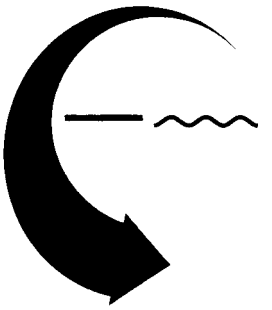
FRASER RIVER ACTION PLAN

Inventory of Wood Residues in the Lower Fraser Basin and on Eastern Vancouver Island

DOE FRAP 1996-05

Environment Canada Environnement Canada



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REPORT

INVENTORY OF WOOD RESIDUES IN THE LOWER FRASER BASIN AND ON EASTERN VANCOUVER ISLAND CONTRACT # KA601-54519

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EXECUTIVE SUMMARY

This study was undertaken by PGL Organix Ltd. on behalf of **Environment Canada** to estimate the surplus of wood residue in the Lower Fraser Basin and on Eastern Vancouver Island. The goal of the study was to provide background information required for the potential establishment of a wood residue reuse facility within the study area.

We surveyed all timber processors in the study area, and used statistics on building permits, demolition permits and other statistical means to estimate the volume of wood residue generated by the timber industry, the demolition, landclearing and construction (DLC) sectors, and waterborne debris control.

The results of the study showed that the timber processors produced 12.5 million m^3 of wood residue, of which 602,000m3 or 5% is currently not being reused. This residue is primarily commingled hog fuel and other debris with a lower reuse potential as a result. Current reuse options include pulp chips and boiler feed in the pulp and paper industry (78'%) and bedding and mulch in agriculture and horticulture (15?40).

We found that the total volume of DLC debris was 3.4 million m^3, primarily landclearing debris (2.2 million m3) and demolition debris (1 .06 million m^3). Virtually all of it is either landfilled in various pnivate landfills or burned. Landclearing debris is mainly generated in the central Fraser Valley and near Nanaimo on Vancouver Island, demolition debris is primarily generated within the Greater Vancouver Regional District (GVRD). Waterborne debris contributes only 0.15 million m^3, but is considered locally as a large surplus.

We conclude that mostly commingled, "dirty" wood residue is currently landfilled and burned, and is available for other options. Technologies should be developed further for the beneficial reuse of this "dirty" material and facilities should be located in the GVRD, in the Fraser Valley or on Vancouver Island near Nanaimo.

1.0 INTRODUCTION

PGL Organix Ltd. (Organix) is pleased to submit our report describing an inventory of wood residues in the Lower Fraser Valley - Contract #KA601-5-4519. The work for this project was performed by PGL Organix Ltd. (Organix) staff, assisted by Zbeetnoff Consulting from White Rock.

This report summarizes the results of a survey of timber processors in the Lower Fraser Basin and on East Vancouver Island to identify the volume of wood residue produced, its use and volumes of residue that could be beneficially reused. Estimates for construction, demolition and landclearing residue, and waterborne debris are provided.

This document introduces the survey's scope, background and approach. The results are discussed with the main conclusions and recommendations presented.

1.1 Scope

Our work program was designed to provide Environment Canada with an update of a study previously conducted by Stewart and Ewing Associates Ltd., F.M.B. Consulting Ent. and J.F. McWilliams (Stewart and Ewing) (1990). In addition to updating previous results for the timber processing section, Organix generated new data on fiber from debris traps, from landclearing and commercial construction, and from demolition activities.

The main part of our work program involved obtaining data for available and potentially available wood waste in the Lower Fraser Drainage Basin (LFDB). For this study the LFDB included the Sunshine Coast and East Vancouver Island, although the emphasis was on the lower reaches of the Fraser River. We divided the study area into several regions to satisfy Environment Canada's objective to determine the potential for local industrial reuse of some fractions of the generated wood waste.

To obtain meaningful results from this work, we generated specific objectives for the wood residue inventory survey. These objectives were to:

- estimate the aggregate volumes of material being generated on an annual basis in each of the identified sectors.
- determine the types and volumes of 'production' in each category of wood residue in each of the sectors.
- determine current destinations of wood residue.
- briefly review alternate reuse options.

1.2 Background

Large quantities of wood residue are produced in B.C. from activities related to wood processing, construction, demolition and city renewal, landclearing and other uses. Data are

available for some of these sources such as the wood processing industry. This industry is well defined and is relatively easily surveyed. The B.C. Ministry of Forests (MOF) conducted a study into the B.C. Forest Industry Mill Residues in 1990, covering the year 1989'. Due to changes in the forestry Industry, and in the regulatory environment, the estimates for wood waste residue needed to be updated.

Changes include the development of new technologies that can utilize lower grade inputs to produce marketable products, and the phase-out of bee-hive burners, a typical disposal option still being used in the more remote parts of the Province.

Although residue from the wood processing sector appears to be a major part of the total residue stream, other wood residue streams are also important. These streams, such as the construction, demolition or landclearing residue streams, typically contain lower quality residue for which no reuses exist. This material, together with low grade residue from the timber processors is being discarded in landfills or other sites that have significant environmental risks.

Environment Canada, MOF, and the B.C. Ministry of Environment, Lands & Parks **(BCE)** are interested in implementing regulations and assisting industry in developing new options for wood residue reuse . The first step in introducing new options is to evaluate the supply of input materials. Once a supply of wood residue is located, companies can be approached for establishing wood residue processing industries. Funds were made available by Environment Canada to conduct this market survey.

2.0 APPROACH

Organix's approach to this work included a survey of timber processors, and a statistically based review of other wood residue sources to obtain estimates for production, reuse and disposal. Timber processors were surveyed directly, while for the generation of demolition, landclearing and construction (DLC) residue we undertook a statistical evaluation of existing data bases of land use, building permits, demolition permits etc., and used these data to calculate volumes of wood residues produced, based on results of previous studies and assumptions. We then compiled all information and grouped it by region. In this section we describe the study area and outline our approach for obtaining accurate and reliable data for the debris from timber processors, construction residue, demolition residue, landclearing residue, and waterborne debris.

2.1 Study Area

The study area for the 1996 wood residue study consisted of the LFDB. This study area was selected based on a number of wood producers, and availability to transportation corridors. We separated the study area into individual regional districts, on which available statistical data

[1] Stewart & Ewing Associates Ltd. (SEAFOR) , F.M.B. Consulting Ent., J.F. McWilliams. 1990. British Columbia Forest Industry Mill Residues for Calendar Year 1989. Project No. B75439, The Ministry of Forests Mill Residue Task Force.

were based. We report data with a regional district as the smallest reporting unit, although data were collected on the basis of Census District and Municipality. The study area includes three distinct regions:

. **Fraser Valley,** which includes the Greater Vancouver Regional District (GVRD), the Central Fraser Valley Regional District, Dewdney-Allouette Regional District and the Fraser Cheam Regional District;

- **Sunshine Coast,** which includes Powell River Regional District, Sunshine Coast Regional District and Squamish Lillooett Regional District; and

- **Eastern Vancouver Island,** including the Capital Region District (CRD), Comox-Strathcona Regional District, Cowichan Valley Regional District and the Nanaimo Regional District.

The study area includes parts of the Vancouver Forest Region (Region 1), and a small part of the Kamloops Forest Region (Region **3).** It covers all of Forest Districts 1, 3 and 5 and parts of Forest Districts 6, 7 and 8.

2.2 'Timber Processing

The inventory of wood residue from timber processors was conducted using standard survey techniques. All surveyees ,received a letter announcing the purpose of the survey and a request for cooperation. Letters were then followed up with a telephone interview, using a standard list with questions. Data obtained included type of residue generated, available reuse options, disposal costs, and hauling distances. The details are enclosed in Appendix A.

Data were converted to a standard unit (m^3) using the conversion factors outlined in Appendix D. Where necessarv, our standard unit was converted to Bone Dry Tonne (BDT), or Solid Wood Equivalent, using the Forintek conversion factors outlined in-the Seafor Report.

2.3 Construction and Demolition Residue

The volumes of construction and demolition residue are difficult to determine because of the diffuse character of the industry, their sense of confidentiality, and the existence of many unregulated disposal facilities. To determine the generation of construction and demolition residue, we therefore used indirect methods. Our methods included estimating construction and demolition activities and then relating these activities to volumes of residue generated, using the results of studies from Mission, Abbotsford, New Westminster, and Edmonton, Alberta. Activity was gauged from municipal building and demolition permits, and from other statistical information including census data from Statistics Canada. Details of databases used, assumptions made and conversion factors are included in Appendix B.

2.4 Landclearing Waste

in the Lower Mainland and other areas with a rapid population growth, large areas of land are converted from forest, agricultural and other land uses to residential and industrial use. This conversion requires clearing of existing vegetation. Clearing is required not only for residential

and commercial development, but also for necessary infrastructure such as roads, pipelines and hydro rights-of-way. Land use conversions generate a one-time surplus of wood residue. As landclearing is a one-time event, surveying its extent required special techniques. We used Statistics Canada data averaged for the last five years to observe historic changes in land use and related those changes to hectares of land cleared and m^3 of wood residue produced. Data files used included: land cover data (street network files); land accounts projects dealing with vegetation types; and census data on agricultural land uses. These extrapolations were verified by contacting regulators and land use planners on the municipal levels, or by contacting the B.C. Ministry of Transportation and Highways (MOTH) in case of provincial rights-of-way.

We obtained data from the City of Mission regarding volumes of wood residue generated on each acre of cleared land to estimate total volumes and used assumptions regarding percentage of each building lot cleared, required footprint, etc. All details for these calculations and all assumptions used are included in Appendix C.

2.5 Waterborne Debris

Significant quantities of waterborne debris are generated in the Lower Mainland, both from natural sources and anthropogenic sources. Some debris from upstream sources is transported down the Fraser River, and is trapped near Agassiz. Other debris is generated below Agassiz from log booms, log sorts, and local streams. The relative heterogeneity of the debris is yet to be determined, but is expected to consist of a variety of materials such a logs, branches, uprooted trees, lost timber from booming grounds, and post-consumer products (e.g., planks, pilings) with different characteristics.

To estimate the type and volume of the waterborne wood residue, we contacted the local parks boards, the Fraser River Harbour Commission (FRHC), and the Fraser River Debris Control Board. This part of data gathering did not require an extensive survey because of the few organizations involved.

2.6 Beneficial Reuse

In order to provide Environment Canada with meaningful results, we investigated some of the specifications of wood debris that facilitate beneficial reuse and comments on the economic feasibility and possible changes in processing that may facilitate beneficial reuse. We contacted several potential candidates who have indicated a willingness to establish a facility in the Lower Mainland for processing wood waste residue into value added products. We have included three companies in this report.

3.0 RESULTS

The results of the study are presented in three different sections: timber processing; DLC debris; and waterborne debris. The DLC section is subdivided, based on the different techniques or databases used for the analysis. The waterborne debris section includes not only information on wood waste debris that is actually recovered, but also estimates of wood residue that is currently not recovered but could be reused.

3.1 Timber Processing

This section describes our survey results for timber processors in the study area. We will discuss number, type and location; size of processors surveyed; type of residue produced; identified residue reuse; and comments from surveyed facilities.

Number, Type, and Location of Facilities Surveyed

To estimate the volume of wood residue generated by the timber processors, we identified 266 facilities. Each facility received a letter and was followed up with a telephone survey. This survey resulted in 106 completed interviews or a response of 78.5% of facilities that could respond. Response rate varied from 80.7°/0 for the Lower Fraser Valley to 69°/0 for Vancouver Island. Reasons that facilities could not complete the survey included:

. facilities out of business/could not contact (14%);
. facilities not responding to our requests for information (11%);
. facilities not producing wood residue in significant quantities (backyard operations);
. sales offices within the study area; and
. duplicate entries (e.g., facilities operating under more than one name).

Most of the facilities surveyed were remanufacturing facilities, sawmills, and shake and shingle mills (87% of facilities). Also, veneer and plywood mills were important (5% of facilities). Table 1 provides details on the number, type and location of facilities.

Timber processors are concentrated in the Lower Fraser Valley, mostly in the Greater Vancouver, Central Fraser Valley and the Dewdney-Allouette Regional Districts (69% of facilities). Another area with a concentration of timber processors is on Vancouver Island, near Nanaimo, Comox and Cowichan (16% of facilities).

Size of Facilities

Facilities vary in size and in wood residue produced. We separated facilities according to wood residue production volume. Large facilities are mainly located in the Dewdney-AIlouette Regional District and in the GVRD. Large facilities are also found near Nanaimo. Table 2 provides information on the volume range of facilities in each regional district.

Wood Residue Produced

The results of our review shows that 12,490,000m3 of wood residue is produced by the timber processors in the study area. Table 3 and 4 provide information on the distribution of residue by type and region. Of the 12.5 million m^3, 44% is non-mixed residue from processing cedar, 44% is non-mixed residue from processing other conifers (whitewood), 6% is hardwood based, and 5% is a cedar whitewood mix. Virtually all of the cedar residue is produced in the Dewdney-Allouette Regional District (44%) and the GVRD (48%). Whitewood residue is ‘ produced mainly in the GVRD (58%) and near Nanaimo (31 %).

Type of Residue

The residue is produced in several different types: bark, sawdust/shavings, trim ends, hog fuel, and chips (Table 5). The cedar residue is primarily produced in clean chips (52%) and as hog fuel (27%). Clean bark is a minor fraction. Whitewood is produced as chips (50%), sawdust/shavings (28%) and hog fuel (14%). Clean bark is a minor fraction (5%).

Residue Re-use

Wood residue is being reused in several different industries. Of the 12.5 million m^3 produced, 9.7 million m^3 (78%) is used by the forest industry as input in the pulping process or as boiler fuel, and 1.86 million m^3 (15%) is reused in agriculture. A relatively small amount is designated for landfill, burning or onsite storage (602,000m3 or 5%). Some material is designated to go to a disposal/separation facility. We assume that most of this material will either be reused in forestry or in agriculture, with a small portion actually being disposed of. We have not included this flow in the disposal categories. We did not identify any innovative uses such as fuel pellets, fuel oils or methanol/ethanol from wood residue. Data in Table 6 represents the reuse of wood residue.

From the reuse figures we conclude that 602,000m3 of wood residue is immediately available for reuse as it is not being utilized right now. This material is indicated in Table 6 as destined for “landfill” and “burning”. All other material has a destination.

Comments

Several timber processors made additional comments during our interviews. These comments indicated that some of the larger facilities are not consistent in accepting the surplus material, and that a good venue apparently has been closed off permanently: the shipping of chips and hog fuel to facilities in the U.S. Further, smaller facilities mentioned that they require assistance in dealing with their wood residue. The establishment of centralized hogging facilities or co-generation plants would be useful for the reuse of wood residue. The general flavour of the comments was that several facilities need better or more reliable solutions for the wood residue. Comments are attached in Appendix A.

3.2 DLC Debris

DLC debris is a residue stream that is uncontrolled. No central disposal facilities or recycling facilities with weigh scales exist for this residue. Currently most of this waste within the GVRD is landfilled in private landfills. The GVRD have estimates for this residue stream, but the values they use in their Solid Waste Management Plan are based on a survey of disposal facilities, not of generators.

As it is difficult to obtain reliable figures from the disposal side of the waste stream, we have focused on the generation side. Through the use of statistics for building permits and demolition permits, and the landclearing required for road building and housing developments, we generated volumes of wood residue produced. Estimated volumes represent the period 1991 to 1995. Because different data bases were used for building and demolition permits and

landclearing, we present these results in these separate subsections. An overview of all data generated is in Table 7. This table shows that the total volume of wood residue from the DLC activities in the study area is 3.4 million m^3.

Construction Residue

In our survey we segregated dimensional lumber and plywood as the two main constituents in the construction residue stream and focused on them. Using local figures from a municipal study in Mission and data from the Edmonton Partners in Clean Construction waste audit, we estimated the volume of wood residue generated per standard building unit (1 OOm^2). Using municipal statistics for building permits, the Statistics Canada information available for subdivisions and information from regional districts, we calculated volumes for each region within the study area. All details of the assumptions are included in Appendix B. This appendix also includes all intermediate calculations used to derive the final figure.

The total volume of construction residue in the study area was 115,500m3 of which 43.4% was plywood and strand board debris, and 56.6% dimensional lumber debris in assorted lengths.

Most of the construction debris was generated in the Fraser Valley Region (69%), and on Vancouver Island (27%). In the Fraser Valley Region, 81 % of the construction debris is generated in the GVRD (65,600m3). On Vancouver Island, the CRD generated 9700m3, while the Nanaimo Regional District produced 9800m^3. The Sunshine Coast area generated relatively small amounts of construction debris. Diagrams 1 to 4 illustrate the distribution of construction waste within the region.

Diagram 1: Construction Debris by Region

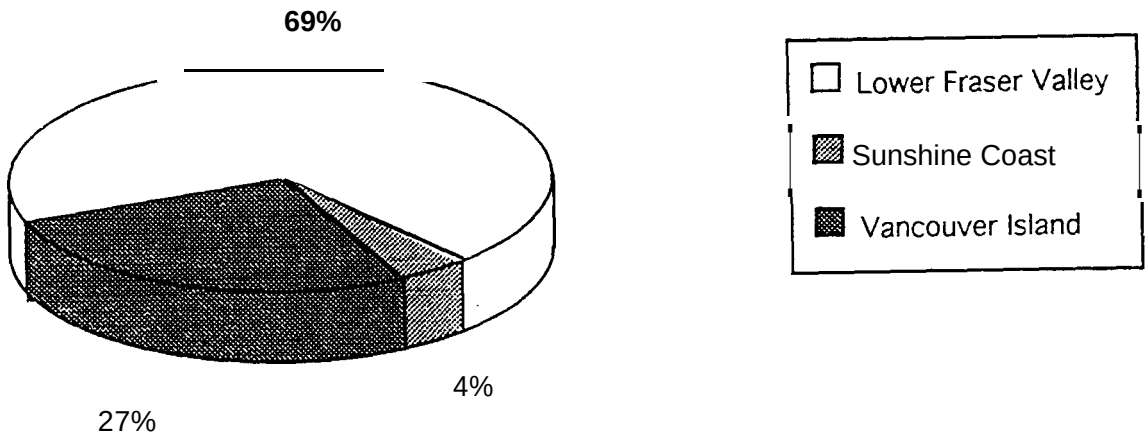


Diagram 2: Construction Debris by Regional District

Fraser Valley Region

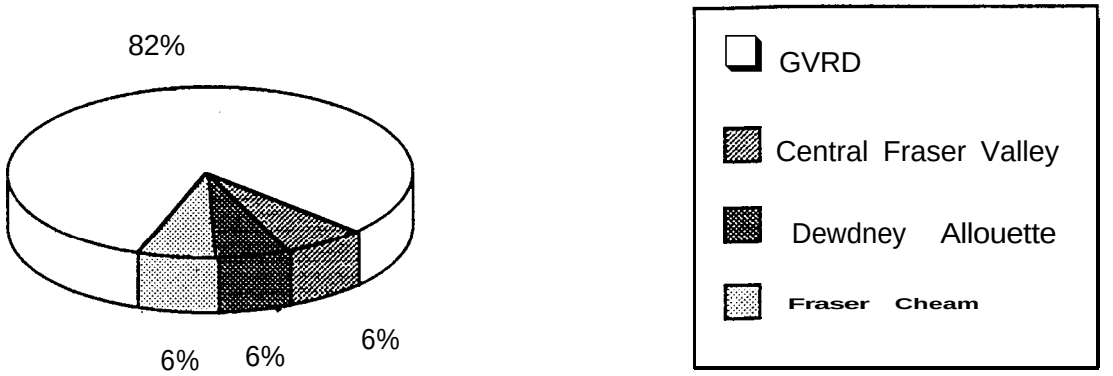


Diagram 3: Construction Debris by Regional District

Vancouver Island Region

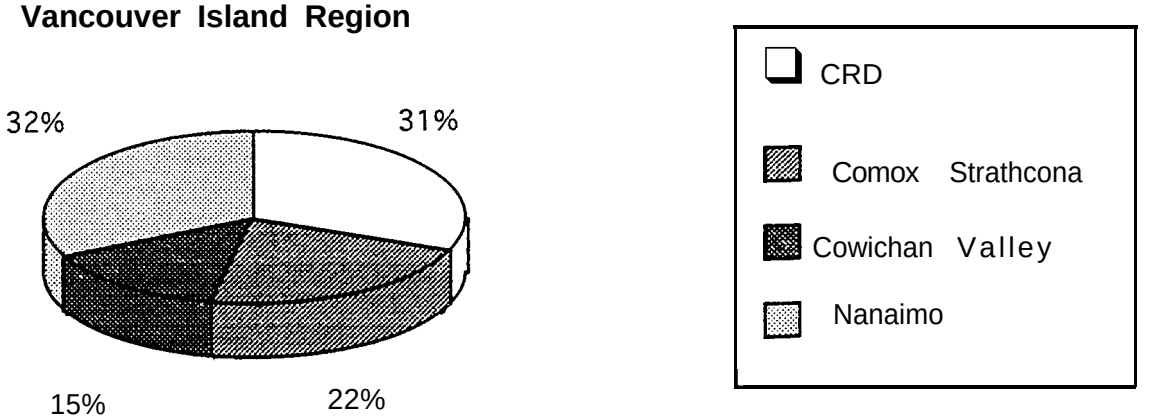
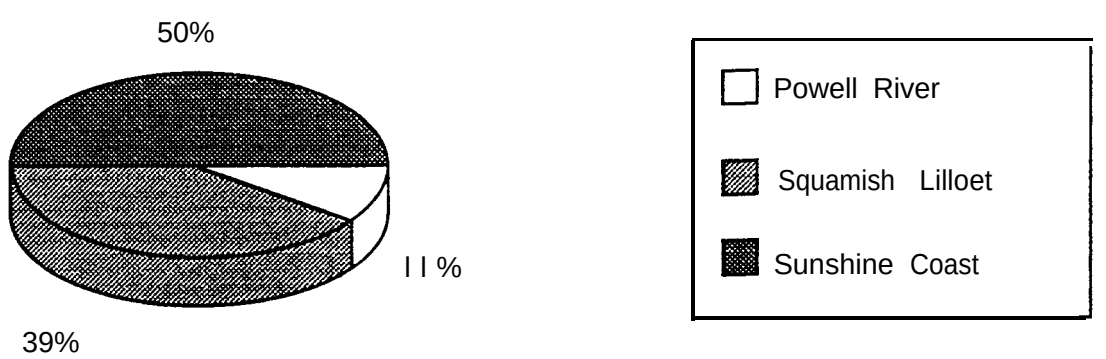


Diagram 4: Construction Debris by Regional District

Sunshine Coast Region



Demolition Residue

Demolition residue in the study area was mainly generated from the demolition of older houses and other dwelling units to make space for new development. In our study we correlated statistics for demolition permits with an average size for the dwelling. As dwelling size varies and thus the amount of demolition waste varies, we used estimates from several experienced realtors for typical houses on lots sold for redevelopment. It appeared that the unit size varied between regions. Therefore, we differentiated between regions and prepared more accurate volumes, instead of using one average unit size. We also used estimates from demolition contractors to determine a typical load of debris. We further assumed that the amount of plywood in the demolition debris would be minimal. Details on these assumptions are listed in Appendix B. We believe that our estimates are conservative because of the trend in urban areas to demolish larger, newer houses in the process of densification and urban renewal.

Using our assumptions, we calculated that 1,057,000m3 of demolition residue is generated annually, mostly in the **GVRD** (906,000m3). Significant amounts of demolition residue were also generated in the **CRD** (84,241 m^3). The distribution of demolition debris by region is pictured in Diagrams 5 to 7.

Only a small percentage of the demolition debris is separated and recycled. Recycling includes hand picking of valuable materials. The remainder, mostly wood waste, is currently landfilled in several private landfills in the study area.

Landclearing Debris

Landclearing debris is generated when new lots are developed, when roads and services are installed, and when older lots are re-developed. We have included all these aspects in our estimates. Our estimates are based on figures from the Mission study and on figures provided to us previously. These estimates are affected by the amount and type of timber on each site, and may vary accordingly. For our estimates we have used an estimate of 1800m3/ha. This value was generated by the District of Mission from actual measurements. In comparison, debris from forest landclearing for large road developments on Vancouver Island range from 600m3 to 3000m3 per hectare, with an average of 900m3 per hectare. The Mission figures are in the higher end of this bracket because sites are covered with dense forest. We also included estimates for shrubs. All details are included in Appendix C.

In the study area, approximately 2,217,000m3 of landclearing debris is produced annually, mainly on East Vancouver Island. Here, most of it is generated in the Nanaimo Regional District (579,000m3). In the Fraser Valley, most landclearing debris is generated in regional districts outside the GVRD (82% or717,000m3). In the Sunshine Coast Region, only small amounts of landclearing debris are generated (4% of the total). Diagrams 8 to 11 outline where landclearing debris is generated.

Comparison with other DLC Statistics

Some statistics are available on the generation of DLC debris. We used the figures from the **GVRD** Solid Waste Management Plan (SWMP) and augmented them with new data. The SWMP shows that in 1994, within the GVRD, 1.3 million tonnes of DLC was generated, of which 56% was recycled. The recycled material was mainly concrete, asphalt and gyproc. The non-recycled portion, mainly woodwaste and landclearing waste, was approximately 519,000 tonnes or 1.98 million m^3 using the "Mission Conversion Factor" of 262kg/m3. This estimate included 10OA recycling of the wood waste component. Our study shows that the estimated amount of construction and demolition waste generated in the **GVRD** amounts to 0.97 million m3, and that the landclearing debris amounts to 0.15 million m^3, fOr a total Of 1.12 million m3, Or 57% of the GVRD estimate.

The estimate for this study is conservative, both in the demolition debris and in the landclearing areas, but we do not expect a variation of more than 15% Therefore, we find the GVRD estimate rather high.

Diagram 5: Demolition Debris by Region

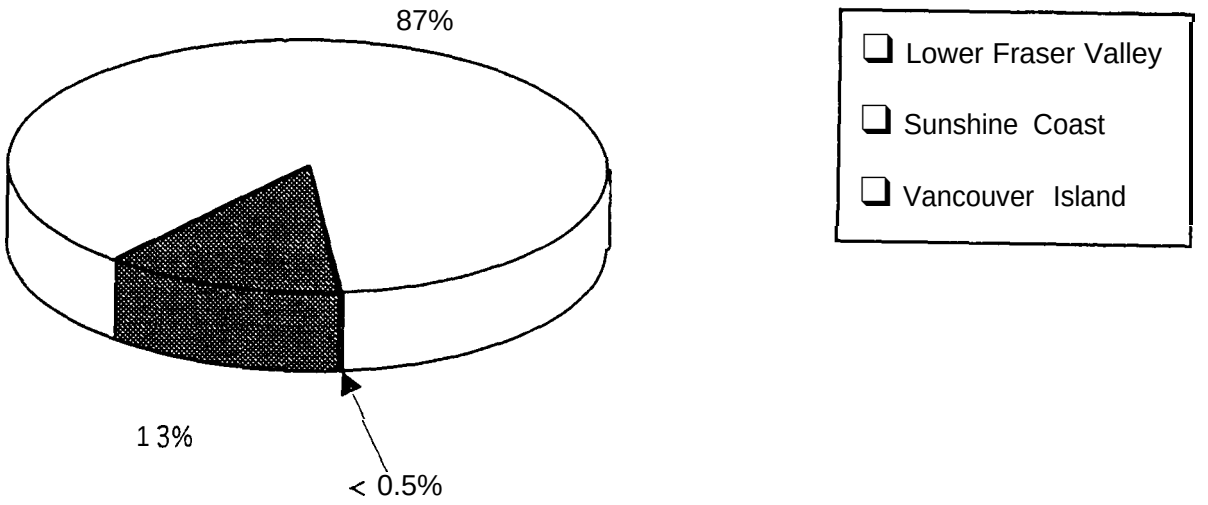


Diagram 6: Demolition Debris by Regional District

Fraser Valley Region

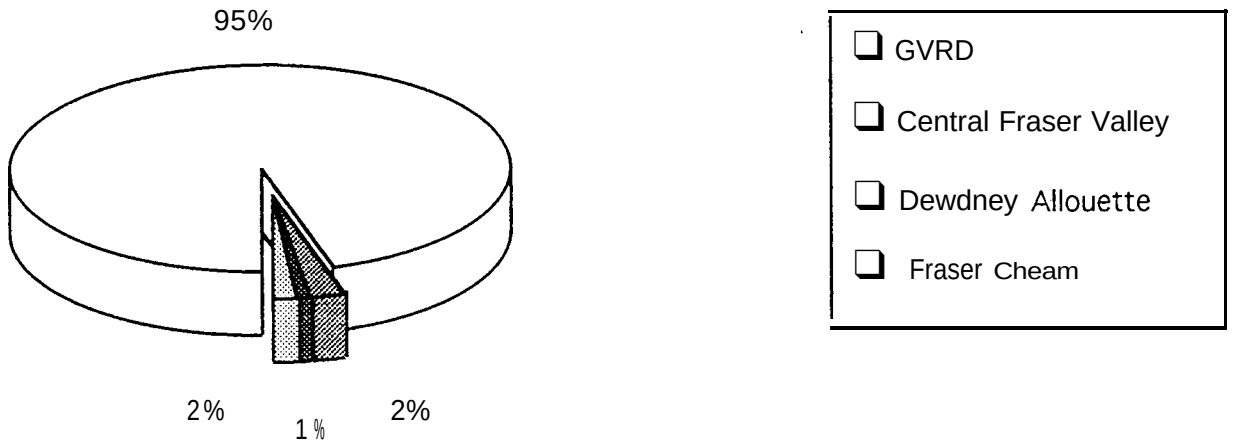


Diagram 7: Demolition Debris by Regional District

Vancouver Island Region

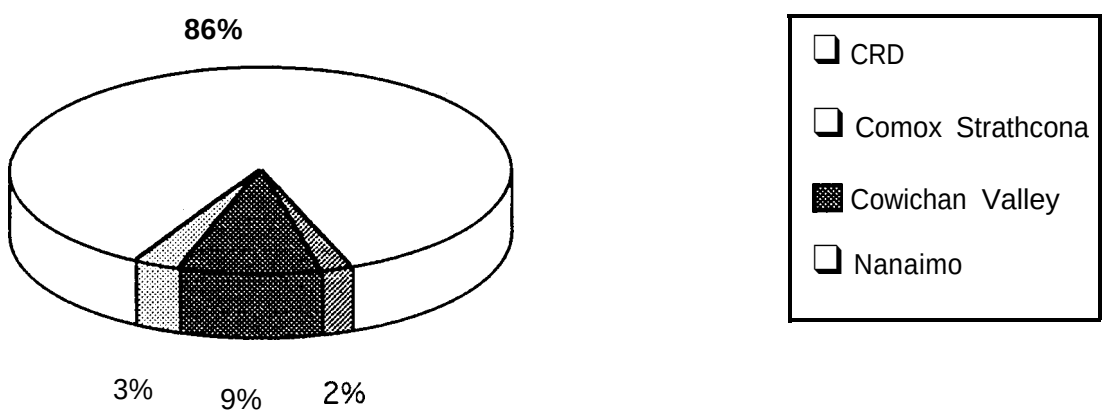


Diagram **8: Landclearing Debris by Region**

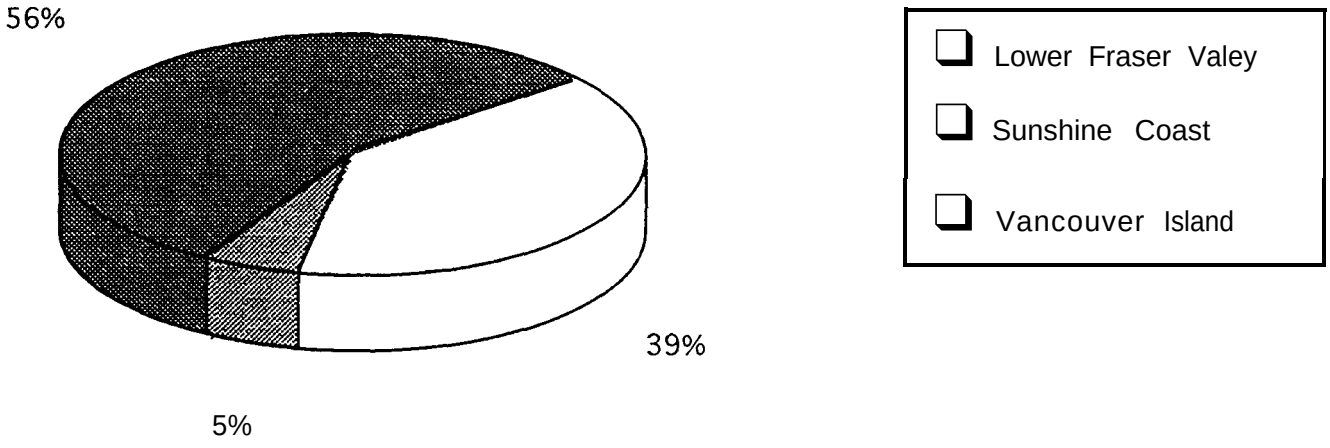
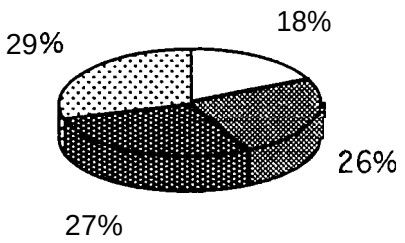


Diagram 9: Landclearing Debris by Regional District

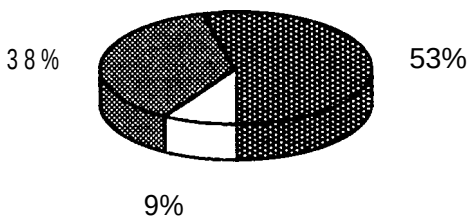
Fraser Valley Region



- GVRD
- Central Fraser Valley
- Dewdney Allouette
- Fraser Cheam

Diagram 10: Landclearing Debris by Regional District

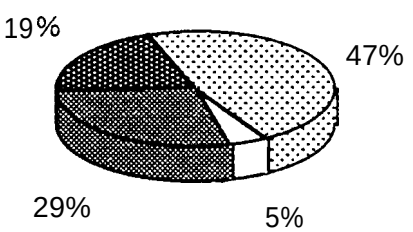
Squamish-Lillooet Region



- Powell River
- Squamish Lilloet
- Sunshine Coast

Diagram 11: Landclearing Debris by Regional District

Vancouver Island Region



- CRD
- Comox Strathcona
- Cowichan Valley
- Nanaimo

3.3 Waterborne Debris

Some waterborne debris is managed within the study area. Where this debris may cause risks to the foreshore, to navigation, or to public health and safety, it is removed from the water. The Debris Control Board controls some of the removal as does the City of Vancouver Parks Board. Some, small programs also operate in Nanaimo and in Ladysmith. This section deals with the materials collected by the Debris Control Board and the City of Vancouver. We also provide a rough estimate of how much waterborne wood residue could be available for beneficial use. This wood residue is currently not recovered.

Debris Traps

A debris trap in Agassiz B.C. collects floating debris from the Fraser River. The wood debris is removed from the collection basins and stockpiled on-shore. Some of it is recycled as firewood or for processing, but most of it has been burned. The Debris Control Board operates this debris trap, and the North Fraser Harbour Commission operates a disposal facility on the North Arm of the Fraser River where wood residue from wood processing facilities along the river is recovered. A third facility is operated in Howe Sound. These other facilities receive debris by boom. This debris originates from the timber sorting and handling basins near sawmills on the lower reach of the Fraser River and in Howe Sound. These facilities collect for disposal approximately 25,000m3 each. This debris has also been burned.

The debris trapped in Agassiz is generally natural debris (89%) with small amounts originating from the forest industry (7%) and other industries (4%), according to 1984 figures cited in the 1991 Log Management Study by FREMP[2]. Approximately 90,000m3 of debris is trapped in Mission.

The debris trapped in Agassiz is of better quality than that trapped in the lower reaches of the Fraser River and in Howe Sound, because it does not contain chlorides from seawater. It may be more suitable for reuse.

Log Recovery

Merchantable logs that escape from booms or from other industrial activities are recovered by log salvaging operations, working on permits. When logs are returned to their rightful owners, a salvage fee is paid. Approximately 20,000m^3 of timber is salvaged through Gulf Log Salvage. The City of Vancouver salvages about 900m3 and provides 600m3 to the public as firewood. Therefore, debris recovered at the North Arm and Howe Sound facilities typically consists of lower quality wood, as higher quality material has been recovered through salvage operations.

Other Sources

Large quantities of wood waste are deposited on marshlands, beaches and other waterfront areas, or are carried by the Fraser River. In this study we only included the wood debris that is currently recovered and that is available for reuse. However, some wood debris is currently not recovered and accumulates on beaches. We have tried to estimate this amount of wood

2 Fraser River Estuary Management Program.

debris; however, to accurately identify where and how much wood debris is deposited requires several separate studies. In this section we discuss some of the wood debris flows and accumulations for illustration and completeness only.

Marshland

The marshes of the Fraser River Estuary have accumulated large amounts of wood debris. FREMP estimates that the most sensitive marshes (3700 ha, representing 68% of the shoreline length, including Boundary Bay, Roberts Bank and Sturgeon Bank), contain approximately 80,000m3 of wood debris, with an accumulation rate of 5% annually (4,000 m3/year). We assume that the other 32% of shoreline also will collect 3,000 m3/year for a total annual accumulation of 7,000m^3.

Coast Line

Wood debris also washes onto the beaches in the Lower Mainland and on Vancouver Island. Significant quantities are removed by **local** authorities to please the beach-going public. The City of Vancouver annually removes 7500m^3 of wood debris from the 12.5km of beaches under their control, the equivalent of 625m3/km. Not included in this estimate is the volume of salvaged logs that are returned via the salvage system, or cut for firewood.

Assuming that Vancouver beaches are representative of typical amounts of wood waste acquired, and that the total length of the shoreline in the study area is approximately 5000km, of which 10OA is beach area, we estimate that all beaches in the study area accumulate approximately 310,000m3 of wood debris annually.

River

The Fraser River is a major contribution to beach-deposited debris. Based on limited observations, we estimate that the Fraser River contributes between 30,000m3 and 40,000m^3 a year. A detailed study would be required to obtain accurate projections for this flow of wood debris.

4.0 DISCUSSION

This discussion deals with the volume of available wood residue, the type of residue used, its quality, its industrial use, quality improvements, and volume projections.

4.1 Available Wood Residue

A large percentage of the wood residue from timber processors is currently being reused, primarily in the forest industry and agriculture. Our data show that only 5% of the total production is available for alternative reuse. This suggests that the timber processing sector does not have a significant wood residue disposal problem. The wood residue from the DLC

sector and the debris control program, however, is not beneficially reused. This volume is approximately 3.5 million m3/year. Together, 4.1 million m^3 a year is available for other uses within the study area.

Several un-tapped sources of wood residue exist in the study area. Wood residue is available from beaches and marshland, or is carried by the Fraser River. We estimate that upwards of 350,000m3 may be available annually from these sources.

4.2 Industrial Use

The majority of the wood residue produced in the study area is reused in industrial and agricultural processes. The pulp industry uses large quantities of chips, sawdust and shavings, and hog fuel. Agriculture uses mainly sawdust/havings and hog fuel. The residue most likely to be disposed in landfills or through burning contains commingled materials or is contaminated with soil, silt, rocks, metal, paint or chemicals, plastics, chlorides, or other materials.

Most industrial or value-added reuses require good quality residue. New industries in the Lower Mainland willing to purchase wood residue in large quantities may upset the existing balance of materials being reused. Removal from this good quality residue will also mean that some of the residue that currently being discarded could be cost effective for higher value use, such as boiler feed. Any additional fiber needs will likely be supplied from the landclearing sector as this stream is compatible with residue from the timber processors. This will force the landclearing sector to implement different harvesting and clearing technologies that are focused on recovering fiber.

4.3 Volume Projections

We foresee that the amount of surplus residue from the timber processing industry will decrease over time. Source separation and increased demand for fiber will drive this trend. The amount of low quality hog fuel currently being landfilled will be reduced as material is separated as chips or chippable wood and bark. This material will be absorbed into the marketplace.

We expect the surplus of demolition waste and landclearing waste to increase in the near future, based on the expected increase in population in the study area. Further, according to the National Housing Outlook3; the housing cycle in B.C. is forecast to turn upwards in 1996, and the long recessionary phase will come to an end. This means that densification and renewal will intensify in the urban areas, generating larger quantities of demolition and construction waste. Communities outside the urban area will expand and will require more building lots. These building lots will be located in forested areas, therefore increasing the annual production of landclearing debris.

3 H. Pastrick. Provincial Housing Outlooks. B.C. National Housing Outlook, First Quarter. 1996:29-33.

4.4 Reuse Technologies

Many reuse technologies are available for beneficial reuse of wood residue. Several are being applied for within the study area. Most technologies require clean sorted material for the manufacturing of value added products such as pulp, particle board, fiber board and others. Commingled materials are generally used as boiler feed.

Beneficial reuse of wood residue requires that the material is clean and non-contaminated. As several residue streams contain chloride (from sea water), sand, rocks, metals or other contaminants, or have been preserved or painted, options for their reuse are limited. These streams include logs soaked with seawater, landclearing and demolition debris, and some types of hog fuel. This “dirty” commingled residue is currently landfilled, burned, or stored.

To identify reuse options for this dirty material, we canvassed several companies that had indicated some interest in processing wood residue. We selected three for further investigation because others either did not respond, could only use clean material, or were early in the commercialization stage. The companies we selected were:

- DynaMotive Technologies Corp.
- Phoenix Industries
- The CanFibre Group Ltd.

DynaMotive Technologies Corp.

DynaMotive Technologies Corp. (DynaMotive) of Vancouver B.C. has developed and is now marketing a system for pyrolysis of organic material, including wood debris, Refuse Derived Fuel (RDF), and other types of organic matter, including petroleum products, plastics and hazardous waste.

Input materials are reduced to <3mm and are then combusted under low oxygen pressure. This process (pyrolysis) yields a liquefied organic product “bio oil” for which the company has identified a market. Bio oil is mixed with lime to form “Bio Lime” which can be used in coal fired power plants and municipal waste incinerators to reduce the emissions of nitrogen oxides (NOX) and sulphur oxides (SOX). Bio oil will be sold for approximately $80/tonne.

The DynaMotive process requires small particles of dry material (<15% moisture) from chlorine free residue. The pulverizing step also demands materials with no metal. The process can accept painted or treated materials.

The technology is currently in the testing phase. Several industrial size pilots will be operating in the near future.

Phoenix Industries

Phoenix Industries is developing a portable machine to produce charcoal briquettes for wood stoves. The machine is being developed in cooperation with UBC. The company is planning to build six machines which, when operational, will require two million tonnes of wood residue a year. The technology will accept most commingled wood residue.

The CanFibre Group Ltd.

CanFibre produces medium density fibreboard (MDF) from surplus wood debris. A facility would require 140,000 tonnes/year of supply, and a long-term guarantee. The incoming materials need to be untreated, unpainted wood; the inclusion of metals such as nails is not critical. The process will not accept levels of contamination greater than 50A.

We conclude that several technologies are available for processing the dirty residue. With some source separation, size reduction and screening of the residue, a large portion of it could be utilized.

4.5 Debris Quality

The quality of wood debris generated in the study area ranged from high quality chips and shavings to low quality, commingled, dirty residue such as hog fuel, demolition debris and landclearing debris. To facilitate the beneficial reuse of the commingled, dirty residue, it must be separated at source or prevented from collecting contaminants. Source separation would be relatively easy in the landclearing sector. Here, through selective logging, removal of slash and stumps with special equipment, and grinding and chipping, the value of the debris may be upgraded so it can be used for comporting or as a fiber source for energy production. The clean product may also be used in new technologies to produce briquettes or bio-oil.

The demolition sector would benefit from selective dismantling of buildings. Although this selective dismantling may seem more time-consuming and less cost-effective, it would yield reusable timber and source separated fiber. Alternatively, demolition debris could be separated and cleaned in sorting facilities. Several of these are planned for the Lower Mainland. When a destination for separated fiber is developed in the Lower Mainland, the stream of demolition debris that is landfilled would be reduced dramatically. The separated fiber may be used in new reuse technologies.

Hog fuel quality can be increased by screening the debris, and by segregating debris streams in sawmills and other timber processors. The resulting chips and bark could then be managed separately.

4.6 Location of Reuse Facility

One of the objectives of this study was to identify areas that could support a wood residue reuse facility. We found that the low quality residue streams that will most likely be available, were primarily generated in the GVRD (demolition debris), in the Fraser Valley (landclearing debris and hog fuel), and around Nanaimo (hog fuel and landclearing waste).

Two likely locations for reuse facilities are: the east part of the GVRD, receiving surplus from Dewdney-Allouette, Central Fraser Valley, and the GVRD; and near Nanaimo, receiving surplus from East Vancouver Island.

Alternatively, a central facility for demolition debris should be located near Vancouver. Once this facility is established, a facility able to process landclearing debris and hog fuel should be located near Matsqui, to absorb landclearing debris and hog fuel.

5.0 SUMMARY AND CONCLUSIONS

We have summarized in this section the findings of our study. They relate to the volumes of wood residue available for alternative reuse options, where it is generated, what the residue consist of, potential reuse options, and potential locations for reuse facilities.

Volume of Wood Residue

1. The volumes of wood residue currently produced in the study area are 12.5 million m^3 from timber processors, 3.4 million m^3 from the construction demolition and landclearing sector, and 145,000m^3 as waterborne debris, for a total of 16.05 million m^3.

2. The volume of wood residue currently burned, landfilled or not being reused is 602,000m^3 from timber processors, 3.4 million m^3 from DLC activities, and 145,000m^3 of waterborne debris for a total of 4.15 million m^3.

Major Generation Areas

3. The wood residue from the timber processing sector is mainly generated in the Lower Fraser Valley and near Nanaimo.

4. The surplus of demolition residue is generated in the urban areas where city renewal takes place. The GVRD contributes 85% of the total demolition debris produced in the study area.

5. The surplus of landclearing waste is generated in the Nanaimo Regional District and in the Fraser Valley outside the GVRD.

Consistency of Surplus

6. Materials not currently being reused consist mainly of lower value commingled debris with varying levels of contamination.

Reuse Options

7. Although the supply of quality materials available for reuse is limited, large quantities of wood residue could be made available if compensation is provided.

8. Several reuse options were identified for “dirty” debris; the most promising alternatives would be those offered by CanFibre and DynaMotive.

Location of Reuse Facilities

9. Facilities to process landclearing debris should be located in the Fraser Valley and in the Duncan/Nanaimo area.

10. A facility to process demolition waste should be located near the urban area of the GVRD.

6.0 STANDARD LIMITATIONS

This study was conducted by Organix for Environment Canada. The presented results are based on information obtained using survey techniques and available statistical data.

The findings and conclusions documented in this report have been developed in a manner consistent with that level of care and skill normally exercised by environmental professionals currently practicing under similar conditions in the area. Organix accepts no responsibility for any damages that may be suffered by third parties as a result of decisions or actions based on this report.

The project has been conducted using the terms of reference and conditions set forth in our work program. No warranty, express or implied, is made.

Table 1

Types and Locations of Timber Processing Facilities in the Lower Fraser Valley and Eastern Vancouver Island

REGIONAL DISTRICT	NUMBER OF FACILITES BY FACILITY TYPE							
	Sawmill	Veneer/ Plywood	Reman.	Shakes/ Shingles	Pole Plant	Log sort	Other	TOTAL
Fraser Cheam	o	0	0	0	0	0	0	0
Central Fraser Valley	1	0	12	2	0	0	0	15
Dewdney-Alouette	5	0	7	8	1	3	0	24
GVRD	11	4	24	1	1	0	1	42
Capital	o	0	2	0	0	0	0	2
Cowichan	3	0	2	2	0	0	0	7
Nanaimo	2	1	1	0	0	0	0	4
Comox-Strathcona	1	0	0	4	0	0	1	6
Powell River	o	0	0	1	0	0	0	1
Squamish-Lillooet	2	0	0	0	0	0	0	2
Sunshine Coast	1	0	0	0	0	0	0	1
Thompson-Nicola	2	0	0	0	0	0	0	2
TOTAL	28	5	48	18	2	3	2	106

Notes: This table only includes those applicable facilities which formed the data set
"Other" includes laminating plants and log home manufacturers.

Table 2
Facility Sizes by Regional District

REGIONAL DISTRICT	VOLUME RANGE (m3) OF TOTAL WOOD WASTE GENERATED AND NUMBER OF FACILITIES							
	<10,000	10,000-50,000	50,000-100,000	100,000-150,000	150,000-200,000	2oo,ooo-250,000	>250,000	TOTAL
Fraser Cheam	o	0	0	0	0	0	0	0
Central Fraser Valley	9	3	3	0	0	0	0	15
Dewdney-Alouette	7	7	3	2	1	1	3	24
GVRD	12	13	4	4	0	1	8	42
Capital	2	0	0	0	0	0	0	2
Cowichan	2	2	1	1	1	0	0	7
Nanaimo	0	1	0	0	0	0	3	4
Comox-Strathcona	3	2	1	0	0	0	0	6
Powell River	1	0	0	0	0	0	0	1
Squamish-Lillooet	1	1	0	0	0	0	0	2
Sunshine Coast	0	0	1	0	0	0	0	1
Thompson-Nicola	0	0	1	1	0	0	0	2
TOTAL	37	29	14	8	2	2	14	106

Table 3
Residue Wood Types by Regional District

REGIONAL DISTRICT	WOOD TYPE AND VOLUME (m3)									
	Cedar	WW	HW	Cedar/WW Mix	Cedar/HW Mix	WW/HW Mix	Full Mix	Other	Don't Know	TOTAL
Fraser Cheam	0	0	0	0	0	0	0	0	0	0
Central Fraser Valley	128,460	5,236	0	136,725	0	48,676	0	115	0	319,212
Dewdney-Alouette	2,402,522	39,876	9,775	127,576	0	0	0	0	6,792	2,586,541
GVRD	2,650,342	3,251,437	734,081	269,555	0	1,720	0	0	0	6,907,135
Capital	0	5,441	0	0	0	0	0	0	0	5,441
Cowichan	27,385	441,795	0	30,564	0	0	0	0	0	499,744
Nanaimo	33,112	1,716,899	0	0	0	0	0	0	0	1,750,011
Comox-Strathcona	"122,389	1,142	0	0	0	0	1,094	0	0	124,625
Powell River	75	0	0	0	0	0	0	0	0	75
Squamish-Lillooet	12,288	0	0	6,088	0	0	0	0	0	18,376
Sunshine Coast	0	0	0	72,000	0	0	0	0	0	72,000
Thompson-Nicola	117,821	90,560	0	0	0	0	0	0	0	208,381
TOTAL	**5,494,394**	**5,552,386**	**743,856**	**642,508**	**0**	**50,396**	**1,094**	**115**	**6,792**	**12,491,540**

Notes: "Cedar" denotes 90% or greater cedar content in total wood residue stream.
'W' denotes 90% or greater whitewood content in total wood residue stream,
"HW' denotes 90% or greater hardwood content in total wood residue stream.
"Other" includes waste from particle board.

Table 4
Wood Residue Type by Regional District

REGIONAL DISTRICT	**RESIDUE TYPE** AND VOLUME **(m3)**						
	Bark	**Sawdust/ Shavings**	**Trim Ends**	**Hog Fuel**	**Chips**	**Other**	TOTAL
Fraser Cheam	0	0	0	0	0	0	0
Central Fraser Valley	0	198,335	58,151	23,395	39,263	68	319,212
Dewdney-Alouette	61,100	82,670	22,077	1,008,075	1,289,433	123,186	2,586,541
GVRD	216,807	2,264,639	128,886	829,960	3,430,420	36,424	6,907,135
Capital	0	382	422	0	4,636	0	5,441
Cowichan	0	195,553	1,132	134,073	168,486	500	499,744
Nanaimo	138,700	220,716	0	219,726	1,110,388	60,481	1,750,011
Comox-Strathcona	0	884	847	53,163	69,106	625	124,625
Powell River	0	0	0	75	0	0	75
Squamish-Lillooet	0	8,684	1,500	0	7,373	819	18,376
Sunshine Coast	0	0	0	32,000	40,000	0	72,000
Thompson-Nicola	22,640	25,770	26,510	34,088	99,373	0	208,381
TOTAL	439,247	2,997,633	239,525	2,334,555	6,258,478	222,102	**12,491,540**

Table 5
Types of Timber Processing Residue by Wood Type

WOOD TYPE	RESIDUE TYPE AND VOLUME (m3)						
	Bark	Sawdust/ Shavings	Trim Ends	Hog Fuel	Chips	Other	Total
>90% Cedar	84,240	903,112	37,968	1,475,731	2,849,392	143,951	**5,494,394**
>90% Whitewood	265,579	1,563,325	104,828	772,698	2,782,348	63,608	**5,552,386**
>90% Hardwood	89,428	159,297	2,983	0	491,854	294	**743,856**
Cedar/Whitewood Mix	0	350,070	64,630	86,126	134,884	6,798	**642,508**
Cedar/Hardwood Mix	0	0	0	0	0	0	**0**
Whitewood/Hardwood Mix	0	21,332	29,065	0	0	0	**50,396**
Full Mix	0	469	0	0	0	625	**1,094**
Other	0	29	52	0	0	35	**115**
Don't Know	0	0	0	0	0	6,792	**6,792**
TOTAL	**439,247**	**2,997,633**	**239,525**	**2,334,555**	**6,258,478**	**222,102**	**12,491,540**

Notes: "Other" for Wood Type includes waste from particle board.
"Other" for Residue Type includes mixtures of wood residue (i.e. where no separation is conducted).

Table 6
Wood Residue End Uses by Residue Type

END USE	RESIDUE TYPE AND VOLUME (m3)						
	Bark	S/S	Trim Ends	Hog Fuel	Chips	Other	TOTAL
Forest Industry							
Forest Industry Cogeneration	236,898	897,609	5,306	1,079,204	280	0	2,219,297
Pulping	0	1,077,041	33,153	9,509	6,019,048	0	7,138,750
Chipping Facility	0	0	50,521	0	0	0	50,521
Remanufacturing	0	5,580	63,754	0	0	0	69,334
Value Added	0	153,645	2,729	17,699	42,450	0	216,523
(total)	**236,898**	**2,133,875**	**155,463**	**1,106,412**	**6,061,778**	**0**	**9,694,425**
Agricultural Industry							
Livestock Bedding	5,739	400,673	765	582,999	81,979	459	1,072,613
Composting	0	382	0	164,140	0	0	164,522
Agricultural Cogeneration	0	16,616	0	0	0	0	16,616
Landscaping	107,870	70,071	0	12,452	19,351	0	209,744
Horsetrack/Roadbeds	56,600	73,509	0	124,996	44,148	0	299,253
Horticultural Application	5,000	86,415	0	5,000	0	0	96,415
(total)	**175,209**	**647,666**	**765**	**889,587**	**145,478**	**459**	**1,859,163**
Other							
Firewood (campground, stove)	0	0	45,322	0	0	1,167	46,489
Disposal/Separation Facility	0	134,753	2,303	0	0	140,793	277,849
Landfill	4,500	46,163	1,648	255,085	38,035	52,586	398,016
Burning	22,640	32,856	28,010	34,088	0	31,737	149,331
On-Site Storage	0	1,132	5,632	39,875	7,373	625	54,637
(total)	**27,140**	**214,904**	**82,915**	**329,048**	**45,408**	**226,907**	**926,321**
Don't Know	**0**	**1,189**	**382**	**9,509**	**0**	**551**	**11,631**
TOTAL	**439,247**	**2,997,633**	**239,525**	**2,334,555**	**6,252,664**	**227,916**	**12,491,640**

Notes: "Other" for Residue Type includes mixtures of wood residue (i.e. where no separation is conducted).

Table 7

Summary of Annual Wood Residue Volumes Created by Construction, Demolition, and Land Clearing, Averages, 1991-1995.

Region	CUBIC METERS OF WOOD WASTE GENERATED ANNUALLY			
Regional District	New Construction 1)	Demolition (2)	Land Clearing (3)	Total Wood Residue Volumes
Lower Fraser Valley (total)	80,502	948,774	870,999	1,900,275
Central Fraser Valley	5,224	20,518	222,482	248,225
Dewdney-Alouette	4,704	6,304	235,547	246,555
Fraser-Cheam	4,929	15,577	258,845	279,351
GVRD	**65,644**	**906,375**	**154,125**	**1,126,144**
Sunshine Coast (total)	**4,362**	**4,284**	**118,566**	**127,212**
Powell River	**474**	**1,775**	**10,280**	**12,529**
Squamish-Lillooel	**1,719**	**1,346**	**44,585**	**47,650**
Sunshine Coast	2,170	1,163	63,700	67,033
East Vancouver Island (total)	30,645	103,843	1,227,822	1,362,311
Capita	9,667	84,241	55,625	149,533
Comox-Strathcona	6,691	2,907	359,897	369,495
Cowichan Valley	4,467	12,645	233,257	250,370
Nanaimc	9,820	4,050	579,043	592,913
TOTALS [All Regions)	115,509	1,056,901	2,217,388	3,389,798

Notes: ,1) Represents post-consumer wood residues from SFD, MFD, Cll and Other construction.

(2) Represents post-consumer wood reisdues from demolitions

(3) Represents wood residues generated due to land clearing for new construction, roads and corridors, agriculture, and other private purposes.

APPENDIX A

BACKGROUND INFORMATION - TIMBER PROCESSORS

Appendix A contains our introduction letter and survey document for the survey of the timber processors. It also includes a list of comments received during the survey, and a list of references used to locate timber processors in the study area.

Environment Canada Environnement Canada

224 WEST ESPLANADE · NORTH Vancouver B.C. V7M 3H7 · (604) 664-9127- FAX 664-9126

April 18, 1996

Dear Sirs

Significant quantities of wood residues are generated from timber processing, construction/demolition, land clearing, natural sources and waterborne debris. Disposal of wood residue is becoming a challenge as governments increase restrictions on land filling, open burning and land application of wood residue. In recognition of this problem, Environment Canada supports initiatives for the beneficial re-use of wood residues. AS a first step in encouraging economic utilization of waste fibre and wood, Environment Canada is sponsoring an inventory of wood residues from all sources in the Lower Fraser Valley and Eastern Vancouver Island.

Environment Canada has commissioned the firm of PGL Organix Ltd., a consulting company based in Vancouver, to undertaLe an inventory survey of wood residues in the Lower Fraser Valley. This survey will take place from March to May 1996. Your assistance in providing the swey team with industry information is essential to the success off the inventory process and would be greatly appreciated. PGL Organix is entrusted to collect and consolidate the information with the strictest care to ensure that the individual responses of all participants are kept confidential.

The results of the inventory will be beneficial to your industry and the final report will be available from Environment Canada upon request.

If you have any questions concerning this project, please do not hesitate to contact meat 664-9127. Thank you for your cooperation.

Sincerely,

Roger McNeill

Roger McNeill
Economist

Canada

WOOD RESIDUE SURVEY - GENERAL QUESTIONS

1. SURVEY IDENTIFICATION (Masterlist # and Operation type code)

2. TYPE OF FACILITY (e.g., sawmill, shakle/shingle, chipping, remanufacturing, veneer/plywood, pole plant, etc.)

3. WHAT IS THE AVERAGE AGE OF YOUR FACILITY? (age in years)

4. DO YOU SEPARATE THE FOLLOWING WASTE STREAMS AT THE PRESENT TIME? (Yes or No, and briefly describe how you handle the waste stream)

   Bark

   SawdusVShavings

   Trim/broken chunks

   Hog Fuel

   Other (e.g chips)

5. ARE YOU CONSIDERING PLANT UPGRADING TO HANDLE WOOD RESIDUE? (Yes or no) WHY OR WHY NOT?

6. IF YES TO 4. ABOVE, WHAT TYPES OF CHANGES IN WOOD RESIDUE HANDLING ARE YOU CONSIDERING?

7. WHAT IS YOUR ANNUAL WOOD CONSUMPTION (CUBIC METERS OR BOARD FEET, AS APPLICABLE)? Please indicate proportions of cedar, whitewood and/or hardwood used annually.

TABLE 1 TIMBER PROCESSOR SURVEY - CURRENT SITUATION

CURRENT SITUATION	Wood Residue Generation			Current Disposal Methods		Wood Residue Value ($/unit)	Cost of Disposal ($/Unit)
	Total Annual Volume (m^3 or units)	Wood Residue Anti-sapstained (%)	Chipped on Site (%)	% or Volume Represented	End Use		
CEDAR Bark							
Sawdust/Shavings							
Trim/Broken Chunks							
Hog fuel							
Chips							
Other							
TOTAL CEDAR							
WHITEWOOD Bark							
Sawdust/Shavings							
Trim/Broken Chunks							
Hog fuel							
Chips							
Other							
TOTAL WHITEWOOD							
HARDWOOD Bark							
Sawdust/Shavings							
Trim/Broken Chunks							
Hog fuel							
Chips							
Other							
TOTAL HARDWOOD							

TABLE 2
TIMBER PROCESSOR SURVEY

WOOD RESIDUE CATEGORY	Haul Distance (Kilometres)	Your Haul Cost ($ per unit)	Wood Residue Value $(+, O, -) per unit	Destination Location(s)	Constraints	Opportunities
Bark						
Sawdust/Shavings						
Trim/Broken Chunks						
Hog Fuel						
Chips						\
Other (Specify)						

Appendix A - Comments from Timber Processors

- want a permanent solution for hog fuel; current situation is too unpredictable
- interested in co-generation - would send hog fuel and bark there
- want to have chipping pay for garbage disposal
- no cooperation, tried already, could not finance testing; smoke free burner (Olivine, US company, Bellingham)
- wants to see permit money put to good use (implement practical solutions)
- long-term concerns: too dependent on other businesses (e.g., pulp and paper) for wood waste disposal
- others without contracts for hog fuel disposal are piling it up along the river bank
- smaller shake and shingle operations lack adequate resources to deal with hog fuel
- wood quality is deteriorating
- hog fuel used to go to **U.S.** to Georgia Pacific; stopped practice when an export permit requirement was placed on three chips sales to **GP** (result: they no longer take the hog fuel for co-gen either)
- putting in another hogger and convincing government to let product to go to **U.S.**
- hauling long distance for disposal/reuse puts more pollution in the air than burning does
- co-generation to create hydro should be pursued
- government should look at helping small companies find homes for chips rather than allowing large companies to chip whole logs
- no market for chips
- wood supply a problem
- without a sawmill (Campbell River area), cannot get enough recovery
- current situation is an absolute waste of a resource. Role of government should be to organize a long term supply of hog fuel to a new centrally located co-generation plant in the Lower Mainland.
- size of operation is too small to consider alternatives for handling wood residue
- wood quality is deteriorating: more hog being produced relative to chips

- cedar: should separate out cedar oil
- suggestion to have satellite hogging facilities to handle wood waste from small operators
- **lean** on large facilities (Fletcher Challenge, etc.) to accept hog/chips, etc. more consistently
- need government help to find cheaper places to put wood waste

Appendix A - References - Timber Processors

1996, January
British Columbia Forest Industries Buyer's Guide, Council of Forest Industries, Vancouver, Canada

1990, August
British Columbia Forest Industry Mill Residues for Calendar Year 1989, Stewart & Ewing Associates Ltd. (SEAFOR) Project No. B75439.

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Madison's Canadian Lumber Directory, 1994-1995, 1995-1996.

1994, May
Major Primary Timber Processing facilities in British Columbia 7994, Economics and Trade Branch, Ministry of Forests, Victoria, B.C.

1995, September
Products and Services Directory, B.C. Wood Specialties Group, Canada.

1996, April
Membership List - Independent Lumber Remanufactures' Association, Langley, B.C.

APPENDIX B

ESTIMATION OF WOOD RESIDUE GENERATED BY LAND CLEARING ACTIVITIES

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APPENDIX B

WOOD RESIDUE GENERATED BY CONSTRUCTION AND DEMOLITION

1.0 INTRODUCTION AND SCOPE

Wood residue is being generated in the Study Area from construction and demolition activities. To estimate quantities, we used statistical data from Statistics Canada and local governments. The Lower Fraser Valley, Sunshine Coast and East Vancouver Island consist of 36 Census Subdivisions within 11 Census Divisions. The Census Divisions are represented by 11 Regional Districts (RDs), which administer 11 electoral or unincorporated areas, and 61 incorporated local governments. These jurisdictions are described in Table B-1.

The objective of this component of the investigation and analysis was to determine the volume of wood residue generated by new construction and demolition activities in the Study Area. The categories selected to provide the information required to estimate wood residue volumes included the following:

- New residential development
- New commercial, industrial and institutional (Cll) structures
- New "other" structures, mainly represented by Cll and residential additions.
- Demolitions, most commonly represented by demolition of older residential structures.

Appendix B also includes trends, methodology and tables.

2.0 TRENDS

British Columbia has experienced a long period of economic and population growth manifested in a strong demand for new residential construction, but characterized by substantial cycles caused by variability in new supply, affordability, interest rates, and general economic and labour market indicators. Residential unit starts in the last 10 years since 1985 had peaked in 1989 and 1993, before dropping off in 1995 to period lows. We have selected estimators and described trends to calculate the volumes of wood residue from the construction and demolition sectors.

2.1 Selection of Estimators

Several estimators were used as key factors in this study. The key variables were number of units constructed by type, average floor space (square metres) of each unit type, and the volume and type of wood residue generated per unit. Demolition estimators included area of demolished structure and volume and type of wood residue generated.

The following information sources have been consulted to calibrate the key variables used in this analysis:

- Annual new single family dwelling (SFD) unit starts (CMHC, local governments, RDs).
- Multi-family dwelling (MFD) unit starts (CMHC, local governments, RDs).
- Annual new commercial, industrial and institutional (Cll) starts, including barns (local government permitting departments, RDs).
- Annual new additions to commercial, industrial, institutional and residential structures, including garages (local governments, RDs).
- Average floor areas of new SFD and MFD units (local governments, Royal LePage, RDs).
- Average floor areas of new Cll units (local governments, ICI Data).
- Average floor areas of new "Other' units (local governments).
- Annual demolitions (local government permitting departments, RDs).
- Average floor areas of demolitions (local governments, RDs).
- Wood residue composition of new construction (research reports).
- Occupied private dwellings and households (Statistics Canada Census Data).

With the exception of dwelling starts statistics, incompleteness was an inevitable problem associated with using existing information bases for unintended purposes. The variety of information gathering systems operating at municipal levels often generate incompatible data, leave information gaps, or are simply not automated for retrieval purposes. Special efforts to retrieve information under these circumstances were beyond the project scope. Nevertheless, some local governments do record new construction information which was especially useful to this study. Where possible, local estimates were extrapolated to the Study Area as a whole. The assumptions used accompany the estimates.

2.2 New **Construction**

We used historical data analysis to estimate trends in housing size and availability. Table B-2 presents dwelling unit statistics by RD in the Study Area over the last 25 years. Although the proportion of SFDS has steadily decreased in the period, the percentage of SFDS in all areas with the exception of Central Fraser Valley, GVRD, Capital and Squamish-Lillooet actually increased between 1976 and 1986 before resuming the trend to a higher proportion of MFDs. The annual growth rate in dwelling units exceeded population growth in the 1976-1995 period, reflecting the impact of unit losses to demolition and the trend toward smaller families.

Affordability of housing is also likely to determine the rate of future new construction activity in the Study Area. With high land costs, the emergence of the "small house on a small lot" product is expected to reduce the amount of wood residue generated per unit constructed. In 1995, 55% of the dwelling units in the Study Area were MFDs.

Age of the SFD house population is another factor which is expected to lead to an increase in repairs in the used house market at the expense of the rate of new SFD construction. With the large stock of "young" dwelling structures, demolition rates may decline as second and third generation owners decide to renovate and/or add onto existing SFD units. In support of this phenomenon, "other" construction numbers, representing additions, are anticipated to exceed new construction starts in metropolitan Victoria and Vancouver for the first time in 1996.

Aging of the house owner population is expected to increase the availability of houses at a time when affordability has diminished due to high prices and economic and labour market uncertainty. This aging segment of the population will also increase the demand for maintenance-free condominiums and smaller floor space accommodation. The construction of a higher proportion of lower density multi-unit structures would be expected to decrease wood residue output.

2.3 Generation of Wood Residue

The amount and type of wood residue from new construction is changing. The trend towards the use of recycled products, composite materials and particle boards in new construction is likely to intensify in response to the increasing value of wood product. The proportion of dimensional lumber and plywood products in new construction is also expected to diminish. Dimensional wood will be increasingly used as a decorative product rather than for structural purposes in new construction.

As 1950's vintage houses begin to be demolished, the proportion of plywood/strand board in demolition waste may be expected to marginally increase at the expense of dimensional lumber. Over the 1991-1995 period, demolitions are estimated to have contributed about 94% of the wood residue generated by new construction and demolition in the Study Area. The average size of demolitions may increase as younger classes of houses are demolished.

3.0 METHODOLOGY

This section describes the methods and assumptions used to estimate the volume of wood residue generated by construction and demolition. We estimated annual numbers of dwelling units constructed and demolished and have provided a description of assumptions used. Wood residue volumes are calculated for new construction and demolition from the following parameters:

- Annual numbers constructed or demolished.
- Average floor space.
- Wood residue per unit.

Table B-4 shows the numbers of new units constructed in each RD of the Study Area.

3.1 Annual Numbers of New Constructions and Demolitions

Numbers of new constructions were calculated for SFD, MFD, Cll, and Other categories. Demolitions were not segregated by type but are predominantly represented by SFDS.

SFD AND MFD Construction

The main information source for new dwelling starts is the Canadian Mortgage and Housing Corporation (CMHC) annual report entitled "Housing Statistics" for the B.C. and Yukon Region. The agency tracks all units of single detached, semi-detached, row and apartment (including duplexes, triplexes, row duplexes, dwellings attached to non-residential structures) dwellings,

but excludes mobile homes. CMHC data is aggregated by census areas (CAS), which in some cases differ from provincial Regional Districts (RDs). Year-end housing reports of CMHC branches and permit statistics of local governments were used as additional data, when required. The dwelling starts database compares only moderately with local government records of new housing construction, with significant year to year reporting discrepancies. These discrepancies are related to actual vs. start dates, permits issued for units not built, the use of net figures (i.e., constructions less demolitions) by some municipalities to report dwelling numbers and other reporting factors. Our investigation did not attempt to resolve discrepancies, but used local government data when differences were substantial.

Cll Construction

Statistical data on the numbers of new commercial, industrial and institutional (Cll) structures were requested from the building inspections departments of 60 local and regional governments. These governments use a variety of reporting methods and, in several cases, it was not possible to differentiate the number of new construction permits from other permits in these classifications. Farm buildings (non-residential) are included in this category.

In those **areas where data are not readily available, we extrapolated figures** for Cll building activity from areas where information is available using the ratio of average new dwelling unit starts to average Cll activity. New Cll construction was assumed to average 25°/0 of new dwelling unit starts in the Study Area. In general, applying this average ratio of CII activity to the entire Study Area tends to over-estimate new starts in outlining areas and under-estimate starts in high population growth areas.

Other Construction

Similarly, data on 'Other" construction (represented by new commercial, industrial, institutional and residential additions, including garages) were requested from the 60 local and regional governments. Reporting methods among local governments were inconsistent. In several cases, additions are combined with a variety of miscellaneous permits. In other instances, additions are combined with new structures permits in each of the commercial, industrial, institutional and residential categories. Whenever the reporting system was considered incompatible with the purpose of this study, the data were not included in the database.

The ratio of average new dwelling starts to average "other" permits obtained in those areas where such data was available has been applied to those local governments for which such data was not readily available. Although there is no direct relationship between new dwelling unit starts and "Other" building activity, this class of construction has approached 100% of SFD start levels and 38% of new dwelling unit starts in recent years in metropolitan areas. "Other" construction is likely to exceed SFD starts as the house population grows into second and third generation ownership (CMHC, personal communication).

The ratio of "Other" construction to dwelling unit starts is higher in slower growth areas and lower in regional districts with a high proportion of multi-unit dwellings. As such, our averaging process will tend to under-estimate "Other" construction in outlying areas and over-estimate it in areas experiencing more intensive housing development.

Demolitions

Demolitions are the largest contributor to wood residue generation in the form of dimensional and plywoodhtrand board products. In some older areas of the province, such as the Cities of Oak Bay, Vancouver, and Victoria, the recycling of decorative woods, beams, doors, etc. is extensive. In general however, demolition waste tends to be mixed or contaminated with other materials and is discarded in landfills. Numbers of demolitions over the 1991-1995 period were obtained from each of the 60 local governments contacted in the Study Area.

3.2 **Average Floor Space Per Unit**

Floor space is defined as the area of liveable or working space constructed or demolished, as indicated in building permits, and may include basements and additional floors. Carports and/or garages built as part of a new structure represent part of the site coverage but are not included in floor space. Findings from several sources were extrapolated to the Study Area.

Floor Space of SFD Units

Average floor size was estimated from data representing the City of New Westminster in the GVRD and the District of Mission and Fraser-Cheam electoral areas in the FVRD. Communication with Royal LePage helped to estimate “average” unit size in the GVRD.

Floor SDace of MFD Units

Per unit floor space information was calculated from building permit records of the City of New Westminister. This average represents the range from triplex and condominium to high rise apartment unit.

Floor Space of Cll Units

Average Cl 1 floor space was calculated from floor areas recorded by the City of Abbotsford. Discussions with ICI Data helped to place some parameters around the average size of Cll units in the GVRD.

Floor Space of Other Units

Average “Other floor space represents an average size of additions to existing commercial, industrial and institutional structures recorded by the City of Abbotsford. We assumed that the average size represented, i.e. 18 m^2 or 194 sq.ft., is also a reasonable average size for residential additions. We also assumed negligible variation in the size of “Other” construction among RDs in the Study Area.

Floor Space of Demolitions

Detailed information on demolition floor space has been provided by the City of New Westminster and FVRD for Fraser-Cheam electoral areas. Rural demolitions were calculated to be marginally smaller than urban demolitions.

3.3 Wood Residue Volume Per Construction/Demolition Unit

The results of the investigation into the volumes of wood residue generated by each construction and demolition type are presented in Table B-4. A breakout of the proportion of dimensional lumber and plywood/strand board per unit is calculated from information supplied by research conducted in the Edmonton area.

information for the District of Mission was used to convert tonnes of wood waste into cubic metres. The conversion factor used in this study is 262 kilograms per cubic metre of post-consumer wood residue generated by construction and demolition.

Using all estimators, assumptions and correction factors, we calculated the volumes of dimensional lumber (Table B-5) and plywood/strand board (Table B-6) generated in new construction and demolition, annually. These estimates are aggregated in Table 7 (main text) to indicate the total volume of wood residue generated by construction and demolition in the Study Area.

Table B-1
Description of Information Base and Geographical Regions in the Study Area.

Statistics Canada Census Division/Provincial Regional District	Statistics Canada Census Subdivision	Incorporated Cities, Towns & Districts
9/Fraser-Cheam (1)	12 Fraser-Cheam Subd A 38 Fraser-Cheam Subd B 50 Fraser-Cheam Subd C	1 District of Chilliwack 2 District of Hope 3 District of Kent 4 Village of Harrison Hot Springs
11/Central Fraser Valley (1)	12 Abbotsford 14 Matsqui	5 District of Abbotsford (2) 6 District of Matqui (2)
13/Dewdney-Alouette (1)	5 Mission 11 Maple Ridge 18 Pitt Meadows 24 Dewdney-Alouette Subd A	7 District of Maple Ridge 8 District of Mission 9 District of Pitt Meadows
15/Greater Vancouver	1 Langley 4 Surrey 11 Delta 15 Richmond 22 Vancouver 25 Burnaby 63 Greater Vancouver Subd A	10 City of Burnaby 11 City of Coquitlam 12 City of Langley 13 City of New Westminster 14 City of North Vancouver 15 City of Port Coquitlam 16 City of Port Moody 17 City of Richmond 18 City of Surrey 19 City of Vancouver 20 City of White Rock 21 District of Delta 22 District of Langley 23 District of North Vancouver 24 District of West Vancouver 25 Village of Anmore 26 Village of Belcarra 27 Village of Lions Bay
17/Capital	5 North Saanich 15 Central Saanich 21 Saanich 25 Capital Subd A 34 Victoria 45 Capital Subd B 55 Capital Subd D	28 City of Colwood 29 City of Victoria 30 District of Central Saanich 31 District of Esquimalt 32 District of Langford 33 District of Metchosin 34 District of North Saanich 35 District of Oak Bay 36 District of Saanich 37 Town of Sidney 38 Town of View Royal
19/Cowichan Valley	14 Cowichan Valley Subd B 31 Cowichan Valley Subd A 45 Cowichan Valley Subd C	39 City of Duncan 40 District of North Cowichan 41 Town of Ladysmith 42 Village of Lake Cowichan
21/Nanaimo	12 Nanaimo Subd A 28 Nanaimo Subd B	43 City of Nanaimo 44 City of Parksville 45 Town of Qualicum Beach
25/Comox-Strathcona	20 Comox-Strathcona Subd C 44 Comox-Strathcona Subd B 47 Comox-Strathcona Subd D 50 Comox-Strathcona Subd A	46 City of Courtenay 47 District of Campbell River 48 Town of Comox 49 Village of Cumberland 50 Village of Gold River 51 Village of Sayward 52 Village of Tahsis 53 Village of Zeballos
27/Powell River	14 Powell River Subd A	54 District of Powell River
29/Sunshine Coast	20 Sunshine Coast Subd A	55 District of Sechelt 56 Sechelt Indian Government 57 Town of Gibsons
31/Squamish-Lillooet	19 Squamish-Lillooet Subd B 30 Squamish-Lillooet Subd A	58 District of Squamish 59 District of Whistler 60 Village of Lillooet 61 Village of Pemberton

Notes: (1) These 3 Regional Districts were amalgamated into the Fraser Valley Regional District in December, 1995.
(2) The Districts of Abbotsford and Matsqui were joined to form the City of Abbotsford in 1994.

Table B-2
Proportion of Single Family Dwellings (SFDs) to Total Dwelling Units by District and Census Year, Study Area.

Region / Regional District	Census Year (1) SFDs/Total Dwelling Units 1971	1976	1981	1986	1991	Total Est. Dwelling Units 1995 (2)	Av. Annual Population Growth Rate (1976-1994) (3)
Lower Fraser Valley	64.8%	58.9%	59.0%	55.2%	51.2%	749,925	
Central Fraser Valley	84.1%	75.8%	71.4%	68.4%	61.1%	35,799	6.5%
Dewdney-Alouette	85.1%	80.0%	78.7%	79.3%	73.6%	31,015	4.4%
Fraser-Cheam	81.8%	74.6%	72.7%	74.7%	70.3%	28,327	2.8%
GVRD	62.1%	56.3%	56.8%	52.5%	48.8%	654,784	2.2%
Sunshine Coast	80.6%	75.0%	75.2%	79.2%	74.0%	24,808	
Powell River	81.7%	78.6%	78.5%	84.5%	81.4%	7,092	0.0%
Squamish-Lillooet	74.7%	65.7%	66.1%	66.6%	59.9%	8,585	4.1%
Sunshine Coast	85.2%	81.0%	81.0%	86.9%	81.4%	9,131	13.3%
East Vancouver Island	72.0%	64.8%	63.8%	66.5%	63.2%	233,045	
Capital	65.8%	59.2%	57.5%	57.9%	55.6%	132,824	2.5%
Comox-Strathcona	77.0%	69.9%	71.0%	76.8%	73.2%	34,550	4.3%
Cowichan Valley	86.2%	76.6%	75.8%	80.0%	76.3%	22,563	2.1%
Nanaimo	79.7%	71.6%	71.3%	77.9%	71.7%	43,108	3.8%
Study Area Average % SFD	66.9%	60.6%	60.5%	58.4%	54.6%		
Dwelling Unit Totals (2)	486,880	582,530	693,220	781,885	897,830	1,007,778	
Average Annual Growth Rate		3.9%	3.8%	2.6%	3.0%	3.1%	2.5%

Notes:
(1) Source: Statistics Canada Census.
(2) Excludes mobile homes
(3) Source: Municipal Statistics.

Table B-3

Average Annual Numbers of Structures Constructed and Demolished, Study Area, 1991-1995.

	A	B	c	B	E	F	G
	New Construction Category				Total New Construction (A+ B+C+D)	Demolition	Total New Construction and Demolition (E+F)
	SFD Units (1)	MFD Units (1)	Other (1)	II Structures (2			
	Number of Units						
Lower Fraser Valley	8,716	12,971	1 1 , 0 6 4	3,132	35,883	3,318	39,200
Central Fraser Valley	618	696	559	211	2,083	90	2,173
Dewdney Alouette	618	523	588	77	1,806	41	1,847
Fraser-Cheam	606	577	610	179	1,973	73	2,046
GVRD	6,873	11,175	9,307	2,665	30,020	3,114	33,134
Sunshine Coast	568	440	759	76	1,843	28	1,871
Powell River	58	33	190	8	288	12	299
Squamish-Lillooet	186	311	272	30	798	9	807
Sunshine Coast	324	96	298	39	757	8	764
East Vancouver Island	4,189	2,374	3,464	996	11,024	424	11,447
Capital	1,181	1,162	1,209	346	3,898	274	4,173
Comox-Strathcona	945	456	652	207	2,259	19	2,278
Cowichan Valley	654	227	454	130	1,466	83	1,548
Nanaimo	1,409	530	1,149	313	3,401	48	3,448
TOTALS	13,472	15,785	15,287	4,205	48,749	3,769	52,519

Notes: (1) SFD = Single Family Dwelling; MFD = Multi-Family Dwelling.
Other consists of new residential, commercial, industrial, institutional and residential additions, including garages. Numbers for the study area regions where information was not readily available are estimated at 45% of total dwelling units created annually.
(2) Cll consists of new commercial, institutional and industrial structures as represented by permits. Numbers for the study area regions where information was not readily available are estimated at 24% of total dwelling units created annually.

Table B-4
Estimates of Wood Residue Generated from New Construction and Demolition, by Amount and Type.

A Category of New Construction Unit	B Area (Sq.M.)	C Wood Type	D Wood Waste Coefficients (Kg Wood Waste Per 100 Sq.M.) (1)	E Kilograms of Wood Waste Per Unit ((BxD)/100)	F Cubic Metres of Wood Waste Per Unit (@262 kg per Cu.M.) (E/262) (2)(8)
Detached SFD and Duplex Units (3)	232	Dimensional Lumber	357	828	3.2
		Plywood/ Strand Board	274	636	2.4
Multi-Dwelling Units (4)	90	Dimensional Lumber	268	241	0.9
		Plywood/ Strand Board	206	185	0.7
New Commercial/ Institutional/ Industrial (5)	648	Dimensional Lumber	43	278	1.1
		Plywood/ Strand Board	33	213	0.8
Other (Additions, etc.) (6)	18	Dimensional Lumber	357	64	0.2
		Plywood/ Strand Board	274	49	0.2
Demolitions Zone 1 (7)	186	Dimensional Lumber			292
		Plywood/ Strand Board			15
Demolitions Zone 2 (7)	139	Dimensional Lumber			218
		Plywood/ Strand Board			11
Demolitions Zone 3 (7)	93	Dimensional Lumber			145
		Plywood/ Strand Board			8

Notes:
(1) Wood waste coefficients have been obtained from Partners in Clean Construction. 1995. A blueprint for action for the residential construction industry. Greater Vancouver Home Building Association/City of Edmonton. It has been assumed that the values represent house sizes and construction materials that are applicable to the Study Area.
(2) Based on a Mission municipal study, construction wood waste may weigh about 200 kg. per Cu.Yd. or 262 kg. per Cu.M.
(3) Mission - average single family dwelling - 267 Sq.M.; Surrey - average SFD - 186 Sq.M. (Royal LePage). Average used = 232 Sq.M. per unit.
(4) Average multi-family dwelling unit = 90 Sq.M., based on information provided by New Westminster Planning Department. It assumed that wood content of the construction is 75% of SFD.
(5) Abbotsford new commercial 734 Sq.M.; new industrial 548 Sq.M.; new institutional 746 Sq.M. for an average of 648 Sq.M. per unit. Wood content is estimated at 12% of SFD construction, after the Mission study.
(6) Abbotsford averages are commercial improvement 17 Sq.M.; industrial improvement 28 Sq.M.; institutional improvement 12 Sq.M. for an average of 18 Sq.M. per unit. This category also includes residential renovations, etc. It is assumed that wood content of construction is 100% of SFD.
(7) Average size dwelling demolitions are estimated for 3 Zones within the study area. Average demolition size in Zone 1, consisting of West Vancouver, Vancouver, Burnaby, Coquitlam, Richmond and Capital Regional District are calculated at 2000 sq.ft. or 186 Sq.M. Average demolition building size in Zone 2, represented by outlying GVRD areas, Chilliwack, Abbotsford and Nanaimo, are estimated at 1500 sq.ft., or 139 Sq.M. All other regions in the study are defined as Zone 3, with average demolition sizes of 1000 sq.ft., or 93 Sq.M.
(8) Based on discussions with demolition companies in Greater Vancouver, wood waste from Zone 1 demolitions are estimated at 306 Cu.M. per 186 Sq.M. building, or 165 Cu.M. per 100 Sq.M. of demolition. Plywood/strand b[illegible]uld represent a small proportion of demolition wood waste, in the order of only 5% of total demolition volumes generated.

Table B-5

Average Annual Cubic Meters of Dimensional Lumber Wood Residue Generated by New Construction and Demolition, 1991-1995.

	A	B	c	B	E	F	G
	New Construction Category (3)				Total New Construction (A+ B+C+D)	Demolition	Total New Construction and Demolition (E+F)
	SFD Units	Multiple Units	Other (1)	II Structures (2			
	Total Cubic Meters of Wood Residue Generated						
Lower Fraser Valley	27,552	11,941	2,714	3,331	45,538	902,535	948,073
Central Fraser Valley	1,954	640	137	224	2,955	19,533	22,488
Dewdney Alouette	1,9541	481	1441	81	2.661	5,9741	8,635
Fraser-Cheam	1,916	532	150	191	2,788	14,819	17,608
GVRD	21,728	10,288	2,283	2,835	37,133	862,209	899,342
Sunshine Coast	1,796	405	186	81	2,468	4,060	6,528
Powell River	183	30	47	8	268	1,682	1,950
Squamish-Lillooet	587	287	67	31	972	1,276	2,248
Sunshine Coast	1,025	88	73	41	1,228	1,102	2,330
East Vancouver Island	13,242	2,186	850	1,059	17,337	98,711	116,048
Capital	3,734	1,070	296	368	5,469	80,125	85,593
Comox-Strathcona	2,986	419	160	220	3,785	2,755	6,540
Cowichan Valley	2,069	209	111	138	2,527	11,984	14,512
Nanaimo	4,453	488	282	333	5,555	3,847	9,403
TOTALS	42,589	14,531	3,750	4,472	65,342	1,005,3071	1,070,649

Notes: (1) SFD = Single Family Dwelling; MFD = Multi-Family Dwelling.
Other consists of new residential, commercial, industrial, institutional and residential additions, including Numbers for the study area regions where information was not readily available are estimated at 45% of total dwelling units created annually.
(2) CII consists of new commercial, institutional and industrial structures as represented by permits. Numbers for the study area regions where information was not readily available are estimated at 24% of total dwelling units created annually.
(3) Per unit wood residue coefficients are presented in Table B4. Assumptions used to generate estimates are detailed in Appendix B.

Table B-6

Average Annual Cubic Meters of Plywood/Strand Board Wood Residue Generated by New Construction and Demolition 1991-1995.

	A	B	c	B	E	F	G
	New Construction Category (3)				Total New Construction (A+ B+C+D)	Demolition	Total New Construction and Demolition (E+F)
	SFD Units	Multiple Units	Other (1)	II Structures (2			
	Total Cubic Meters of Wood Residue Generated						
Lower Fraser Valley	21,146	9,178	2,083	2,557	34,964	46.239	81,203
Central' Fraser Valley	1,499	492	105	172	2,269	986	3,255
Dewdney Alouette	1,500	370	111	63	2,043	330	2,373
Fraser-Cheam	1,471	409	115	146	2,141	758	2,898
GVRD	16,676	7,908	1,752	2,175	28,511	44,166	72,677
Sunshine Coast	1,378	311	143	62	1894	224	2,118
Powell River	141	23	36	6	206	93	298
Squamish-Lillooet	451	220	51	24	746	70	817
Sunshine Coast	787	68	56	32	942	61	1,003
East Vancouver Island	10,163	1,680	652	813	13,309	5,131	18,440
Capital	2,866	823	227	282	4,198	4,116	8,314
Comox-Strathcona	2,292	322	123	169	2,906	152	3,058
Cowichan Valley	1,588	160	86	106	1,940	661	2,601
Nanaimo	3,418	375	216	256	4,264	202	4,467
TOTALS	32,688	11,170	2,878	3,432	50,167	51,594	101,761

Notes:

(1) SFD = Single Family Dwelling; MFD = Multi-Family Dwelling.
Other consists of new residential, commercial, industrial, institutional and residential additions, including Numbers for the study area regions where information was not readily available are estimated at 45% of total dwelling units created annually.

(2) CII consists of new commercial, institutional and industrial structures as represented by permits. Numbers for the study area regions where information was not readily available are estimated at 24?4. of total dwelling units created annually.

(3) Per unit wood residue coefficients are presented in Table B-4. Assumptions used to generate estimates are detailed in Appendix B.

APPENDIX C

ESTIMATION OF WOOD RESIDUE GENERATED BY LAND CLEARING ACTIVITIES

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APPENDIX C

ESTIMATION OF WOOD RESIDUE GENERATED BY LAND CLEARING ACTIVITIES

1.0 INTRODUCTION AND SCOPE

Road construction, housing developments or other land uses generate wood residue in the Study Area. To estimate the quantities involved, we used data from Statistics Canada, B.C. Ministry of Agriculture, Fisheries and Food, Ministry of Transportation and Highways, Ministry of Municipal Affairs, B.C. Assessment Authority, and had discussions with provincial and local government officials. The Lower Fraser Valley, Sunshine Coast and East Vancouver Island consist of 36 Census Subdivisions within 11 Census Divisions. The Census Divisions are represented by 11 Regional Districts (RDs), which administer 11 electoral or unincorporated areas, and 61 incorporated local governments. These jurisdictions are described in Table B-1 in Appendix B.

The objective of this component of the investigation and analysis was to determine the volume of wood residue generated by land use conversion activities, excluding forestry, in the Study Area. Land use conversion activities are defined as those which create wood residues through the process of land clearing. The major activities examined are:

- New residential development
- New commercial, industrial and institutional development (Cll)
- Land clearing associated with demolition site re-development
- New transportation and utility corridors
- Agricultural land clearing
- Other private land clearing

We present trends, methodology, and specific findings for residential, roads, agricultural, other private and demolition site land clearing.

2.0 TRENDS

The rate of land conversion responds to various factors including housing demand, economic trends, population growth, cost of land as well as government policies, initiatives and expenditures. In general, these factors have worked to promote the steady conversion of land from its natural state although the rate has fluctuated substantially over the historical period. We have selected estimators to describe the fluctuations, provided a summation of sources used, and examined future new construction and land clearing needs.

2.1 Selection of Estimators

Estimators were selected based on key variables: the number of land conversions by type, the average “footprint” or acreage associated with each type , the land clearing requirement associated with each “footprint”, and the volumes of wood residue created by each unit of land clearing. The generalized equation for each land conversion type is:

Total annual m^3 wood waste = (annual #of units) X ("footprint" acreage) X (% land clearing requirement) X (m^3 wood residue/acre)

An effort has been made to calibrate these variables to conditions in each of the 11 Regional Districts comprising the Study Area, based on information generated in the investigative process.

2.2 Sources of Information

Several sources of information were pursued to develop a profile of the land conversion activities in the Study Area. These include:

- Annual new single family dwelling (SFD) starts, converted into an acreage "footprint" based on average per unit site area, of which a proportion would represent a land clearing requirement (CMHC, local governments, Regional Districts, Royal LePage, land clearing companies).
- Annual new multi-family dwelling starts, converted into an acreage "footprint" based on average per unit site area, of which a proportion would represent a land clearing requirement (CMHC, local governments, Regional Districts, land clearing companies).
- Annual new Cl 1 starts, converted into an acreage "footprint" based on average per unit site area, of which a proportion would represent a land clearing requirement (local governments, ICI Data Port Moody, Regional Districts).
- Annual new structures created in unincorporated areas (BC Assessment Authority).
- Annual demolitions, converted into an acreage "footprint" based on average per unit site area, of which a proportion would represent a land clearing requirement (local governments, Regional Districts).
- Annual increases in transportation and utility corridors in unincorporated areas (Electoral Areas) of the Study Area, converted into a land clearing requirement (Regional Districts, Ministry of Transportation and Highways).
- Annual increases in transportation and utility corridors in incorporated areas of the Study Area, converted into a land clearing requirement (Ministry of Municipal Affairs).
- Annual agricultural land clearing (Agriculture Land Development Assistance program, Ministry of Agriculture, Fisheries and Food District Agriculturalists).
- Annual changes in the Agricultural Land Reserve (Agricultural Land Commission annual reports).
- Annual changes in the agricultural woodlands (Agricultural Census, Statistics Canada).
- Annual new lot creation in unincorporated areas (Ministry of Transportation and Highways, Regional Districts).

A study for State of the Environment Directorate, Environment Canada, dealing with "Land-Activity Change"1 in the Capital region and the GVRD covering the 1986-1990 period provided an opportunity to test the findings of the current investigation against the Statistics Canada database. The comparison is contained in this report.

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1 The work, produced by Spatial Analysis and Geomatics Applications, Agriculture Division, Statistics Canada, is at a preliminary stage of completion.

2.3 Future New Construction Considerations

Although projecting the level of future new **construction activities** in the Study Area is beyond the scope of this report, some discussion is necessary about the historical data in relation to near term future likelihoods.

New dwelling construction activity in the Study Area peaked in the 1986-1990 period before dropping to 10 year lows in 1995. In 1996, housing activity is expected to rise modestly to 1991 levels. Discussions with various local government officials, revealed that the previous growth spurt is now considered to have been too rapid, unsustainable, and unlikely to be allowed again in the foreseeable future in many jurisdictions.

For the purposes of projecting wood waste generation from future land clearing activities, it has been assumed that the average levels of new construction in the 1991-1995 period may be realistic indicators of the demand for land conversion in the immediate future. In those RDs attracting the majority of population growth (i.e., GVRD, Capital, Nanaimo, and Comox-Strathcona), the 5 year averages are above actual activity levels in 1994 and 1995, and probably 1996. Construction in outlying urban and rural areas appears to be less cyclic and less influenced by downturns in the high growth areas. Nonetheless, the contribution of outlying areas to overall construction levels in the Study Area is probably less than 40% of the total. New Cll construction activity and “other” construction has mirrored the cycle of new dwelling construction in the 1991-1995 period.

In the short term, several factors appear likely to continue to slow the pace of B.C.’S economic and population growth including:

- Slow growth in the U.S. economy and demand for B.C. exports
- Appreciating Canadian currency
- Slow employment growth in the province
- Reduction in interprovincial migration to B.C.
- Reduced international migration
- Reduced tourism in response to economic and environmental conditions

In the longer term, recovery of the Japanese economy and renewed domestic and international immigration offer economic and population growth opportunities in the Study Area.

2.4 Future Land Clearing Considerations

clearly, new construction activity directly affects land clearing demands. other factors also exist which are likely to alter the linkage between new construction and the resulting land clearing requirement. first, the loss of agricultural land reserve (air) lands to non-agricultural development in the study area has been slowed considerably in most rds. inevitably, this may be expected to shunt future growth into more fully forested areas. second, the emergence of the “small house on the small lot” product has implications for the acreage required to accommodate population growth in metropolitan areas. third, continued emphasis by many local governments on tree preservation is expected to reduce the unnecessary volumes of wood residue associated with new development.

3.0 METHODOLOGY

Our methodology is based on estimates of annual numbers of new construction and demolition, a "footprint" analysis, land clearing requirements, and the volume of wood waste per cleared site.

3.1 Annual Numbers of New Construction and Demolitions

The estimate of annual numbers of new construction, as a guideline for land clearing requirements, is based on the rate of construction of SFD and MFD, Cll construction, other **construction, and demolitions.**

SFD AND MFD Construction

The main data source for new dwelling starts is the Canadian Mortgage and Housing Corporation (CMHC) annual report entitled "Housing Statistics" for the B.C. and Yukon Region. The agency tracks all units of single detached, semi-detached, row and apartment (includes duplexes, triplexes, row duplexes, dwellings attached to non-residential structures) dwellings, but excludes mobile homes. CMHC data is aggregated by census areas (CAS), which in some cases differ from provincial Regional Districts (RDs). Year-end housing reports of CMHC branches and permit statistics of local governments were used as additional data, when required. The overall comparability of the dwelling starts database with local government records of new housing construction is moderate, with significant year to year reporting discrepancies related to actual vs. start dates, issuance of permits for units not built, some municipalities reporting net dwelling increases (i.e., less demolitions) and other reporting factors. Our investigation did not attempt to resolve discrepancies, but used local government data when differences were substantial.

Cll construction

Statistical data on the numbers of new commercial, industrial and institutional (Cll) structures were requested from the building inspections departments of 60 local and regional governments. Government reporting methods vary and in several cases it was not possible to break out new construction from other permits in these classifications. Farm buildings (non-residential) are included in this category.

Cll building activity in those areas where data is not readily available has been extrapolated from the ratio of average new dwelling unit starts to average Cll activity in those areas where information is available. On average, new Cll construction is assumed to average 25°/0 of new dwelling unit starts in the Study Area. In general, applying the average ratio of Cll activity to the study area tends to over-estimate new Cll starts in outlining areas and under-estimate starts in high population growth areas.

"Other" Construction

Similarly, data on "Other" construction (represented by new commercial, industrial, institutional and residential additions, including garages) was requested from the 60 local and regional

governments. Reporting methods are not consistent. In several cases, additions are lumped in with a variety of miscellaneous permits. In other instances, additions are combined with new structures permits in each of the commercial, industrial, institutional and residential categories. Whenever the reporting system was considered suspect for the purpose of this study, the data was not included in the database.

The ratio of new average new dwelling starts to average “Other” permits obtained in those areas where the information has been supplied has been applied to those local governments for which data has not been readily available. Although there is no direct relationship between new dwelling unit starts and “Other” building activity, this class of construction has approached 100% of SFD start levels and 38% of new dwelling unit starts in recent years in metropolitan areas. “Other" construction is likely to exceed SFD starts as the house population grows into second and third generation ownership (CMHC, personal communication).

It **is** noted that the ratio of “Other” construction to dwelling unit starts is higher in slower growth areas and lower in regional districts with a high proportion of multi-unit dwellings. As such, our averaging process will tend to under-estimate “Other” construction in outlying areas and over-estimate it in areas experiencing more intensive housing development. However, since “Other” category structures are mostly attached to existing structures, the class is not considered to generate a significant need for land clearing relative to other components of the study.

Demolitions

Demolitions contribute to land conversion associated with new building construction in two manners. First, demolitions generate land clearing wood waste in those cases where the cleared area of the site is increased or existing landscaping is stripped to make way for new construction. Second, demolitions supply land for new construction, reducing the land clearing demand in an area. Numbers of demolitions were obtained from each of the 60 local governments in the Study Area.

3.2 **“Footprint” Analysis**

The “footprint” of a new construction is defined as the acreage of a new building site used for structure, yard, garden, private roadway, etc. The acreage is the total potential land clearing requirement associated with the new construction. Included are footprint requirements for new SFD, new MFD, new Cll, other construction, and new construction on demolition sites,

New Single Family Dwelling (SFD) Construction

For the purposes of analysis, SFDS refer to both single detached dwelling units and duplex dwelling units. The footprints of new SFDS tend to vary as a function of whether the construction is metropolitan urban, outlying urban or rural in layout and/or location.

Information on outlying urban and rural footprints was obtained from an 1995 audit of wood waste generation activities in the District of Mission. Metropolitan urban footprints were estimated on the basis of site area sizes for new SFDS supplied by the City of New Westminister. Findings and application to the study area are presented in Table C-1.

New Multi-Family Dwelling (MFD) Construction

MFDs include a number of housing types, ranging from triplexes to modern high rise apartments. City of New Westminster data on the multiple dwelling lot size and numbers of units were used to calculate the size of an average MFD unit footprint. In addition, the District of Mission study provided an estimate of the MFD footprint for outlying urban areas. As shown in Table C-2, the density of MFD units is relatively higher, and the footprint smaller, in metropolitan urban areas.

*New Co*mmercial. Industrial and Institutional (CII) Construction

Footprints of new CII construction are expected to vary significantly in the Study Area. Based on District of Mission data, the average CII land clearing requirement is indicated at 1.5 acres per CII unit in outlying urban areas. The CII footprint in metropolitan urban areas is generally expected to be significantly smaller, due to higher land costs, limited land availability and the associated need for denser development. It is also evident that the more extensive CII activities (i.e., larger footprints), such as warehousing, on-site production and storage, are located where land is cheaper. Footprint estimates of CII construction and application to the Study Area are shown in Table C-3.

Other Construction

The footprint of additions, garages, etc. has been assumed to be the average area of all units in this category. Estimates of the average areas of new "Other" construction were obtained from the building permit records for the City of Abbotsford. These values, presented in Table C-4, were assumed to, apply to the Study Area.

*New Co*nstruction on Demolition Sites

Lot sizes of housing demolition sites for 4 of the last 5 years were obtained from building permit data supplied by the City of New Westminister. On average, the footprint of lots containing demolitions has been calculated at 0.1639 acre per demolition site. This value has been applied to demolition sites in all RDs of the Study Area.

3.3 Land Clearing Requirements Associated with New Construction

Land clearing is associated with any new construction. We estimated the average land clearing requirement to support new construction within the footprints calculated for each RD. The land clearing requirement is a function of the natural state of acreage prior to development. A land clearing study in the District of Mission has been used as a reference for estimating land clearing in the RDs.

Land clearing requirements for new lots are assumed to be lowest in metropolitan areas and older deforested areas, mid-range in those districts representing mixes of forested and agricultural areas, and highest in forested areas. Table C-5 presents the estimated percentage and acreage of the land clearing footprint required in each RD by type of new construction.

3.4 **Wood Residue Volume Per Cleared Acre of New Construction**

Wood residue is generated from land clearing for most construction. We estimated the volume of wood residue from the residual ground cover on these sites. Two types of ground cover requiring land clearing have been considered: timber and scrub. The volumes may be highly variable, ranging from under 450 m^3 to over 2500 m^3 per acre. The District of Mission study estimated an average wood residue volume of 765 m^3 per acre for that area. This value has been applied to estimate wood waste volumes in the RDs, adjusted for the proportion of timbered vs. Scrub cover. Table C-6 indicates the estimated proportion of ground cover types and average wood waste volume per acre in each RD.

4.0 LAND CLEARING FOR NEW TRANSPORTATION AND UTILITY CORRIDORS

Land clearing is required for new transportation and utility corridors. We have considered municipal streets, roads and alleys, provincial highways, and roads in unincorporated areas.

Municipal Streets, Roads and Alleys

Incorporated areas of the Study Area are represented by cities, districts, towns and villages. Annual municipal statistics track street, road and alley distances and areas for which the municipality is responsible, excluding those arterial roadways under provincial jurisdiction. Small acreages of roads are transferred from the province to municipalities from time to time when no longer required for **arterial** highway purposes.

Changes in the area of municipal streets, roads and alleys (SRA) were examined in each RD since 1980. With the exception of the Powell River, Squamish-Lillooet and Sunshine Coast, all RDs indicated steady growth in municipal SRA area consistent with increasing population and housing activity. Based on the total change in SRA area in the 1990 to 1994 period (1995 data not available), an annual rate of SRA growth has been calculated for each RD. For the purposes of analysis, this rate is assumed to be a realistic estimator of future annual SRA development.

Conversion of SRA area into wood residue estimates required assumptions about the land clearing requirement and average wood residue volumes per acre. The average per acre wood residue volumes estimated for new construction land clearing have been used (Table C-6). A summary of the acreages of land clearing required by the different categories of road construction are presented in Table C-7.

4.2 **Provincial Arterial and Secondary Highways**

Ministry of Highways and Transportation (MOTH) statistics on arterial and secondary highways (ASH) distance in each of the RDs was obtained for the March, 1991 to March, 1996 period. Changes in this period were converted into an average number of kilometres annually, then multiplied by a factor of 15 acres per kilometre to estimate areas.

No growth in distances occurred in the Powell River, Squamish-Lillooet and the Sunshine Coast RDs. East Vancouver Island and the Lower Fraser Valley exhibited average annual growth in ASH distances representing 190 and 113 acres per year in the period, respectively. Conversion coefficients used to estimate land clearing requirements and wood residue volumes are contained in Table C-6.

4.3 **Roads and Access Widening in Unincorporated Areas**

Roads in electoral areas of RDs are the responsibility of MOTH. Three years of statistics (1992-1994) were used to calculate annual averages of

- Kilometres of new fee simple road created by subdivision plans
- Hectares of widened right-of-way from rural fee simple subdivisions.

Kilometres have been converted into acres at the conversion rate of 5 acres per kilometre. It is possible that the reporting in the Nanaimo RD also represents land clearing associated with the Island Highway route. If such is the case, the annual land clearing requirement is overestimated (in Table C-7) since no new capital projects are forecast in the Study Area in the immediate future.

5.0 AGRICULTURAL LAND CLEARING

The Agricultural Regional Development Assistance (ALDA) program has provided low interest loans to farmers for various farm capital projects, including land clearing. The program was terminated in 1995, although some funding of previously committed projects is still occurring. Ministry of Agriculture, Fisheries and Food (MAFF) records were obtained for the 1981-1995 period. Discussion with MAFF staff indicated that the program was fully accessible to farmers in the 1981-1991 period, but limited in funding allocation from 1992 onwards. Accordingly, the 1981-1991 period, was averaged to obtain an estimate of average annual agricultural land clearing in the Study Area. This average has been assumed to be representative of land clearing activities in the immediate future, since the impact of ALDA termination in the current low interest rate period is probably minimized.

Communication with District Agriculturalists revealed that some portion of the agricultural land clearing did occur without assistance from ALDA. It has been assumed that ALDA approvals represented between 50 and 65°A of the total agricultural land clearing over this period, depending on RD. Table C-8 summarizes estimates of average annual acreages cleared in each of the RDs. Per acre volumes of wood residues generated by agricultural land clearing activities are calculated from the schedule laid out in Table C-6.

6.0 OTHER PRIVATE LAND CLEARING

In addition to the activities indicated above, land clearing takes place in some RDs for other purposes such as: expanding existing rural units, clearing for larger yards, gravel pit extension and logging in response to good prices and in anticipation of future subdivision. This class of activity has been addressed in the 1995 Mission study. Extrapolation of results to the other RDs has proved difficult and probably requires additional study.

Based on estimates of ALDA program uptake, agricultural clearing in the Mission/Abbotsford area may account for 77 acres, annually, of which some 50 acres could be located in the District of Mission. Based on an estimated annual total of agricultural and other private land clearing of 100 acres in Mission, agricultural land clearing may represent only 50°A of the total land clearing in any particular RD. Based on discussions through the course of the investigation, a possible breakout of other land clearing is presented in Table C-8. Wood residue volume estimates are calculated from the schedule presented in Table C-6.

7.0 EFFECT OF DEMOLITIONS ON LAND CLEARING REQUIREMENTS

Most demolitions are for the purpose of re-development. Since older structures are smaller in footprint than new construction and the bulk of demolitions consist of older structures, demolitions often result in the enlargement of the development footprint. As a result, the fringes of a demolition site, containing tree, landscaping, scrub bush, etc., may be cleared. Table C-9 indicates the assumptions related to land clearing requirement and average wood residue volumes associated with demolition sites. Local by-laws governing tree removal are expected to lead to greater preservation of existing urban trees and landscaping in the future.

The second effect of demolitions is to free up land for conversion into new uses. As such, conversions reduce the land clearing requirement associated with new construction. These “negative footprints”, indicated in brackets in Table C-9, have been subtracted from the gross footprint totals calculated above to generate a net acreage requirement for the study area. The per acre wood residue volume schedule in Table C-6 was applied to the net demolition footprint in each RD.

8.0 TOTAL VOLUMES OF LAND CLEARING WOOD RESIDUE GENERATED

Using all estimators, assumptions and correction factors, we calculated the volume of land clearing debris generated in the Study Area. Tables C-1 O and C-11 indicate the estimated requirement for land and land clearing, respectively, associated with new construction and demolition site land clearing for redevelopment. In Table C-12, total wood residue volumes from land clearing for new construction are calculated.

Tables C-1 3 and C-14 indicate the estimated acreage and land clearing requirements (in acres) from all land uses, including new construction, demolition, agriculture, roads, and other clearing. Table C-1 5 indicates the estimated wood residue production from the required land base. The total wood residue volumes are presented in Table 7 in the main body of the report.

9.0 COMPARISON OF LAND CLEARING ESTIMATES TO STATISTICS CANADA LAND ACTIVITY STUDY, 1986-1991.

A study of land conversion in the GVRD and Capital Regional District of British Columbia has been recently undertaken by Statistics Canada, Agriculture Division, Spatial Analysis and Geomatics Applications. The preliminary results, tabulated by Census Subdivision and Metropolitan Area, quantify the change in residential and Cll areas between 1986 and 1991. The estimates of land conversion in the 1991 to 1995 period generated by our investigation are compared to the Statistics Canada study in this section.

Our methodology is to compare the two time series by using dwelling unit starts as a proxy for land conversion. Thus, having established a ratio between housing starts and land clearing in the 1991-1995 interval, we sought to test its predictability for the 1986-1991 period.

Estimation of land conversion associated with new construction represented an intermediate step in the calculation of land clearing requirements in the Study Area. Table C-16 indicates how the coefficients of the ratios were determined and compares their predictive characteristics for the 1986-1991 period with the Statistics Canada estimate of land conversion. The findings suggest that, while the correlation between Statistics Canada data and our investigation for the GVRD is high (97%), the association may be spurious. While statistics on Cll construction are incomplete, the application of the ratios in the Capital RD is less satisfactory, explaining only 719!0 of the land conversion indicated by the Statistics Canada analysis.

Since the completeness of the dwelling starts data is relatively high (although accuracy may be problematic), it is probable that gaps in the Cll database can explain the lower coefficient in Table C-1 6, Column 1 for the Capital RD. However, on-the-ground sampling and detailed investigation of permits data for a specific jurisdiction would appear necessary to establish how well the databases reflect reality in their respective periods.

Table C-1
Estimated Footprints of Metropolitan Urban, Outlying Urban and Rural New SFD Construction

SFD Location	New Westminster	Mission	RDs of Application
	Footprint Acreage		
Metropolitan Urban	0.143		GVRD, Capital
Outlying Urban		0.17	Nanaimo, Cowichan, Comox-Strathcona, Powell River, Squamish-Lillooet, Sunshine Coast
Rural		1.00	
Area Average		0.302	Central Fraser Valley, Dewdney-Alouette, Fraser Cheam

Table C-2
Estimated Footpr ts of Metropolitan Urban and Outlying Urban New MFD Construction.

SFD Location	**New** Westminster	**Mission**	RDs of Application
	Footprint Acreage		
Metropolitan Urban	0.0154		GVRD, Capital
Outlying Urban		**0.03**	Nanaimo, Cowichan, Comox-Strathcona, Powell River, Squamish-Lillooet, Sunshine Coast, Central Fraser Valley, Dewdney-Alouette., Fraser-Cheam

Table C-3
Estimated Footprint of New Cll Construction.

Cl I Location	New Westminster	Mission	RDs of Application
	Footprint Acreage		
Metropolitan Urban	0.25		GVRD, Capital
Outlying Urban		1.5	Nanaimo, Cowichan, Comox-Strathcona, Central Fraser Valley, Dewdney-Alouette, Fraser Cheam
Outlying Urban/Rural		0.5	Powell River, Squamish-Lillooet, Sunshine Coast

Table C-4
Estimated Footprint of New Other Construction.

Other Sub-Class	Abbotsford Footprint (Sq.M.)	RDs of Application
Commercial	17	
Industrial	28	
Institutional	12	
Average	18	GVRD, Capital, Powell River, Nanaimo, Cowichan, Comox-Strathcona, Central Fraser Valley, Dewdney-Alouette, Fraser Cheam, Squamish-Lillooet, Sunshine Coast

Notes: Average size of residential additions/garages assumed to be similar to the average in the table.
18 Sq.M. = 0.0044 acre.

Table C-5
Estimated Land Clearing Requirement as a Percentage of Footprint by Construction Type and Regional District.

Regional District	SFD Unit	MFD Unit	CII Unit	Other Unit	Demolition Site
	Estimated Percentage of Footprint Requiring Land Clearing by Type of New Construction				
Central Fraser Valley	40%	40%	30%	0%	5%
Dewdney-Alouette	75%	75%	50%	0%	5%
Fraser-Cheam	40%	40%	30%	0%	5%
GVRD	40%	40%	30%	0%	2%
Powell River	90%	90%	75%	0%	10%
Squamish-Lillooet	90%	90%	75%	0%	10%
Sunshine Coast	90%	90%	75%	0%	10%
Capital	40%	40%	30%	0%	2%
Comox-Strathcona	90%	90%	75%	0%	10%
Cowichan Valley	90%	90%	75%	0%	10%
Nanaimo	90%	90%	75%	0%	10%

Notes: Estimates for the RDs are based on percentages derived in the Mission area (presented as the Dewdney-Alouette RD).

Table C-6
Estimated Average Wood Residue Volumes Per Acre Cleared in the Regional Districts.

Regional District	Timbered Land Wood Residue Volume (m^3/acre)	Proportion of Timbered Land (%)	Scrub Land Wood Residue Volume (m^3/acre)	Proportion of Scrub Land (%)	Weighted Average Wood Residue Volume (m^3/acre)
Central Fraser Valley	875	75%	450	25%	769
Dewdney-Alouette	875	75%	450	25%	769
Fraser-Cheam	875	75%	450	25%	769
GVRD	875	50%	450	50%	663
Powell River	875	95%	450	5%	854
Squamish-Lillooet	875	95%	450	5%	854
Sunshine Coast	875	95%	450	5%	854
Capital	875	50%	450	50%	663
Comox-Strathcona	875	75%	450	25%	769
Cowichan Valley	875	75%	450	25%	769
Nanaimo	875	75%	450	25%	769

Table C-7
Estimated Land Clearing Requirement and Wood Residue Volumes Per Acre Associated with Road Construction.

Regional District	Average Wood Residue Volume (m^3/acre)	Percent of Road Acreage Requiring Land Clearing	Annual Municipal Road Construction (acres/year)	Annual Provincial Arterial Highway Construction and ROW's (acres/year)	Annual Road Access Construction in Unincorporated Areas (acres/year)
Central Fraser Valley	769	40%	128	3	11
Dewdney-Alouette	769	75%	5	0	0
Fraser-Cheam	769	40%	62	74	0
GVRD	663	40%	247	35	0
Powell River	854	90%	0	0	0
Squamish-Lillooet	854	90%	0	0	3
Sunshine Coast	854	90%	0	0	7
Capital	663	40%	82	0	0
Comox-Strathcona	854	90%	11	102	0
Cowichan Valley	854	90%	15	15	0
Nanaimo	854	90%	17	72	64
		Totals	567	301	85

Table C-8
Estimated Land Clearing Requirement and Wood Residue Volumes Per Acre Associated Agricultural and Other Private Land Clearing.

Regional District			New Agricultural Acreage (acres/year)	New Other Private Acreage (acres/year)
Central Fraser Valley	769	100%	34	34
Dewdney-Alouette	769	100%	50	50
Fraser-Cheam	769	100%	66	66
GVRD	663	100%	4	4
Powell River	854	100%	0	1
Squamish-Lillooet	854	100%	0	2
Sunshine Coast	854	100%	0	3
Capital	663	100%	0	0
Comox-Strathcona	854	100%	60	60
Cowichan Valley	854	100%	52	52
Nanaimo	854	100%	0	0
		Totals	266	272

Table C-9
Estimated Land Clearing Requirement and Reduction in Footprint from New Construction on Demolition Sites.

Regional District			Demolition Contribution to Land Requirement (acres/year)	Demolition Land Clearing Requirement (% of Footprint)	Net Demolition Contribution to Land Clearing Requirement (acres/year)
Central Fraser Valley	90	0.1639	(15)	5%	(14)
Dewdney-Alouette	41	0.1639	(7)	5%	**(6)**
Fraser-Cheam	73	0.1639	(12)	5%	(11)
GVRD	3114	0.1639	(510)	2%	*(500)*
Powell River	12	0.1639	(2)	1 0%	**(2)**
Squamish-Lillooet	9	0.1639	(1)	10?40	(1)
Sunshine Coast	8	0.1639	(1)	10%	(1)
Capital	274	0.1639	(45)	2%	*(44)*
Comox-Strathcona	19	0.1639	(3)	1 0 %	*(3)*
Cowichan Valley	83	0.1639	(14)	10?40	*(12)*
Nanaimo	48	0.1639	(8)	10%	*(7)*
Totals	3771		(618)		

Table C-10
Acreage Required Annually for New Construction, Average 1991-1995. (4)

Regional District	SFD Units (1)	MFD Units (1)	CII Units (1)	Other Units (2)	Demolition Units (3)	Total Net Land Conversation Requirements
	Number of Acres Required Annually					
Lower Fraser Valley	1,539	226	1,203	36	-544	2,460
Central Fraser Valley	187	21	317	2	-15	512
Dewdney-Alouette	187	16	115	1	-7	312
Fraser-Cheam	183	17	269	3	-12	460
GVRD	982	172	503	30	-510	1,177
Sunshine Coast	97	13	38	3	-5	147
Powell River	10	1	4	1	-2	14
Squamish-Lillooet	32	9	15	1	-1	55
Sunshine Coast	55	3	19	1	-1	77
East Vancouver Island	680	54	764	18	-69	1,447
Capital	169	18	68	9	-45	219
Comox-Strathcona	161	14	122	3	-3	296
Cowichan Valley	111	7	104	2	-14	*210*
Nanaimo	239	16	470	5	-8	722
Totals	2,315	294	2,006	57	-618	4,054

Notes:
(1) SFD = new Single Family Dwelling; MFD = new Multi-family Dwelling:
CII = new Commercial, Industrial and Institutional.
(2) Other = Commercial, industrial, institutional and residential additions, including garages.
(3) Figures in parenthesis indicate that demolition sites reduce the need to clear land to support new development.
(4) Assumption are detailed in Appendix C.

Table C-1 1

Acreage Requiring Land Clearing for Construction Development by Regional District, Average 1991-1995. (4)

Regional District	SFD Units (1)	MFD Units (1)	Cll Units (1)	Other Units (2)	Demolition Units (3)	Total Net Land Clearing Requirement
	Number of Acres Cleared Annually					
Lower Fraser Valley	681	96	384	0	-532	629
Central Fraser Valley	75	8	95	0	-14	164
Dewdney-Alouette	140	12	57	0	-6	203
Fraser-Cheam	73	7	81	0	-11	150
GVRD	393	69	151	0	-500	112
Sunshine Coast	87	12	29	0	-4	123
Powell River	9	1	3	0	-2	11
Squamish-Lillooet	28	8	11	0	-1	47
Sunshine Coast	50	3	15	0	-1	66
East Vancouver Island	528	40	542	0	-66	1,044
Capital	68	7	21	0	-44	51
Comox-Strathcona	145	12	92	0	-3	246
Cowichan Valley	100	6	78	0	-12	172
Nanaimo	216	14	352	0	-7	575
Totals	1,295	148	955	0	-602	1,796

Notes:

(1) SFD = new Single Family Dwelling; MFD = new Multi-family Dwelling:
Cll = new Commercial, Industrial and Institutional.

(2) Other = Commercial, industrial, institutional and residential additions, including garages,

(3) Figures in parenthesis indicate that demolition sites reduce the need to clear land to support new development.

(4) Assumption are detailed in Appendix C.

Table C-12
Wood Residue Generated by Land Clearing for New Construction by Regional District, Average 1991-1995. (4)

Regional District	SFD Units (1)	MFD Units (1)	Cll Units (1)	Other Units (2)	Demolition Units (3)	Total Volume Wood Residue Generated
	Cubic Meters					
Lower Fraser Valley	481,621	66,434	279,166	0	-355,737	471,484
Central Fraser Valley	57,391	6,417	72,993	0	-10,724	126,076
Dewdney-Alouette	107,642	9,043	44,165	0	-4,931	155,918
Fraser-Cheam	56,289	5,327	62,084	0	-8,714	114,986
GVRD	260,300	45,647	99,924	0	-331,368	74,503
Sunshine Coast	74,212	10,131	24,332	0	-3,526	105,149
Powell River	7,576	751	2,433	0	-1,461	9,300
Squamish-Lillooet	24,270	7,178	9,477	0	-1,108	39,817
Sunshine Coast	42,366	2,201	12,422	0	-957	56,032
East Vancouver Island	398,484	29,905	414,767	0	-46,121	797,035
Capital	44,734	4,748	13,609	0	-29,198	33,894
Comox-Strathcona	111,103	9,457	70,571	0	-2,154	188,976
Cowichan Valley	76,970	4,708	59,717	0	-9,372	132,023
Nanaimo	165,678	10,993	270,869	0	-5,397	442,142
Totals	954,317	106,470	718,265	0	-405,385	1,373,667

Notes:
(1) SFD = new Single Family Dwelling; MFD = new Multi-family Dwelling:
Cll = new Commercial, Industrial and Institutional.
(2) Other = Commercial, industrial, institutional and residential additions, including garages,
(3) Figures in parenthesis indicate that demolition sites reduce the need to clear land to support new development.
(4) Assumptions are detailed in Appendix C.

Table C-13
Acreage Required for Land Development by Component and Regional District, Average 1991-1995.

Regional District	New SFD and MFD Construction	New Cll and Other Construction	Demolition Sites	All Roads	Agricultural Land Clearing	Other Private Land Clearing	TOTAL LAND CONVERSION REQMNT
	Number of Acres Required Annually						
Lower Fraser Valley	1,765	1,239	-544	566	154	154	3,334
Central Fraser Valley	208	319	-15	143	34	34	723
Dewdney-Alouette	202	116	-7	5	50	50	416
Fraser-Cheam	200	272	-12	136	66	66	729
GVRD	1,155	532	-510	282	4	4	1,466
Sunshine Coast	110	41	-5	11	0	6	163
Powell Rive	11	5	-2	0	0	1	15
Squamish-Lillooe	41	16	-1	4	0	2	61
Sunshine Coas	58	21	-1	7	0	3	87
East Vancouver Island	734	783	-69	379	112	152	2,091
Capita	187	77	-45	82	0	0	301
Comox-Strathcona	174	125	-3	113	60	60	530
Cowichan Valley	118	105	-14	30	52	52	345
Nanaimo	255	475	-8	153	0	40	916
Totals	2,609	2,063	-618	955	267	313	5,589

Table C-14

Summary of Land Clearing Requirement by Contributing Land Development Component and Regional District, Average 1991-1995.

Regional District	New SFD and MFD Construction	New Cll and Other Construction	Demolition Sites	All Roads	Agricultural Land Clearing	Other Private Land Clearing	TOTAL IAND CLEARING REQMNT
	Number of Acres Cleared Annually						
Lower Fraser Valley	777	384	-532	228	154	154	1,165
Central Fraser Valley	83	95	-14	57	34	34	289
Dewdney-Alouettel	152	57	-6	4	50	50	306
Fraser-Cheam	80	81	-11	54	66	66	337
GVRD	462	151	-500	113	4	4	233
Sunshine Coast	99	29	-4	10	0	6	139
Powell River	10	3	-2	0	0	1	12
Sauamish-Lillooet	37	11	-1	4	0	2	52
Sunshine Coast	52	15	-1	6	0	3	75
East Vancouver Island	568	542	-66	300	112	152	1,609
Capital	75	21	-44	33	0	0	84
Comox-Strathcona	157	92	-3	102	60	60	468
Cowichan Valley	106	78	-12	27	52	52	303
Nanaimo	230	352	-7	138	0	40	753
Totals	1,443	955	-602	538	267	313	2.913

Table C-15
Wood Residue Volumes Generated by Land Development Component and Regional District, Average 1991-1995.

Regional District	New SFD and MFD Construction	New CII and Other Construction	Demolition Sites	All Roads	Agricultural Land Clearing	Other Private Land Clearing	TOTAL WOOD RESIDUES VOLUME
	Cubic Meters Generated						
Lower Fraser Valley	548,055	279,166	-355,737	163,212	118,152	118,152	870,999
Central Fraser Valley	63,807	72,993	-10,724	43,830	26,288	26,288	222,482
Dewdney-Alouette	116,685	44,165	-4,931	2,753	38,438	38,438	235,547
Fraser-Cheam	61,616	62,084	-8,714	41,825	51,017	51,017	258,845
GVRD	305,947	99,924	-331,368	74,804	2,409	2,409	154,125
Sunshine Coast	84,343	24,332	-3,526	8,295	0	5,123	118,566
Powell River	8,328	2,433	-1,461	127	0	854	10,280
Squamish-Lillooet	31,448	9,477	-1,108	3,061	0	1,708	44,585
Sunshine Coast	44,567	12,422	-957	5,107	0	2,561	63,700
East Vancouver Island	428,389	414,767	-46,121	227,279	86,380	117,130	1,227,822
Capital	49,482	13,609	-29,198	21,731	0	0	55,625
Comox-Strathcona	120,559	70,571	-2,154	78,391	46,265	46,265	359,897
Cowichan Valley	81,677	59,717	-9,372	21,005	40,115	40,115	233,257
Nanaimo	176,670	270,869	-5,397	106,151	0	30,750	579,043
Totals	1,060,787	718,265	-405,385	398,786	204,531	240,404	2,217,388

Table C-16
Ratios of New SFD and MFD Construction to Land Conversion in the GVRD and Capital RD for the 1986-1990 and 1991-1995 Periods, Acreages Compared to Statistics Canada Land Conversion Estimate.

(A) GVRD	(B) SFD #'s	(C) Estimated Annual Land Conversion Requirement for SFDs (Acres)	(D) Ratio C/D	(E) MFD #'s	(F) Estimated Annual Land Conversion Requirement for MFDs (Acres)	(G) Ratio F/E	(H) Total Estimated Net Annual Land Conversion Requirement (Acres)	(I) Ratio H/(C+F)
Present Study 1991-1995 Averages	6,873	1,026	0.1493	11,175	169	0.0151	1,466	1.23
1986-1990 Calculated Averages	8,027	1,198		8,339	126		1,625	
Statistics Canada Study Results (1986-1991)							1,581	
Capital RD								
Present Study 1991-1995 Averages	1,181	199	0.1684	1,162	18	0.0151	301	1.39
1986-1990 Calculated Averages	1,358	229		1,148	17		342	
Statistics Canada Study (1986-1991)							484	

APPENDIX D

LIST OF ASSUMPTIONS AND CONVERSIONS

1000 fbm (board feet)	= *2.36* m^3
1 unit (e.g., hog fuel)	= 200 ft^3 (or 72 ft^3 of solid wood) = 5.66 m^3
*1 "truck"	= approx. 10 m^3 (tandem truck)
*1 "large truck"	= 8 units = approx. 45 m^3
1 section of a log boom	= 21.34m x21.34m = 455 m^2 = 4900 tonnes

wood waste bulk densities:

bark, hog fuel	160-320 kg/m3 (average 240 kg/m3)
chips, shavings	160-480 kg/m3 (average 320 kg/m3)
sawdust	approx. 400 kg/m3
trim ends	approx. 153 kg/m3

* Facilities operate on a 5-day workweek, 50 weeks a year.

* Wood residue from timber processing facilities is 26-35'% of total wood consumption.

Where a numerical range was given for wood and wood residue volumes, the lower value of the range was used so as to provide the most conservative estimate.

Where a numerical range was given for costs, the average cost was used,

Where several possible end uses were specified for a wood waste stream, the total volume of that waste stream was divided evenly between the different uses.

* These assumptions were used only where survey responses were not specific enough.