

Validation of a Modified Operational Cruise Designed to Sample Dead Wood

Interim Working Document
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Prepared for the TWF/INTERFOR Project Subcommittee¹

of the

Vancouver Forest Region CWD Working Group

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Disclaimer: *This is a living document and will be revised to address measurement, implementation, and/or compilation issues as they arise.*

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1. Introduction

In B.C. the management of CWD is a legislative requirement under the *Forest Practices Code Act of British Columbia*. Quantitative direction on CWD retention is required in Forest Development Plans (OPR Sec 18(1)(u)) and Silviculture Prescriptions (OPR Sec 39(3)(m)). The recently released document titled *A Short-term Strategy for Coarse Woody Debris Management in British Columbia's Forests*¹ provides guiding principles and management considerations to improve CWD retention within the context of the utilization policy. The next step, which is the development of quantitative targets, requires the collection of dead wood data in both second and old growth forests across major ecosystems and timber types. Current information on dead wood is too sparse to develop such targets. In the interim, field staff is burdened with the task of implementing vague CWD management strategies. In the Vancouver Forest Region, a working group has been formed that currently includes representatives from the five major licencees, SBFEP, Forest Engineering Research Institute of Canada, Long Beach Model Forest, Residue Value Enhancement Association, Ministry of Forests and Ministry of Environment, Lands and Parks. The purpose of this group is to collaboratively test the main principles outlined in the short-term strategy, and to develop CWD retention targets over the next few years.

One of the first tasks of this group is to address the dead wood data shortfall. Current operational surveys (i.e. residue and waste, operational cruise) provide only a portion of the required data. Research data, while often complete, is limited in scope. This relegates data collection to an independent survey, which is expensive. The alternative to an independent survey is to append the collection of the "missing" data to an existing operational survey. "Missing" data refers to dead standing stems and windfalls <50% sound, CWD pieces other than windfalls and stumps <3 m in length². Because these dead wood attributes are closely tied to the standing live and dead merchantable stems, the logical choice is to append these measurements to the operational cruise.

Timber West Forests (TWF), a member of the Vancouver Forest Region CWD working group, proposed undertaking a pilot to evaluate the effectiveness (i.e., cost, data reliability) of a modified operational cruise to provide estimates of the "missing" dead wood volume and attributes (Appendix A). International Forest Products Ltd. (INTERFOR) agreed to participate in the 2001/2002 trial.

The data collected in the modified operational cruise will include attributes of size and merchantability for live, dead standing and windfalls, stumps, and CWD pieces >1.3 m in height (length). The live trees, dead standing stems, and windfalls will be identified for measurement using the prism, which is the standard operational cruising procedure. All CWD will be measured using a prism as part of the augmented cruise. Further, all measurements "additional" to the standard operational cruise will be estimated. The reliability of the data from the modifications to the operational cruise will be validated through the use of "check" plots on a subsample of the total number of plots. This document provides details on the just-described validation study.

¹ The URL for this document is: <http://www.for.gov.bc.ca/research/deadwood/DTgui3.htm>.

² When referring to inequalities involving lengths and heights in this report, a strict inequality (i.e. > or <) will always be assigned to the "greater than" condition.

2. Objectives

There are two components to the validation study: 1) field sampling validation and 2) summary strata validation. The three main objectives of the field sampling component are:

1. to gain comfort that all appropriate stumps ($\geq 1.3 \text{ m}^3$), CWD pieces ($\geq 1.3 \text{ m}$), and windfalls are counted in the modified operational cruise.
2. to evaluate the significance or triviality of those pieces deliberately not measured in the modified operational cruise (e.g., stumps $< 1.3 \text{ m}$ in height, CWD pieces $< 1.3 \text{ m}$ in length).
3. to determine the effect of using estimates of piece volume based on a taper equation (i.e. where knowledge of only DBH and length is required) versus volume based on the specific geometry of each piece (e.g. formulas attributed to Smalian, Huber, etc.)⁴.

The primary motivation for the preceding objectives is to ensure that the modified operational cruise is as effective as possible for estimating dead wood parameters (i.e. fine-tune the “additional” measurements as the study progresses), rather than an attempt to estimate adjustment factors to be applied in retrospect.

The three main objectives of the summary strata component of the validation study are:

1. to evaluate whether timber type and site index groupings can be lumped into broader categories (based on total dead wood volume and other attributes).
2. to evaluate the effectiveness of subzone variant and moisture groupings (on delineating total dead wood volume and other attributes), and
3. to integrate timber type/site index and subzone variant/moisture groupings.

As a first step, the plot-level data from the modified operational cruise will be summarized by broad strata based on timber type and site index groupings used by TWF and INTERFOR. The effectiveness of these strata to distinguish between major differences in dead wood volumes and attributes compared to other strata (e.g., biogeoclimatic subzones) will be evaluated.

3. Site Selection

For both TWF and INTERFOR, site selection will be tied to the operational cruise schedule. Sites will be limited to public land (TFL 2, TSA Sunshine Coast and TSA Strathcona). Mature stands are the sampling priority for 2001/2002. It is anticipated that between 500 – 700 plots will be sampled in total.

Within each block, plots will be established on a $100 \times 100 \text{ m}$ grid (1 plot/ha). All plots will be full measure plots. Ten percent of the plots will be systematically selected as validation plots. This will be achieved by selecting 20% of the sites (i.e. every 5th beginning with a random start) and then choosing every second plot centre from the selected sites.

³ Note that actual length will be recorded in 1 meter multiples, starting at a 1 meter length

⁴ These require additional measurements are not part of the operational cruise (e.g. butt and top diameters).

4. Field Methods

4.1. Overview of the Modified Operational Cruise

A draft of the modified operational cruise sampling method is provided in Appendix B. Table 1 lists the structures and corresponding tree classes for mature stands. Those structures with tree class 4 are “additional” measurements to the standard operational cruise. All of the “additional” measurements will be estimated.

Table 1. Structures and associated Tree Class Codes

Description	Minimum DBH (cm)	Minimum Height/Length (m)	Tree Class Codes used in the Compilation
Live merchantable – standing	17.5	1.3	1: nonsuspect (no pathological indicators present)
Live merchantable – standing	17.5	1.3	2: suspect (pathological indicators present)
Live merchantable – windfall	17.5	1.3	1W: nonsuspect with E or G damage code
Live merchantable – windfall	17.5	1.3	2W: suspect with E or G damage code
Dead merchantable – standing	17.5	1.3	3
Dead merchantable – windfall	17.5	1.3	3W: E or G damage code
Dead non-merchantable – standing	17.5	1.3	4: ≥ 3 m
Dead non-merchantable – windfall	17.5	1.3	4W: >3 m with E or G damage code
Stump	17.5	1.3	4: <3.0 m
Piece	17.5	1.3	4Z: E or G damage code (and first log will be coded as Z10)

For mature stands, which are the focus of this pilot, a minimum DBH of ≥ 17.5 cm outside bark (if present) will apply to all tree classes. In second growth stands the minimum DBH is ≥ 12.0 cm. All live and dead trees standing and fallen must be ≥ 1.3 m in length. Dead stems <3 m are classified as stumps in the compilation. Stumps must be between 1.3 m – 3.0 m in height. Root wads will be pencil bucked at the high side. Pieces are dead down wood without attached roots. DBH is recorded 1.3 m up from the butt. Only pieces ≥ 1.3 m in length will be recorded because DBH is at 1.3 m and length measurements are estimated to the nearest metre. Table 2 is a list of attributes measured by structure, or data type.

Table 2. Attributes Measured in Modified Operational Cruise and Validation Plots

Data Type	Attributes Measured in Modified Operational Cruise	Attributes Measured in Validation Plots
Live and Dead Merchantable Standing Stems ≥ 1.3 m in Height and ≥ 17.5 (or ≥ 12) cm at DBH	≥ 17.5 cm DBH <ul style="list-style-type: none"> • Species • DBH • Total Height or Estimated Total Height in the case of Broken Tops • Logs 1-6: Grade, Length, % Soundness • Pathological Indicators 	For stems < 17.5 and ≥ 12 cm at DBH : <ul style="list-style-type: none"> • Species • DBH • Total Height or Estimated Total Height in the case of Broken Tops • Estimated Original Height in the Case of Broken Tops
Live and Dead Merchantable Windfalls ≥ 1.3 m in Height and ≥ 17.5 (or ≥ 12) cm at DBH	≥ 17.5 cm DBH <ul style="list-style-type: none"> • Species • DBH • Total Height or Estimated Total Height in the case of Broken Tops • Logs 1-6: Grade, Length, % Soundness • Pathological Indicators 	≥ 12.0 cm DBH <ul style="list-style-type: none"> • Species • DBH • Total Length • Butt Diameter @0.3m • Top Diameter • Number of Breaks (average distance)
Dead Non-Merchantable Standing Stems and Dead Non-Merchantable Windfalls ≥ 1.3 m in Height and ≥ 17.5 (or ≥ 12) cm at DBH	≥ 17.5 cm DBH <ul style="list-style-type: none"> • Species • DBH • Total Height or Estimated Total Height in the case of Broken Tops • Logs 1-6: Grade, Length, % Soundness • Pathological Indicators 	≥ 12.0 cm DBH <ul style="list-style-type: none"> • Species • DBH (OD) • Total Length • Butt Diameter (height/width) @0.3 m (ID) • Top Diameter (height/width) (ID) • Number of Breaks (average distance)
Pieces ≥ 1.3 m in Length and ≥ 17.5 (or ≥ 12) cm 1.3m up from the butt	≥ 17.5 cm DBH <ul style="list-style-type: none"> • Species • DBH (1.3 m up from butt) • Estimated Total Length (height) • Logs 1-6: Grade, Length, % Soundness 	≥ 12.0 cm DBH <ul style="list-style-type: none"> • Species • DBH (1.3 m up from butt OD) • Total Length • Butt Diameter (ID) (height/width) • Top Diameter (ID) (height/width) • Number of Breaks (average distance)
Stumps between 0.3 and 1.3 m in Height and ≥ 12.0 cm at top and Pieces < 1.3 m in Length and ≥ 12.0 cm	N/A	≥ 12.0 cm @ top <ul style="list-style-type: none"> • Species • Total Length/Height • Diameter @ 0.3 m (stumps) or butt (pieces) (ID) • Top Diameter (ID)

4.2. Validation Field Plots

For each validation plot, the plot centre of the original cruise plot will be re-established. Two plot types will be used in the validation plot: prism (i.e. variable radius) and fixed radius circular plots. When a plot falls partially within the study area (i.e. some of it lies outside of the study boundary), a ½ plot will be established.

For the validation plots, measurements will be recorded when DBH ≥ 12 cm for both mature and second growth stands. Hence information will always be available for DBH between 12 and 17.5 cm, and DBH ≥ 17.5 cm.

Table 3 identifies structures that are commonly included in estimates of total dead wood, by plot type. Table 3 also divides structures into six categories:

- i) structures which meet the modified operational cruise criteria for mature stands
- ii) structures which meet the modified operational cruise DBH criteria but not length criteria for mature stands
- iii) structures which meet the modified operational cruise criteria for second growth stands
- iv) structures which meet the modified operational cruise DBH criteria but not length criteria for second growth stands
- v) structures in between the mature and second growth modified operational cruise criteria (structures in item i. minus those in item iii.)
- vi) structures in between mature and second growth criteria that meet the modified operational cruise DBH criteria but not length criteria (structures in item ii. minus those in item iv)

Structures routinely measured in an operational cruise will not be re-measured in the validation plot (i.e. tree classes 1-3). Dead and live merchantable windfalls are the exception, as these will be tallied. All windfalls will be recorded to provide the data required to evaluate estimates of volume based on the taper equation versus the specific geometry of each piece. In the validation plots, dead and live merchantable windfalls will be treated as “additional” structures.

The “additional” structures measured in the modified operational cruise will be identified and re-measured for a partial list of the original measurements (refer to Table 2). The “additional” structures measured in the modified operational cruise (i.e. tree class 4) will be re-measured using the same prism basal area factor (BAF) as the operational cruise.

Structures smaller than the operational cruise limits will be measured in either a fixed area plot or with a prism appropriate for a second growth stand. The fixed area plot will be used to identify:

- Stumps (≥ 0.3 m and < 1.3 m in height; ≥ 12.0 cm at the top).
- Pieces (< 1.3 m in length; ≥ 12.0 cm at the butt)
- Small windfalls (< 1.3 m in length and ≥ 12.0 cm at DBH or at the butt).

Small windfalls will be treated as CWD pieces; the root wad will be pencil bucked at the high side. For stumps height will be recorded from 0.3 m to the top; for windfalls and pieces length will be recorded from the butt to the cruise minimum top diameter (IB). Stumps are included when $> 50\%$ of the basal area lies within the fixed area plot; pieces are included when the midpoint lies within the fixed area plot.

A prism will be used to identify live and dead standing stems, windfalls, stumps and pieces which are > 1.3 m in height/length and ≥ 12.0 and < 17.5 cm at DBH. Small windfalls ≥ 1.3 and < 3.0 m in length will be treated as a piece.

In the validation survey, borderline pieces will be assessed to determine whether the pieces belong within the operational cruise prism sweep. For each borderline piece, the distance between the plot centre to the piece's centre will be measured in metres (i.e. the distance to the front of the piece facing the plot centre plus half of the piece's diameter). If this distance exceeds the theoretical limiting distance of $(\text{DBH in cm}) / (2 \cdot \sqrt{\text{BAF}})$, the piece will not be

tallied, and an applicable code assigned. Using this code to indicate whether borderline pieces are 'in' or 'out' of the validation sweep will identify pieces incorrectly included or excluded from the operational cruise.

Table 3. Data to be Collected in the Validation Plot for each Plot Type

	Scenario	Data type	Plot type
i.	Structures which meet the Modified Operational Cruise Criteria for Mature Stands	<ul style="list-style-type: none"> Pieces ≥ 1.3 m in length and ≥ 17.5 cm at DBH Dead and live merchantable and dead non-merchantable windfalls ≥ 1.3 m in length and ≥ 17.5 cm at DBH Dead and live non-merchantable standing stems ≥ 1.3 m in height and ≥ 17.5 cm at DBH 	Prism with same BAF as cruise
ii.	Structures which meet the Modified Operational Cruise DBH Criteria but not Length Criteria for Mature Stands	<ul style="list-style-type: none"> Stumps ≥ 0.3 m and < 1.3 m in height – top diameter must be ≥ 17.5 cm Pieces ≥ 0.3 m and < 1.3 m in length and ≥ 17.5 cm at DBH or ≥ 17.5 cm at the butt Dead and live windfalls ≥ 0.3 m and < 3.0 m in length and ≥ 17.5 cm at DBH or ≥ 17.5 cm at 0.3m 	2.54 m radius circular
iii.	Structures which meet the Modified Operational Cruise Criteria for Second Growth Stands	<ul style="list-style-type: none"> Pieces ≥ 1.3 m in length and ≥ 12.0 cm at DBH Dead and live merchantable and dead non-merchantable windfalls ≥ 1.3 m in length and ≥ 12.0 cm at DBH Dead non-merchantable standing stems > 3.0 m in height and ≥ 12.0 cm at DBH 	Prism with same BAF as cruise for 2 nd growth
iv.	Structures which meet the Modified Operational Cruise DBH Criteria but not Length Criteria for Second Growth Stands	<ul style="list-style-type: none"> Stumps ≥ 0.3 m and < 1.3 m in height – top diameter must be ≥ 12.0 cm Pieces ≥ 0.3 m and < 1.3 m in length and ≥ 12.0 cm at DBH or ≥ 12.0 cm at butt Dead and live windfalls ≥ 0.3 m and < 1.3 m in length and ≥ 12.0 cm at DBH or ≥ 12.0 cm at butt 	2.54 m radius circular
v.	Structures between Mature and Second Growth Criteria (only for Mature Stands)	<ul style="list-style-type: none"> Pieces ≥ 1.3 m in length between 12 and 17.5 cm at DBH Dead and live windfalls ≥ 1.3 m in length between 12 and 17.5 cm at DBH Dead and live non-merchantable standing stems ≥ 1.3 m in height between 12.0 and 17.5 cm at DBH 	Prism with same BAF as cruise for 2 nd growth
vi.	Structures between Mature and Second Growth Criteria that meet the Modified Operational Cruise DBH Criteria but not Length Criteria.	<ul style="list-style-type: none"> Stumps ≥ 0.3 m and < 1.3 m in height – top diameters must be between 12.0 and 17.5 cm Pieces > 0.3 m and < 1.3 m in length and butt diameter between 12 and 17.5 cm Dead and live windfalls ≥ 0.3 m and < 1.3 m in length and DBH or butt diameter between 12 and 17.5 cm 	2.54 m radius circular

5. Compilation

Claymore Consulting Group Limited will be contracted to develop the compilation program and database. The compilation program will provide three products:

1. summary tables of per hectare gross volumes and grade volumes by timber type and site index groupings for all structures (i.e. live stems, dead stems, windfalls, CWD).
2. raw data in order to compare individual pieces found in the validation plot with what the cruise tallied. This will be used to determine under/over estimation (perhaps by data type) within each plot.
3. database of plot summary data which can be used to evaluate the proposed summary strata groupings (refer to Appendix C for a draft list of attributes to be included in database).

5.1. Summary Tables

The summary tables (Item 1 above) is not part of the validation study per se, although many of the summary attributes will be used in the validation steps. Table 4 is an example of the Timber type/SI groupings used by TWF. In this example, the mature forests are grouped into 50 unique 'strata' defined by timber type and site index (i.e. perceived volume per hectare).

Table 4. Timberwest's Dead Wood Strata based on Perceived Characteristics in Mature Stands

Stratum	Species Group	Volume (m ³ /ha)	Site Index (m)	Stratum	Species Group	Volume (m ³ /ha)	Site Index (m)
1	FC	>600	30	26	HC	201 – 400	20
2	FH	≤200	15	27	HC	401 – 600	25
3	FH	201 – 400	20	28	HC	401 – 600	30
4	FH	401 – 600	25	29	HC	>600	25
5	FH	>600	25	30	HC	>600	30
6	FH	>600	30	31	HB	≤200	15
7	FH	>600	35	32	HB	201 – 400	15
8	CH	≤200	15	33	HB	201 – 400	25
9	CH	≤200	20	34	HB	401 – 600	25
10	CH	201 – 400	20	35	HB	401 – 600	30
11	CH	201 – 400	25	36	HB	>600	25
12	CH	401 – 600	20	37	HB	>600	30
13	CH	401 – 600	25	38	BH	401 – 600	25
14	CH	401 – 600	30	39	BH	>600	25
15	CH	>600	25	40	BH	>600	30
16	CH	>600	30	41	BH	>600	35
17	CH	>600	35	42	SH	201 – 400	30
18	CB	>600	25	43	HS	>600	30
19	CB	>600	30	44	YH	≤200	15
20	H	>600	25	45	YH	≤200	20
21	H	>600	30	46	YH	201 – 400	15
22	HF	401 – 600	25	47	YH	201 – 400	20
23	HF	>600	25	48	YH	401 – 600	20
24	HF	>600	30	49	YH	401 – 600	25
25	HF	>600	35	50	YH	>600	25

5.2. Field Data Validation

- **Modified Operational Cruise Data**

The compiled output for this component of the study will include the following plot-level attributes for structures coded as tree class 4 and tree class 3W: block number, plot number, piece number, windfall damage code, code for first log, damage code, species, DBH, total height/length, whether piece is broken and if so calculated original height, calculated butt diameter, calculated top diameter, and total gross volume (based on the MOF taper equation). The output file will only include the validation plots.

- **Validation Plot Data**

The data collected in the validation survey will be summarized in a similar format to the modified operational cruise data output. Gross volume for the small stems and windfalls will be calculated based on the MOF taper equation. Gross volume for windfalls, stumps, and pieces will be calculated based on the Smalian or Huber equations.

5.3. Strata Validation

As mentioned in section 5.1, summary statistics of gross volume for various structural attributes will be compiled and presented by Timber type/SI groupings used by TWF and INTERFOR. Other possible sub-domains for reporting purposes include subzone variant and site series.

An output file will be generated for each plot which includes information such as: block #, plot #, timber type, SI, total gross volume, total dead wood volume, total gross volume and piece density by grade and size. A more detailed list is provided in Appendix C.

Another file will be generated with the following information: block # plot #, biogeoclimatic subzone variant, and moisture/nutrient regime. The later information will be summarized from the silviculture prescriptions.

These two files will be used to examine different approaches to summarizing dead wood structural attributes using a limited number of groupings which have application to both operations and ecology.

It is anticipated that approximately 500 –700 plots will be sampled in 2001/2002. It is therefore unlikely that the number of plots per strata will be equal. This will limit the extent of the analyses in the first year.

6. Analyses & Reporting

6.1. Field Data Validation

For each of the validation plots, comparisons will be made between attributes measured in and/or compiled based on the operational cruise and those measured in and/or compiled based on the validation survey. In general, the following analyses will be performed:

- Examine estimated bias (e.g. under/over estimation) of various parameters (e.g. density, net volume, etc.) for various structures
- Report estimated parameters for each structure among sub-domains

6.2. Strata Validation

For reporting purposes various sub-domains can be used e.g., site index, timber type, subzone variant and site series.

To determine the relationship between subzone variant/site series and timber type/site index, the following analyses will be conducted:

- Create a misclassification matrix between observed BEC subzone and timber type.
- Determine whether BEC or timber type is better at classifying certain parameters (e.g. live to dead volume ratio). This will entail discriminant function or cluster analysis.
- Compare estimated parameters for each structure among sub-domains. This will involve ANOVA along with custom contrasts.

Since some sites will include more than one combination of subzone variant and site series⁵, data will be summarized on a plot basis rather than block basis.

7. Discussion & Conclusion

Limitations of this study include:

- non-random selection of sites (e.g. sampling predominantly on ridge tops) – this could potentially limit the applicability of making inference to all types of old growth forests
- results of old growth information will be used for managing second growth forests

8. References

BC Ministry of Forests. 2000. *A Short-Term Strategy for Coarse Woody Debris Management in British Columbia's Forests, March 2000*. Victoria, BC.

⁵ The BEC subzone variant and site series will be recorded using information from the silviculture plan (SP).

APPENDIX A TWF's Proposal to Develop A CWD Collection and Compilation System

Introduction

There is accumulating qualitative evidence that dead wood, in its various stages of decay, and spatial orientation are important to well functioning ecosystems. There is a desire by the MOF and MOE to manage CWD as a resource, and as such, general guidance has been legislated into the Forest Practices Code of BC Act 's Operating Planning Regulations.⁶

On January 12, 2000, the Operating Division of the MOF released a paper called Short Term Strategy for Coarse Woody Debris.⁷ Forest Districts were encouraged to implement the strategy, with a review scheduled after 3 years. To assist in this strategy, the Vancouver Forest Region formed a CWD Working Group.

Their Terms of Reference are:

1. Develop and implement a co-operative study to test the principals outlined in: “ *A Short Term Strategy for Coarse Woody Debris Management in BC Forests*”.
2. Develop CWD retention targets over a 1-2 year period.
3. Targets should be based on sound ecological principals (as we currently understand them), and be simple to measure, compile and administrate.

TimberWest was requested to join this group in October 2000.

One of the major issues, if one is to manage CWD, is to determine the current baseline preharvest CWD component in various forest stands. The group has facilitated some site specific pre/post harvest studies. These are slow, expensive, and very site specific.

A need for a cheaper, far ranging sampling process was recognized. TimberWest volunteered to sponsor the development of a system to measure CWD that could be based on Inventory Strata, with the baseline data gathered from Cutting Permit Cruise plots.⁸

The Vancouver Region CWD working Group is supportive of this proposal.⁹

Objectives

- To develop and field test a methodology for gathering data from which to determine Coarse Woody Debris baselines. This methodology should be cost effective and able to be implemented during a Cutting Permit timber cruise.
- Note that the data gathered will be call graded and net-factored, to conform with the data from the Vegetation Inventory
- To adapt present cruise compilations to report CWD, volumes and grades, in both pre and post harvesting scenarios.
- Develop a validation procedure and validate the CWD information through a 3rd party and report findings.
- Maintain a database of field data.

Methodology

- Utilize the skills and knowledge of TimberWest inventory specialists in concert with compilation experts to develop field and compilation methods, tools, and reports needed to collect and process CWD data.
- Test the developed methods and tools at TWFL HoneyMoon Bay Operation.

⁶ OPR Sections 18 (u) and 39 (3)(m)(i) – (See Appendix A)

⁷ See Appendix B

⁸ Please note that the data to be gathered is based on call grading and net factoring to maintain consistency with the Vegetation Inventory Program.

⁹ See Appendix C for letter of support.

- Review methods and results with members of the CWD Working group and make changes as required.
- Utilize methodology during the 2001 cruising field season to develop data for the proposed data base and to determine incremental costs to cruising to collect the new data.

Project Contributors or Involvement

TWFL – HBO (TFL 46)	- Project proponent
	- Field data collection site
CWD Regional Working Group	- Functional guidance
	- Evaluation and recommendation for use to the Vancouver Forest Region
	- if adopted, maintenance of CWD data base.
TWFL Key players	- Alec Orr-Ewing - lead developer
	- Tom Jones - HBO lead proponent
	- Mike Johnson - field implementation and data collection
Vancouver Forest Region	Gerry Davis and Bruce Markstrom - Ministry contacts and lead on developing validation compilation tools.
Claymore Consultants	- to work with TWFL to develop compilation tools, data base and report and statistical formats
FRBC	Funding source for project development
	Funding source for incremental costs of the CWD project for the year 2001, 2002

Outputs

The outputs of this project will be:

- Field Methodology to collect CWD, that is compatible with the Vegetation Inventory
- Compilation program to compile and present the CWD data
- Validation procedures and assessment of CWD information.

If there are any questions please contact Tom Jones at 250-749-6805.

~~Memorandum~~

To: COARSE WOODY DEBRIS COMMITTEE
From: A. Orr-Ewing
Date: July 19,2001
Re: COARSE WOODY DEBRIS SAMPLING METHODOLOGY

The basic premis of the methodology for the Coarse Woody Debris (CWD) pilot project is to maintain the sampling criteria that a timber cruiser is familiar and skilled with. As such, all data will gathered using Variable Plot cruising techniques. This will assist in the consistency of data gathered, as well as keeping additional costs to a minimum.

The secondary premis, is to maintain the present field data recording and compilation formats as close as possible. This entails compiling all data per total height and MoF taper factors. This will assist in the quality of the data gathered, as well as keeping training and other additional costs to a minimum.

The tertiary premis is that **all data recorded, for non-stumpage criteria**, will be estimated.

PROCEDURES

All tree data is based on call grading and net factoring, using preferred log lengths. These TWF criteria are compatible with the Veg Inventory and could be used in conjunction with their data.

LIVE MERCH TREES	MoF REQ.	as per TWF standards	cg/nf	pr. length
DEAD MERCH TREES	MoF REQ.	as per TWF standards	cg/nf	pr. length
W / F MERCH TREES ¹⁰	MoF REQ.	as per TWF standards	cg/nf	pr. length
DEAD TREES	CWD REQ.	as per TWF standards	cg/nf	pr. length
W / F TREES	CWD REQ.	as per TWF standards	cg/nf	pr. length
STUMPS	CWD REQ.	as per TWF standards	cg/nf	length
PIECES	CWD REQ.	as per TWF standards	cg/nf	length

DBH all trees (stump attached) are measured (**estimated**) at 1.3 meters above high side
all pieces are estimated at 1.3 meters from the 'large end'
 'jagged ends' will be folded back (as per scaling) to determine if dbh 'exists'

IN / OUT all items are measured (**estimated**) as they lie

HEIGHTS all trees or pieces have a total height recorded

MISSING WOOD Z grade, net factor 0, with a length for the missing piece(s) is recorded
 if the top of the tree is missing, the conventions is to record Z 99 0

BROKEN WINDFALL merch logs, if available will be bucked out, thence the remaining log lengths are
 determined by the lengths between the breaks
 'jagged ends' will be folded back (as per scaling) to determine recorded length

¹⁰ In / out trees are based on DBH, plot radius factors, and horizontal distance to the DBH as it lies

LOG LENGTHS

all merch logs are based on preferred lengths
 all other log lengths are in one meter multiples
 maximum log length is 13 meters
 minimum log length is **1** meters

NET FACTORING

all 'logs' are net factored, in units of 10%, for percentage sound remaining
 100% sound is recorded as a dash (-)

BREAKAGE

with the exception of 'spike top' cedar, breakage is not recorded **or compiled**

UTILIZATION

for the mature stands, merch volume is compiled to a 30 cm. stump and a 15 cm top
 DIB
**the 'new' stumps and the remaining volume above utilization will be included in
 the post logging CWD data**

FIELD DATA RECORDING

As noted, the recording of the field data will incorporate various MoF's coding criteria, to separate the data into the desired CWD classes.

LIVE TREES MoF tree classes **1** non suspect
2. suspect (having pathological indicators)

DEAD TREES MoF tree classes **3** dead (with greater than 50% sound wood remaining)
4 dead (with less than 50% sound wood remaining)
>= 3 meters of length are trees
< 3 meters of length are stumps

WINDFALL MoF tree classes **1** non suspect
with MoF windfall codes E or G
2 suspect (having pathological indicators)
with MoF windfall codes E or G
3 dead (with greater than 50% sound wood remaining)
with MoF windfall codes E or G
4 dead (with less than 50% sound wood remaining)
with MoF windfall codes E or G
MAN MADE MODIFICATIONS

- if there is a 'saw' cut, the portion from roots to saw cut will be classified as 'windfall'
- that portion above the sawcut will be classified as a 'piece'

PIECES MoF tree class **4** dead
with MoF windfall codes E or G
with first log being C 1 0 (chunk)

COMPILATION

Though the final report format has yet to be decided, the basic criteria are:

PRE HARVEST DATA

1. Total **LIVE** volume **0 cm stump 0 cm top DIB no breakage or waste factors**

2.	Total DEAD volume	0 cm stump	0 cm top DIB	no breakage or waste factors
3.	Total STUMP volume	0 cm stump		no breakage or waste factors
4.	Total PIECE volume			no breakage or waste factors

The data will be sorted by:

- top DIB classes, by total , live and dead
- per above classes by stumps, logs (by length classes) and tops (utilization to total top)
- per above criteria, number of pieces and M3 will be compiled

POST HARVEST DATA

1.	Total LIVE volume	0 cm stump	0 cm top DIB	no breakage or waste factors
	• To deal with variable retention			
	• All other merch volume (\geq X grade) is deemed to be removed			
2.	Total DEAD volume	0 cm stump	0 cm top DIB	no breakage or waste factors
	• All other merch volume (\geq X grade) is deemed to be removed			
3.	Total STUMP volume	0 cm stump		no breakage or waste factors
	• All stumps from harvested trees to be added in			
8.	Total PIECE volume			no breakage or waste factors
	• All tops from harvested trees to be added in			
	• All Y grade from harvested trees to added in			

The data will be sorted by:

- top DIB classes, by total , live and dead
- per above classes by stumps, logs (by length classes) and tops (utilization to total top)
- per above criteria, number of pieces and M3 will be compiled
- this data will thence be broken into Y and Z grade by length classes
- per above criteria, number of pieces and M3 will be compiled

POTENTIAL CWD

- a further report on the distribution of X grade by Top DIB and length will be produced

TIMBERWEST CALL GRADING AND NET FACTORING CRITERIA

The cruiser is trained (and required) to emulate the faller, who will maximize industrial end use sorts using preferred log lengths.

Using this methodology the sort is maximized first, the preferred log length second and thence the alpha grade and net factor is applied

These Mature sorts ¹¹ are:	Highgrade	in general D and F grades
	Peeler	in general B and C grades
	Standard	in general H and I grades
	Shingle	in general K.L and M grades
	Gang	in general J grade (and some U)
	Pulp	in general X and Y grades (and some (U)

The preferred log lengths are 13 m, 12 m, 11m, 8 m, and 6 m.

¹¹ please note that all transactional data is by log sort, not by MoF alpha grades

The minimum lengths are:

- gang and greater, 5 meters.
- shingle 4 meters
- pulp 3 meters
- Z grade (non recoverable) 1 meter

Timber west net factoring criteria are: ¹²

	Length	NF	Grade	
Blind Conk	whole tree	50%	Y	
Conk	2m above & 4m below	50%	Y	
Rotten Branch	1m below	50%	Z	
Butt Rot	assigned by cruiser from scaling tables		assigned	
Frost Crack		10% per	assigned	
Fork/Crook	1m	assigned	Z	
Scar		assigned	assigned	
Broken Top	assigned	0%	Z	
Dead Top		assigned	assigned	
Breakage	assigned	assigned	assigned	(≤ 3m chunks) Undersize
	whole tree	assigned	Z	

Awaiting your comments
 Alec Orr-Ewing
 ATE

¹² please note that these net factor criteria are basically the same as the 'Original' Veg Inv. manual

Appendix C Output Compilation File by Plot for Strata Validation

Strata Validation – Overview of Density (# of pieces/ha) and Gross Volume (m³/ha)	
Structure description	Level(s) of Interest
Live Standing	total
Dead Potential Standing	total
Dead Useless Standing	total
Total Dead Standing	total
Stumps	total
Dead Potential Fallen	total
Dead Useless Fallen	total
Total Dead Fallen	total
Total Dead Trees	total
Pieces	total
Total CWD	total
Total Dead	total
Total Site	total
Non-Merchantable – Overview of Gross Volume (m³/ha) and Density	
Structure description	Level(s) of Interest
Live Standing	J+, X+U, Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Dead Potential Standing	J+, X+U, Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Dead Useless Standing	J+, X+U, Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Total Dead Standing	J+, X+U, Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Stumps	J+, X+U, Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Dead Potential Fallen	J+, X+U, Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Dead Useless Fallen	J+, X+U, Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Total Dead Fallen	J+, X+U, Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Total Dead Trees	J+, X+U, Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Pieces	J+, X+U, Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Total CWD	J+, X+U, Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Total Dead	J+, X+U, Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Total Site	J+, X+U, Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Grades Y, and Z – Overview of Gross Volume (m³/ha), Density and Total Y+Z as a % of the Total Gross Volume	
Structure description	Level(s) of Interest
Live Standing	Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Dead Potential Standing	Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Dead Useless Standing	Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Total Dead Standing	Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Stumps	Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Dead Potential Fallen	Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Dead Useless Fallen	Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Total Dead Fallen	Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Total Dead Trees	Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Pieces	Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Total CWD	Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Total Dead	Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
Total Site	Y, Y(>80% sound), Y(≤80% sound), Z, Y+Z, stump, tops, total
CWD – Overview of Density (# of pieces/ha) and Gross Volume (m³/ha)	
Structure description	Level(s) of Interest

Total Dead Fallen	3 butt diameter classes, 3 length classes, total
Pieces	3 butt diameter classes, 3 length classes, total
Total CWD	3 butt diameter classes, 3 length classes, total
Total CWD	Cumulative frequency distribution for length and butt diameter: upper 5, 10, 15, and 20 th percentiles
Potential Large Low-value Pieces (Y+Z) – Overview of Density (# of pieces/ha) and Gross Volume (m³/ha)	
Structure description	Level(s) of Interest
Live Standing	total
Dead Potential Standing	total
Dead Useless Standing	total
Total Dead Standing	total
Stumps	total
Dead Potential Fallen	total
Dead Useless Fallen	total
Total Dead Fallen	total
Total Dead Trees	total
Pieces	total
Total CWD	total
Total Dead	total
Total Site	total

Interim Working Document
Appendix D. Validation Plot Data Requirements

2001/12/03

Data Type	Cruise Codes	S/D	L/D	Min height/length	Max height/length	Min Dia	Plot	Species	DBH (OB)	Estimated Original Height	Actual Height	Butt Dia (IB)	Butt Dia (depth) (IB)	Top Dia (IB)	Top Dia (depth) (IB)	# Breaks	Decay Class
Merch 12-17.5	1or2	S	L	1.3		12-17.5 dbh	Prism (2nd growth)	x	x	x	x						
Merch 12-17.5	3	S	D	1.3		12-17.5 dbh	Prism (2nd growth)	x	x	x	x						
Merch 12-17.5 and >=17.5	1W or 2W	D	L	1.3		>=12 dbh	Prism (2nd growth)	x	x	x	x	1.3	x	x	x	x	x
Merch 12-17.5 and >=17.5	3W	D	D	1.3		>=12 dbh	Prism (2nd growth)	x	x	x	x	1.3	x	x	x	x	x
Dead NonMerch 12-17.5 and >17.5	4	S	L+D	1.3		>=12 dbh	Prism (2nd growth)	x	x	x	x	1.3					
Dead NonMerch 12-17.5 and >17.5	4W	D	L+D	1.3		>=12 dbh	Prism (2nd growth)	x	x	x	x	1.3	x	x	x	x	x
Pieces	4C	D	D	1.3		>=12 dbh	Prism (2nd growth)	x	x	x		end	x	x	x	x	x
OTHER	new codes																
Windfalls	4SW (small windfalls)	D	D	0.3	1.3	>=12 top	2.54m r	x	x	x	x	1.3	1.3	x	x	x	x
Pieces	4SC (small chunks)	D	D	0.3	1.3	>=12 top	2.54m r	x	x	x	x	end	end	x	x	x	x
Stumps	4(small stumps)	S	D	0.3	1.3	>=12 top	2.54m r	x	x	x	x	0.3	0.3	x	x		