest

recreation and tourism benefits will increase proportionately with improved ecological conditions. We make no adjustment for increased population base of either residents or visitors[18].

i) Increased Recreation and Tourism Expenditures Associated with Proposed Forest Standards

Ministry of Forestry (1991) estimates that British Columbia residents spent $1,562 million on recreation in the province's forests in 1989[19]. Recalling that the 43.3 million hectare forest land base utilized in ecological impact sections of this report excluded "non-forested" lands including alpine forest, we reduced this expenditure to $1,484 million to exclude activities associated with motor cruising, skin and scuba diving, mountain and rock climbing and 50% of downhill and cross country skiing[20].

The B.C. Research Corp estimated that tourists from outside British Columbia spent $550 million on forest recreation during December through June of 1989[21]. As with our resident assessment, we reduce this estimate to $523 million to exclude activities that may have occurred outside the forest land base used for our ecological analysis.

To expand our 7 month $523 million tourism expenditure estimate to an annual total, we multiplied by the ratio of person tourist trips to British Columbia for the eleven months of 1989, excluding August, to trips for the

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[18] At some point, economic value can be expected to increase more slowly than ecological renewal. Given current timber - ecology balances in B.C. forests, demand-supply conditions for forest recreation, and the magnitude of ecological change expected here, this is not anticipated as a significant concern for the present analysis.

[19] Ministry of Forestry, 1991. Outdoor Recreation Survey 1989/90 . Recreation Branch Technical Report 1991-1.

[20] On an activity day basis, these excluded activities amounted to approximately five percent of total activities for 1989.

[21] B.C. Research Corp, 1990. Visitor '89 - Wildlife Viewing and Forest Recreation. A report to the Ministry of Tourism.

seven month December through June period[22]. August was excluded to dampen our estimate with respect to possible forest closures due to threat of fire. This calculation resulted in an estimate of 1989 tourist expenditure on forest related activity in British Columbia of $928 million.

Adding these estimates for forest related recreation expenditure by British Columbia residents and for tourists visiting British Columbia, a total expenditure estimate for 1989 of $2,412 million is obtained. Finally, this estimate is updated to a 1993 figure of $2,870 million, using the Consumer Price Index for British Columbia. These calculations are specified on a line by line basis in Table 6.

Table 6

Estimated Annual Expenditure on Forest Related Recreation and Tourism - 1993 Dollars

(1)	Resident Forest Recreation Expenditure - 1989		= $1,562 million
(2)	Reduce by 5% re. Forest Ecology Impact Base		= **$1,484 million**
(3)	Non-Res. 7 Month Forest Tourism Expend.- 1989		= $ 550 million
(4)	Reduce by 5% re. Forest Ecology Impact Base		= $ 523 million
(5)	Expand (4) to 11 month Annual Expend.	{X 1.775}	= $ **928 million**
(6)	1989 Resident and Non-Res. Expend.	{(2)+(5)}	= **$2,412 million**
(7)	Update Estimate to 1993 Prices	{ X 1.19}	= **$2,870 million**

This forest land-based recreation and tourism gross expenditure figure is subject to a number of biassing concerns. First, in the time available, we were unable to quantify biological linkages between protection of forest streams and returns of anadromous salmon and steelhead to saltwater commercial and sport fisheries. Hence, no beneficial impact on the Province's $342 million per year

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[22] From Visitor '89 - A Travel Survey of Visitors to British Columbia(1990). Industry, Science and Technology Canada, Ministry of Tourism and Ministry of Regional Economic Development.

commercial salmon fishery[23] or $600 million per year tidal sport fishery[24] is included in this analysis.

Second, tourist expenditures in this report only represent days "in forest". To the extent that British Columbia's forests are a primary attractant for tourists visiting the province, the calculating procedures applied here will significantly understate total forest-related provincial benefits.

Finally, economists often deduct associated goods and service production costs from gross value calculations to estimate net economic benefits. Such deduction would reduce the estimate provided here. However, ecological benefits that are the subject of this report occur in moderate increments over the assumed 80 year forest rotation, and would be dispersed throughout British Columbia. Under these conditions, and noting chronically higher levels of unemployment in rural areas of the province, it is concluded that gross and net estimates of economic impact would be little different.

In balancing these concerns, we conclude that the economic indicator data provided here is substantially conservative. Combining results from Tables (5) and (6), we estimate business economic impacts from proposed new forest standards in Table 7.

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[23] Ministry of Agriculture, Fisheries and Food, 1992. Fishery Production Statistics of British Columbia, 1990.

[24] Department of Fisheries and Oceans, 1993. 1990 National Sport Fishing Survey.

Table 7

Estimated Business Impacts Associated with Forest Recreation and Tourism from Implementation of Proposed Forest Standards

Principal Code No.	Description of Standard	Estimated Economic Benefits				
		Year 1	Year 5	Year 10	Year 25	Year 80
		-------in millions of dollars------				
3.3	Designated areas.	3.4	16.9	33.9	84.7	270.9
10.1	Forest harvest planning.	7.7	38.7	77.5	193.7	619.9
9.0	Road Construction	0.3	1.1	2.6	6.3	20.7
9.8	Road Maintenance	3.7	18.1	36.2	90.4	289.3
9.9	Road Deactivation	0.3	1.7	3.4	8.6	27.6
10.2	Stream Protection	2.9	14.9	17.8	26.4	58.0
Total Estimated Business Impacts		18.3	91.4	171.4	410.1	1,286.4

ii) Non-Marketed Benefits Associated with Proposed Forest Standards

Recreationalists and tourists often associate benefits with their forest activities and/or interests over and above the value of related purchases they make in economic markets. Economists term these additional benefits **non-market benefits**. Non-market benefits refer to both additional satisfaction that recreators and tourists associate with visits to the forest - over and above the costs incurred to engage in those activities, and to the satisfaction of knowing the forest is being preserved in a manner that will ensure its continued existence. The former type of non-market value can be termed non-market value associated with use. The latter type of non-market value is often termed **preservation value**, and need not be associated with actual forest recreation or tourism.

We have been unable to find any comprehensive estimate of non-market values associated with forest recreational use in British Columbia. Work in British Columbia by Stone (1988)[25] and Reid (1985)[26] suggest that non-market values for fishing and hunting may range from approximately 0.33 to 0.5 of actual expenditures. Data from adjacent areas of Washington state indicate that non-market values for nature-based recreation can substantially exceed actual market-based expenditures[27]. We do not adjust the cash expenditures outlined in Table 7 to account for the non-market component of recreational use of British Columbia's forests - but would conservatively estimate that such expansion to increase the benefits displayed there by at least 50 percent.

Ministry of Forests [28] did provide data on non-market values associated with **preservation** of recreation resources in British Columbia's forests. They estimate that British Columbians "would pay" $113 million per year to protect and maintain such resources[29]. Application of this preservation value to the present analysis is somewhat problematic - being dependent upon identification of some set of forest characteristics below which the forests "are not being preserved" for recreation purposes. Obviously, different interest groups and experts within the Province have different opinions about where the forest preservation threshold may lie. We reach three conclusions with respect to the application of such preservation values to this forest standards analysis.

* If the bulk of proposed new forest standards are implemented, present preservation values associated with recreation in B.C.'s forests will be preserved.

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[25] Stone, M. 1988. Economic Values and Impacts of Freshwater Sport Fishing in British Columbia. Ministry of Environment. Fishery Management Report No. 91.

[26] Reid, R. 1985. The Value and Characteristics of Resident Hunting. Ministry of Environment.

[27] See, for example, Biosytems Analysis, Inc. 1984. Methods for Valuation of Environmental Costs and Benefits of Hydroelectric Facilities. A Report to Bonneville Power Administration. DOE/BP-266.

[28] Ministry of Forests (1991). Op. cit.

[29] Ibid., p. 2.

* We are unable to predict, for discrete changes in present characteristics of the B.C. forest as a whole, that preservation values will be lost.

* If the negative effects of timber management and harvest on the ecology of B.C.'s forests are not mitigated, it is predictable that at some point in time within the period of this analysis preservation values associated with forest recreation by present citizens of British Columbia will, in fact, be lost.

Finally, this analysis is not inclusive of cultural, religious or other non-economic values associated with British Columbia forests by Aboriginal peoples.

V. Impacts on the Timber Industry from the Proposed Rules

Saunders (1993) presents an estimate of **forest industry cost to increase regulatory compliance from the level of current standards to that indicated by the proposed code.** They develop this estimate in two parts. First, they assume that present forest industry costs are "locked in", and that an estimated 10% to 20% decrease in AAC resulting from the proposed new forest standards will result in a 10% to 20% increase in costs per unit of remaining product. They further assume the B.C. forest industry to be price takers on the international market -so that costs cannot be passed through to customers[30]. This procedure produces a range of estimate between $49 million and $98 million. However, Saunders (1993) indicate that a substantial portion of this cost may be attributable to factors other than the proposed code[31]. They note that there may be other industry costs they have not considered.

Saunders also assesses direct costs of compliance for each element of the proposed forest practices code. These direct costs are treated as additive to the locked-in costs described in the previous paragraph.

1) Locked-in Costs to Industry

In addition to the range of uncertainty associated with the estimate of locked-in costs, and noted by Saunders, their estimate poses two significant additional concerns.

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[30] Economists would term this type of cost situation "frictional costs".

[31] By way of alternative example, Saunders (1993) also provides cost figures in the $12 million to $25 million per year range on page 16 of their report.

i) The British Columbia Forest Industry as Pure Price Takers

The assumption by Saunders that forest products producers in British Columbia will face constant product prices, irrespective of declines in supply volumes, conforms to neither economic theory nor to apparent factual circumstance. Economic theory stipulates that generally, consumers will pay higher prices as supply is decreased, and defines this inverse relationship between price paid and supply offered as the **price elasticity of demand.** Phelps (1993) has just completed a review of empirical estimates of such elasticities of demand in North American softwood lumber markets[32]. Examination of recent data from that publication suggests that prices can be expected to rise by approximately 3.5% for each 10% decrease in product supplied[3334].

These elasticity estimates apply to supply changes in total markets. However, British Columbia softwood producers are in a strong position in Canada. Further, with respect to the United States, data from Haynes (1990) indicates that Canadian exports of softwoods accounted for about 25% of U.S. consumption in the late 1980's, with B.C being the chief supplier[35]. The same author identifies that new multiple use balances between timber, fish and wildlife will act to restrict timber supply in the United States[36] as well as in British Columbia. Overall, he notes:

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[32] Phelps, S.E. 1993. A Summary of Elasticities of Demand and Supply for North American Softwood Lumber. Forestry Canada: Policy and Economics Directorate. Ottawa.

[33] Ibid., pp. 2-3.

[34] Some local commentators have suggested that price elasticities should not be applied in this forest code analysis because empirical estimators range broadly. Given the reconnaissance level of present analysis, and the range of uncertainty involved in most other estimators employed by the Saunders report, we do not concur.

[35] Haynes, Richard W. 1990. An Analysis of the Timber Situation in the United States: 1989-2040. U.S. Forest Service: General Technical Report RM-199, pp. 81-82.

[36] Ibid., p. 157.

> The U.S. softwood sawtimber supply situation will be unprecedented through 2020. Throughout its history, the United States has had available a reserve of undeveloped softwood sawtimber. The timber resources of first the Northeast, then the South, the Lake States, the U.S. West Coast, interior British Columbia, and then the South again all played important roles in development of the Nation. For the next two decades, until the pine plantations in the South reach maturity, the United States will not have a reserve of softwood lumber available for harvest. There will be a period of two or three decades when the price of softwood lumber will increase significantly.[37]

Haynes predicts average annual roundwood stumpage price increases in the Pacific Northwest region of 2.8% through the year 2020[38].

Reviewing these data, we conclude that the Saunders calculation, which holds product prices constant to predict industry losses equivalent to locked-in cost, likely overestimates net costs of compliance. Economic theory and empirical analysis related to demand for forest products, notation of the significant role that B.C. softwood producers play in North American markets, and predicted substantial roundwood price increases due to North American supply deficiencies through at least 2020, all suggest that real increases in product price can be expected to mitigate the cost estimates provided by Saunders. Detailed statistical specification of the potential magnitude of such price changes is beyond the scope of this reconnaissance review. It does not appear unreasonable, however, to expect price increases to at least conform to the 2.8% annual estimate by Haynes (1990). We use this estimate, rather than the 3.5% to 7.0% estimate that would result from literal application of elasticity averages from Phelps (1993) to the respective 10% lower bound and 20% upper bound estimates of reduced AAC from Saunders. Such adjustment correspondingly reduces Saunders' full estimate of annual AAC-based loss to between $35 million and $72 million[39].

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[37] Ibid., p. 4.

[38] Ibid., p. 4.

[39] This adjustment reduces Saunders' lower range "example" cost estimate to between $9 million and $18 million annually.

ii) Dissipation of Frictional Costs Over Time

A second major issue associated with Saunders (1993) AAC-related cost analysis concerns the dissipation of these costs over time. Such "locked-in" costs will be unlocked over time as timber companies reinvest in machinery and equipment - altering both scale of operations and production functions to take fullest advantage of changing demand-supply circumstances. Given this progression, it is judged that frictional costs will be largely dissipated over a ten to fifteen year period.

iii) Summary of Locked-In Costs

It is concluded that anticipated price increases will likely reduce AAC-related industry costs by substantially less than the $100 million per year upper estimate in Saunders (1993). Our judgement is that a range of potential annual cost between the mid-point of Saunders' estimate ($74 million) at the high end, and some lower number (perhaps $25 million) at the low end - both then suitably adjusted with respect to anticipated future prices, might be reasonable. If we follow this logic, we obtain a mid-point estimate of $36 million in annual cost for year one. Reducing this annual cost evenly over 15 years, we then obtain a figure of $24 million dollars at Year 5, and $12 million at Year 10.

2. Direct Costs of Industry Compliance with the New Rules

In addition to estimating the impact of locked-in costs, Saunders (1993) estimates the direct cost for industry of raising compliance levels to those proposed in the new code. These estimates are apparently based on consultation with the Ministry of Forests, and on the authors' own knowledge as a forest consultant. In Table 8, we present these cost estimates, restructured to conform to the groupings of forest code measures used in the previous ecological section of this report.

Table 8

Annual Costs to Industry of Direct Compliance with Proposed Forest Standards

Forest Code #'s	Description of Grouping	Estimated Direct Cost --$'000--
3.3	Designated areas.]_	488
3.4	Watershed assessment.]	
10.5	Map & flag designated zones.	935
	Total Designated Areas.	1,423
10.1	**Forest Harvest Planning.**	3,774
8	Silviculture Systems	1,309
4	Forest Health	150
11	Forest Regeneration	9,884
12	Forest Tending	--
	Total Silviculture & Related	11,343
5	**Soil Conservation.**	669
9	**Forest Roads.**	17,858
10.2	**Timber Harvesting.**	3,900
7	Range Management.	--
	Total Industry Direct Costs	27,624*

Source: Saunders (1993).

VI. Government Costs of Forest Practice Requirements

Saunders (1993) provides estimates of direct cost to MOF[40] and to the Small Business Forest Enterprise Program, by code rule, to raise compliance from current regulatory standards to those in the proposed forest practices code. These estimates are largely an assemblage of judgements provided by Ministry of Forests staff. In a substantial number of instances, a range of estimate was provided. In such instances, Saunders usually selected moderate to low numbers from these ranges for analysis. Saunders (1993)' approach in this regard is considered conservative and reasonable. Table 9 displays these estimates, again reordered to conform to the groupings of code rules employed earlier in this report.

[40] These estimates include estimates for MELP.

Table 9
Annual Costs to Government to Attain Compliance with Proposed Forest Standards

Forest Code #'s	Description of Grouping	Estimated Cost MOF	Estimated Cost SBFEP
		--$'000--	
3.3	Designated areas.]_	262	147
3.4	Watershed assessment.]		
10.5	Map & flag designated zones.	--	276
	Total Designated Areas.	262	423
10.1	**Forest Harvest Planning.**	3,746	256
8	Silviculture Systems.	--	387
4	Forest Health.	950	150
11	Forest Regeneration	458	1,446
12	Forest Tending	164	--
	Total Silviculture & Related.	1,572	1,983
5	**Soil Conservation.**	--	86
9	**Forest Roads.**	1,022	1,848
10	**Timber Harvesting.**	979	854
7	Range Management.	--	324
	Total Government Cost	7,907	4,984

Source: Saunders (1993).

Saunders (1993) estimates the annual cost of a new Forest Practices Review Board at $5 million.

The economic area where the government of British Columbia has has greatest control is with respect to its own direct costs. Contrary to implications of the MOF-Saunders workup, it does not follow that improved forest standards can only be implemented **after** present standards are fully complied with. A more realistic expectation is that there will be a level of non-compliance for **each** level of regulatory standard. With this view in mind, compliance rates are held constant in the present regulatory analysis.

VII. A Summary of Benefits and Costs Associated with the Proposed Forest Practice Rules

The analyses provided here, together with the principal sources relied on, have been conducted at a reconnaissance level, and principally represent judgement by experts in the fields of forest management and ecology. The conclusions presented are directed toward policy options which may be available to government decision-makers.

1. Economic Value Associated with Ecological Improvements in the Proposed Forest Practice Rules

Ecological benefits in the proposed forest practices code are modest in initial years and increase progressively as forest activities are rebalanced over the timber harvest rotation. Under levels of compliance similar to those in place in the recent past, ecological improvements are estimated to generate annual economic benefits to businesses servicing recreationalists and tourists of $11.5 million in the initial year. These revenues are estimated to increase to $57 million in Year 5, to $102 million by Year 10, and to $238 million by Year 25 (Table 7, pg. 20). By the end of a full 80 year rotation, it is estimated that these improvements will generate annual benefits of $735 million. Under an assumption of full compliance, benefits in the initial year will approximate $14 million, and will rise to $903 million at the end of the 80 year rotation period. Non-market benefits will rise at the same pace, to the extent of an additional $.50 or more for each dollar of business benefits.

The single most important code section, from an ecological perspective, is long term forest development planning (Code 10.1.4), which is eventually expected to generate $620 million of business benefits at full rotation. Provision for designated areas (Code 3.3) are also important, and are considered a key building block in eventual provision of a further $271 million. A series of provisions to govern road maintenance and construction, to deactivate roads and to protect streams make up the balance of the ecologically important elements of the proposed code.

2. An Integrated Assessment of Benefits and Costs of the Proposed Forest Practice Rules

Table 10 displays estimated potential economic benefits and costs associated with the proposed forest practice standards, under a range of alternative assumptions. These alternative scenarios are defined as follows:

Scenario 1: Assumes ecological business benefits as defined in this report, and full costs as estimated by Saunders (1993).

Scenario 2: Adds non-market ecological benefits at $.50 to the business dollar to Scenario 1.

Scenario 3: Reduces costs associated with loss of AAC in Scenario 1 by 28 percent to account for product price increases and changes in producer production functions (pp. 19-22).

Scenario 4: Combines Scenarios (2) and (3).

Table 10

Alternative Estimates of Net Annual Benefit - Achievement of Proposed Forest Practice Standards for British Columbia

Scenario	Estimated Annual Net Benefits				
	Year 1	Year 5	Year 10	Year 25	Year 80
	------in millions of dollars-----				
Scenario 1:	-112.6	-44.9	27.0	246.7	1,078.7
Scenario 2:	-110.3	-27.7	61.4	332.8	1,354.2
Scenario 3:	-75.1	4.6	88.5	320.2	1,147.7
Scenerio 4:	-72.7	21.8	122.9	406.3	1,423.2

It can be observed from Table 10 that the period of time by which net benefits from the proposed forest standards code will turn positive depends on analytical assumptions employed in the analysis.

Table 11 outlines the benefits from implementation of ecological code groupings discussed throughout this report, net of their associated costs. Delineation of costs between forest roads and timber harvest/stream protection are somewhat arbitrary - and these are only broken out separately to highlight the important role that road-related costs play in the total standards cost picture. Costs associated with loss of AAC and with the proposed Forest Practices Board are not apportioned between ecological groupings, and appear at the bottom of the table. Costs incorporated in this table are from Saunders (1993), and reflect Scenario 1 from Table 10.

Table 11

Net Business Benefits Associated with Proposed Forest Standards, by Ecological and Cost Grouping

Forest Code #'s	Grouping	Net Business Benefits Year 1	Year 5	Year 10	Year 25	Year 25
		------in millions of dollars------				
3.3 3.4 10.5	Designated areas.] Watershed assess.] Map & flag] desig. zones.	1.3	14.8	18.3	52.1	187.5
10.1	Forest harvest planning.	-0.1	30.9	69.7	185.9	612.1
8 4 11 12	Silviculture & Related	-14.9	-14.9	-14.9	-14.9	-14.9
9	Forest Roads	-17.2	-6.0	20.7	83.8	316.1
10.2	Timber Harvest/ Stream Protection	-3.2	8.8	11.7	18.3	51.9
	Loss of AAC	-73.5	-73.5	-73.5	-73.5	-73.5
	Forest Practices Board	-5.0	-5.0	-5.0	-5.0	-5.0
Total Net Benefits		-112.6	-44.9	27.0	246.7	1,078.7

Table 11 illustrates the important role which road construction and maintenance and assumptions with respect to loss of AAC play in overall program costs. Losses due to AAC have been previously discussed.

Road costs, as developed in Saunders (1993) and elsewhere[41], are driven by cut block assumptions that predict road areas and costs will remain the same, or even increase as a result of the proposed forest standards. These assumptions also affect other cost elements in the Saunders analysis. MELP staff believes that integrated examination of cut block design, greenup requirements, leave strips and related forest issues could result in revised cut block design that could reduce roaded area and hence industry cost, while maintaining the level of ecological protection associated with the proposed forest standards[42]. In view of the key role that the cut block assumptions play on the cost side of this analysis, such an integrated review would seem beneficial.

Finally, reviewers are reminded that this is a reconnaissance review of benefits and costs associated with the newly proposed forest practice standards. A more extensive analysis, perhaps patterned after Haynes (1990) would need to consider the changing balance between uses of forest land in British Columbia over a rotation, the sustainable carrying capacity of our forests with respect to those balances, associated changes in the production functions of timber, recreation, tourism, Aboriginal and other interests, and demand conditions both in British Columbia and abroad for the forest products which result.

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[41] eg. Nelson, J.D., 1993. The Effects of Harvesting Guidelines on Timber Supply and Delivered Wood Costs. A Report to the Ministry of Forests.

[42] Mike Fenger, personal communication.