

**Pulp Fibre Availability in British Columbia:  
A Case Study of the 1995 Price Spike**

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by

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## EXECUTIVE SUMMARY

The pulp and paper industry in British Columbia has grown over the past two decades to the point that it is an integral complement to the lumber industry. Both sub-sectors consume approximately equal amounts of fibre. In most years the value of lumber industry shipments and exports exceeds that of pulp and paper. Direct employment in the lumber industry is about twice the level of that in the capital-intensive pulp and paper industry. However, one recent estimate of the value added by forest sector activity found both sub-sectors are roughly equivalent (Schwindt and Heaps, 1996). The two sectors are increasingly reliant upon one another; pulp and paper mills draw the residual wood chips produced by solid wood processors for the bulk of their fibre needs and the lumber mills rely on the additional income from these furnish sales to meet the rising cost of timber.

This study is based on a direct mill survey of solid wood processors and pulp mills in British Columbia. The focus of the study was on the supply and disposition of pulp furnish in the year 1995. In this particular year the markets produced a strong price spike for pulp and paper products. Table I provides a recent price history and a forecast for the major forest products. Both the 1995 pulp price spike and the magnitude of the forest product price volatility are presented in this table. The results from the survey provide additional information on the amounts of fibre imported into the province in 1995 and that in the absence of this imported fibre BC would have faced a significant pulp fibre deficit.

It is estimated that in 1995 BC imported 3.5 million m<sup>3</sup> of solid wood and a further 470,000 BDU's in wood chips.

**Table I. Commodity Forecasts (C\$/Unit)**

|             | Units    | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|-------------|----------|------|------|------|------|------|------|------|
| NBSK Pulp   | m. tonne | 737  | 594  | 765  | 1202 | 810  | 751  | 956  |
| Newsprint   | m. tonne | 594  | 628  | 642  | 915  | 881  | 785  | 854  |
| Liner Board | sh. ton  | 474  | 430  | 512  | 696  | 522  | 546  | 615  |
| Lumber      | mbf      | 317  | 455  | 470  | 341  | 482  | 451  | 437  |
| OSB         | msf      | 294  | 318  | 362  | 335  | 251  | 212  | 191  |
| Cdn Dollar  | Cdn\$    | 0.83 | 0.78 | 0.73 | 0.73 | 0.73 | 0.75 | 0.75 |

*Source:* CIBC Wood Gundy, 1996 (exchange rates in effect March, 1996).

The analysis shows that the BC Coastal pulp mills rely on the Interior for a substantial portion of their fibre needs; the Coastal region acquired an estimated 845,000 BDU's from the Interior in 1995. However, the ability of inter-provincial fibre flow to meet pulp mill furnish needs will be increasingly challenged in periods of tight demands. Based on the anticipated reductions in BC harvest levels (arising from recent policy initiatives including the Forest Practices Code, the Protected Areas Strategy, and the Timber Supply Review) and an assumption of the pulp industry operating at full capacity, the province could face an aggregate shortfall of 3.3 million BDU's (approximately 9 million cubic

metres or the annual consumption of six 'average' pulp mills). While both the Coast and Interior regions would need to import substantial quantities of fibre, the Coastal industry would face the greater supply deficit.

These additional demands on furnish acquisition are coming in a period when the pulp and paper industry is increasingly challenged with rising costs and a consequent deteriorating competitive position. Table II provides a regional comparison of estimated production costs itemized in terms of the various factors of production. The BC Coast is the high cost region followed closely by the BC Interior.

**Table II. Market Pulp Regional Comparison of Production Costs (1995)<sup>1</sup>**

|                              | <i>US<br/>South</i> | <i>Eastern<br/>Canada</i> | <i>Sweden/<br/>Finland</i> | <i>US<br/>West</i> | <i>BC<br/>Interior</i> | <i>BC<br/>Coast</i> |
|------------------------------|---------------------|---------------------------|----------------------------|--------------------|------------------------|---------------------|
| Fibre                        | 193                 | 270                       | 378                        | 388                | 396                    | 425                 |
| Labour                       | 86                  | 103                       | 72                         | 81                 | 108                    | 137                 |
| Chemicals                    | 87                  | 61                        | 76                         | 73                 | 76                     | 69                  |
| Energy                       | 25                  | 35                        | 14                         | 58                 | 32                     | 47                  |
| Other Mill                   | 63                  | 76                        | 72                         | 85                 | 109                    | 123                 |
| Corp. and Selling            | <u>15</u>           | <u>31</u>                 | <u>13</u>                  | <u>31</u>          | <u>20</u>              | <u>30</u>           |
| <i>Total (less delivery)</i> | <i>469</i>          | <i>576</i>                | <i>625</i>                 | <i>716</i>         | <i>741</i>             | <i>831</i>          |
| Delivery                     | <u>74</u>           | <u>59</u>                 | <u>63</u>                  | <u>92</u>          | <u>116</u>             | <u>78</u>           |
| <b><i>Total 1995</i></b>     | <b><i>543</i></b>   | <b><i>635</i></b>         | <b><i>688</i></b>          | <b><i>808</i></b>  | <b><i>857</i></b>      | <b><i>909</i></b>   |

<sup>1</sup>Softwood kraft market pulp only. Costs are calculated before depreciation and are in Cdn \$/tonne (using exchange rates in effect on March 31, 1996).

Source: Price Waterhouse 1996

The recent changes in BC forest policy are expected to produce further reductions in future harvest levels for solid wood processors and to increase timber costs. Both of these will also impact the cost structure of the pulp and paper industry. Not only will less volume be available, but the remaining fibre will, in periods of supply/demand imbalance, enter at higher prices than experienced in the past as these two sectors compete to secure their fibre requirements. The volatility in furnish prices will also be aggravated to a degree by new OSB and MDF capacity.

Alternative sources of fibre such as recovered paper, hardwoods, or imports are unlikely to either exist in sufficient quantities or be available at viable prices to fill this fibre gap. The likely result will be increased price volatility and a restructuring of the industry as pulping capacity adjusts to lower harvest levels and rising costs.

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## SECTION 1

### INTRODUCTION

This paper examines the pulp fibre market and its importance to solid wood processors and pulp mills in the province of British Columbia. A survey, undertaken in 1996, of the major BC pulp mills and solid wood processors on the consumption and production of pulp logs and wood chips provides the information for this analysis. The role of wood chips as an input for pulp producers and a by-product for solid wood processors, make the supply and demand of wood chips an important component affecting the profitability of the BC forest industry. Building on an earlier study by Appleby (1989) this project identifies and quantifies BC's pulp fibre producing and consuming mills as well as the regional flows of wood chips. It also examines the outlook for the future by looking at the interaction between forecast harvest levels and operating rates within the pulp and paper and sawmilling industries.

### BACKGROUND TO INDUSTRY STRUCTURE

As the supply of BC's marketable wood fibre declines, the availability of pulp fibre continues to be a major concern for the province's pulp and paper industry. In December, 1996 the BC Chief Forester released his final allowable annual cut determination under the first round of the Timber Supply Review (TSR). The conventional softwood harvest was reduced by about 5% to 63.348 million m<sup>3</sup>. As detailed in Table 1, this reduction was largely offset by increases in the harvest volumes of deciduous, insect/pest and marginal economic stands.

**Table 1. 1992-1996 Timber Supply Review - Changes in TSA and TFL Annual Allowable Cut (AAC)<sup>1</sup>**

|          |               | <i>AAC</i>   | <i>Conventional</i> | <i>Deciduous</i> | <i>Insect/disease</i> | <i>Marginal</i> |
|----------|---------------|--------------|---------------------|------------------|-----------------------|-----------------|
| Zone I   | pre-TSR       | 35,760,416   | 31,803,085          | 2,207,334        | 850,000               | 900,000         |
|          | post-TSR      | 36,885,560   | 31,063,960          | 2,871,500        | 1,140,000             | 1,810,100       |
|          | <i>Change</i> | <i>3.1%</i>  | <i>-2.3%</i>        | <i>30.1%</i>     | <i>34.1%</i>          | <i>101.1%</i>   |
| Zone II  | pre-TSR       | 13,746,667   | 13,746,667          | 0                | 0                     | 0               |
|          | post-TSR      | 13,669,530   | 12,982,530          | 0                | 0                     | 687,000         |
|          | <i>Change</i> | <i>-0.6%</i> | <i>-5.6%</i>        | <i>0.0%</i>      | <i>0.0%</i>           | <i>∞</i>        |
| Zone III | pre-TSR       | 21,674,046   | 21,269,359          | 138,687          | 0                     | 266,000         |
|          | post-TSR      | 20,300,160   | 19,30,700           | 289,260          | 0                     | 709,200         |
|          | <i>Change</i> | <i>-6.3%</i> | <i>-9.3%</i>        | <i>108.6%</i>    | <i>0.0%</i>           | <i>166.6%</i>   |
| Total BC | pre-TSR       | 71,181,129   | 66,819,111          | 2,346,018        | 850,000               | 1,166,000       |
|          | post-TSR      | 70,855,250   | 63,348,190          | 3,160,760        | 1,140,000             | 3,206,300       |
|          | <i>Change</i> | <i>-0.5%</i> | <i>-5.2%</i>        | <i>34.7%</i>     | <i>34.1%</i>          | <i>175.0%</i>   |

Source: Timber Supply Branch, BC Ministry of Forests 1997

Rising production costs, seemingly increasing product price volatility, and uncertain fibre supply provide the impetus for research in one of the province's most important industries. The size of the pulp and paper industry, in terms of provincial gross domestic

<sup>1</sup> As outlined in Section 2, the BC Forest Service Regions have been divided into 3 zones for the purpose of this study. Zone I refers to the Prince George, Prince Rupert and Cariboo Forest Regions; Zone II refers to the Kamloops and Nelson Forest Regions; and Zone III refers to the Vancouver Forest Region.

product (GDP), is second only to the lumber industry and accounts for about 38% of total forest industry GDP. Its use of wood fibre is approximately equal to the lumber industry (when the use of residual wood fibre is taken into account) and, in 1995, pulp and paper led the province in export sales; \$7.9 billion compared to \$7.4 billion in lumber (Statistics Canada, 1996).

Table 2 shows the historic production of lumber and pulp and paper in BC over the past eleven years. Lumber production peaked in 1987 and has since declined, while pulp and paper production reached record levels in 1994 and would have likely exceeded these levels in 1995 if strikes had not curtailed production at several mills.

Within BC there are 27 pulp and paper mills<sup>2</sup>. In this total, 25 mills produce pulp which is either converted on-site into paper products or sold as market pulp to other paper mills. Differences in forest types, species and quality of wood, as well as different historical development between the Coast and the Interior have led to two distinctive pulp industries. A significant difference lies in the Coastal industry's dependence on roundwood as a significant source of fibre, while the Interior relies on residual chips for the bulk of its fibre supply, which in turn has implications for their respective cost structures.

**Table 2. Lumber and Pulp and Paper Production in BC from 1985 to 1995**

Lumber Production in MMbfm; Pulp and Paper Production in thousands of tonnes

| Year | Lumber   |       |        | Pulp and Paper |
|------|----------|-------|--------|----------------|
|      | Interior | Coast | Total  | Total          |
| 1985 | 10,007   | 3,996 | 14,003 | 5,816          |
| 1986 | 9,581    | 3,753 | 13,334 | 6,258          |
| 1987 | 11,212   | 4,674 | 15,886 | 6,934          |
| 1988 | 10,989   | 4,583 | 15,572 | 7,105          |
| 1989 | 11,094   | 4,140 | 15,234 | 7,002          |
| 1990 | 10,400   | 3,798 | 14,198 | 6,593          |
| 1991 | 9,843    | 3,465 | 13,308 | 6,568          |
| 1992 | 10,625   | 3,516 | 14,141 | 6,541          |
| 1993 | 10,796   | 3,585 | 14,381 | 6,939          |
| 1994 | 10,588   | 3,681 | 14,269 | 7,497          |
| 1995 | 10,506   | 3,313 | 13,819 | 7,454          |

Source: CPPA, 1996; Statistics Canada, various issues.

BC's first pulp mills originated on Vancouver Island at the turn of the century. The Coast (defined as Vancouver Island and the Southern Coast) is now home to eleven mills and accounts for approximately half of the pulping capacity in the province<sup>3</sup>. Table 3 provides a summary of BC pulp capacity by region and by pulping process. A variety of products are produced, ranging from newsprint to directory papers to lightweight coated

<sup>2</sup> This includes two mills which only produce paper products (Island Paper Mills Company and Crown Packaging Ltd.) and nine mills which produce both pulp and paper products.

<sup>3</sup> This includes Newstech Recycling Inc. in Vancouver which is furnished from recycled fibre.

paper, as well as market pulp. Many of the mills have been upgraded over time, but on average are older than the mills in the Interior. Initially, Coastal mills relied completely on roundwood, but developments in pulping technology during the 1940s and 1950s enabled them to use residual chips produced by sawmills. While residual chips provided a significant new source of fibre for Coastal mills, process-specific requirements requiring solid wood fibre, such as logs or groundwood blocks, limited the substitution of residual chips for roundwood fibre. In addition, the characteristics of the wood supply on the Coast meant that a certain portion of the wood harvested was suitable only for pulping or chipping. As a consequence, Coastal pulp mills rely on residual chips for approximately half their fibre requirements.

**Table 3. BC Pulp Mill Capacity by Type and Region (1995)**

|           | Chemical     |           | Mechanical   |           | Total        |            |
|-----------|--------------|-----------|--------------|-----------|--------------|------------|
|           | '000 tonnes  | %         | '000 tonnes  | %         | '000 tonnes  | %          |
| Coastal   | 1,842        | 44        | 2,356        | 56        | 4,198        | 49         |
| Interior  | 3,072        | 71        | 1,283        | 29        | 4,355        | 51         |
| <i>BC</i> | <i>4,914</i> | <i>57</i> | <i>3,639</i> | <i>43</i> | <i>8,553</i> | <i>100</i> |

*Source:* Economics and Trade, BC Ministry of Forests (1995) and authors' estimates.

The Interior's fourteen pulp mills (the two pulp mills on the North Coast, despite their use of roundwood and location, are commonly included in the Interior because of their substantial reliance on fibre from the Interior) produce newsprint and other paper products, but the bulk of production is in market pulp. The Interior industry developed much later than the Coastal industry, with the first pulp mill established in the early 1960's (although the pulp mill in Prince Rupert was built earlier, it initially did not rely on fibre from the Interior). While the first pulp mills were initially built with wood rooms, the rapid expansion of the Interior sawmilling industry meant that the increasing supply of residual chips was sufficient to meet the furnish needs of the pulp mills. The rapid expansion of the Interior pulp industry reflected the apparently inexhaustible supply of pulp fibre in the form of inexpensive wood chips generated by the sawmill industry. This chip supply enabled Interior operations to build large capacity mills to take advantage of the economies of scale and become one of the world's low cost pulp producers.

Chemical pulping is the primary process used in BC pulp manufacturing (approximately 87% of all market pulp produced) due to its production of high quality pulp (bleached softwood kraft pulp is produced through chemical pulping). However, the use of the chemi-thermomechanical (CTMP) process has been growing. Most of the BC pulp capacity is used to make commodity pulp; 62% of provincial pulp capacity is dedicated to market pulp compared to only 23% for the rest of Canada. The remainder of the pulp is processed into newsprint, paper packaging products, paperboard, woodfree and groundwood papers, and tissue. This emphasis on market pulp reflects the historic availability of low cost, high quality fibre which was used to produce the high quality pulp in high demand for its strength and brightness characteristics. In addition, tariffs in



the US, Europe, and Pacific Rim markets have favored the export of pulp, compared to higher-valued paper products.

Softwoods are the predominant fibre used for pulp in BC. Due to their long fibers and natural brightness, the softwood species found in BC produce strong pulps which are desirable for both lightweight printing and writing papers and paper products requiring strength such as linerboard. Wood fibre for pulping purposes (pulp fibre) is produced in several different ways. It is produced as a residual at primary breakdown facilities, including sawmills, veneer mills, and shake and shingle mills. It is also produced at remanufacturing operations to a limited extent and mainly within the Lower Mainland. Pulp fibre is also produced at chip mills, which are stand-alone operations that are either portable or fixed. Some sawmills have chipping capacity on site, enabling them to choose how to best maximize log value. Finally, pulp fibre can be delivered directly to the pulp mill wood room, as is the case for those pulp mills that use groundwood blocks or pulp logs.

## **ALTERNATIVE FIBRE SOURCES**

### ***Hardwood***

There are four hardwood species that exist in large enough volumes to warrant commercial management in BC; alder and cottonwood on the Coast and birch and aspen in the Interior. Two pulp mills within the province, Scott Paper in New Westminster and the Louisiana Pacific mill in Chetwynd, use hardwood fibre exclusively (cottonwood and aspen respectively). In addition, some of the other pulp mills have been experimenting with hardwood fibre by blending it with softwood fibre.<sup>4</sup> The aspen harvest is also currently used to supply three OSB plants, a chopstick plant and some minor amounts of hardwood chips (both aspen and alder) have been exported<sup>5</sup>.

Although it was not possible to obtain exact figures on hardwood use in BC pulp production it is clear that softwoods are the dominant source of furnish. The two BC mills which are dedicated to using hardwood fibre have a production capacity of only about 2% of total provincial pulping capacity. In addition, hardwoods constituted only about 3% of the total provincial harvest volume of 76 million cubic metres in 1995.

The potential use of hardwood is limited by both the need for substantial investment required to use hardwood and the market share BC firms currently enjoy based on the

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<sup>4</sup> Fibreco Pulp Inc. has announced plans for a major capacity expansion from 120,000 tonnes per year to 300,000 tonnes, based on the use of aspen. MacMillan Bloedel Ltd. (MB) has undertaken an extensive hybrid poplar planting program off their private lands on Vancouver Island to supplement fibre needs. Currently, MB has planted about 5,000 ha. of these short-rotation poplars. As a result of the TSR the allowable annual deciduous harvest has increased 35% to 3.16 million m<sup>3</sup>. The bulk of this volume is in the Prince George Forest Region.

<sup>5</sup> The Slocan Forest Products Ltd. OSB mill in Fort Nelson came on stream in 1996. Capacity is 179 million sq.ft. (3/8" basis) and the furnish is aspen and balsam poplar. The chopstick plant in Fort Nelson closed in 1996 but the operation in Kelowna remains in operation.

production of high quality softwood pulp. Increasing production of hardwood pulps or pulp with an increased hardwood content would mean competing with hardwood pulp that is being increasingly produced throughout the rest of the world on a very low cost basis (Pulp and Paper, 1996). These Southern Hemisphere hardwood pulp mills are state of the art physical capital, have small labour requirements and they generate their furnish needs in very short rotations (6-8 years). An additional challenge to northern bleached softwood kraft (NBSK) are the technological advances that allow major reductions, even the elimination, of NBSK in a range of paper products that have historically been a blend of softwood and hardwood pulp.

### ***Recovered Paper***

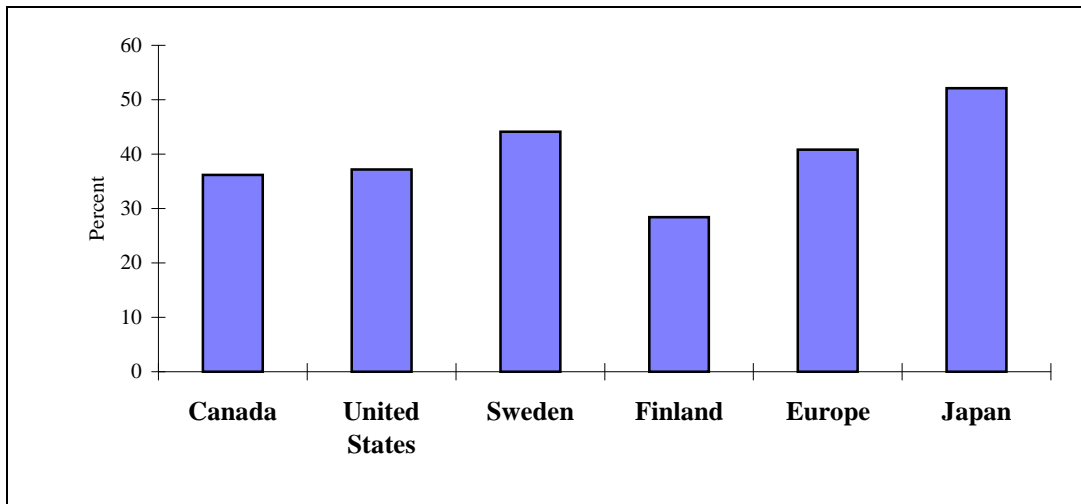
The Newstech Recycling Inc. mill in Coquitlam, BC uses recovered paper to produce deinked pulp. Total capacity for the mill is approximately 145,000 tonnes per year, with most of the sales split between Fletcher Challenge Canada Ltd. and MacMillan Bloedel Ltd. under long-term supply contracts. Newstech supplies the bulk of its recovered paper needs from outside the province, importing recovered paper from across the western provinces as well as the US. Increasing deinked pulp capacity within the US has increased the demand for recovered paper to the point that prices for recovered paper are expected to move up to permanently higher levels, and new mills have to carefully evaluate the source and security of their recovered paper supply. In fact, most of the increase in pulp production in North America in recent years has come from deinked pulp mills, and many industry analysts believe that the practical limits of recovered paper volumes will soon be reached (Forrest, 1996; Lynn, 1996). The North American maximum achievable recovery level is estimated at 50-55% and it is expected that this level will be met by 2000. Figure 1 and 2 illustrate the recovery and utilization rates for recovered paper in a selection of jurisdictions.<sup>6</sup>

Canada's recovery rates are roughly consistent with those in the major markets for Canadian pulp and paper product exports and also those attained by trade competitors. The Canadian recovery rate is increasing due to, among other signals, recycled content regulations in importing markets, increased competition for recovered paper, pressure on virgin fibre supplies, and the pricing vagaries of imported recovered paper. Canada imports almost 50% of the recyclable paper used in production from the US and it is the largest export market for US recovered paper. The Canadian recovery rate in 1995 was 41% (CPPA, 1996).

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<sup>6</sup> The term "recovery rate" refers to the ratio of recovered paper production (recovery) to apparent consumption of paper and paperboard. The term "utilization rate" refers to the ratio of apparent recovered paper consumption to the production of paper and paperboard.

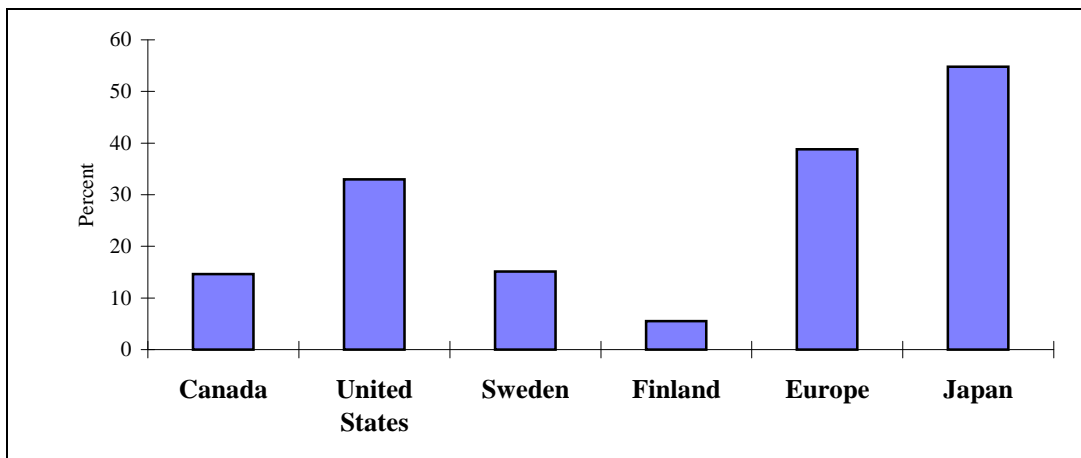
**Figure 1. Recovered Paper Recovery Rates - 1993**



Source: ECE 1994.

The recovered paper utilization rates shown in Figure 2 reflect, among other factors, the relative availability of virgin fibre to wastepaper (pricing differentials) and the regulatory requirements for recycled content in paper products in the serviced markets. The Canadian utilization rate increased to just under 22% in 1995 (CPPA, 1996). An international examination of utilization of recycled fibre produced a roughly uniform distribution of products. Of the recovered paper collected about 29% is used to make containerboard, 19% folding boxboard, 15% wrapping/package paper, 12% newsprint and 25% in a mix of other grades of paper (Easton, 1966).

**Figure 2. Recovered Paper Utilization Rates - 1993**



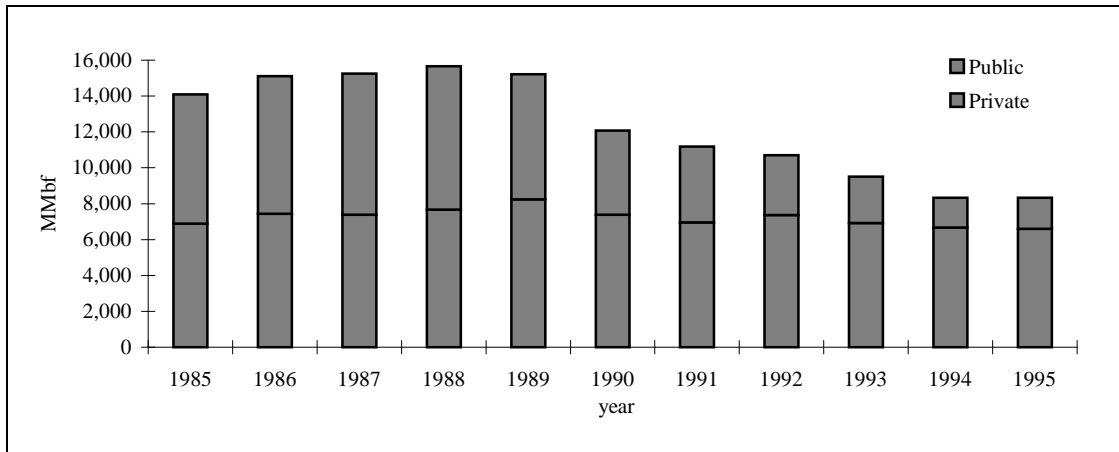
Source: ECE 1994.

### ***Imports***

Despite recent events in the US Pacific Northwest that have led to an apparent glut of pulp fibre, most industry analysts expect a basic shortage of pulp fibre in the traditional

processing areas of North America (Hagler, 1996; McLaren, 1996). While fibre will continue to be available in this market, supply is likely to enter at higher costs as firms within fibre-short regions compete in this market to supplement the shortfall due to reduced local harvest levels. Figure 3 provides a summary of total timber harvest in Washington/Oregon for the past decade. The harvest volume has declined about 47% to approximately 8 billion board feet. The harvest on private land has remained roughly constant despite the supply constraint on public land harvest and the consequent price response.

**Figure 3. Timber Harvest, Private and Public - Washington/Oregon**



Source: Warren 1996

### ***Other Residuals***

Three mills in BC use sawdust to produce short-fibre pulp. Fletcher Challenge recently announced that they will begin converting some of their residual chip fibre capacity to sawdust, decreasing pulp production from chips by 94,000 tonnes while increasing pulp production from sawdust by 109,000 tonnes (Price Waterhouse, 1996). Improving processes in chip production, chip storage and the pulping of chips may yield significant benefits as juvenile wood (which is expected to increase as a proportion of future harvests) has different pulping properties relative to mature wood (Hatton, 1997). Increased fibre costs could lead to an emphasis on improving the recovery of fibre at both the sawmill and pulpmill. An examination of kraft pulp mills in BC suggests that there are fibre losses on the order of 5-10% during the pulping process, some of which may be avoidable (Watson and Hatton, 1996).<sup>7</sup>

Additional sources of short-fibre demand are the West Fraser Mills Ltd. medium density fibre (MDF) plant located in Quesnel which opened in 1996. The MDF plant capacity is

<sup>7</sup> The BC restriction on bee-hive burners has led to a number of proposals for MDF plants. The assessment of financial viability and regulatory review of these options is underway. Construction of MDF facilities will provide additional demands on the fibre supply as these plants respond to the market.

144 million sq.ft. (3/4" basis). The three particleboard plants in BC have an annual production capacity of 360 million sq.ft. (3/4" basis).

## **OUTLINE OF STUDY**

The data for this study was generated through a survey that was sent to all pulp fibre producing and consuming plants in BC asking for information on the 1995 calendar year. The survey was designed to support a quantification of the production, consumption, imports, exports and inventory information of BC pulp producers and to estimate the 1995 pulp fibre demand and supply. Specifically, the following information was requested in the survey:

- production and projected production for all pulp producing mills;
- fibre consumption and projected consumption for all pulp fibre consuming mills;
- pulp fibre production/consumption by type;
- the amount of fibre imported both by solid wood processors as well as pulp mills; and
- the current conversion figures used by the industry in pulp fibre production.

Pulp fibre production and consumption were aggregated into three zones: the Coast Forest (excluding the North Coast); Southern Interior (Kamloops and Nelson Forest Regions); and the Northern Interior (including the North Coast). These divisions have been used within the industry and there are historical statistics based on this breakdown. Appleby (1989) divided the province into 14 chip supply regions which corresponded roughly to timber supply areas. However, initial inquiries suggested that most firms were uncomfortable with providing information which would be publicly reported in this level of regional detail.

All major solid wood processing and pulp and paper companies were contacted prior to mailing the questionnaire. While firms were willing to answer most questions, there were certain areas of information, such as imported fibre and inventory levels, that some firms did not answer.

A description and analysis of the survey results are provided in Section 2. This section outlines survey methodology and details pulp fibre production, chip flows, imports, exports and price sensitivity. Section 3 uses the results of the survey to project capacity and future availability of pulp fibre for BC mills. Finally, conclusions are offered in Section 4.

## SECTION 2

### SURVEY DESIGN AND METHODOLOGY

The survey recipient list was created using a compilation from different company and product directories for the BC forest industry.<sup>8</sup> These publications inventory wood processing facilities within the province. The survey mail-out included all pulp mills (with the exception of Newstech which consumes recovered paper), chip mills, veneer mills and panelboard mills. It also included 252 sawmills with annual mill production greater than 2 million board feet and all shake and shingle mills producing over 10,000 squares per year.<sup>9</sup> The survey of secondary manufacturers was limited to a sample 106 producers.

Due to the varying industry characteristics, each sector received a different questionnaire; in total, five questionnaires were used. Sawmills, veneer mills, and chip mills were grouped together, with the questionnaire modified to represent their product. Pulp mills, panelboard, secondary manufacturers, and shake and shingle mills all received unique survey questionnaires.

The first section of the questionnaire was designed to elicit information about the quantities and disposition of pulp fibre; the latter part was designed to investigate what actions firms may have undertaken (or could anticipate undertaking) in the face of pulp fibre supply shortfalls. The questionnaires were designed on the survey work by Appleby (1989) with modifications based on discussions with industry participants and government officials to include additional areas such as fibre imports (in the form of both sawlogs and chips). Table 4 shows the industry groupings and number of questionnaires mailed out and returned.

**Table 4. Questionnaire Response by Industry Group**

| Industry Group          | Surveys mailed | Surveys returned | % returned | % returned of capacity* |
|-------------------------|----------------|------------------|------------|-------------------------|
| Chip mills              | 18             | 5                | 27         | 30%                     |
| Sawmills                | 252            | 80               | 32         | 80%                     |
| Plywood/Veneer mills    | 19             | 7                | 37         | 40%                     |
| Panelboard mills        | 7              | 0                | 0          | 0%                      |
| Secondary manufacturers | 106            | 28               | 26         | n/a                     |
| Shake and shingle mills | 45             | 9                | 20         | 20%                     |
| Pulp mills              | 24             | 18               | 75         | 85%                     |
| <b>Total</b>            | <b>485</b>     | <b>147</b>       | <b>30</b>  |                         |

\* Based on reported residual chip production numbers for 1995 from the BC Ministry of Forests.

<sup>8</sup> These directories included Economics and Trade, BC Ministry of Forest (1995); Madison's (1996); and Independent Directories (1996).

<sup>9</sup> The 252 sawmills include 27 small sawmills that likely have annual capacities under 2 mmbf (the directories did not list shift/annual capacities).

Several integrated companies returned aggregated results for their solid wood processors. The response rate in terms of actual production covered rises substantially when measured as a percentage of capacity due to the fact that a much higher number of questionnaires were returned from large companies. In order to develop complete estimates of fibre production and consumption, a variety of secondary sources were consulted using both industry statistics and annual reports as well as other publications. In addition, the pulp mill survey also asked companies to identify their suppliers, which provided a means to cross-check reported production numbers as well as providing another source for information. The resulting estimates for total production and consumption were then compared to the only other publicly available estimates of fibre production and consumption (Economics and Trade, BC Ministry of Forests, 1995). The estimates were within 1% of the BC Ministry of Forest's estimates of both production and consumption.<sup>10</sup>

Larger companies that did not return surveys were contacted, in some cases several times, until they either declined to participate or returned the survey. Two trips were made to the Interior, one to Prince George and the surrounding area and one to the southern Interior to meet with companies to explain the purpose of the questionnaire and to gather their observations on changes in the pulp fibre market. For the most part, industry participants were extremely helpful and generous with their time.

The lack of response to the questionnaire from panelboard mills and hardwood-based pulp mills led to hardwood fibre and sawdust being dropped as part of the study.

Low response rates reflect several factors. The first appears to be a general fatigue associated with the number of surveys that firms receive and the perception that the considerable time and effort required to respond to these surveys yields little or no direct benefit to the company.<sup>11</sup> This is especially an issue for smaller companies; several companies were grappling with the increased administrative requirements brought about by changes in forest policy and stated that they simply did not have the resources to respond to the survey. The second factor is an increased sensitivity to the issue of fibre availability that extends throughout all sectors of the industry. The issue of confidentiality and the need to ensure that no individual companies were identified directly or indirectly was raised repeatedly.

## **CHIP PRODUCTION**

Total BC chip production for 1995 is displayed in Table 5. The production figures include all chips produced (both roundwood and residual), and where provided, pulp mill wood

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<sup>10</sup> Statistics Canada also tracks all pulp fibre consumption on a monthly and annual basis. Initial checking with Statistics Canada showed a large discrepancy, which on further examination, revealed an error that was corrected in the Statistics Canada survey. The revised Statistics Canada measure of all pulp fibre consumed was 3% greater. However, the Statistics Canada figure includes both recovered and deciduous material which were not included in the estimates developed in this study.

<sup>11</sup> This was a common comment offered by mills in follow-up efforts seeking their participation.

room chips are included. As in the past, chip production is greatest in the Vancouver and Prince George Forest Regions reflecting the concentration of solid wood processors in each region.

**Table 5. BC Chip Production (1995)**

| <i>Study Region</i>     | <i>BC Forest Service Region</i> | <i>Chip Production ('000 BDU's)</i> |
|-------------------------|---------------------------------|-------------------------------------|
|                         | Prince Rupert                   | 1,231                               |
|                         | Prince George                   | 2,718                               |
|                         | Cariboo                         | <u>1,447</u>                        |
| <b>Zone I</b>           |                                 | <b>5,396</b>                        |
|                         | Kamloops                        | 1,258                               |
|                         | Nelson                          | <u>1,043</u>                        |
| <b>Zone II</b>          |                                 | <b>2,301</b>                        |
|                         | Vancouver                       | <u>4,616</u>                        |
| <b>Zone III</b>         |                                 | <b>4,616</b>                        |
| <b>Total Production</b> |                                 | <b><u>12,313</u></b>                |

Due to concerns of disclosure it was necessary for chip production by type and receipts to be aggregated into three zones. Zone I covers the Prince Rupert, Prince George, and Cariboo Forest Regions; Zone II covers the Kamloops and Nelson Forest Regions; and Zone III covers the Vancouver Forest Region. Table 6 shows the production and receipt of chips by zone, as well as the type of chip produced.

**Table 6. Production by Type of Chips and Receipts (1995)**

|                                | <b>Zone I</b> |     | <b>Zone II</b> |     | <b>Zone III</b> |     |
|--------------------------------|---------------|-----|----------------|-----|-----------------|-----|
| <b>Production ('000 BDU's)</b> |               |     |                |     |                 |     |
| Roundwood                      | 964           | 18% | 266            | 12% | 2,163           | 47% |
| Residual                       | 4,432         | 82% | 2,035          | 88% | 2,453           | 53% |
| <i>Total</i>                   | <i>5,396</i>  |     | <i>2,301</i>   |     | <i>4,616</i>    |     |
| <b>Receipts</b>                | 4,907         |     | 1,908          |     | 5,872           |     |
| <b>Difference</b>              | 489           |     | 393            |     | (1,256)         |     |

The difference between production and receipts reflects the movement of chips between the different zones of the province, as well as imports and exports. While firms were uncomfortable with publicly reporting imports, even on a regional basis, it is possible to show the broad movement of chips between these three zones within the province.

The significantly larger proportion of roundwood chips in Zone III (Vancouver Forest Region) relative to Zone I and II is due to the influence of two factors. One is the type of



the forest resource; greater amounts of the timber stock on the Coast contains decadent wood with little solid wood value relative to the Interior. As an illustration, lumber production in terms of cubic metres of lumber produced relative to cubic metres of timber harvested in 1995 was 30% for the Coast, and 49% for the Interior. The second factor is the historical development of the BC pulp industry which has (in response to regional timber characteristics, available technology, and prices) produced a Coastal industry in which mechanical capacity is a much greater proportion of total capacity than it is in the Interior. Although aggregate capacity is about evenly split between zones, mechanical pulping technology constitutes about 56% of Coastal capacity but only 29% of Interior capacity (see Table 3).

The survey results show a small movement of chips from Zone I to Zone II. The bulk of regional movements were from the two Interior zones to the Coast. Reported shipments from Zone I and Zone II to the Coast were 31,000 and 685,000 BDU's, respectively; another 129,000 BDU's of receipts received on the Coast were simply reported as Interior chips. The total transfer of chips from the Interior to the Coast was 845,000 BDU's. This can be placed in perspective by noting the "average" BC pulpmill draws about 550 BDU's in annual furnish.<sup>12</sup>

The survey also asked for information on future pulp fibre production and consumption. Several pulp mills indicated that they projected small increases in capacity, however not all mills planned to change pulp capacity. The total planned increase in pulp capacity is 93,800 metric tonnes while the associated demand for solid wood pulp fibre is projected to drop slightly on both the Coast and in the Interior, reflecting the conversion of chip consuming capacity to sawdust capacity.

### **CHIP FLOWS, IMPORTS, AND EXPORTS**

Respondents reported that 1.4 million cubic metres of solid wood and about 500,000 BDU's of wood chips were imported. Several respondents did not quantify how much fibre they imported, and therefore this number provides a lower bound on imported fibre. Statistics compiled by various government agencies can be used to develop an estimate of BC fibre imports. Table 7 shows imports totaled 3.5 million cubic metres of solid wood and 470,000 BDU's of wood chips. There were also minor imports of solid wood from Saskatchewan although no estimates could be developed.

For this study, all shipments from Alberta and the Yukon were assumed to go to Interior mills; imports from the US were assigned to the Coast or Interior depending on the state of origin or the species. It should be noted that to date all imported chips from outside of Canada have come from either Alaska, Washington, Idaho, or Montana.

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<sup>12</sup> The 129,000 BDU's of Interior chips unassigned to either zone reflect survey respondents who did not identify specific suppliers or regions within the Interior.

**Table 7. Reported imports from outside British Columbia (1995)**

| <i>Region</i>   | <i>Logs ( cubic metres)</i> | <i>Chips (BDU's)</i> |
|-----------------|-----------------------------|----------------------|
| Alberta         | 2,100,000                   | 66,000               |
| Yukon           | 212,000                     |                      |
| United States*  | 168,169                     | 405,824              |
| United States** | 1,002,763                   |                      |

\* pulpwood \*\* softwood sawlogs

Source: Statistics Canada; Resource Management Branch, Yukon; Forest Revenue, Alberta

In order to report chip imports, consumption, and inventory changes, it was necessary to aggregate the two Interior zones to maintain confidentiality of data sources. Table 8 shows the reported production and disposition of that fibre. The import volumes in Table 7 include all chips from outside BC, regardless of whether they came from the US or elsewhere in Canada.

**Table 8. Fibre Source and Use by the Coast and Interior in MBDU's (1995)**

|                                  | <i>Interior</i> | <i>Coast</i> | <i>Total</i> |
|----------------------------------|-----------------|--------------|--------------|
| Production                       | 7,697           | 4,616        | 12,313       |
| Transfers Out/In                 | (845)           | 845          |              |
| Import                           | 274             | 416          | 690          |
| Export                           | 353             | 108          | 461          |
| Consumption                      | 6,412           | 5,496        | 11,908       |
| Consumption as a % of Production | 83%             | 119%         | 97%          |
| Receipts                         | 6,815           | 5,872        | 12,687       |
| Fibre Available *                | 6,772           | 5,770        | 12,542       |

\*Fibre Available is calculated as production + imports + net transfers - exports.

While fibre availability and fibre receipts should be the same, the excess of 145,000 BDU's likely reflects direct receipts of pulpwood at wood rooms not captured in the pulp fibre production (some mills did not distinguish roundwood chips from external operations versus production in their own wood rooms). This excess was largest on the Coast at 102,000 BDU's.

Consumption of pulp fibre was 6,412,000 BDU's in the Interior, and, 5,496,000 BDU's on the Coast (excluding sawdust and hardwood chip volumes). While consumption within the Interior was 83% of the production of pulp fibre within the Interior, Coastal consumption was 119%, reflecting the need to draw additional fibre from outside regions. Reported inventory changes showed an increase in inventory of 403,000 BDU's at Interior pulp mills and 253,000 BDU's at Coastal pulp mills—a total increase of 655,000 BDU's.

Reconciling receipts with consumption indicates that there was an additional 123,000 BDU's received on the Coast that was not consumed; this likely reflects an increase in inventory. This additional fibre increased Coastal inventories to 376,000 BDU's, and provincial inventory levels to 779,000 BDU's at the end of 1995.

## FIBRE BALANCE

As displayed in Table 8, there was a net gain of 229,000 BDU's (the amount by which pulp fibre imports exceeded chip exports) from direct imports. If the direct imports of pulp fibre of 690,000 BDU's are compared to the increase in inventory of between 655,000 to 779,000 BDU's, this suggests that the province as a whole was, "roughly", in a fibre balance in 1995. However, a substantial volume of solid wood fibre also entered the province. While some of this was directly classified as pulp fibre (168,169 cubic metres out of 3.5 million cubic metres), it is not possible to identify whether all of the remaining material was sawlog quality.<sup>13</sup> Assuming that all volumes not reported as pulpwood or chips were sawlogs, this would still mean that an additional 351,000 BDU's of residual chips in the Interior and an additional 146,000 BDU's of residual chips on the Coast would have come from processing imported sawlogs (assuming 0.15 BDU's per cubic metre of log sawn). Thus, an estimated additional 497,000 BDU's were indirectly imported as a byproduct of sawmill operations (this number would be lower and direct imports higher if a greater proportion of the solid wood imports entered as pulpwood and not as sawlogs).

The indirect imports are reported separately because of their sensitivity to the ratio of sawlogs to pulpwood employed in the estimation. Table 9 displays their effect on the production and consumption of pulp fibre assuming minimal imports of pulpwood. *Production* reports production using both imported and domestically produced fibre, while *Production Excluding Indirect Imports* reports production from fibre harvested only within BC. If indirect imports had not been available, domestic production would have been less than the consumption of pulp fibre.

**Table 9. Pulp Fibre Production and Indirect Imports of Residual Pulp Fibre into the Coast and Interior in MBDU's (1995)**

|                                       | Interior | Coast   | Total  |
|---------------------------------------|----------|---------|--------|
| Production                            | 7,697    | 4,616   | 12,313 |
| Indirect Imports                      | 351      | 147     | 497    |
| Production Excluding Indirect Imports | 7,347    | 4,469   | 11,816 |
| Consumption                           | 6,412    | 5,496   | 11,908 |
| Balance                               | 934      | (1,027) | (92)   |

## SENSITIVITY OF PULP FIBRE SUPPLY TO PRICE

Pulp fibre producers were asked to comment on their reaction to high pulp fibre prices during 1995. Several respondents noted that they had chipped low grade lumber while others noted that they had brought additional pulp fibre into the mill. The total amount of lumber chipped was approximately 1% of the respondents' total lumber production. Estimates of the additional fibre retrieved as a percentage of each mill's harvest ranged from 2 to 10%. Some secondary manufacturing operations had difficulty in obtaining

<sup>13</sup> Several industry participants in Prince George suggested that there had been significant imports of pulpwood from Alberta but could not provide any estimates.

their raw materials, such as lumber trim, during times of peak fibre demand. Somewhat paradoxically, these secondary manufacturing operations stated that they had no outlet for their residual fibre and often had to incur disposal costs. Problems in utilizing this source of fibre include the variation in type of fibre and the small volumes associated with most operations.

Respondents were also asked to remark on how price affected their decisions to change their supply of pulp fibre. As expected, respondents stated that they started to chip lumber when net revenues from selling lumber dropped below chip prices. Respondents were not willing to identify the price level at which they would bring in additional pulp fibre. However chip prices ranging from \$39/cubic metre to \$69/cubic metre in the Interior and up to \$100 per cubic metre on the North Coast were reported, while several reported the price as “their logging cost”.<sup>14</sup>

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<sup>14</sup> Thirteen firms provided prices, all in the Interior. No Coastal firm reported any specific prices although several stated their logging cost as their price.

## SECTION 3

### RECOVERY RATES AND FIBRE USE

One of the primary objectives of this study was to look at present and future fibre availability in BC. By assessing recovery factors as well as trends involving the direction of fibre flows and changes in the forest products industry, observations regarding future supply conditions can be made.

Survey results show that the historic chip recovery factors have remained relatively constant over time. Table 10 reports the chip recovery factors (in BDU's per cubic metre of log sawn) by Forest Region for selected years. Included in this table are the reported 1995 chip recovery factors derived from the pulp fibre survey. Most individual companies that provided historic chip recovery factors or discussed their projected chip recovery factor indicated that it had fallen slightly over time as lumber recovery increased. The apparent lack of change likely reflects improvements in lumber recovery being offset by a secular decline in log quality over the same period. Regional differences in chip recovery is due to differences in technology and log size, along with different production decisions (for example, maximizing lumber recovery versus lumber produced per shift will lead to different rates of chip production).

**Table 10. Historic and Reported Chip Recovery Factors (BDU/cubic metre)**

| <i>Region</i>            | <i>1987</i> | <i>1990</i> | <i>1993</i> | <i>1995<sup>1</sup></i>  |
|--------------------------|-------------|-------------|-------------|--------------------------|
| Cariboo                  | 0.16        | 0.15        | 0.16        | 0.124-0.168              |
| Prince George            | 0.14        | 0.14        | 0.14        | 0.110-0.168              |
| Kamloops                 | 0.13        | 0.16        | 0.14        | 0.150-0.185              |
| Nelson                   | 0.14        | 0.14        | 0.13        | 0.157-0.165              |
| Prince Rupert            | -           | -           | -           | 0.133-0.180              |
| Prince Rupert (Interior) | 0.16        | -           | -           | -                        |
| Prince Rupert (Coast)    | 0.16        | 0.18        | 0.15        | -                        |
| Vancouver                | 0.16        | 0.17        | 0.15        | 0.138-0.194 <sup>*</sup> |

<sup>\*</sup> volumetric units (VU) per cubic metre of log sawn.

<sup>1</sup> Data for 1995 developed from this survey.

Source: Economics and Trade, BC Ministry of Forests

Although residual chips from sawmills has declined with the amount of lumber produced (see Table 11 and Table 12), the percent of harvest utilized by the pulp and paper industry has remained relatively unchanged. Also, the increase in harvest processed at veneer and panel mills reflects an actual decrease in solid wood consumption and associated residual chips, due to increased OSB production (OSB mills that consume chips rather than produce them are included in this category). Pulp mills are looking to other sources of fibre, including whole log chipping and imports. Over the 1990-1995 period whole log chipping increased by 157% (Table 12) and increased demand in BC reduced the volume of chip exports (see Figure 4).

**Table 11. Softwood Fibre Consumption by BC Pulp and Paper Mills ('000 m<sup>3</sup>)**

|                           | 1990   | 1991   | 1992   | 1993   | 1994   | 1995   |
|---------------------------|--------|--------|--------|--------|--------|--------|
| Consumption               | 31,850 | 31,156 | 29,461 | 32,262 | 34,413 | 34,290 |
| Direct                    | 16%    | 32%    | 19.70% | 21.50% | 20.30% | 23.50% |
| Chip Imports              | N/A    | N/A    | 0.40%  | 0.30%  | 3.00%  | 3.50%  |
| Indirect                  | 84%    | 68%    | 80%    | 78%    | 77%    | 73%    |
| <br>% Harvest used by P&P | 41%    | 42%    | 40%    | 43%    | 44%    | 43%    |

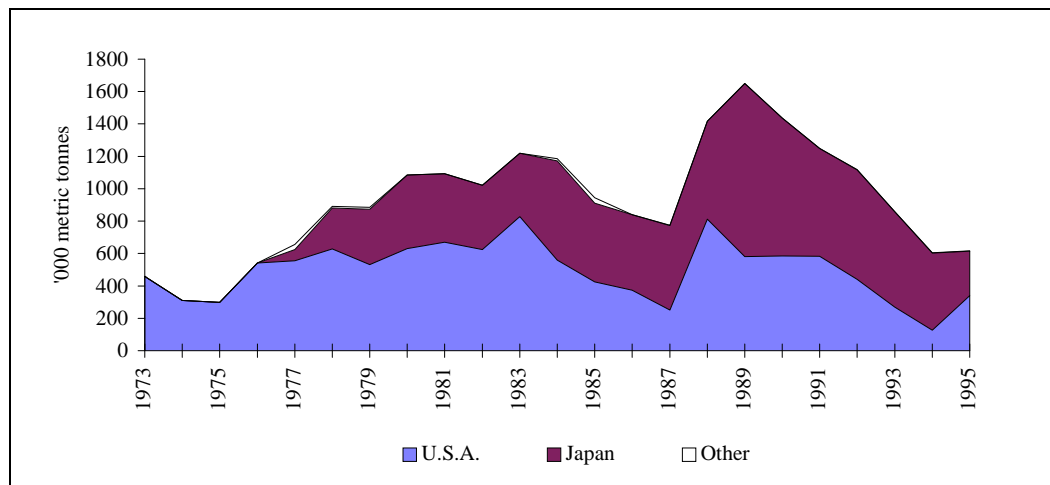
**Note:** Sawdust volumes may not have been completely captured prior to 1992; 1995 reported as 12.7 million BDU's and includes hardwood volumes. Direct reflects wood processed directly in wood rooms and chipping mills as a percentage of consumption. Indirect equals all fibre consumed less imports and directly processed fibre.

*Source:* Economics and Trade, BC Ministry of Forests; Statistics Canada

**Table 12. Primary Breakdown of Timber Harvest ('000 m<sup>3</sup>)**

| Primary Use   | 1990          | 1991          | 1992          | 1993          | 1994          | 1995          | % change |  | % of harvest |      |
|---------------|---------------|---------------|---------------|---------------|---------------|---------------|----------|--|--------------|------|
|               |               |               |               |               |               |               | 1990-95  |  | 1990         | 1995 |
| Lumber        | 64,129        | 58,182        | 60,849        | 61,472        | 60,098        | 59,576        | -7       |  | 81.9         | 77.6 |
| Chip          | 1,647         | 2,237         | 2,468         | 3,098         | 4,155         | 4,237         | 157      |  | 2.1          | 5.5  |
| Pulp Mill     | 3,605         | 7,600         | 3,349         | 3,851         | 2,841         | 3,815         | 6        |  | 4.6          | 5.0  |
| Veneer/Panel  | 4,406         | 4,450         | 4,713         | 4,642         | 5,413         | 5,435         | 23       |  | 5.6          | 7.1  |
| Shake/Shingle | 1,711         | 1,539         | 1,321         | 1,223         | 1,173         | 1,291         | -25      |  | 2.           | 1.7  |
| Post/Log Home | 372           | 521           | 530           | 476           | 479           | 582           | 56       |  | 0.5          | 0.8  |
| Exports       | 804           | 768           | 1,139         | 1,170         | 735           | 612           | -24      |  | 1.0          | 0.8  |
| Reject Logs   | 197           |               |               |               |               | 596           |          |  | 0.3          | 0.8  |
| <b>Total</b>  | <b>76,477</b> | <b>75,297</b> | <b>74,369</b> | <b>75,932</b> | <b>74,894</b> | <b>74,952</b> |          |  |              |      |
| <br>Harvest   | 78,316        | 73,676        | 74,004        | 75,392        | 75,650        | 76,741        |          |  |              |      |

*Source:* Economics and Trade, Ministry of Forests

**Figure 4. Exports of Wood Chips from BC**

*Source:* Statistics Canada, Catalog 65-004, COFI.

Respondents indicated that consumption factors, in BDU's per tonne of pulp produced, were 1.79, and 1.66 BDU's for the Interior and Coast, respectively. These values drop to 1.71 and 1.58 with sawdust excluded from the furnish and aggregate production maintained at the same level.<sup>15</sup> Historic data suggests that these consumption factors have fallen over time as pulp yields improved due to the increasing proportion of high yield pulp produced. The higher consumption factor for the Interior, relative to the Coast, reflects the greater proportion of chemical pulp (which has lower yields than mechanical pulp) produced in the Interior. About 70% of Interior capacity is chemical pulp versus 44% of Coastal capacity. In addition, Interior chemical pulp capacity is about 60% of total provincial chemical pulp capacity (see Table 3) . Several pulp mills noted that they had seen a measurable improvement in chip recovery by changing chip screens.

### **FUTURE AVAILABILITY**

Table 13 shows an approximation of regional and provincial residual chip deficit/surplus based on a selection of operating rates for the sawmill and pulp industries. Note that these tables do not include chips from chipping mills, other residual chips, nor fibre consumed directly in pulp mill wood rooms.<sup>16</sup> Table 13 also shows the imputed flow of sawlogs through the sawmill sector at different rates of capacity utilization.

Not surprisingly, residual chips are insufficient to sustain the Coastal industry even during good lumber markets and poor pulp markets. As noted earlier, the Coastal industry relies on residual chips for approximately half its fibre furnish. The situation is somewhat better in the Interior; good lumber markets can sustain the Interior industry under poor market conditions for pulp, although additional analysis not reported in this study suggested that the balances differ sharply between Zone I and Zone II.

The first part of Table 13 shows residual fibre from the sawmill sector. Based on the past averages reported in Table 12, residual chips from veneer and shake and shingle mills have averaged approximately 750,000 BDU's annually (note that reported consumption in 1994 and 1995 include OSB mills), while roundwood chip production in both wood rooms and at chip mills has steadily increased, reaching 2.9 million BDU's in 1995. If veneer and shake and shingle mills are able to maintain historic rates of production, and roundwood chip production is maintained at 1995 levels, these sources would generate a total of 3.65 million BDU's of additional pulp fibre. This scenario is detailed in the second part of Table 13, showing the impact on the provincial fibre balance. According to these calculations, BC as a whole would only need to find additional sources of pulp

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<sup>15</sup> Note that this aggregates all types of pulp production (mechanical and chemical) and is based on reported production and consumption for 1995. Further information on the calculation of these numbers is provided in the Appendix along with a glossary of terminology.

<sup>16</sup> The additional fibre in Table 13 was constructed by examining the average consumption of timber by veneer and shake and shingle mills for 1990-1993 (1994 and 1995 were excluded because the increase in apparent consumption for veneer mills is due to the incorporation of OSB mills, which consume rather than produce chips). Using an average chip recovery factor of 35% (log recovery), and using 2.7 BDU's per cubic metre, this led to an average annual production level of 778,000 BDU's, rounded down to 750,000 BDU's. Chip mill and pulp mill wood room production of 2.9 million BDU's come directly from the harvest consumed in 1995 and converted using the same measure.

fibre whenever the pulp sector was operating near capacity and the sawmill sector was operating well below full capacity.

**Table 13. Pulp Fibre Balance - Surplus (Deficit) in MBDU's  
(Residual sawmill chips only)**

| Provincial     |        | Pulp Markets |        |        |        |        |
|----------------|--------|--------------|--------|--------|--------|--------|
| Imputed Sawlog |        |              |        |        |        |        |
| Harvest        | Lumber | 70%          | 75%    | 80%    | 90%    | 100%   |
| 45,307         | 70%    | -3,039       | -3,692 | -4,345 | -5,650 | -6,955 |
| 51,779         | 80%    | -2,168       | -2,821 | -3,474 | -4,779 | -6,084 |
| 58,252         | 90%    | -1,297       | -1,950 | -2,603 | -3,908 | -5,213 |
| 64,724         | 100%   | -426         | -1,079 | -1,732 | -3,037 | -4,342 |

| Coast          |        | Pulp Markets |        |        |        |        |
|----------------|--------|--------------|--------|--------|--------|--------|
| Imputed Sawlog |        |              |        |        |        |        |
| Harvest        | Lumber | 70%          | 75%    | 80%    | 90%    | 100%   |
| 14,228         | 70%    | -2,624       | -2,926 | -3,227 | -3,829 | -4,431 |
| 16,261         | 80%    | -2,397       | -2,698 | -2,999 | -3,602 | -4,204 |
| 18,293         | 90%    | -2,170       | -2,471 | -2,772 | -3,374 | -3,976 |
| 20,326         | 100%   | -1,942       | -2,244 | -2,545 | -3,147 | -3,749 |

| Interior       |        | Pulp Markets |       |        |        |        |
|----------------|--------|--------------|-------|--------|--------|--------|
| Imputed Sawlog |        |              |       |        |        |        |
| Harvest        | Lumber | 70%          | 75%   | 80%    | 90%    | 100%   |
| 31,079         | 70%    | -415         | -767  | -1,118 | -1,821 | -2,524 |
| 35,518         | 80%    | 229          | -123  | -474   | -1,177 | -1,881 |
| 39,958         | 90%    | 872          | 521   | 169    | -534   | -1,237 |
| 44,398         | 100%   | 1,516        | 1,165 | 813    | 110    | -593   |

**Provincial Fibre Balance Including 3.65 million BDU's of Roundwood and Other  
Residual Production**

| Provincial     |        | Pulp Markets |       |       |        |        |
|----------------|--------|--------------|-------|-------|--------|--------|
| Imputed Sawlog |        |              |       |       |        |        |
| Harvest        | Lumber | 70%          | 75%   | 80%   | 90%    | 100%   |
| 45,307         | 70%    | 611          | -42   | -695  | -2,000 | -3,305 |
| 51,779         | 80%    | 1,482        | 829   | 176   | -1,129 | -2,434 |
| 58,252         | 90%    | 2,353        | 1,700 | 1,047 | -258   | -1,563 |
| 64,724         | 100%   | 3,224        | 2,571 | 1,918 | 613    | -692   |

As an example, in 1995 the pulp and paper industry on the Coast and in the Interior operated at 91% and 93%, respectively. During this same period, the Coastal lumber industry operated at 77% of capacity and the Interior lumber industry at 95% of capacity. By incorporating these utilization measures, there would be an estimated shortfall of



500,000 BDU's during 1995. This shortfall is comparable to the 229,000 BDU's of imports in that year.

However, given the anticipated reductions in the allowable cut, the harvest level could fall 17% (Price Waterhouse 1995(a)).<sup>17</sup> A 17% reduction in harvest levels, assuming it was solely reflected in a reduction of available sawlogs, would reduce available residual chips by 1.74 million BDU's (in essence, the lumber industry would move from operating at 90% of capacity to 70% based solely on fibre availability). This in turn would create a fibre deficit of 3.3 million BDU's if the pulp industry were operating at full capacity.<sup>18</sup> Using figures provided by the Canadian Pulp and Paper Association (1996), the utilization rate in the BC pulp and paper industry between 1980 and 1995 fluctuated between 75.4% and 99.7% and averaged 88.3%.

If the factors used to estimate consumption and production are modified, the fibre balance can change dramatically. Table 14 shows the change in the relative fibre balance for a 10% increase and decrease in chip recovery, and the effects of increasing and decreasing regional consumption factors of pulp production by 10%. Two representative utilization levels are shown to illustrate the effects of changing the underlying variables. The baseline comes from Table 13.

**Table 14. Sensitivity of Estimated Fibre Balance to Changes in Model Variables**

|                                | Relative Utilization Levels<br>Lumber, Pulp Industries |           |
|--------------------------------|--------------------------------------------------------|-----------|
|                                | 70%,70%                                                | 100%,100% |
| Baseline                       | 611                                                    | (692)     |
| 10% increase in chip recovery  | 1,220                                                  | 179       |
| 10 % decrease in chip recovery | 1                                                      | (1,563)   |
| 10 % increase in consumption   | (303)                                                  | (1,997)   |
| 10 % decrease in consumption   | 1,524                                                  | 613       |

Baseline Assumptions: Chip Recovery Factor = .53 BDU per mbf on the Coast; .58 BDU per mbf in the Interior  
Consumption factors: 1.58 BDU/tonne on the Coast; 1.71 BDU per tonne in the Interior

## DISCUSSION

It must be emphasized that these forecasts rely on historic numbers, based on past harvests and consumption patterns. Note that the estimated consumption is based on 1995 production and since the product mix may vary in the future, so will the consumption factor. An additional factor is the differences in the sources of supply. For example, private harvests in BC have averaged between 9 to 10 million cubic metres in the past few years. These harvests, along with the current level of imports, have been very sensitive to the record prices paid for fibre in the past two years, and may not be sustainable in the long run. Another variable is the chip recovery factor. Some mills

<sup>17</sup> The annual allowable cut stood at approximately 71.4 million cubic metres in 1995.

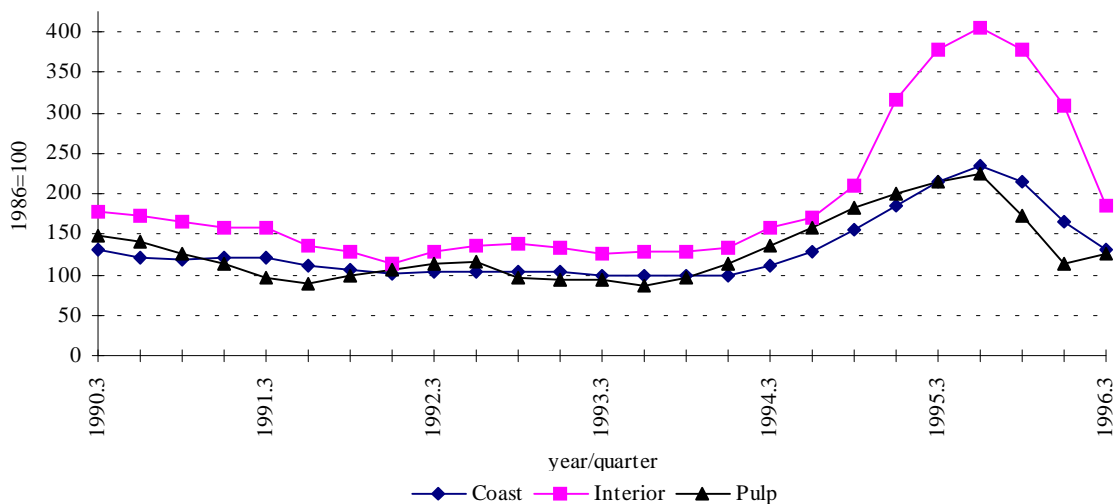
<sup>18</sup> Note also that these harvest reductions are not uniformly spread throughout the province; it is expected that harvest levels on the Coast might fall even further.

reported altering their chip production in response to the record prices paid in 1995, although such responsiveness is limited by lumber prices that in the past have tended to be substantially higher than the chip value of the equivalent wood fibre. As well, the fibre produced from roundwood chips has supplemented the existing residual fibre in the past. If both the sawmill and pulp and paper sectors turn to the same fibre source, such as small wood, the resulting competition may make this fibre more costly to the point that it is uneconomic.<sup>19</sup>

Finally, the volume-based quota system of the Canada-US Softwood Lumber Agreement may lead to changes in production patterns. The availability and attractiveness of the different sources of fibre will depend on the relative prices in the log, lumber, and pulp markets, as well as the overall economic activity. Quite clearly a large component of future pulp fibre supply will be increasingly sensitive to prices and costs; more so than in the past.

Figure 5 displays the relative change in wood chip prices in both the Coastal and Interior chip markets, as well as the price of bleached pulp (Statistics Canada 1996). The rapid run-up in chip prices led to a sudden influx of pulp fibre from the variety of sources outlined earlier. However, the unexpected decline in the pulp market and commitments to long-term supply contracts of imported fibre led to a rapid increase in inventory levels in the later part of 1995 as pulp production and shipments slowed down.

**Figure 5. Relative Price Index for Wood Chips and Bleached Chemical Pulp Exports**



Source: Statistics Canada Catalog, various issues; COFI Stats, various issues

<sup>19</sup> Lippke(1996) states that in the peak market conditions in 1995 pulp mills could afford to outbid sawmills for small logs in the Pacific Northwest. However, given the relative product prices for pulp and lumber, this ability does not represent long-term supply prices but merely a period of extreme market premiums to pulp furnish.

Table 15 details the fibre costs of the traditional producers of softwood market kraft pulp. The impact of these fibre prices can be seen in the substantial increase in fibre costs paid by BC mills. While fibre costs increased in all six regions in 1995, the increases in BC, which averaged about 80% year over 1994, were considerably greater than those in the competing regions. BC had the highest fibre costs among the regions. At these price levels, BC becomes the marginal producer of market pulp and during periods of low demand, higher cost mills will be the first to shut. Table 16 provides an estimate of relative production costs across major producers. This illustrates the vulnerability of BC production to the periods of low pulp prices and the difficult competitive market position.

**Table 15. Fibre Costs per Tonne for 1994 and 1995 by Region (C\$/tonne)**

| <b>Region</b>  | <b>1994</b> | <b>1995</b> | <b>% Change</b> |
|----------------|-------------|-------------|-----------------|
| US South       | \$185       | \$193       | 4%              |
| US West        | \$287       | \$388       | 26%             |
| BC Interior    | \$216       | \$396       | 83%             |
| BC Coast       | \$239       | \$425       | 78%             |
| Eastern Canada | \$225       | \$270       | 20%             |
| Scandinavia    | \$320       | \$378       | 18%             |

Source: Price Waterhouse, 1995(b), 1996

**Table 16. Market Pulp Regional Comparison of Production Costs (1995)<sup>1</sup>**

|                              | <i><b>US<br/>South</b></i> | <i><b>Eastern<br/>Canada</b></i> | <i><b>Sweden/<br/>Finland</b></i> | <i><b>US<br/>West</b></i> | <i><b>BC<br/>Interior</b></i> | <i><b>BC<br/>Coast</b></i> |
|------------------------------|----------------------------|----------------------------------|-----------------------------------|---------------------------|-------------------------------|----------------------------|
| Fibre                        | 193                        | 270                              | 378                               | 388                       | 396                           | 425                        |
| Labour                       | 86                         | 103                              | 72                                | 81                        | 108                           | 137                        |
| Chemicals                    | 87                         | 61                               | 76                                | 73                        | 76                            | 69                         |
| Energy                       | 25                         | 35                               | 14                                | 58                        | 32                            | 47                         |
| Other Mill                   | 63                         | 76                               | 72                                | 85                        | 109                           | 123                        |
| Corp. and Selling            | <u>15</u>                  | <u>31</u>                        | <u>13</u>                         | <u>31</u>                 | <u>20</u>                     | <u>30</u>                  |
| <i>Total (less delivery)</i> | <i>469</i>                 | <i>576</i>                       | <i>625</i>                        | <i>716</i>                | <i>741</i>                    | <i>831</i>                 |
| Delivery                     | <u>74</u>                  | <u>59</u>                        | <u>63</u>                         | <u>92</u>                 | <u>116</u>                    | <u>78</u>                  |
| <b>Total 1995</b>            | <b>543</b>                 | <b>635</b>                       | <b>688</b>                        | <b>808</b>                | <b>857</b>                    | <b>909</b>                 |

<sup>1</sup>Softwood kraft market pulp only. Costs are calculated before depreciation and are in Cdn \$/tonne (using exchange rates in effect on March 31, 1996).

Source: Price Waterhouse, 1996

BC pulp is heavily dependent on the export market (over 90% is exported out of the province) and the prices for these commodities have a history of extreme volatility. There is no reason to expect that this characteristic will change. Table 17 provides a recent price history and a forecast for the pulp and the other major forest products. A further factor which affects domestic returns is the impact of exchange rates; exports of

pulp are largely sold in US dollars. Thus, any appreciation in the Canadian dollar means that exporters receive less for their products.<sup>20</sup>

**Table 17. Commodity Forecasts (C\$/Unit)**

|             | Units    | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|-------------|----------|------|------|------|------|------|------|------|
| NBSK Pulp   | m. tonne | 737  | 594  | 765  | 1202 | 810  | 751  | 956  |
| Newsprint   | m. tonne | 594  | 628  | 642  | 915  | 881  | 785  | 854  |
| Liner Board | sh. ton  | 474  | 430  | 512  | 696  | 522  | 546  | 615  |
| Lumber      | mbf      | 317  | 455  | 470  | 341  | 482  | 451  | 437  |
| OSB         | msf      | 294  | 318  | 362  | 335  | 251  | 212  | 191  |
| Cdn Dollar  | Cdn\$    | 0.83 | 0.78 | 0.73 | 0.73 | 0.73 | 0.75 | 0.75 |

*Source:* CIBC Wood Gundy, 1996 (exchange rates in effect March, 1996).

The BC forest industry has seen a number of recent policy changes regarding stumpage levels, harvesting practices, and land use planning. This has created a great deal of uncertainty as the industry attempts to come to terms with these changes. The greatest impact of these policy changes will be felt by the Coast which holds half of the province's pulp capacity. The greatest challenge is the increased cost of fibre arising from these changes. This in turn will have a significant impact on the sawmilling industry, due to the highly integrated nature of residual wood chips and pulpwood.

Other variables which affect the chip market include government policy with respect to restrictions on chip exports and changes within the corporate structure. In addition, the industry faces large capital expenditures to meet effluent standards over the next five years, reducing the opportunity to undertake investments to either find alternative sources of supply or to convert low-yielding chemical pulp capacity into higher-yielding mechanical pulps, or to move up the product value chain.<sup>21</sup>

<sup>20</sup> It is estimated that a 1 cent increase in the Canadian/US exchange rate costs the BC forest industry about \$200 million dollars in annual returns. (Price Waterhouse, 1996).

<sup>21</sup> In January, 1992 BC Environment amended the mill liquid effluent regulations to require the complete elimination of AOX (adsorbable organic halides) produced by the bleaching process by December 31, 2002.

## SECTION 4

### CONCLUSIONS

While the province has recently tended to have a surplus of pulp fibre, the 1995 supply and disposition analysis suggests that the BC industry faces a significant shortfall in fibre supply. Although the actual magnitude of fibre deficit may vary, the estimated decreases in residual chip production in both the Interior and on the Coast point to the increasing use of roundwood in both regions. On the Coast, this fibre is likely to come at an increased cost, both in terms of harvesting costs as well as the opportunity cost of what that wood may yield in alternative solid wood products. In the Interior, sufficient roundwood fibre exists to meet the needs of the Interior industry even during times of peak demand. However, given the magnitude of the fibre deficit on the Coast, more fibre is likely to flow from the Interior to the Coast, which in turn could place significant competitive pressures on the Interior. If production falls in both regions, due to either harvest level reductions or in response to lumber export quota restraints, there is likely to be additional cost pressure on the residual chip market, as the base across which fixed costs can be spread shrinks for lumber manufacturers.

The magnitude of the estimated 17% decline in fibre availability<sup>22</sup>, roughly comparable to the capacity of six 'average' pulp mills, coupled with changes in the nature of that fibre supply, suggest the industry is entering a period of increased volatility as both the sawmill sector and pulp and paper sector attempt to develop alternative supplies. While increased roundwood offers the possibility of replacing some of the lost residual chip supply, the increase in cost associated with roundwood raises the possibility that there will be a reduction in pulp capacity to reflect the reduced pulp fibre supply. Long term adjustments in the relative sizes of the solid wood sector and pulp and paper sector will ultimately depend on the equilibrium price structure for solid wood and pulp and paper products.

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<sup>22</sup> Price Waterhouse, 1995. This estimate was based on the 5-10 year impacts of the Timber Supply Review (TSR), the Protected Areas Strategy (PAS) and the Forest Practices Code (FPC) on the allowable annual cut.

## REFERENCES

- Appleby, P.W. 1989. Pulp Chip Availability in British Columbia: 1987. FRDA Report 061.
- CIBC Wood Gundy. 1996. Forest Industry Facts. *Investment Research*. Toronto.
- COFI Stats. Various issues. *Council of Forest Industries*. Monthly.
- CPPA. 1996. Wood Pulp--Reference Tables. *Canadian Pulp and Paper Association*. Montreal.
- Easton, John. 1996. North American Wastepaper Supply and Demand: Global Implications. *Canadian Papermaker*, January: 55-57.
- ECE. 1994. *Forest Products Annual Market Review 1993-1994*. United Nations Economic Commission for Europe, Food and Agriculture Organization of the United Nations:48 (3).
- Economics and Trade, BC Ministry of Forests. 1995. Major Primary Timber Processing Facilities in British Columbia. Victoria.
- Economics and Trade, BC Ministry of Forests. 1996. Personal Communications with Viggo Holm and Winston Wai. Various months.
- Forest Management Division, Alberta. 1996. Personal Communication with Ron Dunnigan. July 3.
- Forrest, Robert. 1996. Newstech: Delivering Solutions. *Canadian Papermaker*, January: 66-69.
- Hagler, Robert. 1996. Global Fiber: Are We Running Out? *Canadian Papermaker*, November: 20-25.
- Hatton, J.V. 1997. Pulping and papermaking properties of managed second-growth softwoods. *TAPPI Journal*, January: 178-184.
- Independent Directories. 1996. Independent Directories' British Columbia Forest Directory. Burnaby, BC.
- Lippke, Bruce. 1996. Is it time to redefine what supply and demand mean? In *Proceedings of the 1995 TAPPI Global Fiber Supply Symposium*. TAPPI, Atlanta, Georgia.
- Lynn, Evadna. 1996. The Outlook for the North American Paper and Wood Products Industry and Implications for Fiber Demand. Paper presented at the *International Woodfiber Conference*. Atlanta, Georgia May 13, 1996.
- MacCallum, Mike. 1996. Forest Policies in BC -- New Challenges. Paper presented at *What is the Future of the BC Forest Industry*, Vancouver, BC December 13, 1996. Fraser Institute, Vancouver, BC.
- McLaren, James. 1996. A glut now, but what about future supplies? *Pulp and Paper International*, April: 41-43.
- Madison's. 1996. Madison's Canadian Lumber Directory. Vancouver, BC.
- Price Waterhouse. 1995(a). *Analysis of Recent British Columbia Government Forest Policy and Land Use Initiatives*, prepared for the Forest Alliance. September.
- Price Waterhouse. 1995(b). *The Forest Industry in British Columbia 1994*. Vancouver, BC.

- Price Waterhouse. 1996. *The Forest Industry in British Columbia 1995*. Vancouver, BC.
- Pulp and Paper*. 1996. "Emerging Commodity Players Shape North America's Pulp, Paper Future". September: 63-87.
- Resource Management Branch, Yukon. 1996. Personal Communication with Lyall Gill. July 4.
- Schwindt, Richard, and Terry Heaps. 1996. *Chopping Up the Money Tree*. David Suzuki Foundation, Vancouver, BC.
- Statistics Canada. Various issues. *Industry Price Indexes*. Catalog #62-011. Ottawa.
- Statistics Canada. 1996. Personal communication with Liisa Pent. August.
- Statistics Canada. Various issues. *Production, shipments, and stocks on hand of sawmills in British Columbia*. Catalog #35-003. Ottawa.
- Statistics Canada. Imports of wood fibre into BC by month and country for 1992-1996. Special compilation.
- Timber Supply Branch, BC Ministry of Forests. 1997. *Summary of Timber Supply Review Results 1992-1996*. Memorandum, January 29, 1997.
- Warren, Debra. 1996. *Production, Prices, Employment, and Trade in Northwest Forest Industries*. Pacific Northwest Research Station, PNW-RB-211.
- Watson, P.A., and J.V. Hatton. 1996. Increasing the use of supplemental fibres in pulping. *Forestry Chronicle* 72 (5):501-504.

## APPENDIX

### DERIVATION OF TABLE 13.

The cells in Table 13 are created by constructing demand and supply for the different rates of capacity utilization. Pulp producing capacity by region comes from the survey respondents. Demand for the pulp sector then equals regional capacity multiplied by the rate of capacity utilization multiplied by the consumption factor. For the province, pulp producing capacity was 7.923 million metric tonnes, and the consumption factors for the Coast and Interior were 1.58 BDU's per tonne and 1.71 BDU's per tonne, respectively, as measured by the survey.<sup>23</sup> These consumption factors were calculated by dividing all solid wood consumption (excluding sawdust) by total production.

The supply of residual chips from the sawmill sector was constructed in the same fashion. Supply of pulp fibre equals lumber capacity multiplied by the rate of capacity utilization multiplied by the chip recovery factor. In this case, measures of lumber capacity came from the 1995 Primary Timber Processors published by the Ministry of Forests. Total estimated capacity for lumber production in 1995 was 15.388 billion board feet. Chip recovery factors again came from the survey, and represent a volume weighted average. The chip recovery factor used for the Coast was .53 BDU's per mbf, and for the Interior .58 BDU's per mbf. Fibre balance then equaled demand less supply.

Solid wood processed by the sawmill sector at different rates of capacity utilization were computed by using a lumber recovery factor of 250 board feet per cubic metre of log input for the Interior and 211 board feet per cubic metre of log input for the Coast.

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<sup>23</sup> The capacity estimate does not include capacity based on sawdust, deciduous or recovered furnish.



## GLOSSARY

### ***Chemical Pulp***

Chemical pulp is produced by using chemicals to free the wood fibres by dissolving the surrounding matrix. As a consequence, the resulting pulp tends to be quite strong, as the length of the fibres is relatively unaffected by this process. Because a significant portion of the raw material is dissolved, however, output yields are on the order of 40-55%. The sulfate process is the most commonly used chemical process, which coupled with bleaching, produces the standard Bleached Kraft Pulp (BKP) produced by most mills in BC.

### ***Measurement Units***

In British Columbia, chip volumes are reported in a variety of measurement units. The measurements differ between units of volume versus units of weight. All data in this report are presented in bone dry units (BDU's). This differs somewhat from the initial report that used cubic metres solid wood equivalent. However, BDU's were the most commonly reported unit of measure. Where other measurement units were reported, the following conversion factors were used. One BDU weighs 2,400 pounds when oven-dry.

#### *Cubic metres (m<sup>3</sup>) or solid wood equivalent (SWE)*

Represents a fixed volume measurement of the amount of solid wood. Because the individual density of different species and the mixture of species can vary from location to location, the weight of a cubic metre will vary as well. For the Interior, 2.76 cubic metres SWE per BDU were used, and for the Coast, 2.6 cubic metres SWE per BDU were used.

#### *Gravity-packed (volumetric) unit (GPU)*

One GPU occupies 200 cubic feet of solid wood when normally compacted.

Conversion factor: 1 GPU= .77 BDU

#### *Oven-dry Tonne (ODT)*

One ODT of chips weighs 2,205 pounds when oven-dry.

Conversion factor: 1 ODT=.917 BDU

### ***Mechanical Pulp***

Mechanical pulp is produced by mechanically separating the wood fibres. As a consequence, the actual yield is much higher than for chemical pulp, on the order of 85-95%, as much of the original material is retained. However, this process in turn leads to higher damage of the wood fibres which weakens the resulting pulp; in addition, the lignin (which serves as the bonding agent) is retained under this process and tends to yellow (i.e., reversion) when exposed to heat or ultraviolet light.

While pulp used to be produced by either chemical or mechanical processes exclusively, advances in mechanical pulping technology have led to a growing range of pulps where the wood fibre receives some form of pre-treatment before the mechanical separation. The most recent technology has been Chemi-thermomechanical pulp (CTMP) where the wood fibre is chemically treated before being heated and mechanically processed. This results in a higher yielding pulp, relative to chemical pulps, that is substantially stronger than purely mechanical pulp.

### ***Residual Chips***

Residual chips are those chips which are produced in the process of making lumber, shakes and shingles, veneer, or other solid wood products.

### ***Roundwood Chips***

Roundwood chips are those chips that are produced by directly chipping logs. In this report, the definition has been broadened to include that fibre consumed at pulp mills as well as any solid wood directly chipped either at sawmills or at chipping mills (including portable chippers).

The distinction between these two lies mainly in the production technique although there are some differences in the quality between the two types of chips (roundwood chips tend to be more uniform than residual chips which in turn increases the yield). These differences in production techniques have in the past led to residual chips being perceived as being a less costly source of fibre than roundwood chips, since residual chips do not have any clearly identified manufacturing costs.