BRITISH COLUMBIA
The Best Place on Earth

Ministry of Forests and Range

Revenue Branch

MEMORANDUM

File: 195-30/CRUI

May 26, 2009

BY EMAIL

To: Regional Executive Directors

Re: ***2009 Cruising Manual***

The purpose of the memo is to inform you that the *2009 Cruising Manual,* becomes effective on June 1, 2009.

The new manual will be available on the internet at the following link:

http://www.for.gov.bc.ca/hva/manuals/cruising.htm

Please find a copy of the *2009 Cruising Manual* highlights attached.

Comments or questions about this manual should be referred to Keith Tudor, Cruising Policy Forester, Revenue Branch at 250-387-8357 or Don Rorison, Cruising Projects Specialist, Revenue Branch at 250-356-7674.

Murray Stech
Director
Revenue Branch

Attachment

pc: Els Armstrong, Regional Cruising Officer, Southern Interior Forest Region
Ron Alton, Cruising and Waste Specialist, Northern Interior Forest Region
Bruce Markstrom, Cruising & Waste Coordinator, Coast Forest Region

REVENUE BRANCH

Cruising Manual

June 1, 2009

BRITISH COLUMBIA
The Best Place on Earth

Annual Highlights - 2009 *Cruising Manual* Changes

The *Cruising Manual* is available on the Internet at:

http://www.for.gov.bc.ca/hva/manuals/cruising.htm

The *Call Grade Net Factor Standards and Procedures are* available in Appendix 10:

http://www.for.gov.bc.ca/hva/manuals/CGNF.htm

Section	Description
1.1	Housekeeping – addition.
2.2.2.1(2)	Housekeeping – section reference revised to (3).
9.1.5.1	The minimum tree count standards are based on individual cruise grids when blocks are combined before the sampling error can be waived.
9.1.5.6	Remove the anecdotal, duplicated sentences that state that plot slope is now a significant factor in appraising harvest methods.
Table 17	Add FIZ H as an allowable FIZ for the Babine PSYU.
Appendix 2	Updated magnetic declination for areas around B.C.
Figure A.1(i)	Housekeeping – Map title updated to read I (not 1).
Appendix A.4.2	Clarification to distinguish between the pathological indicator records on dead potential trees for the coast and interior.

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Introduction 1

This manual outlines the cruising procedures to be used for stumpage appraisal purposes for timber on the Crown lands of British Columbia. It supersedes previous manuals and instructions.

If a timber cruiser determines that it is unsafe to measure any cruise attribute(s) and the safety concern cannot be reasonably mitigated, they can estimate the attribute(s). Information not measured by the cruiser due to a safety concern will be estimated by the Ministry of Forests and Range.

The sale of Crown timber is a business proposition and both the buyer and the Ministry of Forests and Range (seller) must know the quantity and the quality of timber being sold. The cruise provides the essential data for determining stumpage rates, for establishing conditions of sale and for planning of the logging operations by the licensee.

In order to ensure that all purchasers of Crown timber are being treated equally and equitably, the manual sets out the minimum cruising standards that must be met. These include specifications for the statistical design of the cruise, the accuracy of field measurements and standard compilation procedures.

Implementation of the procedures and standards is a regional responsibility and the manual provides for sufficient flexibility that special circumstances can be accommodated. The appropriate Regional office should be consulted periodically for any revisions to the manual, for copies of Regional Guidelines, or the issuance of specifications for cruising salvage sales, minor product sales, etc. Refer to Chapter 4 of the *Coast Appraisal Manual* and *Interior Appraisal Manual* for further guidance.

The reliability of any cruise is based on statistical concepts and the cruise provides an estimate of the volume on the area cruised. The reliability of this estimate is a function of the intensity of sampling, the uniformity of the timber on the area cruised and the degree of fit of the volume equation and loss factors to the particular stand. It is for these reasons that two cruises of the same stand, carried out to the same standard may yield different volumes. For administrative purposes it is assumed that the calculated volume is the true volume.

1.1 Terms of Reference

The *Forest Act*, Section 103 to 108 and regulations provide the statutory authority for the determination of stumpage rates for crown timber.

The *Forest Act*, Section 105, requires adherence to the policies and procedures approved for the forest regions by the Minister of Forests and Range. The *Coast Appraisal Manual* and *Interior Appraisal Manual*, approved by the Minister of Forests and Range, contains the policies and procedures for determining stumpage rates charged for Crown timber.

The *Coast Appraisal Manual* and *Interior Appraisal Manual* specify that cruise data must be gathered and compiled according to procedures established in the *Cruising Manual* and the *Cruise Compilation Manual*. The *Cruising Manual* and *Cruise Compilation Manual* are approved by the Director, Revenue Branch.

Cruise Design 2

2.1 Cruise Objective

The objective is to obtain an unbiased estimate of the volume and quality of timber on a cutting authority area to a specified confidence interval or sampling intensity. The area cruised may be one or several cutting blocks that will be covered under one cutting permit and subject to one appraisal. Unless special circumstances indicate otherwise, a systematic design for plot layouts must be used. All species listed under Section 6.3.2 of this manual shall be cruised and the minimum sampling error requirements will be based on all species.

The cruise plan and the accuracy requirements are affected by the timber appraisal.

1. For scale-based sales, the cruise provides the basis for determining the stumpage rate while the amount billed is based on the scale.

   For cruise-based sales, both the estimate of the stumpage rate and billing are based on the cruise.

2. In special cases, such as salvage sales, small sales and right-of-way sales, cruising standards may be varied by the Regional Executive Director in accordance with Chapters 4 and 6 of the *Coast Appraisal Manual* and *Interior Appraisal Manual*.

2.1.1 Cruise Plans

It is *mandatory* for licensees and Timber Sale Managers to submit plans to the District Manager prior to the commencement of a timber cruise. Plans are required for new or amended cruises.

It is recommended that the cruise plan be submitted at least 30 days in advance of the fieldwork The plan is submitted to MFR staff to allow the development of field quality assurance schedules; to provide a basis for comparison against the final appraisal map and to allow review of any concerns in the sample plan.

Cruise plans must contain:

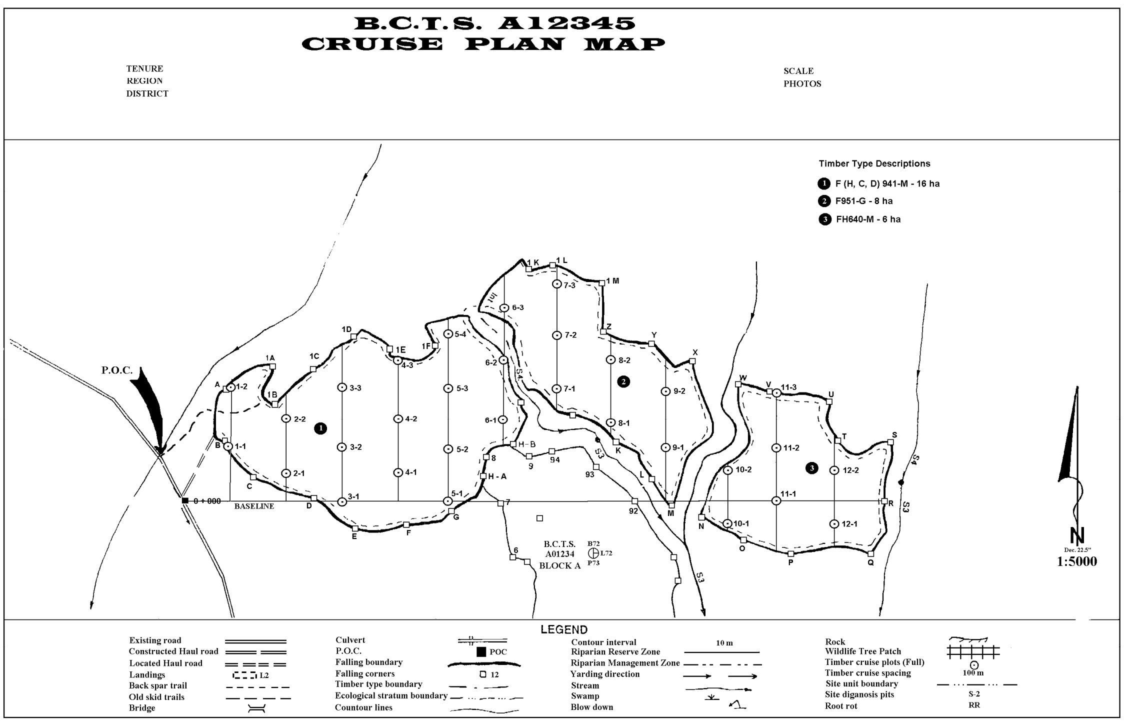
- See Section 3.1.7,
- See forms Section for FS 693 and 694 and
- See Figure 2.1.

The cruise plan is a professional document that forms the basis for the statistical sample. It identifies the population to be sampled and the design that will be used to the meet the minimum cruise standards. The cruise plan is the key document that provides assurances to the MFR that the data supplied to the appraisal was collected in an unbiased manner, however, like any plan, unforeseen circumstances may necessitate a change to the plan.

Changes to a cruise plan should be rare and minor in nature and must be undertaken to affect unforeseen issues that affect good forest management or other minor operational issues.

The submitting forest professional recognizes that changes to a plan, such as a change in area or the removal of a plot(s) is biased and will have assessed the impact of the alterations against the principles of sampling identified in these standards. The submitting forest professional will submit a record of all relevant information that was used to develop the original cruise plan and final appraisal map. This model is consistent with the direction of professional reliance.

The district will review each change on a case by case basis and determine if the change meets the intent of providing good forest management or addressing unforeseen minor operational issues.



DIGITAL GPS SURVEY AND MAPING DATA MUST BE PROVIDED UPON REQUEST.
REFER TO THE FS 694, PROVINCIAL CRUISE PLAN AND MAP CHECK LIST FOR FURTHER INFORMATION.

Figure 2.1 Cruise Plan Map.

2.1.2 Scale-Based Stumpage Assessment - Timber Sales or Cutting Permits

General Conditions:

- all species listed under Section 6.3.2 of this manual shall be cruised,
- the minimum tree sizes are specified in Chapter 6,
- all references to "plots", "cruise plots", and "measure plots" must be interpreted as Full Measure Plots unless specified otherwise,
- Sampling Error objective is based on full measure and count plots (unless specified otherwise),
- all plots must originate from the harvest area. Plots in areas 100 percent reserved from cutting must not be used in the compilation.
- all measure and count plot data originating from the harvest area must be used in the cruise compilation, and
- cruises are the responsibility of the district that contains fifty percent or more of the cruise area.
- cutting boundaries and timber types must not be located based on the inspection of cruise plot information as this constitutes bias.

Minimum Tree Counts (All Species, Tree Classes 1, 2, 3, 5, 7, 8, 9)

Variable Plots	Fixed Plots
4.0	10.0

a. The minimum average tree counts are required for all cruises that do not meet the minimum sampling error requirements.

b. If the timber types are very open and the minimum tree count can not be achieved with a BAF 2 prism, then the minimum tree count requirement may be waived.

c. Include tree classes 1, 2, 3, 5, 7, 8, 9 of all species listed in Section 6.3.2. Also include trees that meet the minimum DBH specifications, but are converted to a tree class 6 in the compilation because they are too short for a merchantable log.

Sampling Error Objective:

1. The scale-based cutting authorities sampling error objective is 15.0 percent at 2 standard errors based on the total stand (before reduction).

2. If the cruise plan does not specify a sampling error objective, then the minimum standard requires the establishment of full measure plots on a 100 m * 100 m grid spacing.

3. The maximum grid spacing:

    - cutting authorities less than 250 ha - 200 m square grid, and
    - cutting authorities greater than or equal to 250 ha - 250 m square grid.
    - Sections 2.1.2.1 to 2.1.2.3 are subject to the requirements listed under Section 2.1.2 unless otherwise stated.

2.1.2.1 Sampling Requirements

1. Partial Cut

    Count plots are permitted in partial cut cruises only if the minimum sampling intensity of a 100 m x 100 m grid of full measure plots has been achieved.

2. Clearcut

    The number of count plots is not limited for clearcut cruises that meet the minimum sampling error requirement based on the measure plots only.

3. All plots must originate from the harvest area. Areas where no cutting is prescribed such as Riparian Management Zones with 100 percent retentions are to be excluded from the cruise.

4. If a range of leave tree or cut tree stems per hectare are reported in the Schedule B of the cutting authority then the average of the highest and lowest number will be used to determine the percent reduction input into the cruise compilation.

5. Helicopter Single Stem - The trees to be harvested must be marked prior to cruising.

    The cruising options are as follows:

    a. establish variable plots and the 15.0 percent sampling error requirement will be based on the cut trees,

    b. two measure plots per hectare with an average of 2.0 cut trees per plot, or

    c. 100 percent cruise.

2.1.2.2 Comparative Cruises

While the *Interior Appraisal Manual* determines the situations **when** comparative cruise data **may be** used for appraisal purposes, the overriding principle of "***if there is time to perform a full cruise, then the timber will be cruised***" **shall be followed**.

1. Definitions:

New Cutting Authority (NCA): the area affected as a "catastrophic event" (i.e., Mountain Pine Beetle infestations, severe blowdown, etc.) that is to be appraised.

Parent Cutting Authority: a cutting authority that has been previously cruised which supplies the cruise data that will be "borrowed" and recompiled for the appraisal of the "New Cutting Authority".

Insufficient Time to Harvest: when a delay in harvesting will severely impact quality and quantity of timber to be harvested.

2. Factors for Determining the Level of Data Required:

   The following matrix is to be used as a guide to determine the amount of work and the level of data required to justify use of a specific comparative cruise.

Factors	Condition	Points	Condition	Points	Condition	Points
New Cutting Authority size m^3	>100 000	15	20 000 – 100 000	10	< 20 000	5
Catastrophic Event Type	**None**	**10**	**Beetle**	**5**	**Unsafe to Cruise**	**2**
Percent beetle in stand	< 25%	3	25% - 75%	2	> 75%	1
Cruise Types Similarity	Dissimilar	3	Similar	2	Very Similar	1
Species & size variability	Variable	3	Average	2	Uniform	1
Sufficient time to harvest	Some	15	Little	5	No time	1

0 to 13 points	A minimum of 2 plots per timber type in the New Cutting Authority.
14 to 23 points	A minimum of 6 plots per timber type in the New Cutting Authority.
> 23 points	**Full Cruise** of the New Cutting Authority.

3. Requirements to ensure that the New and Parent Areas are Comparable:

   Levels of data/work required:

The factors in Section 2 above determine the level of the data required. The levels of work required based on individual situations are:

a. Ten plots in the “NCA” with a minimum of two plots per type (0 – 13 points).

b. Twenty plots in the “NCA” with a minimum of six plots per type (14 – 23 points).

c. A full cruise (as per Section 2.1.2 of the *Cruising Manua*l - > 23 points).

Other requirements:

a. Both Parent and NCA cruise must be in the same biogeoclimatic subzone, FIZ, PSYU, Wet or Dry Belt.

b. If the comparative cruise is for a beetle damaged stand the timber species impacted must exceed 70% of the total stand net volume (volume based on sample plots taken on NCA area).

c. The parent cruise must not be older than five years for immature timber and ten years for mature timber.

d. The Provincial Comparative Cruise Checklist (FS 698) of the *Cruising Manual* is to be used in comparing the new and parent cruise’s data.

e. Parent Cutting Authority and the NCA piece size [Merch Vol/Tree (m^3)] must be similar. **BOTH DATA SETS MUST BE > 0.20 m^3 OR < 0.20 m^3**.

THERE SHALL BE NO VARIATION FROM THIS REQUIREMENT.

4. Pre-planning:

a. The licensee must request in writing the use of a comparative cruise and must meet with MOF District staff to determine the level of field work to be completed prior to the approval of the request for the use of comparative cruising.

b. Written request must include the following:

i) The application to use comparative cruising in lieu of a full cruise must meet the requirements of the *Interior Appraisal Manual* and all other requirements as outlined in Section 2 above.

ii) The licensee shall submit a cruise plan as per the Cruising Manual for plots to be established within the “NCA”.

iii) A list of all cutting authorities and the specific timber types that may be used in the comparison must be provided to the MOF.

5. Field Procedures:

   a. All plots in the "NCA" must be established using an unbiased systematic grid and must be representative of the timber type areas.

   b. All cruise plots will be full measure variable radius plots. Plot prism size must be consistent throughout the type and must be chosen so that there is a minimum average of five merchantable coniferous trees (live and/or dead potential) per plot.

   c. All measurements in the "NCA" plots including slope and damage codes must be done as per the cruising requirements as set out in this manual.

      The damage codes recorded in the "NCA" plots will be brought forward to the parent cruise data and the same percentages will replace the parent damage coding.

      The recorded slope of the "NCA" plots shall be averaged and brought forward to all the parent plot slopes.

   d. There must be a minimum of two tree ages measured for the leading species of every plot and 1 age taken for all other species.

   e. Field checking of comparative cruise areas will be expedited so that forest operations will not be delayed unnecessarily.

6. Data Submission:

   The licensee shall submit the following information to the District Manager:

   a. A complete cruise plan form (FS 693) for the "NCA" – prior to commencing field work, and the original cruise plan for the parent cruise.

   b. Two maps; a location map showing the "NCA" area in comparison to the Parent cutting authority(s) location; and cruise plan map for the "NCA".

   c. All field cruise cards and strip traversing notes for the Parent and "NCA".

   d. Digital cruise data files for the Parent cutting authority (as per Section 4.6.1 of the *Cruising Manual*), and digital files for the sample plots for the NCA.

   e. Full cruise compilations for the Parent and "NCA" – including data listings (i.e., Parent Full Volume, "NCA" Full Volume, "NCA" Factored Compilation, etc.).

   f. Schedule B for residue and waste issues for the "NCA".

   g. A completed copy of the Provincial Comparative Cruise Checklist (FS 698).

7. Compiling Procedures:

   All compilations used for comparison cruising purposes must be compiled using the most recent version of an approved cruise compilation program.

   a. It is acceptable to select timber types from different parent cruises. If there is more than one type in the new cruise, the selected parent cruise(s) must be recompiled using the comparative parent type averages and the new cruise type areas.

      A full volume compilation of the original cruise data must be submitted for each parent timber type selected.

   b. Once the “appropriate” parent cruise type has been selected and approved for the comparative cruise, the original parent cruise data must be compiled to the new cruise areas.

      > The timber type may be the whole CP if one type (this must be jointly agreed to between the licensee and the district). **The parent data type shall have a minimum of 10 plots to be eligible to be used as a parent data set.**

      For example, the original parent cruise is 143.5 ha, and the NCA is 75.2 ha. The area (ha’s) in the new compilation submitted for appraisal purposes must be equal to the NCA area (75.2 ha).

   c. The District will review the submitted information to ensure that the parent and new cruises meet the standards for comparative cruises as described in the *Cruising Manual* and in the Provincial Comparative Cruise Checklist.

8. Accountability:

   The Licensee shall record and submit to the Ministry of Forests and Range the rationale for choosing the data used in selecting a “Parent Cruise”. This document will be reviewed by District staff and will be attached to the cutting authority file.

9. Data Review and Acceptability:

   a. The comparison MAY be made by using either cutting permit or type summaries of similar sales, NOT block summaries.

   b. The following parameters shall be compared to those from the established statistical cruise in the same area which is intended to be used for the comparison:

Criteria	Acceptability Parameter	Critical Value (High – Medium)
Major Species Composition	± 5 %	HIGH
Minor Species Composition	± 10 %	MEDIUM
Net Merch. Vol/ha	± 10 %	HIGH
Average DBH	± 10 %	MEDIUM
Average Height	± 10 %	MEDIUM
PIECE SIZE Merch. Vol/tree (m^3)	± 10 %	HIGH
Stems/ha	± 10 %	MEDIUM
Average LRF	± 5 points	HIGH

c. The NCA data shall be compared to the "parent" data to determine whether it falls within acceptability parameters listed above.

   Comparative data may be accepted if all High Valued criteria parameters are met. The Medium Valued criteria "may" be varied by an additional 10 % after consultation with District staff.

d. The Forest Officer responsible for cruising in a district shall make a decision as to whether to use similar data on its own, or establish more plots to supplement the cruise; based on the outcome of the comparative cruise.

10. Reporting:

    Licensees shall report to the district the harvested and R & W volumes for the cutting authority once harvesting is completed. This provides feedback to the district and licensee on the reliability of the parent to NCA data selection and assists in refining the comparative cruise methodology.

2.1.2.3 Unsafe to Cruise

Two methods may be utilized in determining stand volume for a cutting authority where it is unsafe for cruisers to sample the stand due to a high down tree component or where heavy fire damage has occurred.

1. The preferred methodology is to establish cruise plots in the same timber type (where it is safe to cruise) adjacent to the unsafe area.

The sampling intensity must be sufficient to meet the minimum sampling requirements for the cruise.

The unsafe areas will be mapped in the cruise plan, field notes and the final cruise map.

If it is unsafe to sample the damaged portions of the stand to determine the damage percentages, then the damage percentages should be performed by a certified photo interpreter.

A damage assessment may be performed using other procedures subject to mutual agreement by the licensee and the District Manager.

2. Where the adjacent stand has insufficient area to establish cruise plots, then the procedures outlined in Section 2.1.2.2 (Comparative Cruising) may be utilized.

2.1.3 Cruise-Based Stumpage Assessment - Timber Sales or Cutting Permits

For cruise based-sales, sufficient samples must be established to meet the following sampling error objectives:

1. Plus or minus 8.0 percent sampling error at 2 Standard Errors (S.E.) for all stands except in 2. below. Count plots may be used provided that a plus or minus 12.0 percent sampling error at 2 S.E. is achieved with measured plots and 8.0 percent with count and measure plots combined.

2. Proposed cut areas where the stands are comparatively very valuable or patchy must be reviewed by the Regional Executive Director, or their designate, to determine whether the above rules should be accepted or the number of sampling points increased.

3. Refer to the Provincial Cruise Based Policy at the following Internet site:

   http://www.for.gov.bc.ca/tasb/manuals/policy/resmngmt/rm8-16.htm

2.1.4 Standards for Recruising

These standards are applicable if the cutting authority is to be appraised or re-appraised for changed circumstances as outlined in the *Coast or Interior Appraisal Manuals*.

1. If the cruise is of mature timber (> 120 years) and 10 years has elapsed since the fieldwork was performed.

2. If the cruise is of immature timber (< 121 years) and 5 years has elapsed since the fieldwork was performed.

3. Catastrophic (severe damage) losses have occurred at any time after the field work was performed.

4. Any major amendments are proposed to the original cruise area. Refer to the *Coast Appraisal Manual* or *Interior Appraisal Manual*.

5. As determined by the Regional Executive Director or their designate.

2.2 Types of Cruise

2.2.1 One Hundred Percent Cruise

The Regional Executive Director may direct that for certain forest stands and valuable species, a one hundred percent cruise is required.

2.2.2 Sampling Patterns - General

Samples within cutting blocks from previous operational cruises of the area may be used in the sampling plan if they meet the standards set in this manual.

Referring to the following types of sampling methods, systematic sampling in conjunction with a grid to locate the plots must be used for appraisal type cruises unless permission is granted by the Regional Executive Director to use one of the other sampling patterns.

All possible sample points that can be established in the harvest area must be cruised.

2.2.2.1 Systematic Sampling

In systematic sampling, plots are at fixed intervals with a minimum of two full measure plots per timber type. The sampling grid spacing must be the same for each timber type. If the grids are different within a timber type in different blocks, then the types can be either labelled as unique types within a block or the areas can be re-cruised to meet the minimum sampling intensity.

In addition:

1. The preferred method of establishing plot locations is to use a GIS based grid system that covers a specific operating area. If a GIS grid system is not available, then a local grid must be established using the following procedure:

   a. Start at the most south-westerly point of the block and measure in one-half (1/2) of your grid distance at a bearing of N45E to set your base plot. Using the base plot, lay your local plot grid on the map oriented in cardinal directions (N-S & E-W) to determine the plot locations. You can start anywhere on the edge of the block and tie-in to the nearest plot.

2. The maximum plot spacing listed in Section 2.1.2 (3) will ensure adequate coverage of the area for timber typing and tree and terrain information.

3. The sampling grid horizontal distances must be equidistant between plots and strips. The options are square grid or staggered grid. The option selected must be used

consistently for the cutting permit. Refer to Figure 2.1 for an example of a staggered grid.

4. Where plots must be added to an existing cruise area, they must be positioned in a systematic random way so they cover the entire timber type(s) that has the highest coefficient of variation. The following method is recommended for adding plots to an existing cruise:

   a. determine the number of additional plots required using the coefficient of variation from the statistical summary report. Adding 10 percent to the number of plots is recommended for a safety margin. If the number of plots meets or exceeds 1.0 plots/ha for the whole cruise area, then the maximum sampling intensity will be 1.0 plots/ha,

   b. determine the new grid for the cutting authority area to obtain the additional number of plots required,

   c. lay the new grid over the original grid by positioning the new plot over top of the original plot that is nearest the P. of C.. Use the same cruise grid orientation,

   d. disregard the overlapping plot and locate the new plots on the cruise map, and

   e. determine the bearings and distances to the new plots from the nearest original plots. This will reduce the amount of traversing required to establish the new plots.

The new grid must be submitted with a cruise plan to the Ministry of Forests and Range district office for approval at least 30 days prior to the commencement of field work.

2.2.2.2 Cruising Road Rights-of-Way

The following procedures are used where road rights-of-way require cruising and the minimum sampling error cannot be achieved:

1. The fixed area plot centres will be located at the midpoint between the R/W edge and centre line and on alternating sides of the R/W centreline.

2. The plots will be circular and 5.05 metre radius.

3. The minimum sampling intensity will be 2.5 percent of the R/W area.

4. Where timber on road rights of way within a cut-block is removed under a road permit (R.P.) after the block is cruised, the cruise plots that are within the area of the R.P. shall be included in the cruise compilation for the cutting permit and the area of R.P. will be removed from the cruise compilation. Record R/W areas that are not part of the cutting authority in card Type H of the Map Area Statement.

5. Refer to the requirements in Section 2.1.2.2 of this manual where comparative cruising is permitted by the Appraisal Manual.

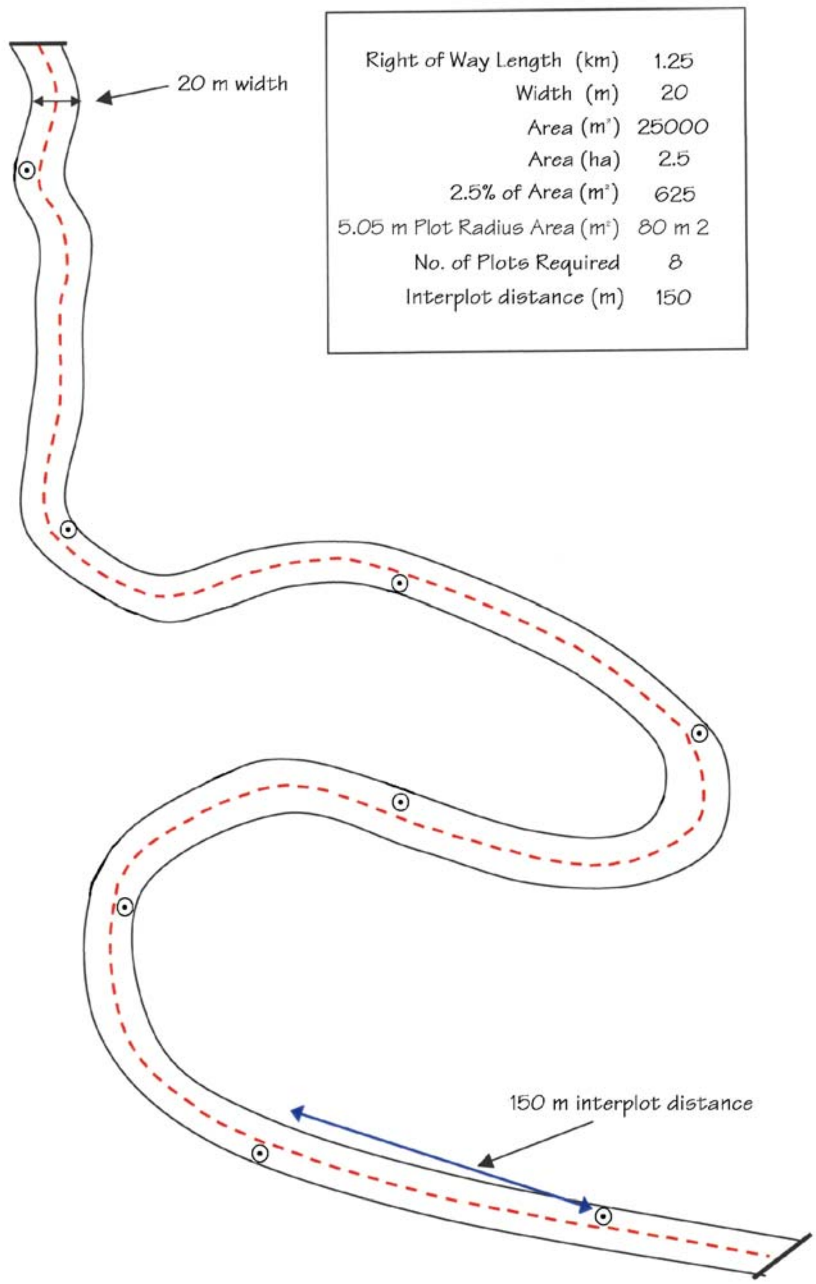


Figure 2.2 Sample Right-of-Way Cruise.

2.2.2.3 Cruising Patch Cuts

The following sampling procedure must be used for cruising patch cut, patch cut with reserves and group selection silviculture systems:

1. Overlay a 100 m grid on the cruise plan map after the patch cuts are accurately located within the block and mapped.
2. Increase or reduce the grid interval in multiples of 5 m until a minimum of one plot per hectare is obtained in the harvest areas.
3. Individual patch cut falling corners may be used as tie points for the cruise plots with the bearing and distance to each plot documented in the cruise plan.
4. Sampling must be confined to the harvest area.
5. If the cruise was originally designed for a silviculture system not listed above then Section 2.2.2.3 does not apply.

Refer to the following web link in the *Cruise Compilation Manual* for more partial-cut scenarios:

http://www.for.gov.bc.ca/hva/manuals/percentreductionscenarios.htm

2.2.2.3.1 Patches Greater Than or Equal To One Hectare

Overlay an appropriate grid interval over the patches that will sample the patches to design requirements.

Example - a 90 metre grid that achieves a sampling intensity of at least 1.0 plots per hectare. All patch cuts are at least 1.0 hectare.

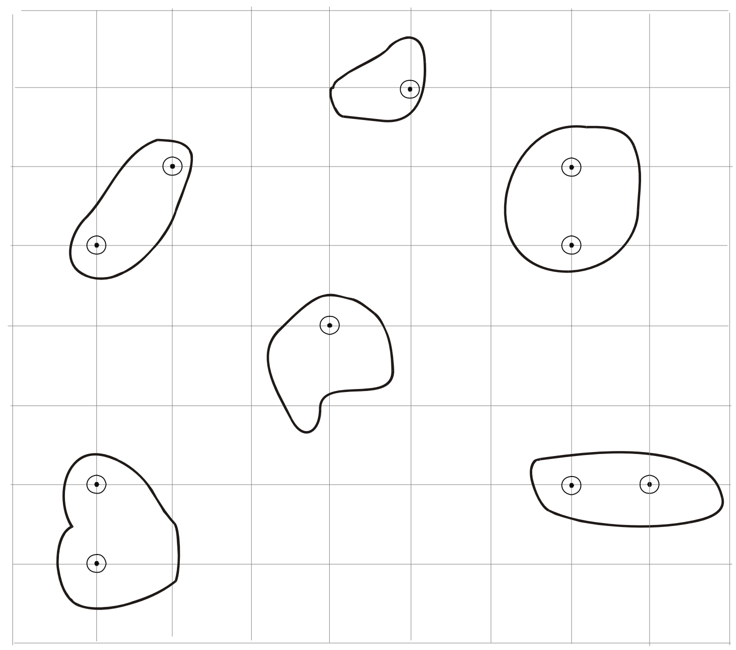


Figure 2.3 Patches Greater Than or Equal One Hectare.

2.2.2.3.2 Patches Less Than One Hectare Using Faller Selection

Overlay an appropriate grid interval over the gross block area that will sample the patches and the surrounding area to achieve the design requirements.

Example:

Gross Block = 30.0 hectares
STU A = Clearcut = 6 patch cuts = 9.0 ha

STU B = Partial cut = 12 patch cuts (A to L) = 5.0 ha

STU C - Clearcut (roads) = 1000 metres x 10 metres = 1.0 ha outside the patch cuts

Percent Reduction

STU B = Partial cut harvest method = 30.0 - (9.0 + 1.0) = 20.0 ha

Therefore $1 - \left(\frac{5.0\,\text{ha}}{20.0\,\text{ha}}\right) = 75\%$ reduction

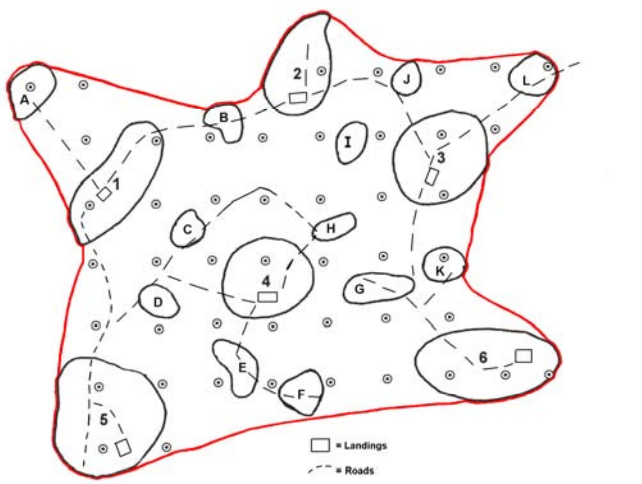


Figure 2.4 Patches Less than One Hectare.

2.2.2.3.3 All Patches Less Than One Hectare and Single Tree Selection Between the Patches

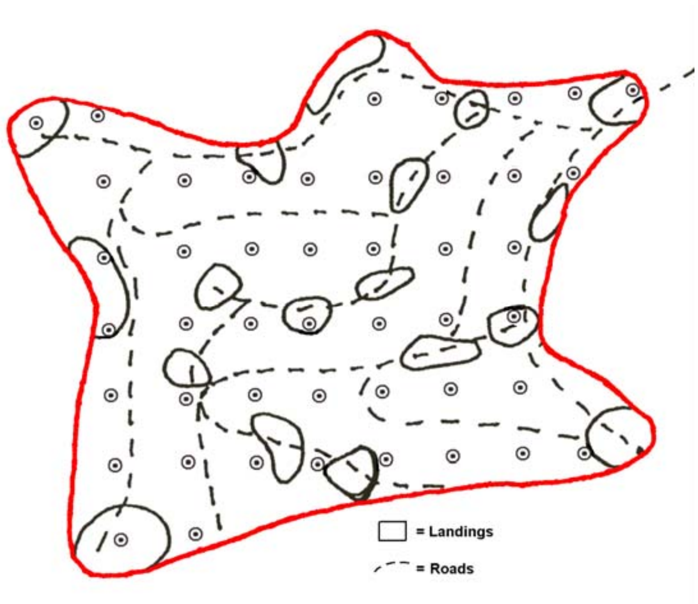


Figure 2.5 All Patches Less than One Hectare.

Overlay an appropriate grid interval over the gross block area that will sample the whole harvest area to meet the design requirements.

Example:

Gross Block = 30.0 hectares, one timber type, one block, species composition is Lodgepole pine, Douglas fir.

STU A = Partial cut = 18 patches = 6.0 ha

STU B = Partial cut = 30.0 ha – (6.0 + 2.0) = 22.0 ha

STU C = Clear cut (roads) = 2 000 metres * 10 metres = 2.0 ha outside of the patch cuts.

Percent Reduction

STU A = Partial cut harvest method = 6.0 ha since all patches are less than 1.0 ha. Prescription is to leave all Douglas fir trees greater than the 35 cm class. Therefore, code the percent reduction worksheet:

Row #1 – Fir, Type 1, STU A, enter 100% in all of the diameter classes 40 cm and greater.

STU B – Partial cut harvest method = 22.0 ha. Prescription is to cut all PL beetle code 1, 2 and 3 trees outside of the patches and leave all fir trees. Therefore, code the percent reduction worksheet:

Row #2 – PL, Type 1, STU B, code I (insect) in the damage column (cut all beetle coded trees)

Row #3 – Fir, Type I, STU B, code 100% in all diameter classes.

STU C = clear cut = 100% cut.

2.2.2.4 Moving Plots

Plots cannot be moved.

2.2.2.5 Probability Proportional to Prediction

"Three P" sampling (Probability Proportional to Prediction) is a sampling technique which randomly selects the sample trees but one basic requirement is that each tree in the entire sale area must be estimated. This method is often used to increase efficiency in comparison to a 100 percent cruise. Three-P sampling is currently being reviewed for potential applications in appraisal cruising.

2.3 Sampling Errors

Cutting authorities must include all commercial species.

In timber cruising a complete record of all trees of merchantable size on the sale is seldom practical, so sampling becomes necessary. The object of sampling is to estimate the volume on only a portion of the area, and convert this to a total area basis.

In sampling there are two major sources of error:

Sampling error or errors in quantities of measurements. Sampling error is the difference between results that would have been obtained by a 100 percent cruise and the result that is obtained by a sample cruise. That is they are errors caused by samples not being absolutely representative of the natural variable conditions over the entire area.

1. The sampling error can be calculated and has been set at:
   - see Section 2.1.2 for scale-based sales, and
   - see Section 2.1.3 for cruise-based sales.
2. Measurement error or errors in qualities of measurements.

   The calculated sampling error can be seriously misleading if the basic data is unreliable.

   If reliable volume estimates are to be obtained measurement errors must be controlled. Constant care and checking is required on all direct measurements (see Section 3.6, Check Cruising).

   The population sampled is the cutting unit and, therefore, all samples on which the stand statistics are based must be systematically located within the proposed cutting boundary so that the forest area is adequately sampled.

2.4 Variable-Plot (Prism) Sampling

2.4.1 Plot Sample Size

In the fixed-area plot method of sampling, accurate boundary location is time-consuming and small diameter classes are sampled more intensively than large diameter classes. This occurs because the probability of tree selection is proportional to tree frequency.

"*Prism*" sampling (also known as "point" sampling, "plotless" sampling or "variable-plot" sampling) overcomes these two disadvantages, since the probability of tree selection is proportional to basal area and the large diameter trees therefore, are sampled with the same intensity as the small diameter trees.

The controlling factors for selecting the prism BAF are the size of the trees and the density of the stand.

Samples that include a small number of trees per point generally result in a high sample variance. As the number of trees increase, a point is reached where a further decrease in basal area factor and a corresponding increase in tree count results in only a slight gain in precision. If a sample contains more than ten trees it is statistically inefficient because it only repeats the information that is obtained from a smaller sampling unit.

2.4.2 Prism Sampling

The choice of plot size will influence the amount of sampling required to achieve the sampling error because sampling intensity depends on coefficient of variation.

Prism sampling can be thought of as sampling in an infinite population, since there are an "infinite" number of prism points in the area to be cruised. Prism sampling can also be thought of as sampling in a finite population with replacement, since a given tree may be included in more than one sample. In either case the finite population multiplier is not included and the equation for determining the number of plots required becomes:

$$n = \frac{t^2 x CV^2}{E^2}$$

2.5 Fixed Area Plot Sampling

2.5.1 Fixed Sample Size

The standard method is sampling in a finite population without replacement. Once a plot has been measured on 0.08 ha, this particular 0.08 ha is withdrawn from the population and it is not permitted to be sampled again. If the sampling intensity is greater than 5 percent of the total merchantable area the basic equation for determining the number of plots required is:

$$\frac{t^2 x CV^2}{E^2}\left(\frac{N-n}{N}\right) where$$

t	=	probability factor
CV	=	coefficient of variation
E	=	error objective in percent
N	=	total possible number of plots in the sale
n	=	actual number of plots in the sale
N-n/N	=	the finite population multiplier

By algebraic manipulation the above equation for number of plots required can be transformed into the more familiar form of:

$$n = \frac{t^2 x CV^2 x N}{N x E^2 + t^2 x CV^2} where$$

n = number of plots required and the other terms are as defined above.

This equation may also be used for plot sampling, but only if the sampling intensity is 5 percent or less.

2.6 Statistical Concepts

2.6.1 Probability Factor "t"

The value of "t" used in the above equations depends on the degrees of freedom (number of plots required minus 1 or n-1), and the desired probability. The desired probability has been specified as 2 S.E. or t.05.

Referring to the table of t.05 (Table 3) the probability factors are very close to 2, except for a small number of plots. The first approximation is done using a probability factor of 2. The probability factor for the resulting "n" is then used to calculate a new "n". This process is repeated until "n" (to the nearest whole number) no longer changes.

Calculate the number of 0.1 ha plots required for a sampling error of + 15 percent at 2 S.E. for a 40 ha timber sale with a coefficient of variation (CV) of 40 percent.

$$n = \frac{t^2 x CV^2 x N}{N x E^2 + t^2 x C^2} = \frac{(2)^2 x (40)^2 x (40 x 10)}{(40 x 10) x (15)^2 + (2)^2 x (40)^2}$$

$$n = \frac{6400 x 400}{90000 + 6400} = \frac{2560000}{96400}$$

$$= 27\ plots$$

Referring to the table of t.05 for 27-1 or 26 degrees of freedom, the probability factor is 2.056. Therefore, the new "n" is:

$$n = \frac{(2.056)^2 x (40)^2 x (40 x 10)}{(40 x 10) x (15)^2 + (2.056)^2 x (40)^2} = 28\ plots$$

Again referring to the table of t.05 for 28-1 or 27 degrees of freedom, the probability factor is 2.052 and the new "n" is 28 plots. Therefore, 28 plots would be the number used.

2.6.2 Coefficient of Variation (CV)

Coefficient of variation may be difficult to estimate and is unique for each type, and also varies with the timber merchantability specifications, gross or net volume, plot size (CV decreases as plot size increases) and shape, and the pattern of sampling. The coefficient of variation may be estimated as follows:

1. From plots previously measured in the same locality.
2. From plots measured in connection with the pre-examination, silvicultural examination, etc.
3. A general knowledge of the timber types on the sales.

By definition the coefficient of variation is the standard deviation expressed as a percentage of the mean volume. The volume of an individual plot minus the mean volume of a group of plots is termed a residual. The sum of the residuals squared, divided by the number of plots minus one, is the variance and the square root of the variance is the standard deviation. The standard deviation is a measure of the dispersion of the plots about the sample mean.

The standard deviation may be calculated by squaring the residuals with the use of a desk calculator and in practice the following method is preferred:

Plot #	Plot Volume	Plot Vol Squared	
1	119	14161	Standard deviation (SD)
2	130	16900	
3	79	6241	$=\sqrt{\dfrac{\left(\Sigma\left(x^2\right)-\dfrac{\left(\Sigma x\right)^2}{n}\right)}{\left(n-1\right)}}$
4	215	46225	
5	46	2116	
6	223	49729	
7	164	26896	
8	317	100489	
9	160	25600	$=\sqrt{\dfrac{362145-\dfrac{2123^2}{16}}{16-1}}$
10	42	1764	
11	77	5929	
12	105	11025	
13	54	2916	Coefficient of Variation (CV)
14	151	22801	
15	108	11664	$=\dfrac{SD}{mean}x100$
16	133	17689	
Sum	2123	362145	
Mean	133		$=\dfrac{73}{133}$ x 100 = 55 percent

In prism cruising the volume per hectare is obtained directly, rather than volume per plot. The use of volume per hectare rather than volume per plot in the above calculations is valid.

When advantage cannot be taken of a sample-based estimate, then CV can be roughly estimated using general knowledge of the timber types. The steps involved are:

1. Estimate the range of volumes per hectare likely to be encountered. Convert this to volume per plot for the plot size to be used in the cruise.

2. Divide the range by 4 to obtain an estimate of the standard deviation (4 is suggested since the number of samples required is unknown and it is an average value for 16 or more samples).

3. Estimate the mean sample volume.

4. Divide the standard deviation by the mean sample volume to obtain an estimate of the coefficient of variation; convert this to percent.

For Example: It is estimated that the volume will range from 3 to 15 m^3 per plot. Therefore, the range is 15 - 3 = 12 m^3. The average sample volume is estimated to be 6 m^3.

Thus:

$$c = \frac{{}^{12}\!/_{4}}{6} \, x \, 100 = \frac{3}{6} \, x \, 100 = 50 \text{ percent}$$

This short-cut method provides a rough approximation of CV, and may only be used when a sample-based estimate of CV cannot be obtained. For an approximation of CV based on prism cruising the range and average volume per hectare can be used in the calculations.

Sample-based estimates of CV (provided 16 or more samples are used) are worth recording as "experience", and may be used for design purposes on nearby sales of comparable timber type.

2.6.3 Stratification

Coefficient of variation (and number of plots required) is directly related to the range of individual plot volumes. The smaller this range is in a population, the more efficient the sampling. The object is to increase sampling efficiency by stratifying larger populations (i.e., a timber sale or cutting permit) into smaller populations (timber types) in such a manner that each one of the timber types has a lesser variation than the larger population.

Consider the following:

1. Are there two or more distinctive timber types that can be identified and can readily be mapped.

2. The timber types can be readily mapped as a result of ground examination.

3. The following attributes should be considered when stratifying timber:

Major species composition,

- age, particularly younger and older immature and mature,
- height of major species, and
- crown closure.

4. Where previous harvesting has resulted in patch-cuts, stratify as follows:

   a. Where previous harvesting has resulted in patch-cuts that are mapped in the Results or Forest Tenure Administration systems, then map them on the cruise plan map. Exclude these harvested patches from the harvest area and do not sample them.

2.6.3.1 Forest Typing

Forest types must be kept fairly broad. There is a common tendency to overtype which nullifies any increases in sampling error achievement.

Forest type islands must not be smaller than 1.0 ha unless the block is less than 1.0 hectare and then the type area can match the block area. Brush patches smaller than 1 ha are normally left in the forest type and sampled. Non-productive types, and other small areas reserved from harvesting, should be typed the same as the partial cut source documents. All types that contain merchantable timber must be sampled unless the timber is reserved from harvesting in the partial cut source documents.

Typing for cruising may differ from typing the partial cut source documents (e.g., silviculture prescription, site plan, appraisal, higher level plan). If the partial cut typing occurs before cruising, the typing will be very similar (except for brush patches smaller than 1 ha). If the partial cut occurs after cruising, there may be significant differences.

A map showing all forest and non-forest types must accompany the cruise plan and must be submitted prior to the commencement of field work. Modifications to the cruise plan typing can only be made when supported by the fieldwork and documented in the field traverse notes. Refer to Section 7.3 for further information regarding the procedure for identifying and labelling timber types.

If typing changes after the cruising field work, due to reserves for example, cruisers may need to revisit the cruise plots in the field to ensure they are not influenced by these changes. Good traverse note taking, to identify potential reserves, will reduce the need for cruisers to re-visit cruise plots.

Use the following methodology for stratification:

1. Forest types must be distinguished before the cruise commences based on:

   a. aerial photograph interpretation, or

   b. the most recent forest cover maps,

2. Field inspection or sampling.

   The type lines must be documented in the traverse notes.

3. If the transition from one timber type to another is very gradual and not detected in the field, then the type line must be drawn equidistant from dissimilar plots.

4. If non-forest types are stratified out of the harvest area, then they must not be sampled.

2.6.3.2 Minimum Plots Per Type

If the sampling error requirement has not been waived or there has not been a boundary amendment after the cruise has been completed the following requirements must be met:

The Average Line Method of Compilation requires a minimum of two measure plots per timber type in the cutting permit.

This is to enable the calculation of sampling statistics.

The second plot in small timber types will be located according to the following procedure to ensure that a minimum of two measure plots are located in the timber type:

1. Locate the second plot one half of the inter-plot spacing along the stripline in the current direction of travel from the single plot in the type. If the plot is still not in the timber type, then

2. Locate the second plot one quarter of the inter-plot spacing along the stripline in the current direction of travel from the single plot in the type. If the plot is still not in the timber type, then

3. Continue steps 1. or 2. at ninety degrees clockwise from the stripline until the second plot can be established.

2.6.3.3 Calculation of Number of Samples

When stratified sampling is used, an average weighted coefficient of variation must be determined. This value is used in the equation to calculate the total number of plots required. For example:

	Type Area		Area X	Proportional	Weighted CV	
Type	**ha**	**Av. Volume/ha**	**Av. Vol.**	**(Area x Vol)**	**CV**	**(P x CV)**
F P1	12	272	3 264`	0.43	30	12.9
P1	12	134	1 608	0.21	50	10.5
P1 F	16	171	2 732	0.36	40	14.4
	40		7 604	1.00		37.8

If this 40 ha timber sale is to be sampled with 0.1 ha plots, and a sampling accuracy of *plus or minus* 15 *percent* at 2 S.E., the required number of samples is:

$$n = \frac{t^2 xCV^2 xN}{NxE^2 + t^2 xCV^2} = \frac{(2)^2 x(38)^2 x400}{400x(15)^2 + (2)^2 x(38)^2}$$

$$= \frac{4x1444x400}{400x225+1444} = \frac{5776x400}{90000+5776} = \frac{2310400}{95776}$$

$$= 24$$

The probability factor for n-1 or 23 is then used to calculate a new "n", which equals 26. These 26 samples are then distributed among the three types as follows:

$$n_1 = \frac{PCV_1}{PCV} x\, n \ etc. = F-Pl;\, n = \frac{12.9}{37.8} x\, 26 = 9$$

$$Pl;\, n = \frac{10.5}{37.8} x\, 26 = 7 \qquad Pl-F; = \frac{14.4}{37.8} x\, 26 = 10$$

Exact estimates of type size, volume and coefficient of variation are not necessary in advance of cruising to predict sampling requirements. Reasonable approximation are sufficient to establish correct relative intensities of sampling for each type.

The sampling error objective (e.g., *plus or minus* 15 *percent*, 19 times out of 20) for scale based cruises is for the total volume of the cutblocks, and the basis for estimating the number of samples required to meet this objective is the forest types within the area to be cut and their relative volumes.

2.7 Double Sampling

As the name implies double sampling consists of sampling certain characteristics within a sample instead of measuring those characteristics throughout the sample. Double sampling improves the volume estimate by species.

2.7.1 Type of Plots

Double sampling requires the use of two types of prism plots, the measured plot and the count plot. The measure and count plots together represent the main sample. Fixed-radius plots may not be used in this form of double-sampling.

2.7.1.1 Measured Plots

The measured plots are conventional samples in which all variables for each tree are measured, identified, recorded and represent the subsample in the double-sampling cruise.

2.7.1.2 Count Plots

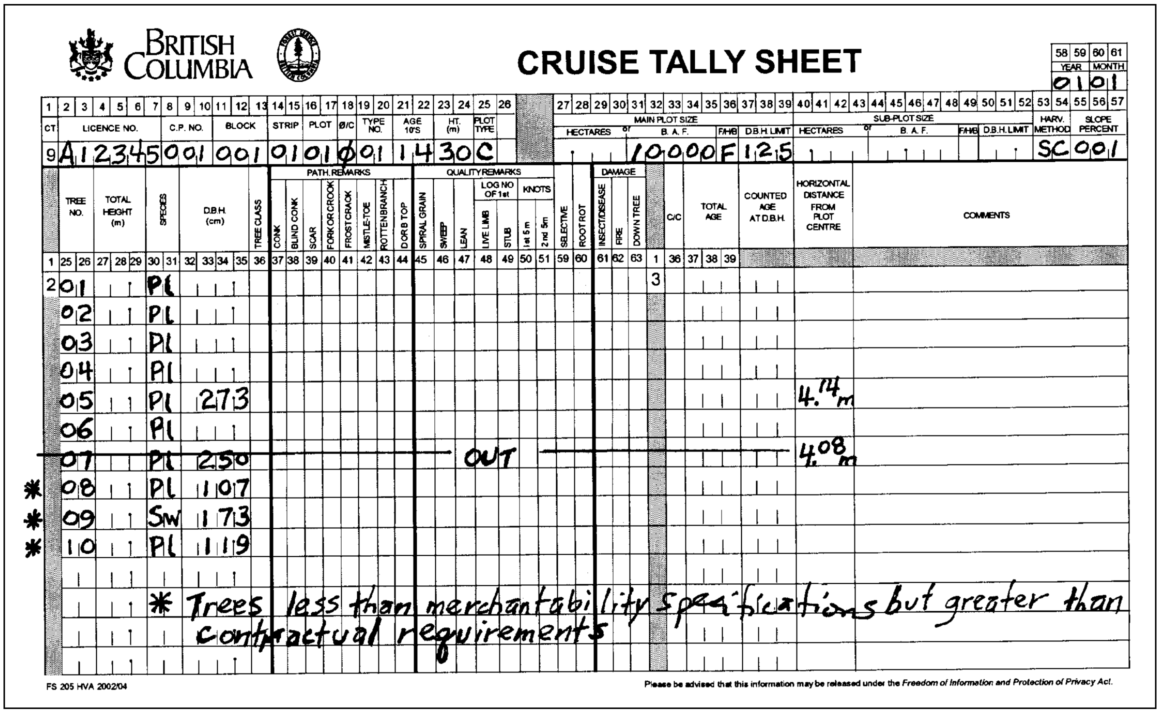
Count plots are samples in which only trees by species are tallied. All live and dead potential trees which are to be included in the compilation are noted. Do not include any tree below the lower dbh to be compiled for that species or tree class 4 (dead useless) or tree class 6 (live useless) trees.

Count plots are not permitted in faller selection or mark to cut or leave cruises unless there is at least 1.0 measure plot per hectare due to the effect on the double sampling ratio when a percent reduction is applied since diameters are not recorded in count plots. There is a high probability that measure information will be missing for count trees.

The procedure for dealing with potential orphan trees (a species not recorded in a measure plot) in count plots during the fieldwork is to record the measure information for all of the orphan species trees in the first count plot where the orphan species is encountered. Move the tree(s) into the nearest measure plot in the same timber type. This will ensure that the same basal area factor has been used in the count and measure plots and that the orphan trees are maintained in the same timber type. If the orphan species is subsequently measured in a measure plot, then return the count plot orphan tree(s) to their respective count plot and remove the measure data from the tree(s).

Record the tree number as 99 (98, 97, etc. if required). Mark the tree numbers on the trees in the field and strike a line through the tree details on the count plot. Record the tree attributes in the nearest measure plot. Consideration will be given to waiving the sampling error if the minimum sampling error requirement is exceeded due to the shift in the tree count.

Figure 2.2 illustrates how count plots must be recorded if they are used for cutting authorities that have different appraisal and merchantability specifications.



	TREE NO.	SPECIES	D.B.H. (cm)	C/C	HORIZONTAL DISTANCE FROM PLOT CENTRE
	2 01	Pl		3	
	02	Pl			
	03	Pl			
	04	Pl			
	05	Pl	27.3		4.74 m
	06	Pl			
	~~07~~	~~Pl~~	~~25.0~~ OUT		4.08 m
*	08	Pl	10.7		
*	09	Sw	17.3		
*	10	Pl	11.9		

Figure 2.6 Cruise Tally Sheet (FS 205) – Card Type 9.

Field Procedures 3

3.1 General Provisions

3.1.1 Signatures

Stumpage rates are estimated on the data collected by timber cruisers. Therefore cruise tally sheets (FS 205 and industry versions) must be signed, name printed and dated by the cruiser who accepts responsibility for the information contained on the card. This assists the check cruiser to sample a representative proportion of each cruiser's work.

3.1.2 Tie-Points

The cruise must originate from valid tie points such as unique photo and map locations like creek junctions, road locations, falling corners and GPS positions. All of the cruise strips must be linked together and to the boundary line.

The tie-point or reference point of each strip-line must be well established on the ground so that it may be found at a future date.

3.1.2.1 Options for selecting the Point of Commencement (POC)

1. Select the map feature (creek, junction, etc.) or GPS station, which is closest to the access in the block that the cruiser's plan to use.

2. In the case of patch-cuts, the POC for each patch will be from the nearest plot in the adjacent patch.

3.1.3 Strip-Lines

The strip-line will be run using compass, clinometer and metric surveyor tape or electronic measuring devices. Allowances for slope must be made since all distances must be horizontal. The line should be marked with plastic marking tape so it is easily visible.

3.1.4 Plot-Centres

When the required distance has been measured along the strip line, a stake, tree or equally effective marker must be established at the plot centre where the compass person marks the chainage. If the chainage is at a tree, mark the plot centre with an "X" at the point where the chainage touches the tree. If a stake is used then the plot centre is the ground level point and not the top of the stake.

A reference point (RP) must be recorded in the traverse notes or on the cruise tally card. It is acceptable to use a reference tree that is an "in" tree and record the bearing and distance to the nearest point on the tree at DBH. The reference tree will be used to determine the position of the plot centre for check cruising. It is recommended that the reference information is recorded below stump height to facilitate post-harvest evaluations. Refer to any regional guidelines for any additional requirements and use of reference trees.

3.1.5 Slopes

3.1.5.1 Slope Percent

Record the most severe slope measurement from the plot centre to a point 15 m slope distance within the harvest area and rights-of-way through block roads. Plot slope data is required for all road rights-of-way areas contained within a cutting authority. Plot slope is not recorded on road cuts or fills.

The plot slope reading must be confined to the harvesting method area if the harvesting method boundary is known when the field work is performed.

3.1.5.2 Distance Slope Correction

All distances (strip and base lines, plot radii and closed traverses) must be corrected for slope to obtain horizontal distance and measured to the standards listed in Section 3.6.3.1 or refer to Table 1.

The formula used to correct for slope is:

$$\mathrm{COS}\left[\mathrm{TAN}^{-1}\left(\frac{\text{slope\%}}{100}\right)\right] = \text{slope correction factor} \leq 1.000$$

The resulting number is multiplied by a measured slope distance to obtain the equivalent horizontal distance. For example:

- slope of 59 percent and measured slope distance of 8.62 m to tie-point,
  - $\mathrm{COS}\left[\mathrm{TAN}^{-1}\left(\frac{59}{100}\right)\right] = 0.8613$, and
- 8.62 m x 0.8613 = 7.42 m horizontal distance to the tie-point.

To obtain a slope distance, the specified horizontal distance is multiplied by the inverse of the slope correction factor. For example:

- slope of 74 percent and specified horizontal distance of 50 m,

- $\text{COS}\left[\text{TAN}^{-1}\left(\frac{74}{100}\right)\right] = 0.8038 \qquad 0.8038^{-1} = 1.2441$, and
- 50 m x 1.2441 = 62.205 m slope distance will give 50 m horizontal distance. Refer to Table 1 for Correction Table.

3.1.6 Traversing

All cutting permits require a closed or GPS traverse of each cut-block. Stations, tie-points, reference points and boundaries must be well established on the ground for permanent future reference and must not be destroyed during or after harvesting operations. Refer to any established district policy on boundary marking where the cruise area is located (e.g., *Forest Practices Code Boundary Marking Guidebook*). Traverse notes shall include tree species and diameters recorded for all stations, tie - points and other boundary references. Refer to Section 3.6.3.1 for the tolerances. The original strip line, type line, boundary traverse notes and GPS coordinates must be made available to the check cruisers upon request. The boundary traverse must be tied to the cruise strips in instances where the harvest boundaries are traversed after cruising.

All areas that are inside the block boundary and will be removed from the harvest area must meet the area error standards in Section 3.6.3.1(8).

The following cruise strip line traverse notes illustrate a recommended format for note taking.

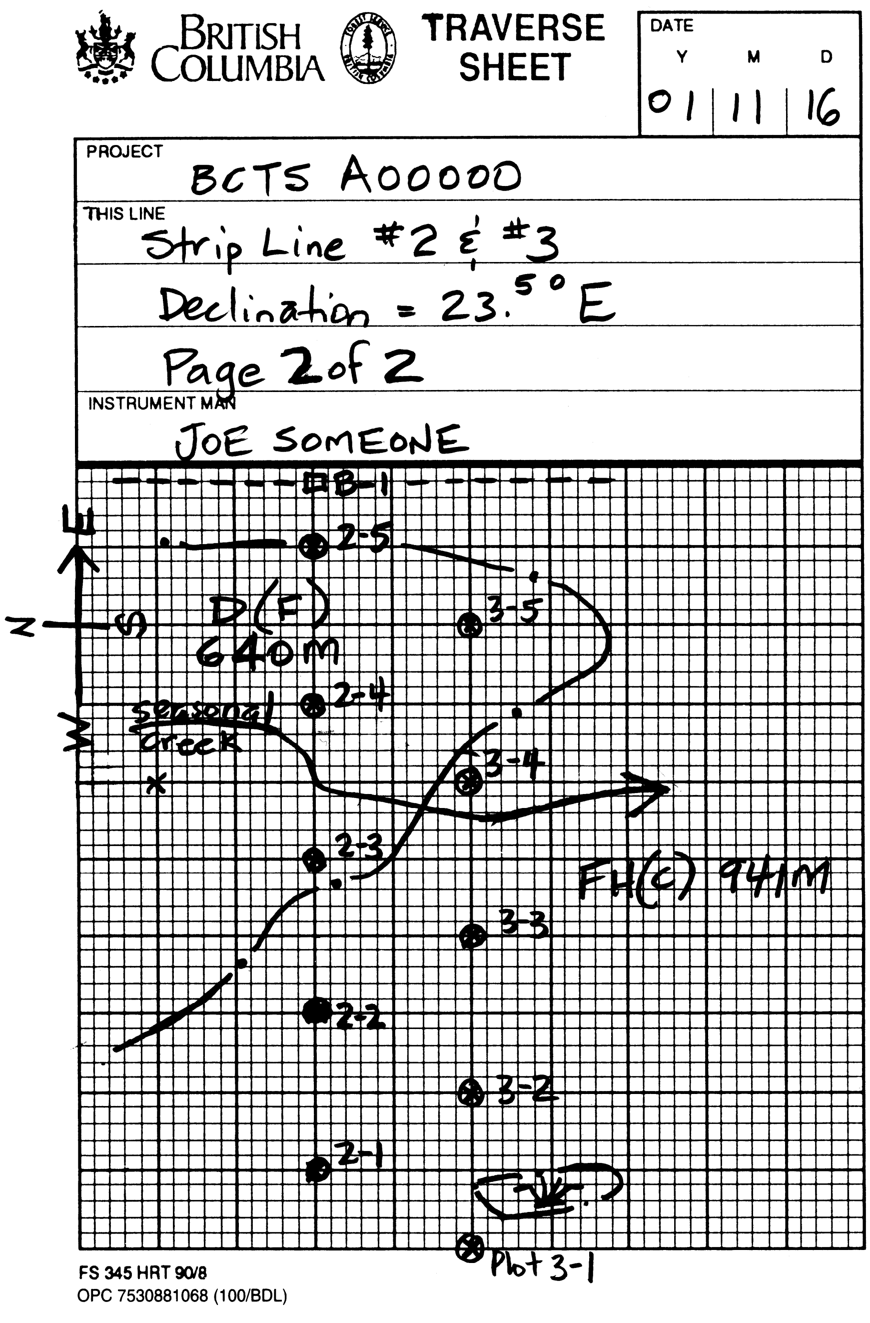


Figure 3.1a Cruise Strip Line Traverse Notes (front).

STATION	FORE BEARING	BACK BEARING	SLOPE %	SLOPE DISTANCE	HORIZONTAL DISTANCE	COMMENTS
0+90	→ See page 2					
	90	271	+4	40	40	
0+50						
	90	270	0	15	15	
0+35	= edge of swamp @ 0+40					
	90	271	0	35	35	
0+00	= PLOT 3-1					
4+40	= Falling Corner B-1 (hemlock, 25cm dbh)					
	90	270	+3	40	40	
4+00	= PLOT 2-5 (Border Plot ref. tree 1.05 m @ 5°)					
	90	270	+2	50	50	
3+50						
	90	269	0	50	50	
3+00	= PLOT 2-4 (reference tree 1.50 m @ 70°)					
	90	270	0	50	50	
2+50	= Seasonal Creek					
	90	270	+5	50	50	
2+00	= PLOT 2-3 (reference tree 2.65 m @ 65°)					
	90	270	+3	20	20	
1+80	= Cross timber type into D(F) 640 M					
	90	271	+4	30	30	
1+50						
	90	270	+3	50	50	
1+00	= PLOT 2-2 (reference tree 1.42 m @ 180°)					
	90	270	0	20	20	
0+80						
	90	271	+5	40	40	
0+40						
	90	270	+3	40	40	
0+00	= PLOT 2-1 (reference tree 2.81 m @ 45°)					

Figure 3.1b Cruise Strip Line Traverse Notes (back).

3.1.6.1 Combined GPS and Conventional Traverse Procedure

To calculate the closing error for traverses where you have a combination of conventional traversing (using a compass, clinometer and metric tape or electronic measuring device) and Global Positioning Systems (GPS) traversing:

1. Calculate the bearing and distance between the first GPS point (end of conventional traverse) and the last GPS point (beginning of conventional traverse).

   On the Internet go to:

http://aardvark.gov.bc.ca/apps/mascotw/, and:

   a. select Survey Utilities,
   b. select Computations on the Ellipsoid,
   c. select Compute Geodetic Observations using the Inverse Problem,
   d. input the latitude [Degrees (45-65), Minutes (00-59), Seconds (0.00000-59.99999)] of the first GPS point under OCCUPIED,
   e. input the longitude [Degrees (109-145), Minutes (00-59), Seconds (0.00000-59.99999) of the first GPS point under OCCUPIED,
   f. input the latitude [Degrees (45-65), Minutes (00-59), Seconds (0.00000-59.99999)] of the last GPS point under SIGHTED,
   g. input the longitude [Degrees (109-145), Minutes (00-59), Seconds (0.00000-59.99999) of the last GPS point under SIGHTED, and
   h. click on “Do Calculation” or hit the “Enter” key and the program will calculate the Azimuth bearing and the distance between the two GPS points.

2. Option to calculate the conventional azimuth bearings from UTM Northing and Easting GPS readings:

   a. select Survey Utilities,
   b. select Mapping Plane Computation,
   c. select Compute Grid Observations using the Inverse Problem,
   d. input the Northing of the first GPS point under OCCUPIED,
   e. input the Easting of the first GPS point under OCCUPIED,
   f. input the Northing of the last GPS point under SIGHTED,

g. input the Easting of the last GPS point under SIGHTED, and

h. click on "Do Calculation" or hit the Enter key, and the program will calculate the azimuth bearing and the distance between the two GPS points.

> There is a free MS-DOS executable file at this site that can be downloaded into your computer for future use.

3. Use the calculated bearing and distance between the first and last GPS points to close the conventional portion of the traverse and determine the closing error.

4. The closing error determined in Step 2. is used to determine if the traverse meets the closure error requirement in Section 3.6.3.

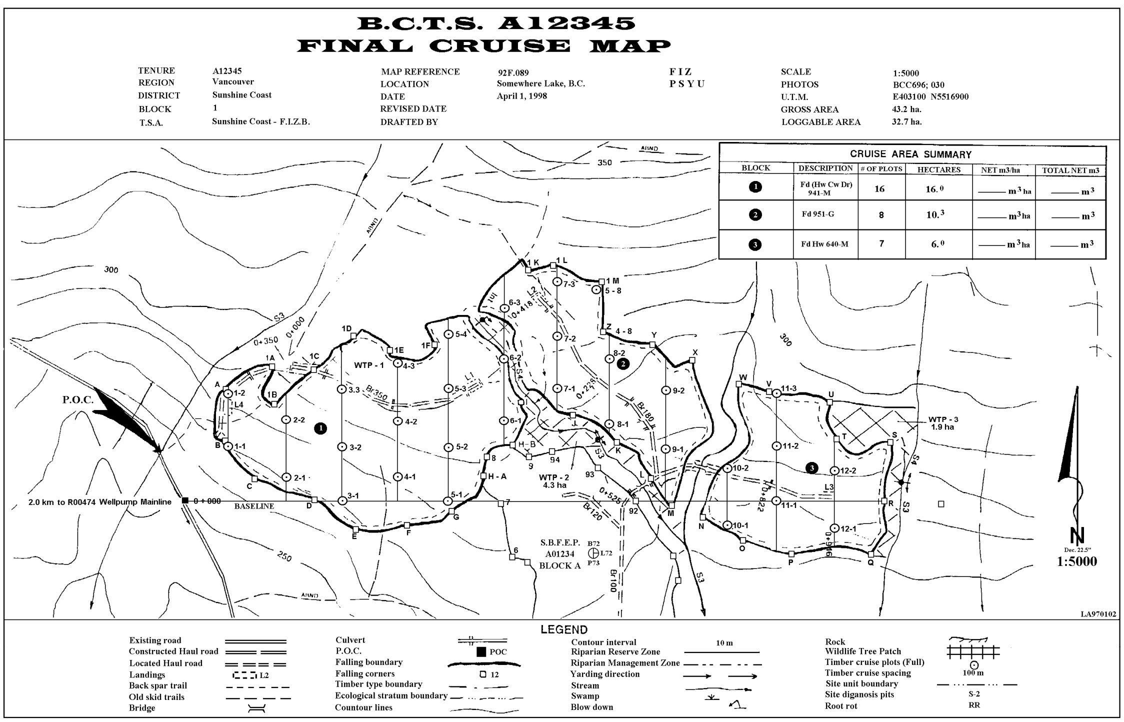


Figure 3.2 Final Cruise Map.

References:	*Standard Procedures for Line and Polygon Mapping Using Global Positioning Technology* Ministry of Sustainable Resource Management web site: http://ilmbwww.gov.bc.ca/bmgs/gsr/specs/bc%20specifications%20-%20gps%20resource%20mapping%20release%203.0.pdf
	Forest Practices Code of BC Act *Boundary Marking Guidebook* Ministry of Forests and Range web site: http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/bound/boundtoc.htm

3.1.7 Mapping

The minimum mapping standards for the cruise plan and final map are as per Sections 3.1.7.1 and 3.1.7.2 (also see Figures 2.1 and 3.2).

3.1.7.1 Cruise Plan Map Standards

1. The cruise map will be legible and of good quality 1:5 000 or 1:10 000 scale.
2. The map will provide neat and clear lines, lettering and numbers.
3. The cruise map and Cruise Area Summary shall include the following:
   a. tenure,
   b. forest region and district,
   c. scale used,
   d. timber supply area,
   e. north arrow and declination,
   f. cut block(s) must be identified as mature or immature,
   g. timber type lines and description, including a forest cover map of the cruise and adjacent areas,
   h. plots must be numbered (measure and count identified), and
   i. types, area and summary, see Section 7.3, Card Type C, timber type label codes.

j. existing and proposed roads,

k. adjacent logging and burn history,

l. inventory region and compartment number,

m. Forest Inventory Zone, and

n. PSYU.

3.1.7.2 Final Cruise Map Standards

Cruise maps must accompany the compilation report, and must be produced as required under Section 3.1.7.1 plus:

1. Scale of 1:5000, 1:10000 or as approved by the District Manager.
2. Plots used in the compilation are to be clearly indicated and numbered on the map.
3. Locations of baselines (when used), boundary tie lines, points of commencement and actual strip line location with direction of travel must be indicated,
4. Contour lines are recommended and must be indicated in such a fashion that they are clearly legible and indicative of local topographic features.
5. Physiographic features must be shown.
6. Legal survey features must be shown.
7. Forest and non-forest type boundaries must be clearly indicated.
8. Status clearance boundaries and cutting boundaries must be shown.
9. Any other features of significance with respect to the sale of Crown timber (i.e., windfall areas, fire areas, insect or disease infestations, fish-bearing streams), and contour logging considerations must also be shown.
10. Digital GPS Survey and mapping data must be provided upon request by the Ministry of Forests and Range if GPS technology is used.
11. Name of the person or company that produced the final cruise map.

3.2 One Hundred Percent Cruises

The boundary of the 100 percent cruised sale must be well marked and each tree numbered or marked. In order to not miss trees a systematic procedure of tree measurement should be adopted:

1. Dividing the area into strips (maximum width 20 m) will help to ensure no trees are missed.

    - the denser the stocking the narrower the strips, and
    - the steeper the slope the narrower the strips.

3.3 Fixed-Area Plot Cruises

The fixed area plot size must be consistent by timber type and count plots are not permitted in fixed area plots. Border plots are permitted in fixed area plots.

3.3.1 Circular Plots

Having established the plot centre, the plot circumference is then determined and marked with string or plastic flagging tape. More radii measurement will be required when there are many trees on or near the plot boundary. At the end of each radius measurement the tree on the plot circumference or nearest to the circumference within the plot must be marked with plastic flagging tape or paint.

When plots are established, slope allowances must be applied to each radius distance. That is, plots must not be established by assuming an average slope and making one slope correction for all radii. The plot radius slope allowance is added along the same slope in which the plot radius is being measured. Plot radii slope corrections are given in Table 2. The formula for calculating these corrections is in Section 3.1.5.2.

3.3.2 Rectangular Plots

A tree on the strip line at the start and end of each plot must be blazed on four sides. A metal tag and/or plastic flagging tape, showing strip number, compass bearing, distance on line and plot number must be attached.

The strip line must constitute the centre line of the plot, and slope allowances must be made in measuring this line. Slope allowances for various short distances are given in Table 1. The plot centre line must be marked with plastic flagging tape every 5 m from the beginning to the end of the plot.

Plot width will be checked along the centre line and the boundary marked with plastic flagging tape. Plot width must be corrected for slope.

3.3.3 Borderline Trees (Fixed-Area Plots)

The horizontal plot radius or plot width must be checked for each borderline tree. A tree will be included "in" the plot if at least half of the diameter of the tree measured at DBH is inside the plot.

3.4 Variable (Prism) Plot Cruises

Having established the plot centre, the prism is used to determine which trees are "in" the plot. Then species, DBH, pathological remarks and quality are measured or determined for each tree.

3.4.1 Sampling Procedures

The cruiser holds the prism exactly over plot centre and looks at a tree across the upper edge of the prism, and so views it simultaneously above the prism and also through the prism. The tree image seen through the prism will be laterally displaced. The prism must be over the sample centre as the prism forms the vertex of the angle being projected.

If the displacement is greater than the diameter of the tree, the tree is "out"; if smaller the tree is "in"; if the same, the horizontal distance to the tree must be measured. The prism will be "swept" around plot centre and all live and dead trees equal or larger than the minimum specified size for the "in plot" trees recorded.

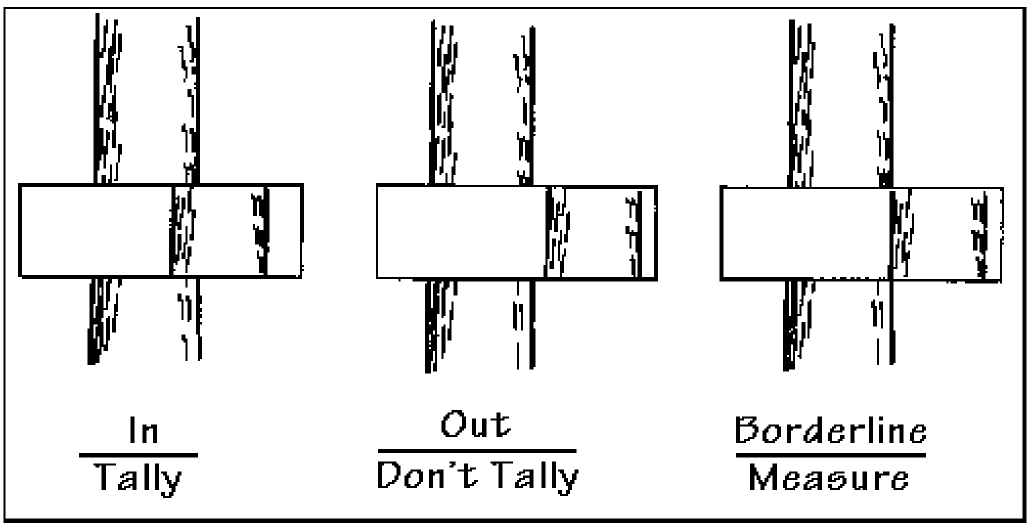


Figure 3.3 "In", "Out" and "Borderline" Trees.

When two prisms are being used on the same plot, each prism will be "swept" through 360^{o} about the plot centre. It is vital that only the appropriate trees be recorded for each sweep. Assume two prisms having basal area factors of 2 and 4 are being used. In this case on the 2 basal area sweep only those trees whose diameters are 17.5 cm and over and less than 27.5 cm DBH, will be recorded. Trees whose diameters are 27.5 cm or greater will not be recorded even if they appear to be "in". Conversely on the 4 basal area sweep, trees whose diameters are less than 27.5 cm will not be recorded even if the appear to be "in". Therefore, on the tally sheet it is vital to record the basal area factors used and the tree diameters to which they apply.

3.4.1.1 BAF Selection

The choice of the proper BAF is based upon two principal considerations:

1. The visibility of the trees that should be "in".

2. The number of trees counted at each point.

The prism size must not be changed at plot centre to include or exclude certain trees or to achieve a specific tree count as that constitutes bias. The intentional use of more than one prism size in a timber type will result in rejection of the cruise.

3.4.1.2 Prism Slope Correction

Since each tree on the area may have its own unique slope angle from the centre, each tree must be considered individually in making slope corrections (see Section 3.1.5.2 for the slope distance correction factor formula). In borderline situations, trees are to be measured as described in the following section.

3.4.1.3 Borderline Trees (Prism Plots)

The status of borderline trees in measure and count-plots must be checked by determining the horizontal distance from the plot centre to the face of the tree trunk at DBH. Add one half of the tree diameter to the horizontal distance to determine the horizontal distance from the tree to the plot centre. In prism cruising every tree has its own plot radius depending on its diameter and the angle of the prism being used (see Figure 4.1). The plot radius factor times DBH gives the appropriate plot radius for any tree. The trees plot radius, distance from the sample plot centre and the prism size determine whether the tree is "in" or "out" of the plot radius. A tree is "in" the plot if at least half of the diameter of the tree measured at DBH is inside the plot. Volume equations are based on DBH, therefore, the prism must be sighted on the tree at breast height in sampling.

Record the measured slope distance and slope percent on the cruise tally card and run a single pencil line through the tree details if the tree is out. If the measurements are not recorded then the check cruiser will be unable to allow for any measurement tolerances.

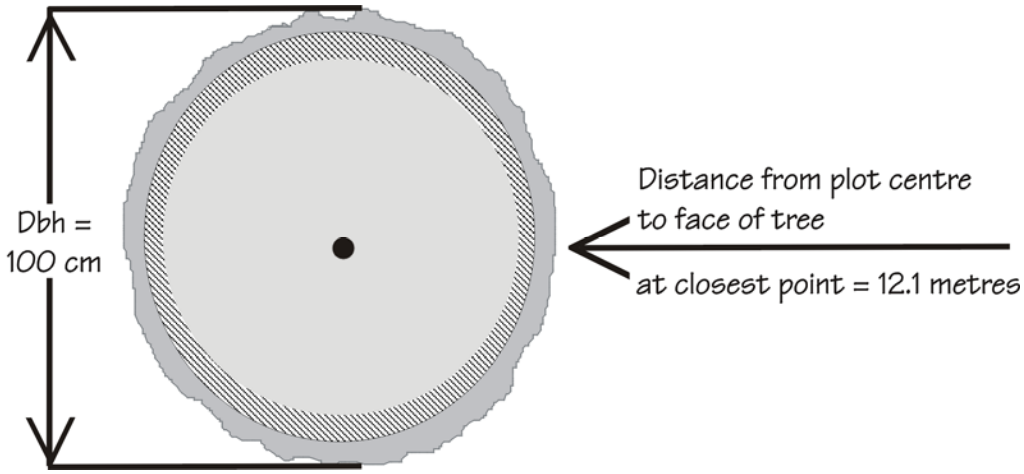


Figure 3.4 Borderline Tree Measurements - Variable Plot.

BAF 16 Prism

PRF = $\frac{1}{2\sqrt{16}} = 0.125$

Plot radius of 100 cm tree = 0.125 x 100 = 12.50 m.

Distance to centre of tree = 12.1 m + $\left(\frac{100\text{cm}}{2} = 0.5\text{m}\right) = 12.60\text{ m}$.

The measured distance exceeds the plot radius of the tree, therefore the tree is out and not tallied. Record the measured horizontal distance in the left margin of the tally card and run a single pencil line through the tree details if the tree is out.

The following table gives plot radius factors for a selection of prism basal area factors.

Basal Area Factor	Plot Radius Factor	Basal Area Factor	Plot Radius Factor
1	0.5000	12.25	0.1429
2	0.3536	13	0.1387
3	0.2887	14	0.1336
4	0.2500	15	0.1291
5	0.2236	16	0.1250
6	0.2041	18	0.1179
6.25	0.2000	20	0.1118
7	0.1890	20.25	0.1111
8	0.1768	24	0.1021
9	0.1667	25	0.1000
10	0.1581	30.25	0.0909
11	0.1508	32	0.0884
12	0.1443	64	0.0625

For example, a tree having a DBH of 28 cm, sighted with a 4 BAF prism, will have a plot radius of 7 m. Therefore, if the horizontal distance from the plot centre to the tree centre is 7 m or less the tree is "in" and will be tallied. If the distance is greater than 7 m the tree is "out" and is not tallied. All "borderline" trees must be measured and the measurements recorded for checking purposes.

3.4.1.4 Leaning or "Down" Trees

Regardless of the direction of a tree's lean or position on the ground, the horizontal distance must be measured from the centre of the top side of the tree at DBH to the plot centre in order to decide whether a tree is "in" or "out”. The position of the point of germination has no bearing on this decision. A tree is considered leaning if the lower third of the stem is more than 10 degrees from vertical.

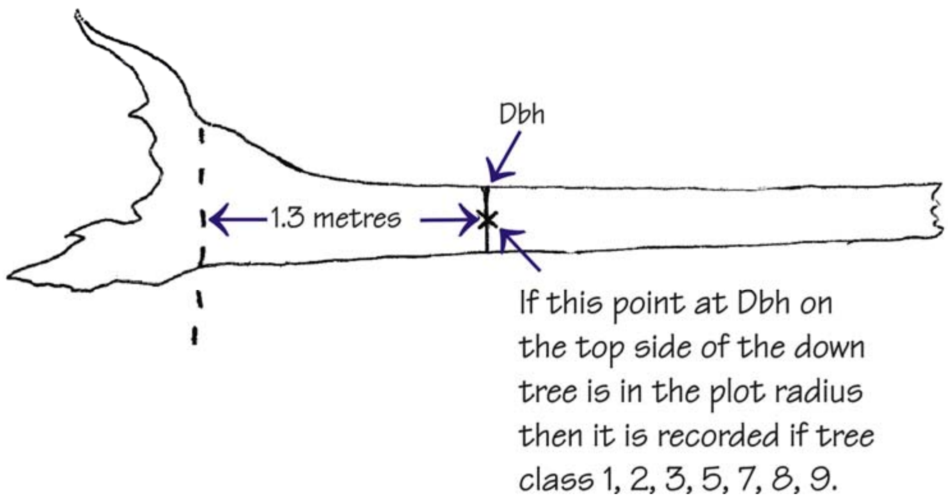


Figure 3.5 Plan View of Leaning or "Down" Trees.

3.4.1.5 Hidden Trees

Trees may be obscured by undergrowth or other trees. In these cases the prism may be moved off the sample centre, maintaining the same distance to the tree in question. However, it may still be difficult to sight the tree at breast height. If the tree qualifies as an "in" tree by sighting above breast height, it would also be an "in" tree if sighted at breast height, unless the tree leans toward the observer.

If a tree cannot be sighted by the above procedures it must be treated as a borderline tree, the trees plot radius calculated and the distance from the plot centre to the tree measured.

3.4.1.6 Fixed Area Border Plots (Plots Falling On Type or Block Boundaries)

Fixed area plots which are affected by harvesting boundaries are split through the plot centre parallel to the harvesting boundary. The trees inside the sample area are recorded and the plot recorded as a B for border/half plot. Border plots cannot be used in count plots.

Plot centres which fall *outside* the sample area will be dropped.

3.4.2 Walkthrough Method

The Walkthrough Method must be used for variable plot appraisal cruises.

* The following general procedures must be followed in the establishment of a walkthrough plot:

Enter an “F” (full plot) on the cruise tally sheet.

Do not tally trees that fall outside the cruise area. Walkthrough plots must not be used near boundaries that are difficult to define in the field, such as timber type and harvest method boundaries. In those situations it is appropriate to use a full sweep plot.

All “in” or “out” tree distance measurements are recorded on a horizontal basis and are measured at 1.3 metres dbh.

Regular Boundary – see figure #3.8

Measure the bearing and distance from the plot centre to the centre of the “in” tree and then measure an equal distance beyond the centre of the tree on the same bearing from plot centre. Record the tree details twice if the point is outside the cruise area. Record separate tree numbers for each tree. Record the tree details once if the point is inside the cruise area.

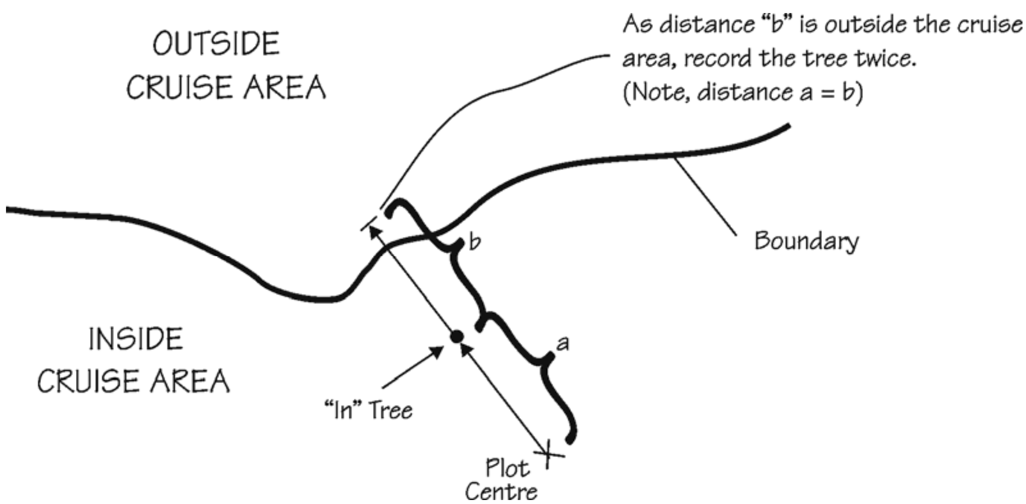


Figure 3.6 Walkthrough Method - Regular Boundary.

* The walkthrough method is based on a description of the procedure from Dr. Iles book entitled “*A Sampler Of Inventory Topics*” and the procedure in the *Coast Forest Region, Regional Guidelines* in Chapter 9 of the *Cruising Manual*.

Irregular Boundary – see figure #3.9

If the point bearing and distance places the point back inside the cruise area then record the tree once.

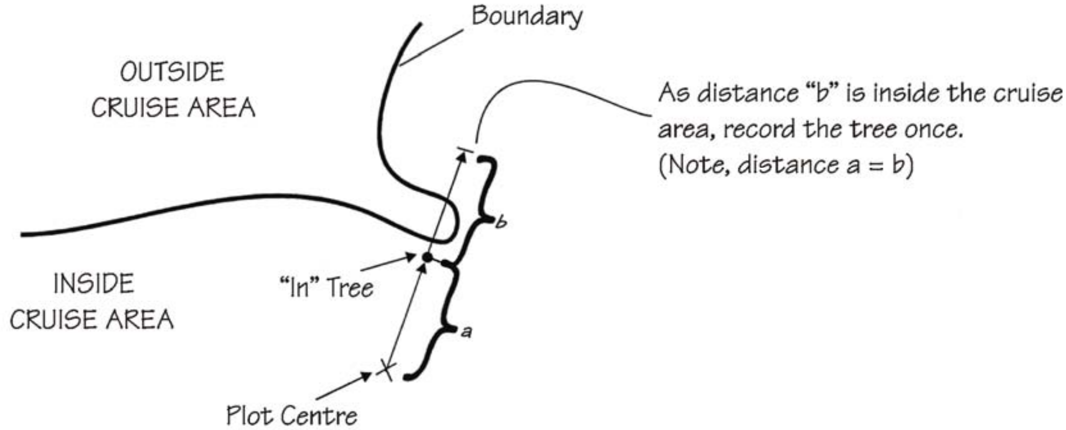


Figure 3.7 Walkthrough Method - Irregular Boundary.

3.5 Tree Measurements - Prism and Fixed-Area Plots

3.5.1 Marking Trees

A paint line or tag must be displayed on the tree at the point of DBH measurement, with the numbers facing the plot centre, to facilitate checking. Borderline "in" trees should be numbered; "out" trees should have an "X". In count plots, only the first tree must be numbered, with an arrow painted on that tree indicating whether the tree tally goes clockwise or counter clockwise. Live useless and dead useless stems are not tallied in count plots.

3.5.2 Species

All living and dead, standing and down trees which are listed in Section 6.3.2 (except dead and down useless) and which meet or exceed the timber merchantability specifications must be recorded when present in a plot. Section 6.3.2 gives a complete list of the commercial tree species and the proper use of genus and species codes.

3.5.3 Heights

The "One Hundred Percent method" must be used on all scale and cruise based tenures cruised after March 31, 1997. The Sample Height method is restricted to use in stump cruises or where severe damage due to windshear or freezing has occurred. Severely damaged stands must be identified on the cruise plan and submitted to the Regional Executive Director or their designate for sampling alternatives. Project the original height of trees with broken tops (as per Figure 3.8 below).

Use adjacent trees and comparable tree heights to estimate heights of trees with broken tops. Trees that are acceptable for comparison are:

- same species,
- same 10 cm diameter class (10-20, 21-30, 31-40, etc.),
- live top,
- if no live tops, then an intact dead top.

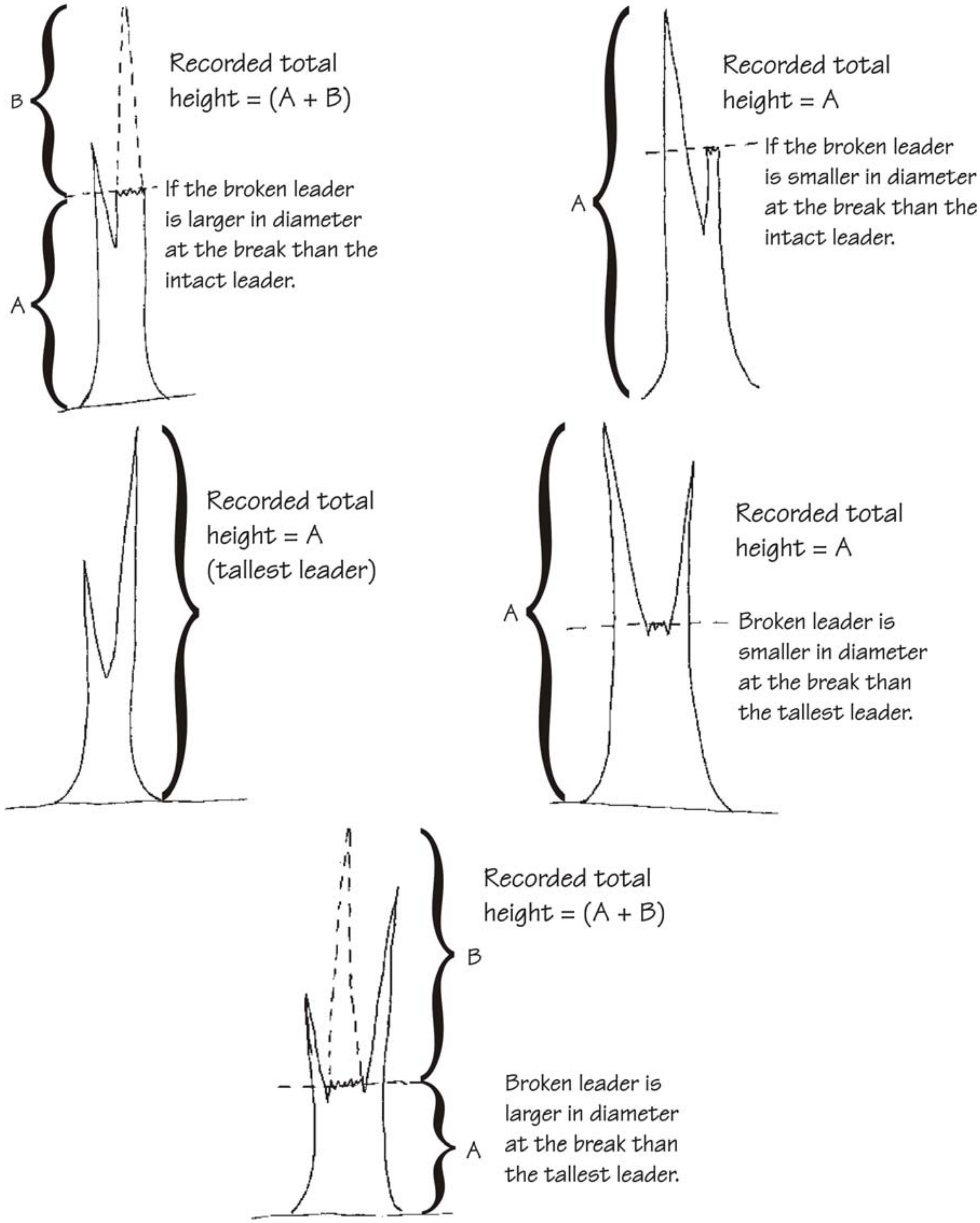


Figure 3.8 Example of Where to Measure the Height on Trees with a Broken Top or Fork/Crook.

3.5.3.1 Leaning Trees

The following method should be used for measuring the tree length of trees leaning more than ten degrees (B) from the vertical (see Figure 3.9). The angle A must be 90 degrees.

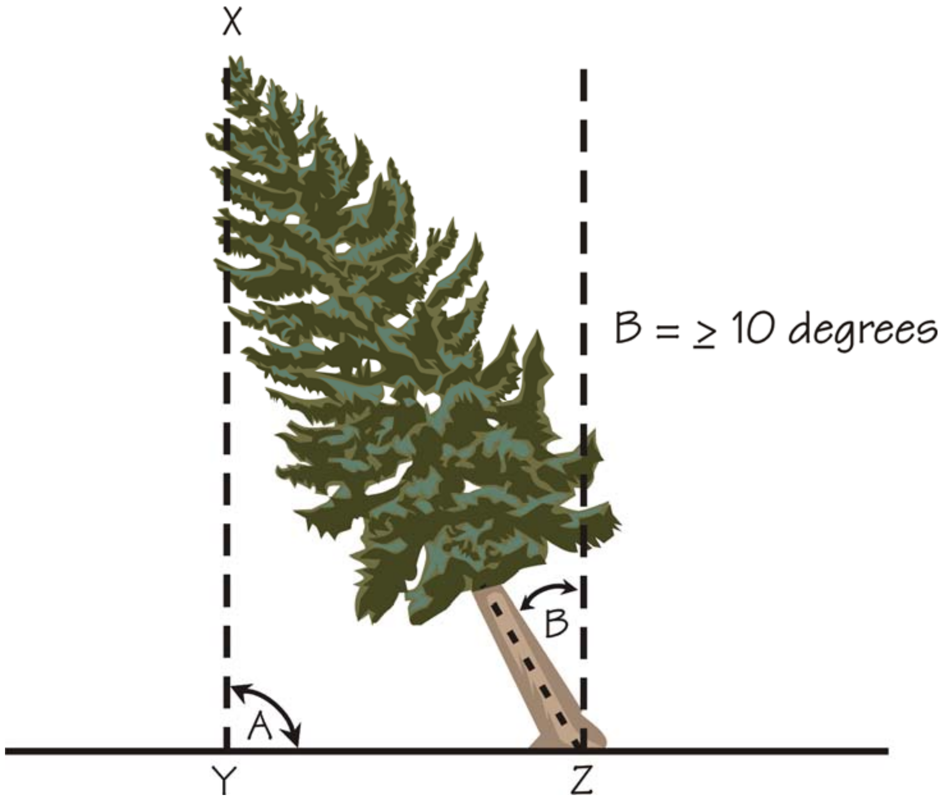


Figure 3.9 Measuring Height of Leaning Trees.

1. Calculate the vertical distance from the ground (Y) to the top of the tree (X) using a clinometer or electronic measuring device from a point perpendicular to the lean of the tree (i.e., A = 90 degrees).

2. Measure the horizontal distance from the centre of the tree (Z) to a point directly under the top of the leaning tree (Y).

3. Calculate the tree length by using the Pythagorean formula for right triangles:

$$Tree\,Length(m) = \sqrt{\left(length\,XY_{(m)}\right)^2 + \left(length\,YZ_{(m)}\right)^2}$$

The degree of lean will not be a check cruising item, however, tree length will be considered the true tree height.

3.5.3.2 Deciduous Tree Heights

Maintain adequate distance from the tree when measuring the highest point on deciduous trees by ensuring that the angle from the cruiser's eye to the highest point is less than 100 percent. This will assist in distinguishing the highest point on the tree from lower branching or forks.

3.5.3.3 "One Hundred Percent" Height Measurements

This is the mandatory method of tree height determination. All tree heights must be either measured or estimated.

With the "One Hundred Percent" height measurement method all trees tallied in C.T. 2 have their heights either *measured or estimated* and entered in columns 27 - 29 (Total Height - metres) between the tree number and species on the Cruise Tally Sheet. The use of a clinometer or electronic measuring device is recommended for tree height measurements and estimates. These measured and estimated heights are used to calculate the volume of the trees within the plot, as opposed to constructing a height curve from height samples.

Estimated heights are obtained for the remaining trees by comparing their height to one or more measured heights.

In plots where there is a high variation of tree heights, more measured height samples may have to be taken to maintain the desired degree of accuracy for the trees.

3.5.3.4 "Sample-Height" Heights (Height/Diameter Curves)

The "sample-height" method only collects heights for some of the tallied trees. This method predicts average height from a height/diameter curve and is restricted to use in stump cruises and severely damaged stands.

Height curves will be permitted in helicopter single stem harvesting. At least 20 tree heights per species and timber type are required. The selection of the trees will be systematic, commencing with the first tree for the species in the timber type and selecting a sample tree interval that will meet or exceed the minimum sampling intensity. Example: every tenth tree, 1, 10, 20, 30, 40, 50, etc. The sample tree heights must cover the full range of diameters that are in the cruise.

Height Sample Size

In general, at least 20 sample trees from each species in each site class on the cutting permit or timber sale must be measured for height. These sample heights must be evenly distributed throughout each type or site-class (i.e., at least one sample height per plot). If it appears that a certain species exhibits the same height/DBH relationship in two or more forest types in the same cutting unit, it is permissible to develop a common height - DBH curve; the tree heights for a given species must be similar throughout the diameter range common to the species. In this case only a total of 20 sample trees need be taken within the two or more forest types. The "same height/diameter relationship" means an average height variation that does not exceed 3 percent over the full range of diameters between two sets of data.

Height Sample Selection (Height/Diameter Curve)

All trees must be marked and numbered at the point of DBH (to facilitate checking) so that the number can be seen when standing at the plot centre.

If the sample tree has also been measured for height and/or age, it must be recorded with the same number, species and DBH. These heights will be used to calculate a height/diameter curve. If the height sample tree is taken outside the plot it will only be recorded in the "Sample Tree Detail" and given numbers 99, 98, 97, etc. to prevent confusion with sample trees inside the plot boundaries.

Abnormal trees such as leaning trees, trees with heavy sweeps, broken tops or forks must not be used as height sample trees. Trees with minor forks or crooks may be used if these trees comprise a considerable portion of the stand.

Dead potential trees should not normally be selected as height sample trees. Under the assumption that these stems died as a result of low vigour and/or pathological depletion, their growth rate would be less than average, hence incorporation of their heights into a general species population height curve could unduly bias that species' height curve. However, if a significant proportion of the population of a certain species is classed as dead potential, a representative number of dead potential stems should be sampled for height (refer to Section 8.4 for additional information).

Height Sample Distribution (Height/Diameter Curves)

Measurements of height and DBH are required so that height DBH relationships can be developed and, therefore, height sample trees must cover the range of heights and diameters in the stand. Each height curve must represent only one species and have at least 2 sample trees for each 10 cm DBH class. The reference point for diameter and height is the high side of the tree as shown in Figure 3.11 of this chapter.

Height samples must be distributed as follows in the normal mature types for each species:

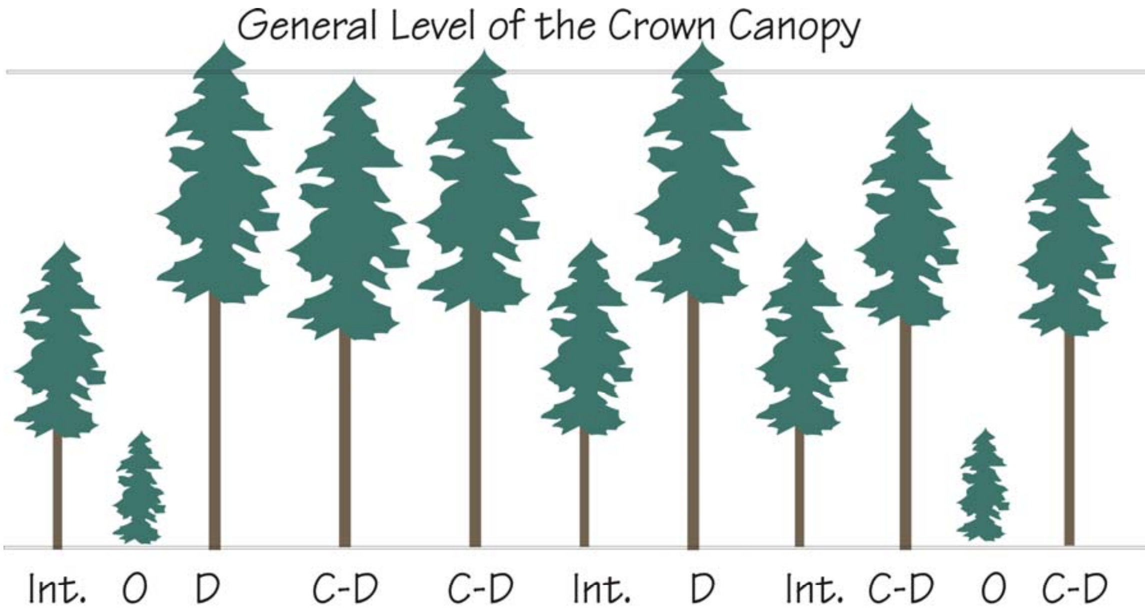
Measure 1/4 in the dominant crown class

Measure 1/2 in the co-dominant crown class

Measure 1/4 in the intermediate and overtopped crown classes

Crown Classes

There are four crown classes (Figure 3.10) as follows:



1. = Dominant (D)	Trees with crowns extending above the general level of the crown canopy. They are somewhat larger than the average and have well developed crowns which may be somewhat crowded on the sides.
2. = Codominant (C-D) Trees	Trees with crowns forming the general level of the crown canopy. The crown is generally smaller than that of the dominant trees and usually more crowded on the sides.
3. = Intermediate (Int)	Trees with crowns below, but still extending into, the general level of the canopy. The crowns are usually small and quite crowded on the sides.
4. = Overtopped (O)	Trees with crowns entirely below the level of the canopy.

Figure 3.10 Crown Classes.

Height Sample Measurements

Tree heights will be measured from the ground on the high side of the tree. The total height of lodgepole pine and broad leaf species is measured to the highest point of the crown, not at the point where the main bole commences natural forking. In general, the lower the reading, the more precise the measurement so try to keep the reading below 100 percent. The most important aspect of taking a tree height is seeing clearly to the top and breast height or bottom of the tree.

Consideration must be given to:

1. Slopes: trees standing adjacent to each other for comparison may not be on the same horizontal plane (i.e., uphill or downhill).

2. Regeneration and underbrush.

3. Tree length of leaning trees must be measured if they lean more than 10 (ten) degrees from vertical.

Paint an "S" on the sample tree facing the direction that the sample tree height was measured from, and must be measured at a 90 degree angle from the direction of the lean.

3.5.4 Diameters

3.5.4.1 High Side

High side is defined as the highest point of the ground around the base of the tree. Kick aside any loose litter and debris. If obstacles obstruct the base of the tree at the high side, measure the DBH from the high side of the ground and *not* from the top of the obstacle.

If high side is lower than the point of germination (POG), then measure DBH from the POG.

If the lower portion of the stem has sweep, pistol grip or the tree is on the ground, then measure DBH along the curve and parallel to the centre line of the tree.

3.5.4.2 Diameter at Breast Height

The diameter of all trees of minimum DBH and larger specified in Chapter 6 will be measured with a diameter tape at a point 1.3 m (DBH) above the high side (see Figure 3.11). Diameter will be measured and recorded to the nearest 0.1 cm. Paint a line at DBH, preferably facing plot centre.

A tree that is forked below DBH will be measured as two trees. If the diameter tape can not be wrapped around the circumference of the tree at DBH because the forks are too close together, then measure the diameter at the nearest opportunity above the fork and adjust for DBH accordingly. Note on the tally card that the diameter has been estimated. Refer to Figure 3.14.

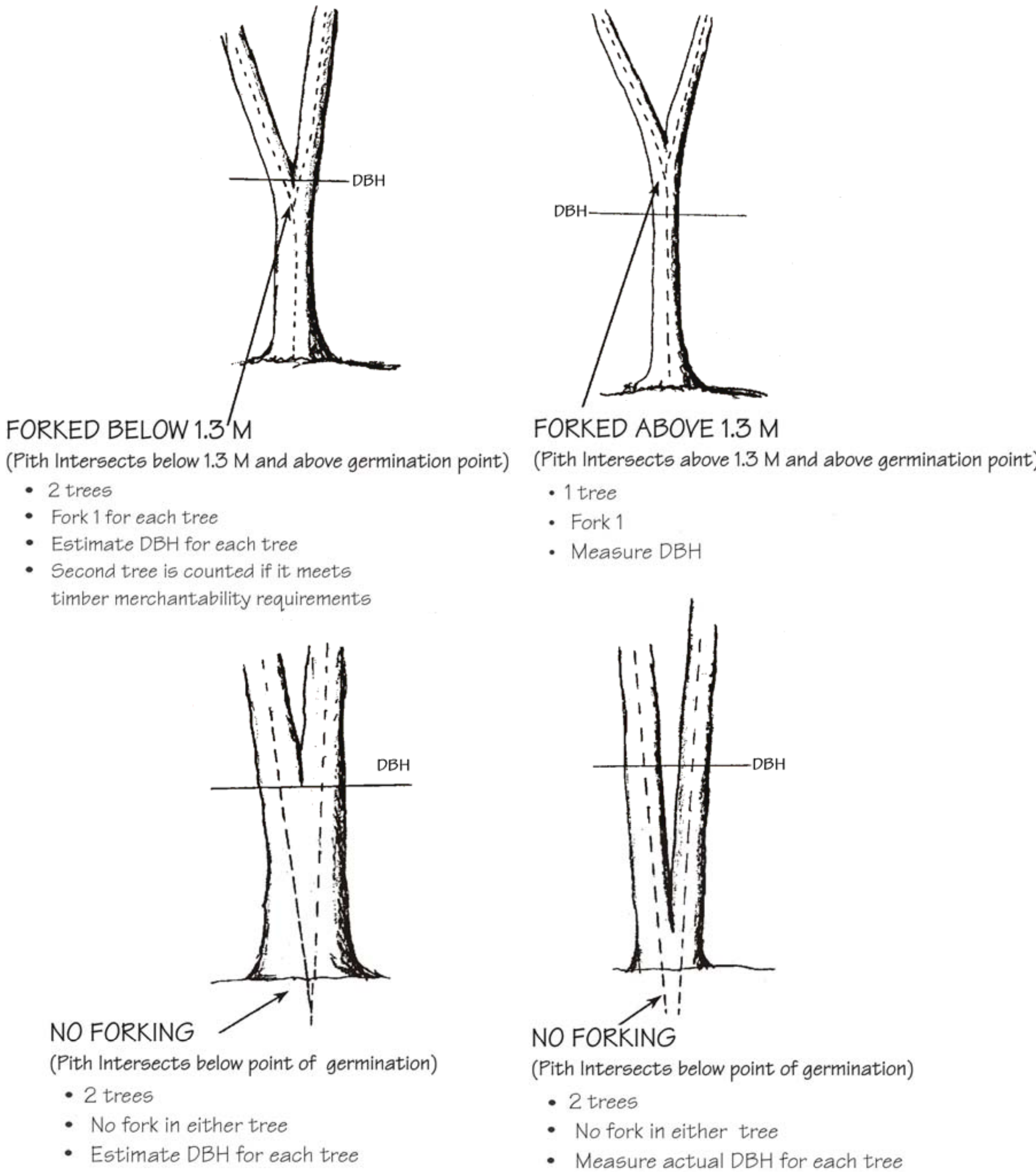


Figure 3.11 Two Trees or One.

Also see Section A.4.2.4 for details regarding forks and crooks.

A tree that is forked at or above DBH will be measured as one tree. If there is swelling at DBH due to the fork, measure the tree at the nearest available location and estimate the diameter at DBH. Note on the tally card that the diameter has been estimated.

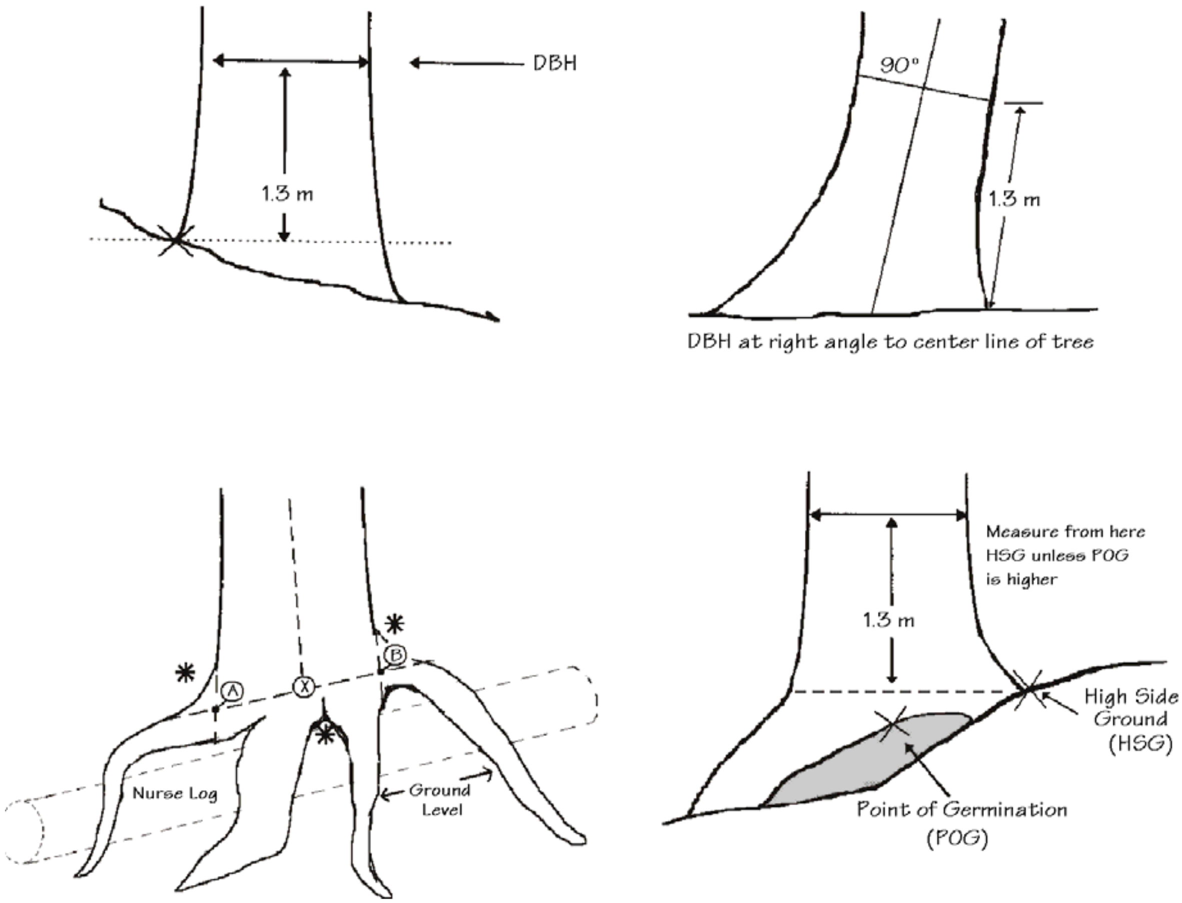
If there are burls, galls or swelling obstructing a normal taper measurement for a tree at DBH, then measure above and below the abnormalities and estimate the diameter from the two measurements. Note on the tally card that the diameter has been estimated.

Do not make allowances for missing bark at DBH.

DBH must still be established at 1.3 m from the high side ground when there is snow on the ground.

Trees or logs that have been cut into pieces or that have had pieces removed will be measured if 50 percent or more of their gross volume is still on site. Measure DBH 1.0 metres from the butt end of the log. The tree height will be measured or estimated from the butt end of the log to the top plus 0.3 metres to allow for a stump height.

The plot radius for the logs will be measured to their DBH using the same method as for uprooted trees (see Section 3.4.1.4). Compile these areas as separate treatment units and timber types if the area is greater than or equal to 1.0 hectares.



High side location when POG clearly above ground level, nurse logs/stumps, hummucky/rocky ground, erosion and upturned stumps.

X POG defined by the midpoint of the low root centre and a transect line to the midpoint of the highroot centre.

A to B The POG is the point where this transect line intersects the pith.

✳ Indicates incorrect locations for highside and POG on this tree.

Figure 3.12 DBH in Relation to High Side.

3.5.5 Pathology

Pathological indicators are recorded when observed on the bole or a merchantable secondary leader (see Section A.4.2) of the tree. The exceptions are *Phaeolus Schweinitzii*, which will occur on the ground near the base of the tree and scars on the root collars. There are qualifications to many of the suspect characters such as age of scars, position of fork or crook, size of rotten branches, etc (please refer to Appendix 4, for a detailed description of pathology).

3.5.6 Tree Classes

All living and dead trees must be given the appropriate tree class code numbered from 1 to 9. It is essential that every tree be viewed from all sides before classification as Residual or Suspect.

> Refer to Appendix 4 for diagrams and further information about residual and suspect trees.

Use the following age in 10s and tree class combinations:

Interior	Enter 11 for the Age in 10's on the cruise tally card type 9. The tree classes will be coded as follows: Older immature – tree class 1 Older immature - Suspect – tree class 2 Older Imm. Dead Potential – tree class 3 Dead useless – tree class 4 *Mature – tree class 5 Live Useless – tree class 6 *Mature-Dead Potential – tree class 7 Younger Immature – tree class 8 Younger Imm. Dead Potential – tree class 9 * = except FIZ K and L Aspen and Cottonwood - see Table 17
Coast	Use the same coding as above for younger and older immature stands if there are not any trees older than 120 years old in a plot. If there are trees older than 121 years old in the plot then refer to Section 9.1.5.7 for details regarding the age in 10s and tree class reporting.

Refer to the tree class modification of Loss Factor Tables at the end of Table 17 for the age in 10s and tree class combinations when combining plots cruised before April 1, 2003 with newer cruise plot data.

3.5.6.1 Tree Class 1 (Older Immature)

These are living trees with none of the eight external pathological indicators.

3.5.6.2 Tree Class 2 (Older Immature)

These are living trees containing one or more of the following eight external pathological indicators of decay:

Conks, Blind Conks, scars, fork and/or pronounced crook, frost crack, mistletoe (trunk infection), rotten branches, dead or broken top.

All pathological indicators must be recorded for each tree where they occur in order for the computer to properly assign the appropriate loss factor. Tree classification will be made on the basis of the above signs of decay only. See "Metric Diameter Class Decay, Waste and Breakage Factors" for the specifications of Risk Groups and Table 18 for risk group assignments by pathological indicators.

3.5.6.3 Tree Class 3 (Older Immature Dead Potential)

Dead standing or down timber which is estimated to contain at least 50 percent of its original gross volume in sound-wood content. All dead potential standing and down trees must be tallied.

Trees with green and/or red needles are considered live trees and will be classified based on pathological indicators. Standing or windfall trees with grey or no needles will be considered dead trees; except however for mountain pine beetle attacked lodgepole pine where a tree with less than 5% red needles will be considered dead.

Down stems in this class will be determined as "in" or "out" by measuring from DBH on the tree where it lies to the plot centre (see Section 3.4.1.4, Leaning or "Down" Trees). For net merchantable volume compilation, dead potential stems will have the highest Risk Group factor for that particular species except Lodgepole Pine which will use Risk Group 2 Loss Factors.

The 50 percent or more firmwood rule is the key consideration. Consider the resistance to decay of the species and the local climate (refer to Table 19 for the Sound Wood Factors for saprot and formulas to assist in the determination of 50 percent soundwood content).

Decay should be determined at various intervals on the tree. Tables are available to estimate cross-sectional area of decay. For example, the outer one-third of a tree represents one half the volume. Also, the bottom third of a tree contains approximately one half of its volume. Other tables are available which show the percentage of volume of the tree in each 10 m log. By estimating percent firmwood in each 10 m log, the firmwood percent of the tree can be determined.

1. Dead Standing

Decay percent is difficult to assess on standing trees, "Sounding" with an axe or equivalent implement can be helpful. Before sounding, look for overhead hazards that may be dislodged.

2. Dead Down

   Good judgement must be exercised in applying tree classes to down material. Since some species are more resistant to decay than others, decisions will therefore be influenced by the tree species involved as well as by local climatic conditions. C, Cy, F, S, P and L are the most decay resistant species and are less likely to exhibit extensively sloughing bark and conks. Other species exhibiting these characteristics are more likely to be "Dead Useless". However, it should be remembered that in drier areas, dead and down Pl and Py may be entirely bark-free yet still be relatively sound.

Pathology is required on all dead potential trees on the coast and dead potential hemlock and white pine in the interior for use in the log grade algorithms.

The only exception to the green and/or red needle rule is for *abies lasciocarpa* in the Interior, where the following guidelines will apply:

Indications – One or More Must be Present

1. Sap-rot and/or,
2. Deep checking and/or,
3. Loose or shedding bark.

Contraindications – None can be Present for Tree Classes 3, 7 and 9 Trees

1. Live Cambium.
2. Green needles.
3. Pitching that is on the end of a log or on exposed wood and not under the bark.
4. Live bark beetles are present.

If there is any doubt after applying the indicators and contraindicators, then the tree will be classified as green.

3.5.6.4 Tree Class 4 (Dead Useless)

Dead standing trees that have less than 50 percent of their original gross volume in firmwood content or otherwise fails to meet the criteria of a dead potential tree as described in Section 3.5.6.3 will be classified as "dead useless" trees. Only dead useless standing trees will be tallied (dead useless down trees are *not* tallied). Dead useless trees are considered standing if they are leaning into another tree. Dead useless standing trees will not be compiled for volume, but along with Live Useless trees, provide a record of snag density in the stand for appraisal purposes. Only trees equal or greater than 3 m high and equal or greater than the minimum timber merchantability specifications must be tallied. Estimate their actual observed height and the original DBH, not an estimate of the stems original height.

3.5.6.5 Tree Class 5 (Mature)

A mature conifer tree is defined as any tree over 120 years old. A mature deciduous tree is defined as any tree over 40 years old. The exceptions are:

a. Aspen and Cottonwood in FIZ K and L where tree classes 5 or 7 will be used for trees 141 years and older,

b. Coastal cruises where there are trees between 121 and 140 years old, then tree classes 5 and 7 will be used for trees 141 years and older.

A reasonable number of mature ages should be sampled along with the age drilling of the main stand component.

3.5.6.6 Tree Class 6 (Live Useless)

Live Useless trees are trees that have only one or two live limbs. They are combined with TC 4 for the compilation of percent snags. This tree class must not be confused with a Tree Class 2 tree, which has a high proportion of rot due to conk.

Cedar and Cypress	The tree must be almost completely rotten or hollow with just a thin shell of sound wood remaining. The low proportion of sound wood must be obvious (i.e., rotten or hollow knots, and large open scar).
Hemlock, Balsam, Fir, Pine & Spruce	The tree must be broken off in the lower or middle thirds (i.e., at least the top third must be missing) with only a few live branches and almost completely rotten or hollow.

3.5.6.7 Tree Class 7 (Mature Dead Potential)

This class is a combination of Veteran and Dead Potential so that the correct loss factor tables are applied in the compilation. The guidelines for TC 3 and TC 5 apply. Dead potential Lodgepole Pine will use Risk Group 2 loss factors unless the tree has conk or blind conk then it will use the highest risk group.

3.5.6.8 Tree Class 8 (Younger Immature)

Younger immature coniferous trees (except Lodgepole Pine) are trees up to and including 80 years of age and Lodgepole Pine are trees up to and including 60 years of age. Younger immature deciduous trees are trees that are up to 20 years of age. When cruising FIZ K and L Aspen and Cottonwood, tree class 8 will be trees that are up to and including 80 years of age.

On the Coast, when the age in 10s is 13 or 14, tree class 8 trees will be trees up to 120 years of age.

3.5.6.9 Tree Class 9 (Younger Immature Dead Potential)

This class is a combination of Immature and Dead Potential so that the correct loss factors are applied in the compilation. The guidelines for TC 3 and TC 8 apply.

3.5.7 Quality

Stem quality information forms the basis for a computerized grading system. Quality remarks are also used for the experimental interior Douglas Fir quality and the interior log grade algorithms (refer to Appendix 7). They are recorded when observed 30 cm or more above the high side of the tree. This data collection is currently optional in the interior.

The quality class information will be collected on all commercial living and dead potential trees (refer to Chapter 6, Positions 45-51, required on the coast for immature, partial harvest cutting authorities, woodlots, Small Business Forest Enterprise Program Timber Sales).

3.5.8 Damage Codes

Standard cruising methods as outlined in Chapter 6 and Appendix 6 of the *Cruising Manual* are to be followed.

Damage codes are to be used when damage is identifiable.

Code the trees as they appear at the time of the cruise with no attempt to guess what the future condition of the trees will be.

3.5.9 Ages

Ninety-five percent of all trees must be in the correct age class. Sufficient trees must be bored for age to ensure the correct maturity classes, except Lodgepole pine where the inventory age will be used to determine the correct age classes. The number of trees that need to be drilled will be dependent upon the maturity profile in each plot.

For over mature stands, the establishment of age is not critical except for interior cedar over 141 years as it requires a different top diameter for compilation.

The age in 10s on the Cruise Tally Sheet is required for all measure and count plots. This age is used in each plot to assign the correct loss factor table, determine maturity and for stratification.

It is important that height as well as age be taken on each age sample tree because the height is used to estimate the years to boring height to obtain total age.

The age correction to Dbh is found in Appendix 9.

Age of sample trees is determined by a ring count from an increment borer core, taken at diameter breast height (DBH).

The pith must be included in at least half the sample tree cores on each plot. In cases where the pith is not contained in the core, and is missed by an estimated three years or more, the tree must be rebored.

"Age bored at 1.3 m must be accompanied by a sample tree height. The Site Index is then determined by using the bored height age (1.3 m trees above high side) and the height of the sample tree. The Total Age of the Age Sample Tree is determined by adding the boring height age to the years to boring height (as determined by the Site Index)."

Tree class 3, 7 and 9 trees – record age as counted and corrected. Do not add the number of years that the tree has been dead.

Use the following procedure for determining the tree classes for interior Lodgepole pine (PL):

- Overlay the most recent Forest Cover Inventory or Vegetation Resource Inventory (VRI) polygon coverage on the cruise plan map.
- Identify the projected age or the age class code for each overlaying polygon. The projected age can be retrieved from the Vegetation Tab in Mapview or from the licensee forest cover mapping system. The age class codes can be retrieved from the most recent TFL or WL inventory maps. Refer to the age class code from the table below to determine the corresponding age range.

Mapview Link

- The age of each interior Lodgepole pine tree tallied in a plot is the projected age or the corresponding age of the inventory polygon in which the plot is located.

Code Age	Age Class Limits	Allowable Tree Classes
1	1 to 20 years	8, 9
2	21 to 40 years	
3	41 to 60 years	
4	61 to 80 years	1, 2, 3
5	81 to 100 years	
6	101 to 120 years	
7	121 to 140 years	5, 7
8	141 to 160 years	
9	250 + years	

Note: Tree Classes 4 and 6 are allowed for all age classes.

Examples of determining PL tree age and tree classes:

1 - Mapview

The polygon projected age is 125 years old. Therefore, the PL trees in the plots in the polygon are classified as mature tree classes 5 or 7.

#2 - Tree Farm Licence

The polygon age class is 4, which corresponds to 61 to 80 years. Therefore, the PL trees are older immature tree classes 1, 2 or 3.

3.6 Check Cruising

If requested by the Ministry of Forests and Range for checking purposes the licensee or consultant shall submit the originals of all the cruise tally sheets, cruise map and traverse notes. All required fields on the cruise tally card must be completed if a cruise compilation check is performed. If magnetic data is requested it must contain the Map Area Statement completed as per Chapter 7, the percent reduction data and followed with the tally sheet listed in numerical order, and shall be submitted electronically in ASCII format.

3.6.1 Data Replacement and Responsibility for Data

All cruise tally cards must be signed and dated by the original cruiser and as appropriate the check cruiser.

Any changes made to plot card data after the original cruise must be initialled and dated by the person making the change.

Any data that was changed must be reflected in the appraisal compilation.

If a re-cruise has been performed, then the cruiser will mark the date that they re-cruised the plot on the reference tree.

A field or compilation check does not preclude a check cruise at a later date by Ministry of Forests and Range staff.

3.6.2 Objectives of Check Cruising

The purpose of check cruising is to verify that field observations and measurements were taken and noted correctly. Checking includes traverse notes, compass notes and tally sheets.

Certain guiding principles will be the basis for all aspects of cruising:

1. All measurements shall be accurately and carefully taken. Personal bias must be eliminated and each classification determined fairly and honestly.

2. Magnitude of sampling errors should be calculable.

3. All measurements must be made with instruments of proven accuracy, and they must be calibrated regularly.

The field check should be performed while the production cruisers are on site provided that an acceptable cruise plan was submitted to the appropriate district office at least 30 days in advance of the commencement of field work. The licensee and cruising agency must be given the opportunity to attend the check and should be given at least ten working days notice unless the cruisers are on site.

3.6.2.1 Risk Management

The risk management principles for check cruising include emphasizing check cruising on parameters that have significant impact in the appraisal. The following parameters should be checked:

1. Check the greater of:

    a. Ten percent of the cruise plots in the cruise.

    b. Five measure or four measure and two count plots.

    c. Twenty trees, including their heights and diameters.

2. Randomly select plots to check each cruiser’s work.

3. Compare the cruise plan map with the cruise strip traverse notes and the final cruise map to verify that the timber type lines and cutting boundaries are correct. Verify that the cruise plots used in the compilation are not within wildlife tree patches (WTP) and non-forest areas, and that these areas are mapped according to the traverse notes. It is important to determine the reason for the addition or deletion of all cruised plots. If the placement of wildlife tree patches (WTPs) causes a cruise plot to be deleted, and it appears that the location of the WTP is not environmentally sound, an explanation by the licensee is required. It is recommended that a written explanation be obtained defending the location of the WTP.

4. At least one plot interval distance check per cruiser.

5. Emphasis in the plot measurements must include tree count, trees species, tree heights risk groups, diameters at breast height (DBH), and plot slope.

6. Boundary and type-line checks will contribute the equivalent of three cruise plots to the check cruise for each one-half day spent checking boundary and type lines.

The following should be used in establishing check cruising priorities:

1. Cruiser's past performance,

2. Cruiser's experience,

3. High value timber (as determined by species selling prices in the Coast Appraisal Manual or Interior Appraisal Manual),

4. Licensee's Allowable Annual Cut in the district.

Upon request, a copy of the Ministry of Forests and Range check cruise comparison shall be submitted to the licensee or consultant in a format acceptable to the Regional Executive Director or their designate.

Check cruising is required for all cruise based sales.

3.6.3 Allowable Non-Sampling Errors

Any one of the items listed in Section 3.6 can lead to either the remeasurement of the entire cruise or the specific parameters that were exceeded. Any changes to a cruise plan must meet the intent of Section 2.1.1 Cruise Plans.

These standards are defined as the maximum allowable measurement error or variation in any measured quantity before such a measurement is considered to be incorrect. Individual standard parameters are to determine whether bias has occurred or not. When an item has a *two part standard*, both parameters must be exceeded before the item is classed as incorrect.

The individual items to be checked and the acceptable limits of error are:

3.6.3.1 Tree Data

1. **Number of Stems**:

   a. Fixed Area and Prism Plots - not more than plus or minus 1 stem in 50 trees checked from the true number for all plots checked (measure and count-plots).

   This tolerance (1 stem in 50 trees) is to be applied as follows.

Trees Checked	Allowable Error
1 to 50	plus or minus 1 tree
51 to 100	plus or minus 2 trees
101 to 150	plus or minus 3 trees

   b. The stem count will include all merchantable trees except live useless or dead useless trees in this check parameter,

   c. all borderline trees must be checked by actual measurement from the plot centre and measurement of the diameter to determine whether the tree is "in" or "out",

   d. all borderline trees are to be measured as per Section 3.3 and 3.4 of the *Cruising Manual*,

   e. if the borderline “out” tree has not been measured and found to be "in" on the check-cruise it will be counted as a "missed" tree,

   f. if the borderline “in” tree has not been measured and found to be "out" on the check-cruise it will be counted in the incorrect stem count,

g. if the borderline 'in' or 'out' tree has been measured it will be accepted, provided that the original plot radius calculated for the tree does not exceed one (1) percent variation from the check plot radius and the original horizontal distance determined for the tree does not exceed one percent variation from the check horizontal distance, and

h. tree diameters at breast height of 12 cm (coastal immature), 12.5 cm (interior Lodgepole Pine), and 17.5 cm are allowed 1 percent variation in diameter at breast height.

> Dead useless and live useless tree counts are a check cruising item for interior appraisal cruises for snag percent. One in fifty trees are the maximum tolerance.
>
> Trees incorrectly identified as dead potential versus dead useless or live useless versus live potential contribute to an incorrect stem count. If safe to do so, dead potential trees should be chopped into at three or more locations to verify percent sound wood content and the calculations shown on the tally sheet.

2. **Species Identification:** the tolerance for species variations is 1 in 50 trees checked excluding tree class 4 and 6 (useless) trees.

Number of Trees Checked	Number of Species Errors Allowed
1 to 50	1
51 to 100	2
101 to 150	3

3. **Heights:**

a. any intentional bias to tree height measurements will result in rejection,

b. use a clinometer and measuring tape or an electronic measuring device to check all tree heights. The accuracy of electronic measuring devices must be demonstrated prior to the commencement of check cruising if they will be used for the true height, and

c. a minimum of 20 tree heights must be checked. If the total cruise does not have 20, then check a minimum of 50 percent of the heights.

All Tree Heights - Average absolute variation must not exceed 5 percent.

Original – Height (m)		Check – Height (m)		Difference – (m)
40.0		42.0		-2.0
42.0		41.0		1.0
43.0		44.0		-1.0
46.0		44.0		2.0
Sum	=	171.0		6.0

$$\text{Absolute Variation } = \frac{6.0}{171.0} = 3.51\,\text{percent}$$

4. **Pathological Indicators and Risk Groups:** no more than 10 percent of all trees checked in a cutting authority area can have a risk group change.

5. **Damage Codes:** if they effect the risk group or an appraisal variable.

   a. No more than 5 percent of all trees checked can have an incorrect code, and

   b. Incorrect codes that result in a risk group change will contribute to Section 3.6.3.1, 4.

   c. For assessment of Mountain Pine Beetle Codes on Lodgepole Pine the following standards will apply:

      i) All reclassification of beetle damage codes must be based on field data collection.

      ii) In order to provide the Ministry of Forests with adequate time to perform check cruises, resweep data must be provided to the Ministry at least 10 working days prior to the commencement of any harvest activity, or some other mutually agreed upon time frame. In turn, the MFR must respond to the licensee within that time frame if there are any concerns with the cruise, otherwise the cruise will be considered acceptable.

      iii) In order to check and verify the resweep beetle code data and confirm who performed the cruise, the following information must be made available to the Ministry of Forests and Range: the date(s) the resweep was completed and by whom; and for each re-classified tree, the original damage code and the updated damage code.

iv) Due to the rapid nature of change associated with needle colour attribute versus other timber attributes, beetle code classification will only be counted as an incorrect damage code if the cruisers' code is greater than the code determined by the Ministry of Forests and Range (e.g., the cruiser called a red attack (code 2) and the check cruise assessed the tree as green attack (code 1)).

v) The intent of allowing licensees to resweep for beetle codes is to provide the most recent description of the beetle code damage. As such, the Ministry of Forests and Range check cruise efforts will focus primarily on the correct determination of the beetle code attribute; however if in the general practice of completing the beetle code assessment, the Ministry of Forests and Range becomes aware of other significant inconsistencies with respect to the cruise standards, these issues will be addressed on a case by case basis.

6. Ages: Refer to Section 3.5.9.

a. The age in 10s and tree classes must result in the correct application of the loss factors consistent with the Tree Class Modification of Loss Factor Tables at the end of Table 17. The original and check cruiser must agree on the maturity class of the trees upon review of the drilled cores.

b. Ninety-five percent of all trees, except Lodgepole pine must be placed in the correct immature and mature class for loss factors,

c. The inventory types will be used to adjudicate the correct age class assignment for interior PL trees.

d. Coast - age in 10s of 13 and 14 - all tree classes must be verified since tree classes 1, 2, 3, 8 and 9 contribute to the percent second growth reporting (see Section 9.1.5.7).

7. Breast Height: when this limit is exceeded, the true position is used for a. and b. below. The height of the diameter-line marked at breast-height must not exceed plus or minus 5 percent (plus or minus 6.5 cm) from the true breast-height of 1.3 m above high side.

Diameter at Breast Height (DBH)			
•	All live and dead potential trees as measured with a steel or equally accurate DBH tape.	a. b.	At least 90 percent of individual stems checked must be within 2 percent of true DBH. Average absolute variation of all DBHs checked must be within plus or minus 2 percent.
•	DU trees can be estimated.	a.	Estimate to the nearest 5 cm class.

8. **Strip Lines or Tie Lines to Prism or Fixed-area Plots:**

Plus or minus 2 percent of horizontal distance.

Bearing-strip to strip or plot to plot and plot centre reference:

Plus or minus 2^{o} - this translates to 3.49 m in 100 m using the formula:

$$(100 * (\tan 2 \text{ degrees})) = 3.49 \text{ percent}$$

Therefore, 3.49 percent * 100 m = 3.49 m.

Plot centre reference tree	Plus or minus 1 percent of horizontal distance
Radius - fixed area plots	Plus or minus 1 percent of horizontal distance
Radius - prism plots	Plus or minus 1 percent of horizontal distance
Length and width: fixed rectangular plots	Plus or minus 1 percent of horizontal distance

Boundary Traverse	**Cruise-Based**	**Scale-Based**
Closure error	Plus or minus 0.7 percent	Plus or minus 1 percent
Area error	Plus or minus 1 percent	Plus or minus 1.5 percent
Inter-station distance	Plus or minus 1 percent	Plus or minus 2 percent

3.6.3.2 Quality (Coast) - as they affect grade

1. **Pathological indicators:** 90 percent of the individual indicators that occur in the middle or lower third must be coded in the correct third.

2. **Quality indicators:**

   a. by Check Plot – greater than or equal to 90 percent of all quality indicators checked must be within plus or minus one code change.

   b. for All Check Plots – greater than or equal to 90 percent of all quality indicators checked must be within plus or minus one code change. The exceptions are:

      - knot codes 5 and 6 must be correct or they contribute to the number of incorrect codes, and

      - Spiral Grain – if the check code is greater than 4 and the original is less than 5, or vice versa, then it is an error. Codes 5 to 9 will generate Y-Grade in all cases.

3.6.3.3 Slopes

3.6.3.3.1 Slope:

1. **Plots:** ≥ 90 percent of the individual plots checked must be within plus or minus 5 slope percentage points of the slope measured by the check cruiser.

   A flagging tape tied at 15 m slope distance from plot centre at the steepest ground with the plot slope written on the flagging tape is recommended to assist in the check cruise process.

2. **Block or Cutting Permit**: the average variation of all slopes checked must be within plus or minus 5 slope percent.

3.6.4 Allowable Non-Sampling Errors - Original Versus Check Plots

Compile original and check plots as separate cruises on the most recent cruise compilation software.

3.6.4.1 Net Volume Standard

The following standards may be used to adjudicate marginal pass/fail check cruises. This section is not used if the other check parameters are clearly exceeded.

	Allowable Error
1. Individual checked plot volumes	• ≥ 90 percent of the individual plot volumes must be within 7 percent of their true plot volume. This means that for 10 plots, only 1 may be 7 percent or more out. For 5 plots, none can be exceeded. Each plot must have a volume calculated for the original and the check data. Use a valid cruise compilation program and apply a one-hectare area. The plot pairs are then compared for net volume.
2. Total volume for all checked plots	• Average variation must be within 5 percent of true plot volume as determined by the check- cruiser. A minimum of 5 plots is required. The variation between the original plots and the check plot is calculated. The average variations are then calculated. The pluses cancel the minuses.
3. LRFs (Interior only)	• LRF must be plus or minus 1 percent of true LRF for all plots checked.

> Any one of the foregoing items, if outside the permissible measurement standard, are grounds for redoing the work.

3.6.5 Standards for Some Basic Cruise Functions

- Sample location must be sufficiently accurate to enable relocation of the samples at a future date. Fixed-area plots are subject to the standards in Section 3.3,
- adequate records must be kept of all data so that they may be traced to their specific sources for evaluation in their primary or later applications,
- the sampling design must meet the standards of Chapter 2,

- inadequate identification of plot centres, sample trees and strip lines in the field may also lead to rejection of the cruise, and
- forest typing must meet the criteria listed in Section 2.6.3.1 to ensure consistency of forest typing within cut blocks and among multiple cut blocks.

3.6.6 Check Cruising Dispute Mechanism

It is strongly recommended that the licensee and cruiser be present at the check cruise.

Where the licensee and ministry check-cruiser do not agree on aspects of the cruise the following procedure is to be followed.

It is recommended that check cruisers carry digital cameras with them in the field so that they can send digital photos to region, branch and third party cruising staff as a method to resolve disputes.

Step 1	The Ministry of Forests and Range representative (MOF) sends the check cruise results to the licensee within one (1) week of the field check.
Step 2	If the cruise is rejected, the MOF attends the site with the original cruiser to attempt resolution of the dispute if necessary.
Step 3	The licensee submits a written complaint to the District Manager (DM) within 30 days.
Step 4	The DM or designate responds within 30 days.
Step 5	If the licensee appeals the District Managers decision, then the Regional Executive Director or designate must hear the appeal. The licensee must make the application to the Regional Manager within 30 days of the District Managers decision.

Cruise Compilation Procedures 4

Because of numerous field observations, complex compilation requirements and a multitude of final reports for appraisal and operational purposes, the system has been oriented towards electronic computers with the facility to quickly and easily summarize the cruise data for each cutting permit or timber sale. Uniformity in the treatment of this data is one of the primary objectives of the system.

4.1 Input

The map area statement (FS 121) and tally sheet (FS 205) are the ministry format used for collection of cruise data. Cruisers may use their own versions of these forms. However, the ministry format and data sequence must be observed when submitting magnetic data for check compilation purposes.

4.1.1 Cruise Tally Sheet (FS 205)

The Ministry of Forests and Range Cruise Tally Sheet (FS 205) has been designed so that the information from one sample plot can be directly key punched (Chapter 6).

4.1.1.1 Plot Record (Card Type 9)

Each plot record (Card Type 9) is identified by plot location within a timber sale or cutting permit, the forest type where it occurs, the age in 10s which determines the loss factors based on tree classes assigned in the plot and the height of the co-dominant and dominant trees used in Loss Factor Table 0296. Loss Factor Table 0296 applies to cruises in the Bowron, Longworth, Monkman, Purden and Robson PSYUs for mature red cedar. The height in metres in Card Type 9 is not a check cruise item in any other PSYUs. Also recorded in Card Type 9 are the plot type, plot size or BAF, full or border plot designation, minimum DBH, harvesting method and plot slope percent (Section 6.3.1).

4.1.1.2 Individual Tree Records (Card Type 2)

Individual Tree Records (Card Type 2) show species code, DBH, tree class, pathological and quality remarks (Section 6.3.2).

4.1.1.3 Sample Tree Details (Card Type 3)

Sample Tree Details (Card Type 3) include species code, DBH, crown class and measured height and ages (Section 6.3.3). This information is required for all stump cruises and any damage cruises that require height/diameter curves.

4.1.2 Map Area Statement (FS 121)

This form provides area information, cutting specification and height/DBH method for the cutting permit or timber sale (Chapter 7).

4.1.2.1 Cruise Identity (Card Type A)

This card establishes the location and describes the nature of the cutting permit or timber sale (Section 7.1).

4.1.2.2 Compilation Standard (Card Type B)

This card defines the standard of compilation and the output required for the sale (Section 7.2).

4.1.2.3 Type Description (Card Type C)

This card contains the type description and silviculture treatment units along with the type number which corresponds to that on the record for every stratum in the cutting permit or timber sale (Section 7.3).

4.1.2.4 Block Description (Card Type D)

The sampling plan is made on the basis of the timber sale or cutting permit which may consist of several sub-units, namely blocks or settings. This card allows the printout, if desired, by species of the net volume for each type in the sub-unit block (Section 7.4).

4.1.2.5 Height/DBH Description (Card Type E)

This card allows the amalgamation of sample trees for the same species in 2 or more types. Minor species should not be amalgamated. The 100 percent height method must be used. If a species for a given type has sufficient sample trees (see Section 3.5.3) or if a local height/DBH curve is provided, this card need not be used but if a species does not have sufficient heights then this card must be used to designate how the heights for each sample tree (Card type 2) will be calculated (Section 7.5).

4.1.2.6 Harvesting Method Description (Card Type F)

The sampling plan is made on the basis of the timber sale or cutting permit which may consist of several harvesting methods.

4.1.2.7 Silviculture Treatment Unit Description (Card Type G)

The treatment units are user coded so that reports are titled by the user definition.

4.2 Compilation Programs

4.2.1 Height-DBH Relationships for Stump Cruises and Severe Damage Timber Cruises

Height-DBH relationships (curves or equations) by species must be used to determine the height for local conditions. Careful height measurement to the nearest 0.1 m and diameter measurements to the nearest 0.1 cm must be made on at least 20 sample trees of each major species in each type included in the cruise. Each major species must have its own curve. If minor species are present (refer to Section 8.4.3).

4.2.1.1 Height-DBH Regression Program

This program uses the height sample trees only to calculate regression constants, standard errors of the estimate for height and volume and the bias for both height and volume for the following equations.

1. Parabola $H=a+bD+cD^2$
2. Conditioned Parabola $H=1.3+bD+cD^2$
3. Hyperbola $a + \frac{b}{D} + cD$
4. Conditioned Hyperbola $1.3 \quad \frac{bD}{(D+1)} + cD$
5. Weibull $H=a* \; 1.0 \; e^{(\; b*D^c)}$
6. Conditioned Weibull $H=1.3+a* \; 1.0 \; e^{(\; b*D^c)}$

Where a, b and c are regression constants:

- e is the base of the natural logarithm,
- H is Total height, and
- D is DBH.

The program selects for the particular set of height sample trees under consideration, the equation which provides the lowest standard error of the estimate for volume. At this point the user has the option to override the computer selection and insert one of the other equations if the equation selected does not on inspection meet the requirements of fit over the range of DBHs.

If the curve with the lowest standard error generates a negative height at 10 cm DBH, the next best curve shall be selected.

Limitations:

1. There must be twenty height sample trees before the constants can be calculated for an equation.
2. The program will only automatically calculate the height sample trees for a particular type. It will not group height sample trees into one equation for like species on the same site from another forest type unless Card Type E is coded with those instructions (see Section 7.5).

4.2.2 Volume and Taper Equations

The 1994 Kozak taper equations Version 4.1 are used to predict log diameters within each tree. These equations are a subroutine in the cruise compilation program.

The information necessary in this subroutine:

1. Species Code

1	=	F
2	=	C
3	=	H
4	=	B
5	=	S
6	=	Y
7	=	Pw
8	=	Pl
9	=	Py
10	=	L

11	=	Ac
12	=	D
13	=	Mb
14	=	E
15	=	At
16	=	Pa

2. Forest Inventory Zone.

Zone	Code
A, B, C	1
D, E, F, G, H, I, J	2
K, L	3

3. DBH - diameter at breast height (high side) outside bark (nearest 0.1 cm).
4. HT - Total height (nearest 0.1 m).
5. SH - Stump height for timber merchantability specifications (nearest 0.1 m).
6. TD - Top diameter for timber merchantability specifications (nearest 0.1 cm).
7. GOL - Log length for log breakdown. In the interior of BC the lumber recovery factors are based on 5 m logs.

Information provided by this subroutine:

1. Number of GOL metre long logs plus one short from the top of the tree.
2. Volume for each log (1, 2, etc.).
3. Top diameter inside bark for each log.

4. Length of top log.
5. Butt diameter inside bark of first log.
6. Total volume between stump height and top diameter.
7. Total volume between ground level and top of the tree.
8. Bark thickness at breast height.

A more complete description of the derivation of this taper equation can be found in the *Canadian Journal of Forest Research* by A. Kozak, entitled "*A Variable-Exponent Taper Equation*", Volume 18, 1988.

4.2.3 Net Volume Factors

The *Cruise Compilation Loss Factor Table Manual* specifies the loss factor tables to be used in the "*Metric Diameter Class Decay, Waste and Breakage Factors*", 1976, Ministry of Forests and Range.

The proper application of the factors is outlined in the preamble preceding the tables. Suffice to note:

1. The factors are generally by species, age and Forest Inventory Zone.
2. Ministry of Forests and Range local factors are published within this book and when available they must be used in preference to the Forest Inventory Zone factor for that species.
3. The age classes to which the loss factors (Forest Inventory Zone or local) apply are shown at the top of each table.
4. The factors usually consist of three Risk Groups, each group containing a percent loss for decay, waste and breakage. Some species may have only 1 or 2 Risk Group factors.
5. The table number of the loss factor used in compilation shall be entered on the output sheet, preferably the Plot Summary.

Standing or down dead potential trees will be compiled using the highest risk group available for the maturity class that the tree is in.

Dead and live useless trees (standing only) will not be compiled for volume but must be recorded as they provide a record of the number of snags per hectare.

In applying the loss factors it must be emphasized that they must be applied individually and in the correct order to the gross merchantable volume of the log or tree.

4.3 Volume Compilation – Fixed-Area Plot Cruising

Total cutting authority area volume will be based on compiling the volume of each plot, as this information is necessary in order to calculate the sampling error of the cruise. If the cutting authority area has been stratified, a total volume for each type will be compiled separately.

Type volume is the average volume (i.e., sum of plot volumes divided by number of plots measured) multiplied by the possible number of plots that could be included in the type of cutting authority area. If volume per hectare is required, this is the average plot volume divided by plot size. Cutting authority area or type volume is then volume per hectare times cutting authority area or type area.

4.4 Log Grade Volume Compilation

The cruise compilation program calculates:

1. For the interior, lumber and chip recoveries for:
   - 5 m logs,
   - stud logs with top diameter less than 20 cm inside bark,
   - small logs are logs with a top diameter of less than 30 cm inside bark, and
   - large logs are logs with a top diameter of 30 cm or more.
2. For the coast appraisal zone, log grade volumes are calculated as per the Cruise Compilation Manual.

4.5 Volume Compilation - Variable-Plot Cruising

In Variable-Plot (prism) cruising, since the radius of the plot varies directly with the diameter of the individual trees being measured, every tree has its own plot size. The area of the plot is directly proportional to the basal area of the tree diameter it represents. Therefore, the relationship of the basal area of one tree to its plot area is the same as the relationship projected to a hectare basis. Basal area per hectare, for a given prism, is the same for every tree regardless of diameter or plot size.

Supporting mathematical calculations are as follows.

For a 5.0 diopter prism:

Basal Area Factor (m^2/ha)	=	6.25
Plot Radius Factor	=	0.2
DBH	=	30 cm
DBH	=	90 cm
Basal Area of a 30 cm tree	=	0.07069 m^2
Basal Area of a 90 cm tree	=	0.63617 m^2

The plot radius for a 30 cm tree = 0.2 x 30 = 6 m. Therefore, a 30 cm tree is counted if it falls within 6 m of the sample point.

The area of 6 m radius plot is 113.098 m^2 or 0.01131 ha, hence there are 88.425 plots per hectare. Therefore, one counted tree represents 88.425 trees per hectare and a basal area per hectare of 88.425 x 0.07069 or 6.25 m^2.

Similarly a 90 cm tree has a plot radius of 0.2 x 90 = 18 m and an area of 1017.878 m^2 or 0.10179 ha. Hence there are 9.824 plots per hectare and one counted tree represents 9.824 trees per hectare and a basal area per hectare of 9.824 x 0.63617 or 6.25 m^2.

In the foregoing example it is shown that each tree regardless of diameter, contributed 6.25 m^2 of basal area per hectare. The Basal Area Factor of the prism used was 6.25. Therefore, total basal area per hectare can be calculated directly by multiplying stem count per point x basal area factor, and this is all that can be calculated directly.

In order to obtain volume per hectare it is necessary to measure DBH on all or some of the samples, and enough tree heights to be able to assign a height to all trees which have been measured for DBH. There are several possible methods of calculating volume per hectare, depending on the method of sampling used and the kind and amount of information required (e.g., total volume per hectare, volume per hectare by species, number of trees per hectare either total, by species or by diameter classes).

4.5.1 Compilation Methods - Using a Single Prism and Full Sweep (360°)

1. A common method of prism cruising is to use the prism simply as a range finder (i.e., to use the prism to determine which trees are to be tallied on the sample). All "in" trees are then recorded by species and DBH and enough sample trees measured for height to permit the derivation of height-diameter relationships (i.e., height -DBH curves or equations). The number of trees per hectare that each counted tree represents is then calculated by first multiplying the plot radius factor times the tree diameter to give the area or plot size each tree with that particular diameter represents and second, by dividing the area of one hectare by the tree's "plot" area.

   Here is the formula for trees per hectare (TPH):

$$tph = \frac{10{,}000 x baf}{\pi\left(\frac{dbh}{2}\right)^2}$$

   The volume of a tree of given DBH and height is determined from a standard volume equation (Newton's) and multiplied by the number of trees per hectare which each counted tree represents (e.g., a prism having a basal area factor of 4, plot radius factor of 0.25) counts one mature fir tree in the Interior (residual) which has a 30 cm DBH and is 21 m tall. Each 30 cm DBH, tree represents 56.59 trees per hectare. The whole stem volume of this tree is 0.525 m^3.

   Therefore, the whole stem volume per hectare represented by this one counted tree is $56.59\,{}^{t}\!/_{ha} x 0.525\,{}^{m^3}\!/_{t} = 29.73 m^3/ha$. It is then necessary to reduce this volume to gross and then net merchantable volume by calculating first the gross volume between stump-height and the merchantable diameter, dib, for the top log to determine the gross merchantable volume and then applying the loss factors for decay, waste 2 and breakage (or, in some cases, decay and breakage only) to arrive at the net merchantable volume.

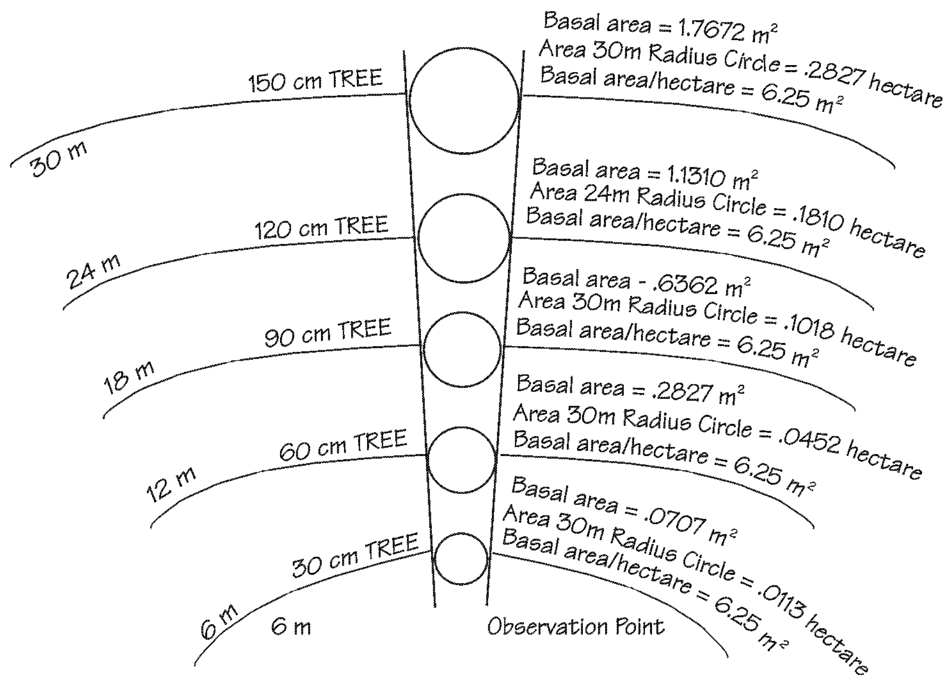


Figure 4.1 Illustration of Basal Area/Hectare.

This figure shows why each tree tallied in a plot, regardless of its diameter, has an equal effect on the basal area per hectare. In this example, a 6.25 BAF (5.000 diopter) wedge prism was used but any BAF or diopter size would still result in equal weighting for each tree.

4.5.2 Compilation Methods - Using 2 Different Prisms And Full Sweep (360^o)

It is important to remember that when two different prisms are used, the trees included by each prism will be handled separately. If compiling is done by determining the number of trees per hectare represented by each counted tree, then care must be taken to use the plot radius factor corresponding to the prism used for each DBH range.

4.5.3 Compilation Methods - Using One Prism With Full And Half-Sweeps

If full sweeps are used, the stem count at each sampling point is converted to basal area per hectare. When half-sweeps are used the stem count at each sampling point is doubled by the computer and then converted to basal area per hectare. Therefore in calculating volume per hectare for trees included by a half-sweep the following procedure is required:

Calculate the plot radius for each tree by multiplying tree DBH by the prism plot radius factor (PRF). The area of the plot calculated from this plot radius is divided into the area of one hectare. This resulting value is the number of trees per hectare that a given tree represents for a full sweep plot (360^{o}). However, when a half-sweep (180^{o}) is used, the number of trees represented by each counted tree are on a half hectare basis and so the resulting number of trees represented by each counted tree must be doubled by the compilation program to bring the answer up to a per hectare basis.

It is important to note that in calculating volume for the trees counted on the half-sweep, the compilation program multiplies the prism BAF used by two, since the prism basal area factor is for one hectare. For example, consider a 30 cm DBH tree counted using a prism with a basal area factor of 4. The plot radius for this tree is 7.5 m and the plot area is 0.01767 ha. However, if the tree is included in a half-sweep the plot area is only 0.00883 ha or the same plot area as for a 30 cm DBH tree included in a full sweep using a prism with a basal area factor of 8.

The computer compilation program makes the appropriate adjustment.

4.5.4 Compilation Methods - Using Count Plots

Where count plots are recorded in addition to measured plots, volumes calculated from measured tree data by species are modified by multiplying each species volume by the total species stem count of the measured and count-plots and the number of measured plots and dividing by the species stem count of the measured plots and by the total number of measured and count plots. Where sample plots have been stratified by timber type, the calculations are made for each type using only the data of measured and count-plots which are located within the type area.

A double sampling ratio (DSR) is calculated to prorate species volumes by timber type when count plots are included in a prism cruise.

Assume a timber type includes two full measure and two count plots using a BAF 10 prism in the following example:

Full meaure plot	#1 - 4 Fir	Total = 9 Fir
Full measure plot	#2 - 5 Fir	
Count plot	#1 - 6 Fir	Total = 8 Fir
Count plot	#2 - 2 Fir	
Total	17 Fir	

$$DSR_{(fir)} = \frac{Number\ measure\ plots}{Total\ number\ plots} \ x \ \frac{Total\ \#\ trees\ for\ species\ x\ Average\ Basal\ Area\ Factor}{\#\ measure\ trees\ for\ species\ x\ Average\ Basal\ Area\ Factor}$$

$$= \frac{2}{4} \ x \ \frac{17\ x\ 10}{9\ x\ 10}$$

$$DSR_{(fir)} = 0.9444$$

4.6 Computer Compilation Output

The cruise compilation shall accurately represent the area and net volume by species, grade, LRF, diameter class, timber type and risk group to be appraised and harvested and shall be compiled on the version of the cruise compilation program in effect:

a. on the date of the appraisal data submission to the Ministry of Forests and Range, or

b. in the case of a changed circumstance reappraisal under the Interior Appraisal Manual requiring a recompilation with an effective date prior to April 1, 2006, use version 2005.01.

The cruise compilation version must be approved by Revenue Branch

> Modifications to the cruise compilation reports utilizing a calculator are not acceptable for initial compilations used in new appraisals. Manual or hand compilations shall only be used in exceptional cases as approved by the Regional Executive Director or their designate.

For cruises compiled by electronic data processing methods, the following basic data will be submitted with the volume compilation for either/or both Coast and Interior timber sales or cutting permits.

4.6.1 Summary of Required/Optional Reports

001a	Edit Report (data listing) of cruise data	Required
001b	Scattergram of all heights and diameters	Required - when used.
003a	Scattergram of sample trees/regression coefficients	Required - when used.
003b	Original scattergram of sample trees/regression coefficients, if suggested curve is over-ridden. Actual keyed values and explanation is required.	Required - when used
004a	Edit Report if height curves used	Required - when used
004b	Double sampling ratios	Required – when count plots used
005a	Percent reduction input values	Required - when used
005b	Cruise Statistics	Required
006	Extended Timber Type Stand and Stock Tables	Required for partial cut
006	Partial Cut Damage Reports	Required if electronic
007	Stand, Stock and Leave Tree Tables	Required for partial cut
008	Volume and Lumber Recovery Information	Required if Interior
009	CP, Type and Block Volume Summaries	Required
011	Detailed Plot Summary	Required
012	Plot Summary by Maturity	Optional
015a	Harvest and all Harvest Method Summaries	Required
015b	Harvest Method Treatment Unit Summaries	Optional
016	Appraisal Summary	Required

Figure 4.2 Required/optional reports.

If percent reduction is being applied, two sets of reports will be required. The original reports before percent reduction applied and the reports after percent reduction has been applied. Also required are the keyed input values for the percent reduction. The source documentation for the partial cutting must be provided to the Ministry of Forests and Range upon request.

The reports can be submitted in hard copy or electronically in portable document (PDF) as required by the Regional Manager or their designate.

4.6.2 FS 221 – Percent Reduction

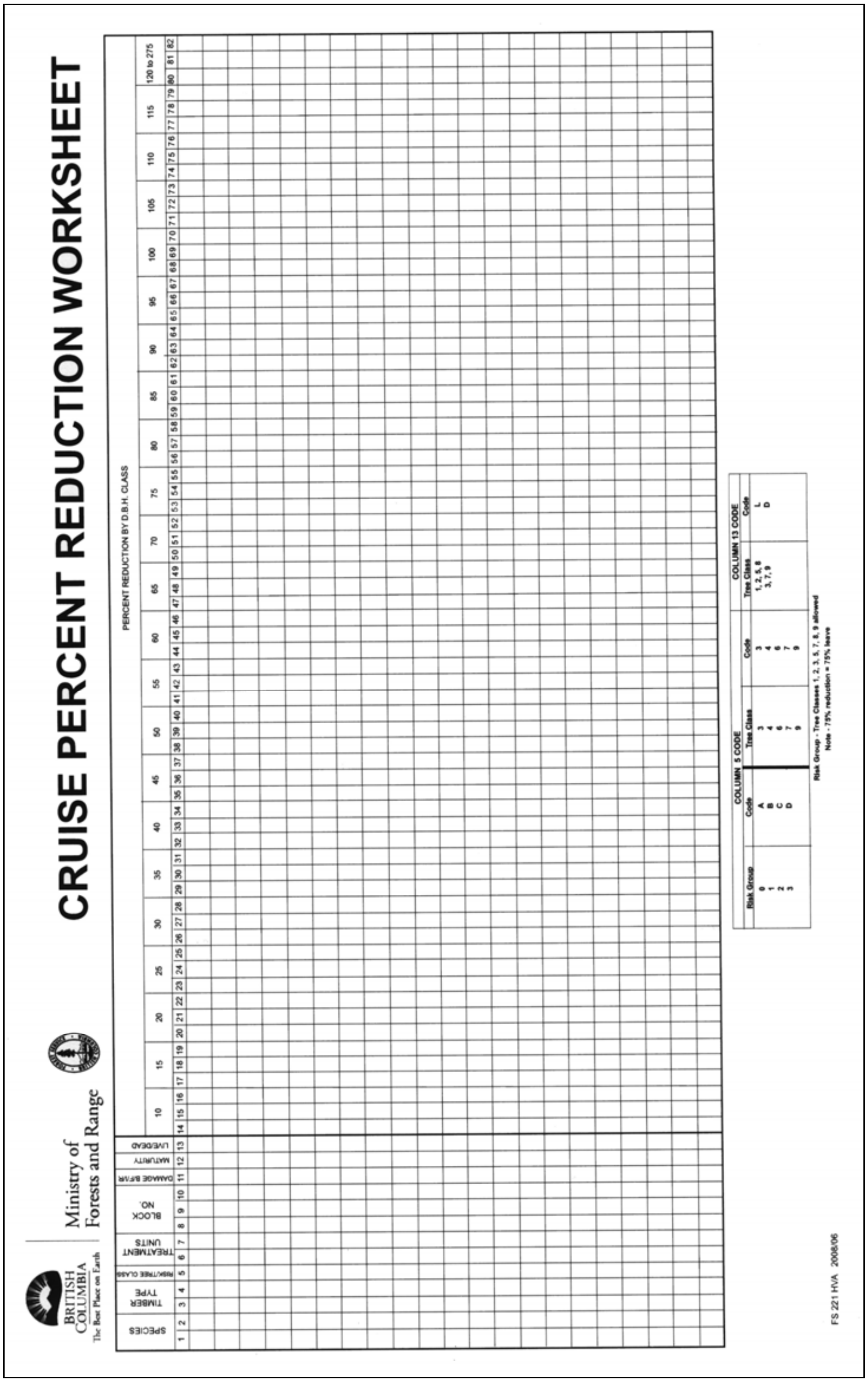


Figure 4.3 Percent Reduction Worksheet.

This form enables the cruising officer to be able to reduce the stems and volumes by percentage points. The reduction can be accomplished by a number of methods when the Forest Type Stand and Stock Table output from FVLCR006 has been analysed. The approved methods of reduction for the dbh classes are:

1. By species, timber type, risk group/tree class and treatment unit.
2. By species, timber type and treatment unit
3. By species, risk group/tree class, mature/second growth *, live/dead *and treatment unit.
4. By species and treatment unit:
   a. Positions 1-2 - Species

      These are the letter codes and all species letters must start in column 1.

      Douglas Fir - use F1 for quality class 1 and F2 for quality class 2. The species columns must be completed unless the reduction applies to all species.

   b. Position 3-4 - Timber Type

      These are the numeric codes of the timber type.

   c. Position 5 - Risk Group or Tree Class

      These are codes with the following breakdown.

Enter	A	Risk Group 0 - Living Trees – not used at this time
	B	Risk Group 1 - Living Trees
	C	Risk Group 2 - Living Trees
	D	Risk Group 3 - Living Trees

Enter	3	Tree class 3 - Dead Potential (Older Immature D.P. in the Interior)
	4	Tree Class 4 - Dead Useless
	6	Tree Class 6 - Live Useless
	7	Tree Class 7 - Mature Dead Potential
	9	Tree Class 9 - Younger Immature Dead Potential

d. Position 6-7 - Silviculture Treatment Units (99 are available) - This is the unit.

e. Position 8-10 - Block Number - This is the block number, code blank if for appraisal.

f. Position 11 - Damage Code - This field corresponds to the damage types – Blowdown = B and includes codes E, G, Fire =F and includes codes A, B, C, Insect = I and includes codes 1 to 8 and X, Y. Root rot = R and includes codes J, K and L. These codes will result in a 100 percent cut of the trees with the appropriate damage type code.

g. Position 14-16 - Percent Reduction for dbh classes (10 cm class = 7.5 - 12.4 cm).

   These are whole numbers only.

   100 percent reduction corresponds to all trees will be retained from harvest.

h. Position 17-82 - Percent reduction for 15 - 275 cm dbh classes.

   See item g.

i. Code "L" for live trees and "D" for dead trees in position 13. These codes allow for all live trees tree classes 1, 2, 5 and 8 or L * or dead tree classes 3, 7 and 9 or D to be “cut trees” in the cruise compilation.

4.6.3 Valid Compilation Programs

The valid compilation programs can be viewed at the following web link:

http://www.for.gov.bc.ca/hva/manuals/cruisecompilation/compversions.htm

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Cruise Analysis 5

5.1 Cruise Statistics

The following cruise statistics are calculated for net volume and basal area for each cutting authority area:

1. Timber Type and Cutting Permit - the average line method is used in all compilations for the calculation of timber type and cutting permit statistics.

    - Mean,
    - Standard Deviation - measured plots only are used in the calculation,
    - Coefficient of Variation - % - weighted by the proportional net volume of the timber types within the cutting permit for measured plots only. Also reported for each species in the cutting permit summary,
    - Standard Error of the Mean - %, and
    - ninety-five percent Confidence Interval - weighted by proportional area of the timber types within the cutting permit. Calculated for measured and all plots. Also reported for each species in the cutting permit summary.

2. Block - the block method uses the average volumes and basal areas for the plots within the timber types within the block. The average line method uses the plots within the timber types.

    - Mean,
    - Standard Deviation - measured plots only are used in the calculation,
    - Coefficient of Variation - % - weighted by the proportional net volume of the timber types within the block for the block method and timber types within the cutting permit for the average line method. Measured plots only are used in the calculation,
    - Standard Error of the Mean - %, and
    - ninety-five percent Confidence Interval - % - weighted by proportional area of the timber types within the blocks.

Since fixed area plots are a sample without replacement, they require an adjustment known as the Finite Population Correction. The factor is multiplied by the standard error of the mean calculation for fixed area cruises. The factor is set to 1.0 for variable plot (prism) sampling.

5.2 Interpretation

The ninety-five percent confidence interval provides a measure of the error due to sampling chance in the volumes reported in a cruise. Provided that there is not any measurement (non-sampling) error, the reported volumes should be within the confidence limits calculated, 19 times out of 20. The calculated volume is assumed to be the correct volume for administrative purposes.

Detailed formula and sample calculations are included in the Chapter 8 of the *Cruise Compilation Manual*.

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Ministry of Forests and Range Cruise Tally Sheet (FS 205) 6

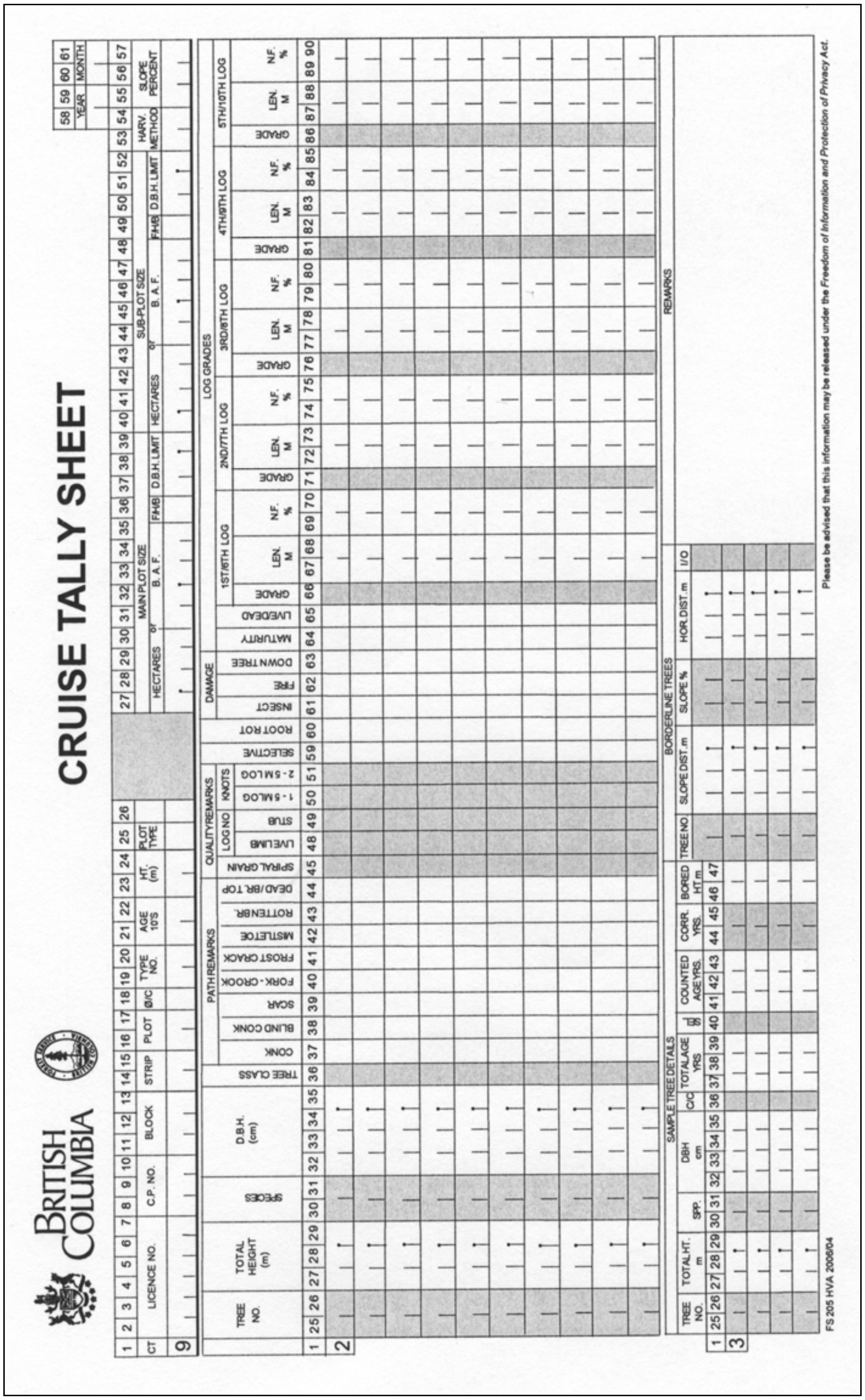
6.1 Form Design - General

All information on the FS 205 is required on all facsimiles of the FS 205, Cruise Tally Sheet.

Measurements taken on samples established in timber sales, cutting permits, etc. will be recorded on a Cruise Tally Sheet that provides the information in this chapter. The front side of the form identifies the plot, records the plot sizes and individual tree measurements while the reverse side provides space for the coding information, remarks and signatures.

Also see the *Call Grade Net Factor Standards and Procedures* for the CGNF tally card details.

Columns 64 to 90 are not required for Loss Factor Cruises.



BRITISH COLUMBIA

CRUISE TALLY SHEET

LOG GRADES

1ST/6TH LOG | 2ND/7TH LOG | 3RD/8TH LOG | 4TH/9TH LOG | 5TH/10TH LOG

SAMPLE TREE DETAILS

BORDERLINE TREES

REMARKS

Please be advised that this information may be released under the Freedom of Information and Protection of Privacy Act.

FS 205 HVA 2006/04

Figure 6.1 Cruise Tally Sheet – FS 205 HVA 2006/01 (front side).

CHECKED BY (PRINT)	DATE Y M D	CRUISED BY (PRINT)	DATE Y M D
SIGNATURE		SIGNATURE (I CERTIFY THAT THIS IS A TRUE STATEMENT OF SAMPLING DONE BY ME AT THE PLACE SHOWN.)	

TREE CLASS (unless Coast age in 10s = 13 or 14)	
1	Older Immature
2	Older Immature - Suspect
3	Older Imm Dead Potential
4	Dead Useless
5	Mature
6	Live Useless
7	Mature-Dead Potential
8	Younger Immature
9	Younger Imm Dead Potential

PATH CODE BY TREE THIRD	1	2	3	4	5	6	7
TOP							
MID							
BOT							

QUALITY CODES

ITEM	CODE	LIMITS
SPIRAL GRAIN	0	0-5%
	1	6-15%
	2	16-25%
	:	:
	9	86 +

ITEM	CODE	LIMITS
SWEEP OR LEAN	0	0-4.9°
	1	5°-9.9°
	2	10° +

KNOT CODE QUARTERS (Q) WITH KNOTS		
0	NONE	
1	ONE Q	5 ONE TO THREE BRANCHES OVER 10 cm
2	TWO Q	
3	THREE Q	6 FOUR OR MORE BRANCHES OVER 10 cm
4	FOUR Q	

CROWN CLASS (CC)	
1	DOMINANT
2	CO-DOMINANT
3	INTERMEDIATE
4	SUPPRESSED

DAMAGE CODES

INSECT CODES

CODE	CONDITION	ALLOWED SPECIES
1	GREEN ATTACK	B, PL, Py, Pw
2	RED ATTACK	
3	GREY ATTACK	
5	GREEN (ALIVE) STRIP	S, F
6	GREEN (DEAD) FULL	
7	GREY ATTACK	
8	RED ATTACK	F only
X	DEFOLIATORS (LIVE)	All
Y	DEFOLIATORS (DEAD)	All

DISEASE CODES	
4	BLISTER RUST ON PW
ROOT ROT	
J	LIGHT
K	MODERATE
L	HEAVY

FIRE CODES	
A	Scorched bark and foliage, no charring in merch portion of trunk.
B	Charring of wood fibre > 100 cm but < 1/3 of tree radius in merch portion of trunk.
C	Charring of wood fibre in 3 or more areas > 100 cm² > 1/3 of tree radius or > 1 check > 1/3 of tree radius if dbh< 30 cm.

UPROOTED CODES

	CONDITION
E	LESS THAN OR EQUAL TO ONE CLEAN BREAK
G	MORE THAN ONE CLEAN BREAK OR ONE OR MORE SHATTERED BREAKS

For Age in 10's/Tree classes refer to Tree Class Modification of Loss Factor Tables at the end of Table 17 in Cruising Manual.

ECOSYSTEM	SNOW DEPTH
REMARKS (OTHER DEFECTS AND QUALITY FACTORS AFFECTING LOGGING)	

Matrix for Uprooted, Ice Damage and Wind Sheared Trees (natural causes only)

STANDING TREES (Ice Damage or Wind Sheared) BROKEN IN

Uprooted	Uprooted with one clean break in merchantable portion of the tree	Uprooted and two or more clean breaks or one shattered break in merchantable portion of the tree	Top 1/3	Middle 1/3	Bottom 1/3	
Record E	Record E	Record G	No down tree code.	Record E only.	Record E	Record G
			Call dead or broken top if ≥ 5 years old	for clean or shattered breaks	for clean breaks	for one clean break in bottom 1/3 and one other clean break any merchantable portion of the tree or one or more shattered breaks.
				Call dead or broken top if ≥ 5 years old	Call dead or broken top if ≥ 5 years old	Call dead or broken top if ≥ 5 years old

Figure 6.2 Cruise Tally Sheet – FS 205 HVA 2006/01(back side).

6.2 Entry of Data in Divided Spaces or Numbered Columns

Alphabetic fields are left justified as in the species code whereas numeric fields are right justified. It is not absolutely necessary that zeros be entered in spaces not required but their use helps avoid errors in placing the digit in its correct column and it is extremely important that this error is not made. For example, if columns for an item are 8, 9 and 10 and the magnitude of the item ranges from 0 to 999, then column 10 will be used for the units digit, column 9 for the tens digit and column 8 for the hundreds digits. For example:

	8	9	10
4 entered as	0	0	4
54 entered as	0	5	4
954 entered as	9	5	4

6.3 Front Side of Cruise Tally Sheet (FS 205 HVA 2002/04)

6.3.1 Card Type 9

Position 2 - 61 Identity Information

This card is to be completed for every new plot. The data on this card gives the location of the plot, forest type in which it occurs, average age and height, and the plot type.

If more than one sheet is required to code all the tree measurements on a given plot, the strip and plot number should be repeated on the second sheet.

Position 2-7 Licence Number

Enter:

1. For X type licences:

Position:	2	X
	3	Region
	4 and 5	Year
	6 and 7	District No. (Region = 00)

2. A56789 for licence A56789.
3. TFL001 for TFL 1
   TFL038 for TFL 38.
4. L0001 for licence to cut.
5. TL0421 for Timber Licence TL 421.
6. If Unauthorized Timber Harvesting use the ERA case file number in positions 2 to 10.

Position 8 to 10 Cutting Permit

Enter:

- can be either left or right oriented. Each tally sheet must be entered in the same format,
- 001 for Cutting Permit #1 (right oriented) (zero entries may be left blank),
- 38 for Cutting Permit #38 (left oriented), and
- A for Cutting Permit A.

> -"X" type = sequential numbering -- CP 001 for the first District or Region compilation for that fiscal year and CP 002 for the next cruise in the same District or Region in the same fiscal year, etc.
> -"Y" licence numbers -- **cannot** have a cutting permit. These positions must be left blank.
> -"A" licence numbers -- might or might not have a cutting permit number, BUT if there is not a cutting permit number, the positions cannot be left blank. There must be at least one zero in one of these three positions.

Position 11 to 13 Block (within the Cutting Permit)

Enter:

- can be either left or right oriented. Each tally sheet must be entered in the same format,
- 001 for Block #1 (right oriented) (zero entries may be left blank),
- 38 for Block #38 (left oriented), and
- A for Block A (left oriented).

Position 14 to 15 Strip Number or Letter (Number or Letter of Strip on which Plot is Located)

Enter 01 for strip #1.

Strips should be numbered or lettered consecutively without duplication for a Block.

Position 16 to 17 Plot Number or Letter

Will accept alpha/numeric designations, either left or right oriented.

Enter 01 for plot #1.

Plots are to be numbered consecutively without duplication on a strip.

Position 18 O/C This Field Must Be Entered

Enter:

O if original measurements.

C if check cruise measurements.

Position 19 to 20 Type Number

Enter the number given to the type in which this plot is located (corresponds to positions 14, 15 on Card type C).

Position 21 to 22 Age in 10s This Field Must Be Entered

See Section 3.5.6 for the coding of the age in 10s.

Age Limits (years)	Class	Age Limits (years)	Class
21-30	03	91-100	10
31-40	04	101-110	11
41-50	05	111-120	12
51-60	06	121-130	13
61-70	07	131-140	14
71-80	08	141-250	15 to 25
81-90	09	251 plus	26

It is important that these age class limits be observed as they govern the proper selection of loss factors.

Coast

See Section 9.1.5.7 for the procedure to assign the age in 10s and tree classes on the Coast if there are any trees 121 to 140 years old in a plot.

Position 23 to 24 Height in Metres

Enter the height to the nearest 1 m for the dominant and co-dominant trees of the major species in the plot. This classification applies to the plot area only and is based on sample tree heights taken on the plot.

Position 25 Plot Type

- Blank or "M" for measured plot,
- "C" for count plot, and
- "S" for stump cruise.

Position 26 This column is not in use.

Positions 27 to 39 Main Plot Size (this field is required unless 100 percent cruise)

These positions describe the plot size of the main stand element being sampled and the minimum DBH.

Position 27 to 30 Hectares (Fixed Plot)

Enter plot size in hectares for circular or rectangular shaped fixed plots: Leave blank if prism plots or 100 percent cruise.

The following plot sizes are recommended:

Size (hectares)	Circular Plots Radius (metres)	Square Plots One Side (metres)
0.005	3.99	7.07
0.010	5.64	10.00
0.02	7.98	14.14
0.03	9.77	17.32
0.04	11.28	20.00
0.05	12.62	22.36
0.06	13.82	24.49
0.08	15.96	28.28
0.10	17.84	31.62
0.20	25.23	44.72

Positions 31 to 35 Basal Area Factor (BAF Variable Plots) m^2/ha

Enter the BAF for the main stand element being sampled. It must be entered to three decimal places.

Imperial/Diopter Conversions

BAF (m^2/ha) = BAF (sq. ft./acre) x 0.229568
where 1 square foot per acre = 0.229568 m^2/ha

BAF (m^2/ha) = 10,000/(1+ $(200/\text{diopters})^2$)
Where 1 diopter represents a right-angled deflection of one unit per one hundred units in distance or 0.5728888° (decimal degrees).

Position 36 Prism Sweep

Enter:

- F (full 360º plot or walkthrough plot) - All trees, and
- B (border 180º plot) - All trees in measured 1/2 of plot.

Position 37 to 39 DBH Limit

The minimum DBH to which the trees on the main plot are measured to meet the merchantability specifications for appraisal purposes. Examples:

Coast CGNF Cruises:

1. Immature - code 12.0 cm (trees less than 141 years old).
2. Mature - code 17.5 cm (trees greater than 140 years old).

Coast Loss Factor Cruises:

1. Immature - code 12.0 cm (trees less than 121 years old).
2. Mature - code 17.5 cm (trees greater than 120 years old).

Interior Cruises:

1. PL with other species code 12.5 cm.
2. PL absent from cruise code 17.5 cm.

> The MAS determines the compilation level of the cruise. Measured trees below this minimum can be tallied but, based on diameter, will be ignored in the compilation. For count-plots the minimum DBH tallied must be the same as the DBH entered on the Map Area Statement (MAS) Section 7.2, Positions 19 to 21.

Positions 40 to 52 Sub-Plot Sizes

In stands with an excessive number of stems in the lower diameter classes, a sub-plot may be established for these lower diameter classes. To prevent unnecessary error, the same sub-plot size should be maintained throughout the timber type. The sub-plot size should never equal or be larger than the main plot size.

Position 40 to 43 Hectares (Fixed Plot)

Smaller plot areas may be required and the following are acceptable in addition to any listed under the main plot (Positions 27 to 30).

Hectare	Radius (m)
0.005	3.99
0.008	5.05
0.010	5.64
0.020	7.98

Position 44 to 48 Basal Area Factor (BAF) Variable Plots

See description as per Main Plot entries in Positions 31 to 35.

Position 49 Prism Sweep

See description under Main Plot entries in position 36.

Positions 50 to 52

The minimum DBH to which trees on the subplot are measured.

Position 53 to 54 Harvesting Method

The harvesting method which will be used:

SL	=	heli selection – land drop	Coast
SW	=	heli selection – water drop	Coast
FL	=	heli single standing stem – land drop	Coast
FW	=	heli single standing stem – water drop	Coast
HW	=	helicopter clearcut - water	Coast
HL	=	helicopter clear-cut - land	Coast
HC	=	helicopter clear-cut	Interior
HS	=	helicopter selective	Interior
CC	=	cable clear-cut	Both
CS	=	cable selective	Both
LC	=	sky line clear-cut	Both
LS	=	sky line selective	Both

HO	=	horse	Interior
SC	=	ground system-clear-cut	Both
SS	=	ground system - selective	Both
SP	=	specified operation	Interior

Position 55 to 57 Slope Percent

Record the most severe slope measurement in any direction to a point 15 m slope distance from plot centre. If slope is missing, it will be compiled as a zero. Plot slope in a border plot must be measured from within the 15 m arc in the plot. Plot slope must be recorded in count plots.

Position 58 to 61 Date

Record the year and month that the fieldwork was performed. The date must be recorded by the cruiser and entered into the cruise compilation.

6.3.2 Card Type 2

Position 1 Tree Details

This card contains the individual tree details or quality and size measurements.

Positions 2 to 24 Common to Card Type 9

Position 25 to 26 Tree Number

Number consecutively preferably from 1 for each plot (no duplicate numbers on any plot). Plot trees selected as sample trees maintain the same number in Sample Tree Details.

Positions 27 to 29 Total Height

When a height is measured or estimated and entered here, it will be used in the calculation of that individual tree's volume. The height must be recorded to the nearest 0.1 m.

Positions 30 to 31 Species

Enter the appropriate commercial species symbol. Genus Symbol letters must be "Capitalized" or upper case. Species symbols should be upper case also (entry is left oriented).

Genus Symbols - These symbols must always be entered for the proper implementation of the volume equations and loss factors.

Species Symbols:

1. The specific symbol for broadleaf maple (Mb), the pines (Pl, Pw, Pa, Py), aspen (At) and cottonwood (Ac) must be entered for the proper implementation of the loss factors and volume equations.

2. The species symbols for other species such as the spruces, hemlock and balsams should only be used when positive identification can be made in the field and the appraisal requires it, however, they must be combined by genus for the harvest method summary. Species specific symbols for *abies amabilis* and *lasciocarpa* must be entered for Interior cruises. Call Grade Net Factor cruises must use species specific symbols for Tsuga mertensiana. Tsuga heterophylla can use H or Hw.

Commercial Tree Species Names and Symbols

Common Name of Genus/Species	Scientific Name of Genus/Species	Genus Symbol*	Species Symbol*
Alder	*Alnus*	**D**	
Red Alder	*A. rubra*		Dr
Balsam	*Abies*	**B**	
Alpine fir	*A. lasiocarpa*		Bl
Amabilis fir	*A. amabilis*		Ba
Grand fir	*A. grandis*		Bg
Birch	*Betula*	**E**	
Common paper birch	*B. papyrifera*		Ep
Alaska paper birch	*B. neoalaskana*		En
Cedar	*Thuja*	**C**	
Western red cedar	*T. plicata*		Cw
Cypress	*Chamaecyparis*	**Y**	
Yellow cedar	*C. nootkataensis*		Yc
Douglas-fir	*Pseudotsuga*	**F**	
Douglas-fir	*P. menziesii*		Fd
Hemlock	*Tsuga*	**H**	
Mountain hemlock	*T. mertensiana*	CGNF cruises	**Hm**
Western hemlock	*T. heterophylla*	CGNF cruises	**Hw or H**

Larch	*Larix*	**L**	
Alpine larch	*L. lyallii*		Li
Tamarack	*L. laricina*		Lt
Western larch	*L. occidentalis*		Lo
Maple	*Acer*	M	
Broadleaved maple	*A. macrophyllum*		**Mb**
Pine	*Pinus*	P	
Lodgepole pine	*P. contorta*		**Pl**
Western white pine	*P. monticola*		**Pw**
Whitebark pine	*P. albicaulis*		**Pa**
Yellow pine	*P. ponderosa*		**Py**
Poplar	*Populus*	A	
Aspen	*P. tremuloides*		**At**
Balsam poplar	*P. balsamifera*		**Ac**
	sub. sp. Balsamifera		
Black cottonwood	*P. balsamifera*		**Ac**
	sub. sp. trichocarpa		
Spruce	*Picea*	**S**	
Black spruce	*P. mariana*		Sb
Englemann spruce	*P. engelmannii*		Se
Sitka spruce	*P. sitchensis*		Ss
White spruce	*P. glauca*		Sw
Yew	*Taxus*	**T**	Optional
Western Yew	*T. brevifolia*		

* The bolded symbols are the standard to be used for operational cruises. *Species* symbols which are not bolded may also be used if required. The symbol(s) chosen must be used consistently in all plots. The genus symbols M (maple), P (pine) and A (poplar) cannot be used. The genus and species symbol is required for Mountain hemlock in Call Grade Net Factor cruises.

Positions 32 to 35 DBH

Enter the diameter in centimetres and decimal centimetres at breast height (1.3 m above the high side) of each tree equal to or above the contract specification. Whole numbers are recorded as decimals (e.g., 12.0 not 12).

Position 36 Tree Class (see Section 3.5.6 for Detailed Descriptions)

The tree class must be consistent with the age in 10's reported by plot.

Positions 37 to 44 Pathological Remarks

Refer to the box entitled "Path Code by Tree Third". This indicates the numerical coding to be used in this section. The tree is schematically divided into thirds, with the bottom (BOT) blocks representing the bottom third, the middle (MID) block the middle third, and the top (TOP) block the top third. The shading indicates in which third or thirds the defects occur based on the codes 1 through 7. The applicable numerical code is shown to the left of the blocks. Thus, if the defects occur in the bottom third only, "1" is entered in the defect column. If a defect occurs in both the middle and top thirds, "5" is entered; etc.

Path Code by Tree Third

	1	2	3	4	5	6	7
TOP							
MID							
BOT							

The column heads under "PATH REMARKS" are self-explanatory except for the last two: "Rotten Br." means "Rotten Branch"; "D. or B. Top" means "Dead or Broken Top". All the suspect characters listed must be noted where they occur.

Refer to the Cruise Compilation Loss Factor Table for pathological occurrence by species and forest inventory zones.

Examples:

1. A suspect tree has conks on the middle and upper thirds of the trunk and an open basal scar on the lower third. Under "Conk" enter "5" and under "Scar" enter "1".

2. A suspect tree has a fork on the middle third, blind conks on the upper third and a broken top. Under "Fork" enter "2", under "Blind Conk" enter "3" and under "D. or B. Top" enter "3".

3. A suspect tree has a fork on the middle third, with a frost crack extending from the ground to the fork; one of the leaders of the fork is broken and the leader is not of merchantable size. Under "Fork or Crook" enter "2", under "Frost Crack" enter "4".

Positions 45 to 51 Quality Remarks Optional in Interior

The quality information will be collected on all age classes and will apply to all commercial living trees plus dead potential standing or down trees found on the plot and on the largest leader on a forked stem. This is in addition to the eight pathological indicators of decay which can also be considered as affecting the quality of products obtained from a given tree.

Quality remarks must include information on all items indicated under this heading. Codes are indicated in the "Quality Code" box on the back of the plot sheet.

Position 45 Spiral Grain

Also known as "twist". The direction of the grain can best be seen in exposed wood such as the open scars in living trees or dead trees with sloughing bark. Spiralling bark fissures and frost cracks provide the next best evidence of the characteristic.

Spiral grain or twist shall be estimated at the halfway point between stump height and 10.3 m and expressed as a percentage.

- Determine the most severe spiral grain on the 1 m section at 5.3 m above the high-side. The offset from the vertical line in centimetres is the percent spiral grain per metre. Use the spiral at DBH as a guide for estimation.

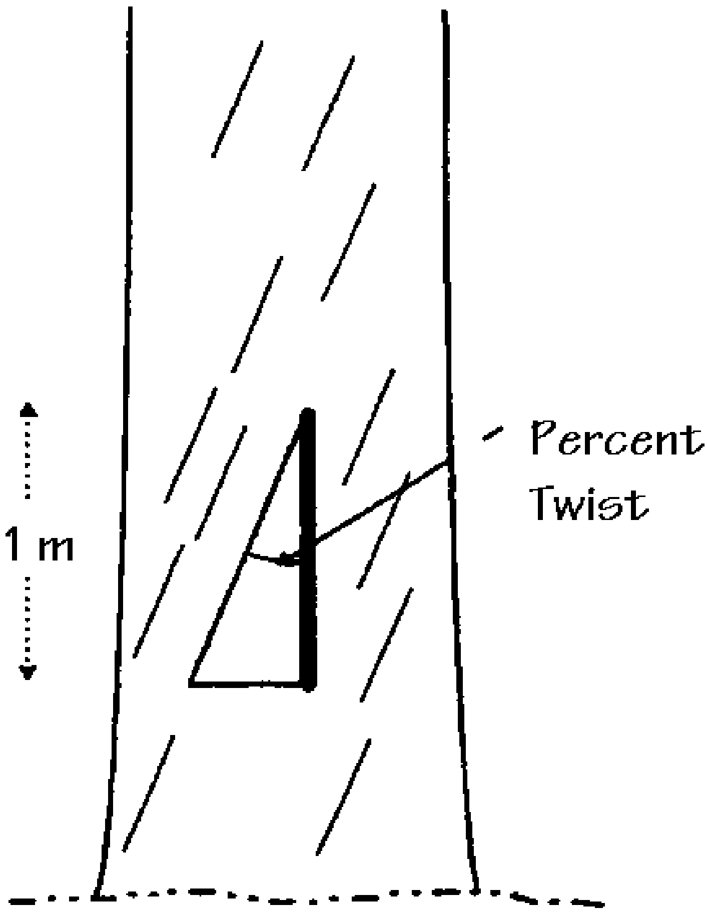


Figure 6.3 Determination of Percent Twist.

Recording Code	% Displacement	Recording Code	% Displacement
0	0 - 5%	5	46 - 55%
1	6 - 15%	6	56 - 65%
2	16 - 25%	7	66 - 75%
3	26 - 35%	8	76 - 85%
4	36 - 45%	9	86 +

Position 46 Sweep

Currently not required.

Position 47 Lean

Currently not required.

Log Number

"Logs" are individual 5 m lengths and are numbered starting at the top of a 30 cm "stump".

Position 48 Live Limb (Grade Change)

Definition: The 5 m log where quality changes from: *no knots* to *knots or knot indicators* or from *small knots* to *large knots* or from *well spaced knots* to *excessive knots*.

The purpose of recording live limb is to identify the first grade change as you move up the tree.

This will assist the log grade algorithm to better determine the cruise grade distribution produced by the cruise compilation program.

If the branching is consistent in frequency and size from the base to the merchantable top diameter of the tree, record live limb as a one (1).

The grades on trees smaller than 60 cm DBH are not affected by the live limb code. On deciduous trees, live limb is recorded as the 5 m log where the natural forking starts. Record live limb for the dead potential tree classes.

Position 49 Log No. of 1st Stub

Enter the log number on which the first stub or first branch occurs, irrespective of diameter or length. This may occur on the same log as the Base of Crown or at some point below.

Any stub, live or dead branch, is considered when identifying the log number of the first stub (see the following section for discussion of epicormic branching).

Positions 50 and 51 Knots, 1st 5 m and 2nd 5 m

The location of clear surface area in the first two 5 m logs indicates the potential grade of a log. The location of the four quarters on the second 5 m log must be the same as the location of the four on the first 5 m log.

A clear quarter must be free of any open knot, knot indicator, branch stub, dead or living side branch, bunch knots or forks. Epicormic branches, suckers and candelabras are not classed as knots. Record the number of clear quarters for the first log (0.3 - 5.3 m from the high side of ground) and for the second log (5.3 - 10.3 m) as follows:

Code	Remarks
0	No quarters with knots (four clear quarters)
1	Knots in one quarter (three clear quarters)
2	Knots in two quarters
3	Knots in three quarters
4	Knots in four quarters
5	One to three knots, branches or stubs estimated to be greater than 10 cm dib, irrespective of the number of clear quarters.
6	Four or more knots, branches or stubs greater than 10 cm dib, irrespective of the number of clear quarters.

Epicormic branches are small sprout-type limbs that originate from dormant or adventitious buds. According to current literature, this type of branching is not generally prevalent on conifers except on the true fir species. Since these branches do not originate from the pith and if present, live for only a short period (4-6 years), they have no effect on the quality of the wood.

Positions 52 to 56

These columns are not in use.

Position 59 Selective Cutting

L	leave tree
Blank or C	cut tree

Position 60 Miscellaneous - optional data collection.

Root Rot	Description
J = light	Tree within a disease centre or within 10 m of a tree or stump that is symptomatic or killed by root disease.
K = moderate	Tree with root disease crown symptoms.
L= heavy	Tree with root disease confirmed by stain, decay, fruiting bodies or basal resinous.

Interior Dead Potential White Pine Log Grade Algorithm

Sap rot and weather checks can be collected in the root rot column, column 60.

The sap rot and weather check codes are as follows:

a. record by tree third as per pathological indicator location codes 1 to 7,

b. record codes 1 to 7 for tree thirds that will not be suitable to produce 50 percent lumber,

c. coding is the same as pathological indicator tree positions,

Refer to Appendix 7 for a more detailed description of the algorithm.

The hemlock and dead white pine grade algorithms are used for interior appraisals. The hemlock algorithm is found in Figure A.42 and the white pine algorithm is found in A.43. Sap rot and suncheck codes are required for the dead potential white pine algorithm. The procedure is outlined in A.7.2(3).

Positions 61 to 63 Damage Codes (see Section A.6)

Damage codes are to be used at all times, and shall be recorded as they appear at the time of the cruise with no attempt to predict the future condition of the trees. Where damage is tallied it will be compiled and reported.

The codes are for appraisal reporting purposes and for net volume adjustment purposes in compilation.

All damage types will be compiled for net volume. Where multiple damage is recorded for a single tree, the most severe damage type will be compiled for that tree.

All damage types will be reported in the cruise as a percentage of the cruise net volume.

Position 61 Insect and Disease Codes (see Appendix 6.13)

Position 62 Fire Damage Codes (see Appendix 6.2)

Position 63 Down Trees (see Appendix 6.3)

6.3.3 Card Type 3

Position 36, Columns 37 - 39 Sample Tree Details

Do not estimate heights for card type 3 sample trees. Sample tree details may be entered for count plots.

Refer to Sections 3.5.3.4 and 8.4 for details regarding the use of height/diameter curves.

Refer to Section 3.5.9 for details regarding the collection of tree ages.

Counted Age at DBH

This is the Breast Height Age referenced above.

Horizontal Distance from Plot Centre

This is the measured distance from the plot centre to the face of standing trees at DBH plus half the DBH and on the top side at mid point for down trees.

6.4 Reverse Side of Cruise Tally Sheet (FS 205 HVA 2002/04)

Growth rates, the number of rings in the last 10 cm, and 10 year growth can be noted in the Remarks section.

6.4.1 Miscellaneous

Ecosystem	Record the Biogeoclimatic subzone and variant if known.
Snow Depth	Note average depth of snow in centimetres at the time of cruise for the cruise plot, along with the date on which the cruise plot was completed.
Cruised By	Signature All Cruise Tally Sheets (FS 205 and industry versions) must be signed and dated by the cruiser in charge, and in so doing, accepts responsibility for the information contained on the card.
Checked By	Signature All Cruise Tally Sheets (FS 205 and industry versions) must be signed and dated by the check cruiser, and in so doing, accepts responsibility for the information contained on the card.

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Ministry of Forests and Range Map Area Statement (FS 121) 7

The Map Area Statement consists of cards A, B, C, D, E, F, G and H which are to be completed for every new Cutting Authority.

7.1 Card Type A

Positions 2 to 80

Cruise Identity Card - this card establishes the location of the cruise from the broadest area (Forest Region) to the most exact (UTM Grid Co-ordinates) and describes the nature of the sale.

Position 2 to 7 Licence Number

Enter:

1. For X type licences:

Position	2	X
	3	Region
	4 and 5	Year
	6 and 7	District No. (Region = 00)

2. CF0001 for Community Forest Agreement.
3. A56789 for licence A56789.
4. TFL001 for TFL 1
   TFL038 for TFL 38.
5. L0001 for licence to cut.
6. TL0421 for Timber Licence TL 421.
7. If Unauthorized Timber Harvesting use the ERA case file number in Positions 2 to 10.

Position 8 to 10 Cutting Permit

Enter 001 for CP1 or 01A for CP1A. Use sequential numbering for X type licences.

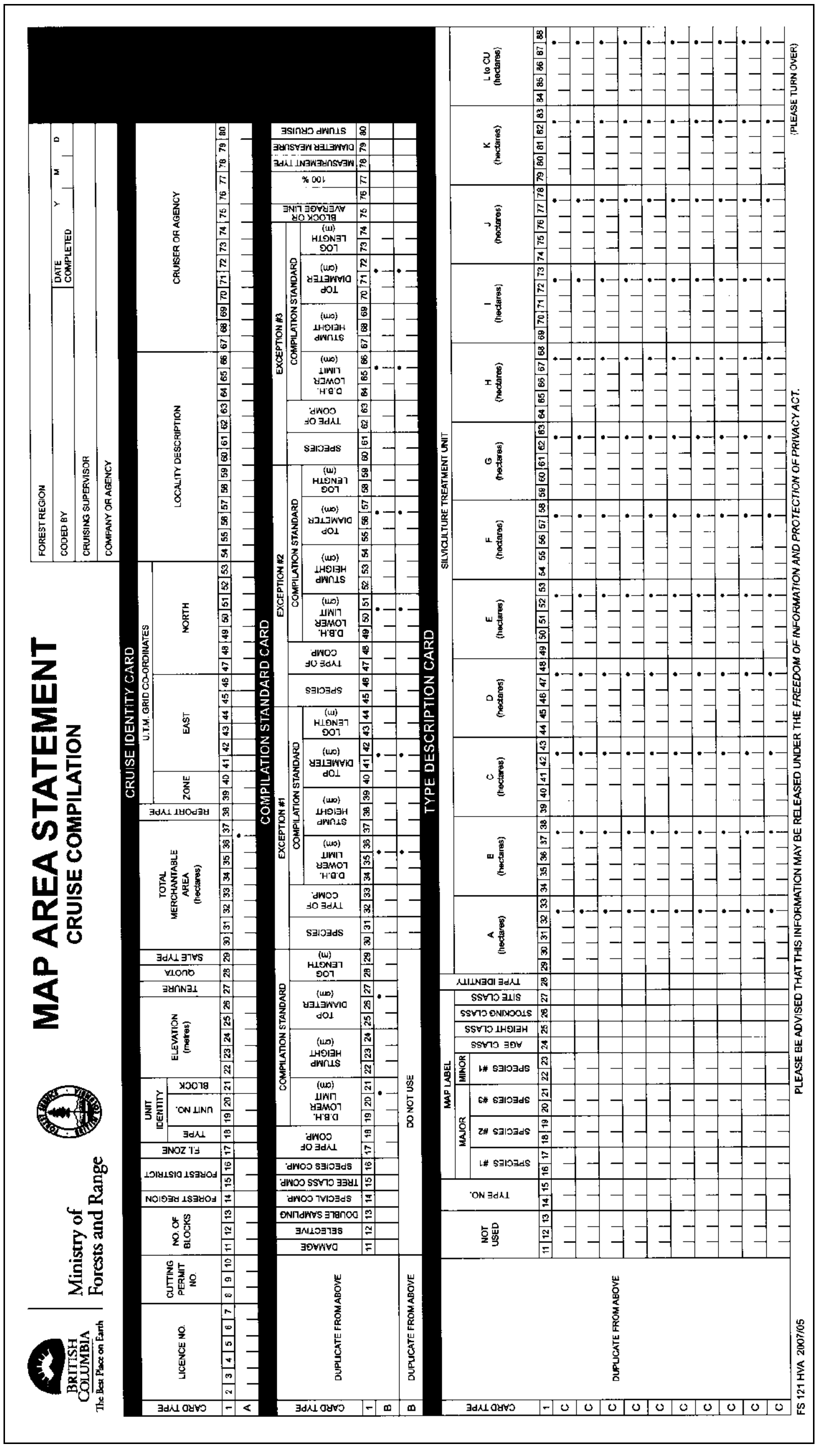


Figure 7.1 Front Side of Map Area Statement Form (FS 121 HRV 2005/06).

Position 11 to 13 Number of Blocks

Enter 001 for one Block
010 for ten Blocks

Position 14 to 16 Forest Regions and Districts

Every district has a number unique to the forest region. If the sale is located within two or more districts, code it by the district with supervisory responsibility.

Refer to Appendix 8 for detailed region and district coding.

Position 17 Forest Inventory Zones

The province is divided into 12 Forest Inventory Zones:

- A, B, C are all Coast zones, and
- D to L are all Interior zones.

The correct zone is vital for the application of volume equations and loss factors.

If more than 1 FIZ exists in a cruise, use the FIZ with the greatest area.

Refer to the Mapview utility on the Internet for a detailed location of the FIZ and Special Cruise Number. See Table 17 for details.

Refer to Appendix 3 for the maps of the general location for the FIZ and P.S.Y.U.

Unit Identity (Positions 18 to 21)

Position 18 Type (of Unit)

Enter 0 if the sale area is located within an established or proposed PSYU which is not part of a larger PHA (Pulp Harvesting Area).

1	if it is located within PHA 1
2	if it is located within PHA 2
3	if it is located within PHA 3
5	if it is located within PHA 5
7	if it is located within PHA 7

Enter:

B	if located in Blue Mountain Forest Reserve
C	if sold under Beach Clearing Licence
E	if located in E & N Land Belt
G	if located in Gulf Islands
K	if located in Kitimat Valley but not in Skeena PSYU or TFL41
L	if sold as Pulp Timber Sale in Nootka PSYU
M	if located in a Municipality
P	if located in a Park
S	if located in a Special Sale Area
T	if located in a TFL
W	if located in a Watershed Reserve.

Leave this position blank if none of the foregoing codes apply.

Position 19 to 20 Number (of the Units)

If a cutting authority area occupies more than one Public Sustained Yield Unit (PSYU), then use the PSYU unit which has the greatest area within the cruise.

Position 21 Block Number (of the Unit)

Enter Zero if unit has no block numbers (see Table 17).

Position 22 to 26 Elevation

Record the elevation of the centre of the sale to the nearest 50 m. Do not leave blank or zero. Must have at least a 1 entered.

Position 27 Tenure

Tenure Description	**Code**
Coast	
Forest Licences	A
Timber Licences	B
C.G. 1914 to date - stumpage & royalty	S
C.G. 1914 to date - stumpage including royalty	U
Road Permits	V
Timber Sales & Licences to Cut	X
T.F.L. Cutting Permits	Y
Woodlot Licences	1
Community Forest Agreements	4
Interior	
Forest Licences	W
C.G. 1914 to date - stumpage & royalty	T
C.G. 1914 to date - stumpage including royalty	2
Road Permits	3
Community Forest Agreements	4
Timber Sales & Licences to Cut	5
T.F.L. Cutting Permits	6
Woodlot Licences	7
All	
Timber Sale Licence Major	8
Unauthorized Timber Harvest	9

Position 28 Quota Type

Leave this column blank if the licensee quota is in a proposed or managed TSA, TFL or SSA.

Enter:

D	for Regional Executive Director Quota
H	for Handlogging Timber Sale
N	for Non-quota timber sold in a managed PSYU, TFL or SSA.
R	for Prince Rupert 20 percent contractor Northline timber
S	for Dead and Down Salvage Sale
T	for Third Band Sale
Q	for Quota Holder

Position 29 Sale Type

Leave blank if none of the following apply.

Enter:

A	for Deciduous
B	for Salvage - Blowdown
C	for Salvage - Cleanup or Residuals
D	for Salvage - Dead or Down
E	for Salvage - Decadent
F	for Salvage - Flood Killed
G	for Salvage - Winter Killed
H	for Salvage - Pondage Clearing
I	for Salvage - Insect Killed
J	for Salvage - Disease Killed

K	for Salvage - Fire Killed
M	for Minor Products only
N	for Cash or Direct Sale
R	for Right of Way Clearing

Positions 30 to 37 Total Merchantable Area (Hectares)

Enter the number of merchantable hectares for each Cutting Block within a Cutting Permit or for the Cutting Permit within a Forest Licence or for each Timber Sale, Timber Licence, Licence to Cut, etc. right oriented (e.g., 157.5 ha enter as 00001575).

Position 38 Ministry of Forests and Range - Appraisal Information

A	=	compilation to be used for appraisal purposes - reports titled "For Appraisal Purposes."
blank or other	=	*Not* for appraisal purposes - reports titled "Not for Appraisal Purposes".

Position 39 to 53 UTM Co-ordinates

The following web site and instructions can be used to access UTM co-ordinates:

http://aardvark.gov.bc.ca/apps/mascotw/

1. Scroll down to *Graphic Based Access*, click *Query By Map* to next screen.

2. Click on correct *Quadrant* to next screen.

3. Click on correct *Zone* to next screen.

4. Locate the *UTM and Zone* at the bottom of the map.

In the Universal Transverse Mercator (UTM) projection the spheroid is divided into 60 zones, each 6° of longitude in width numbered eastward from the 180° meridian through Greenwich. Four zones numbered 8, 9, 10 and 11 cover British Columbia.

The approximate centre of the cut block should be referenced with this system (*Standard System of Mapping for British Columbia*, Geographic Data BC, Ministry of Environment, Lands and Parks).

Positions 54 to 66 Locality Description

Enter a brief description where the sale is located (e.g., 15 km N.E. of Pr. George, FADEAR CR. LT 2315).

Positions 67 to 80 Cruised By

Enter first initial and last name or cruising agency name.

7.2 Card Type B

Position 1

This card defines the standard of compilation and the output required for the sale.

Positions 2 to 10 Common to Card Type A

Position 11 Damage Reporting

Blank	All damage reporting

Position 12 Partial Cutting Indicator

blank	compile all trees
C	compile only "C" indicated (cut trees) and blank indicated trees.
L	compile only "L" indicated (leave trees) trees.

Position 13 Double Sampling Indicator

Enter:

0	0 = all plots to be used
1	count-plots not to be used

Position 14 Special Compilation

WET AND DRY BELT DOUGLAS FIR ZONES		
	Biogeoclimatic Zone	**Biogeoclimatic Subzone and Variant**
Wet Belt	ICH (Interior Cedar Hemlock)	dw, dk, mw, mm, mk, mc, wk, vk, vc
Code = 1	SBS (Sub-Boreal Spruce)	dh, dw, dk, mh, mw, mm, mk, mc, wk, vk
	IDF (Interior Douglas Fir)	mw, ww
	ESSF (Englemann Spruce - Subalpine Fir)	dc, dk, dv, mw, mv, mm, mk, mc, wv, wm, wk, wc, vc, vv
	SBPS (Sub-Boreal Pine - Spruce)	mk, dc, mc
Dry Belt	ICH (Interior Cedar Hemlock)	xw
Code = 2	IDF (Interior Douglas Fir)	undifferentiated, dk1, dk2, dm2, xh, xw, xm, dm1
	ESSF (Englemann Spruce - Subalpine Fir)	xc
	MS (Montane Spruce)	xk, dc, dk, dm, xv
	SBPS (Sub-Boreal Pine - Spruce)	xc
	PP (Ponderosa Pine)	xh, dh

If subzones are missing from the above listing, the general rule to apply is: very dry and dry subzones are Dry Belt; and moist, wet and very wet are Wet Belt.

Enter:

(blank)	if Coast compilation
0	if Interior compilation is required by the three quality classes. *This option has been disabled*.
1	if interior fir is present and sale is in the Wet Belt.
2	if interior fir is present and sale is in the Dry Belt.

If the cutting permit occupies both Wet and Dry Belt BEC zones, subzones or variants, compile using the zone with the highest Douglas fir total net volume based on the cruise data.

Position 15 Tree Class Combinations

This column states which tree classes will be included in the final volume.

Blank or 0	useless volumes excluded - if only residual, suspect and dead potential tree volumes are required,
1	useless volumes included - if residual, suspect, dead potential plus live and dead useless volumes are required. Do Not use for appraisal purposes. Reports will be titled "Not for Appraisal Purposes".

Position 16 Species Compilation

This column indicates whether all the species on the sale are to be compiled in the same manner or whether an exception is required. For example:

1. Cedar poles or veneer for only Douglas Fir (not programmed as yet).

2. The stump height, top dib, DBH limit or log length could be altered for one species on the sale (i.e., in the Interior, lodgepole pine is compiled to 12.5 cm plus, while all other species are compiled to a 17.5 cm DBH).

Enter:

0	if all species are to be compiled in the same manner.
1	if all species are to be compiled the same with an exception.

Positions 17 to 18 Type of Compilation (majority of species)

The code for the appropriate end product or combination of products is entered. Present appraisals require option 3 for the interior, option 32 for the coast.

03	Lumber including all logs.
32	Coast Integrated Company - with Peeler segregation

Compilation Standard

Specify the timber merchantability specifications required. This will be for the majority of the species.

Positions 19 to 21 DBH Lower Limit

Specify to the nearest 0.1 cm the minimum DBH to be compiled.

Coast Call Grade Net Factor Cruise	Mature (141 yrs +) = 17.5 cm Immature (< 141 yrs) = 12.0 cm
Coast Loss Factor Cruise	Mature (121 yrs +) = 17.5 cm Immature (< 121 yrs) = 12.0 cm
Interior	Lodgepole Pine = 12.5 cm Other Species = 17.5 cm

Positions 22 to 24 Stump Height

Specify Stump Height required to the nearest cm (e.g., timber merchantability specifications = 30 cm).

Positions 25 to 27 Top Diameter

Specify top dib for the tree to the nearest 0.1 cm

Coast	Mature (121 yrs +) = 15 cm Immature (<121 yrs) = 10 cm
Interior	10 cm

Red cedar (Interior only):

- if greater than 50 percent of the red cedar net volume is in trees less than 141 years the top diameter inside bark is 10 cm, and
- if greater than or equal to 50 percent of the red cedar net volume is in trees greater than 140 years the top diameter inside bark is 15 cm.

Positions 28 to 29 Log Lengths (to the nearest metre)

Log Lengths for product analysis. If not equal to 5 m for Interior or 10 m for Coast, reports are titled "Not for Appraisal Purposes".

One exception is the portion of the Kalum Forest District west of the Cascade Mountains administrative line in coastal FIZ A utilizes Interior appraisals. This area is permitted to use 5 m logs for interior appraisal purposes.

Log Lengths for other purposes can be 1 to 99 m.

(Zero) 0 = total tree length between stump height and top dib.

Positions 30 to 44

Exception Number 1.

Compilation for a species may require a different type of compilation; Lower DBH Limit (i.e., PL = 12.5 cm DBH). Stump height, top dib, and log length.

Positions 45 to 59

Exception Number 2 (i.e., Cedar 160 years = 15 cm top) Stump height, top dib, and log length.

Positions 60 to 74

Exception Number 3.

> Positions 30 to 74 on second line allows three more exceptions for one compilation.

Position 75 Block or Average Line Method (Type Average) of Compilation

A	average line (type average) method.
B	block method.

The average line (type average) method of compilation uses all plots from the timber type that are common to all blocks in a cruise. The average line method must be used for all appraisal cruises.

The block method uses only the plots in the timber type within the block or the plots in the timber type within the harvest method. This method is no longer used for appraisal.

If a reduction by block is required by the prescribing forest professional, then the timber types that are common to more than one block will need to be assigned unique timber type numbers so that the timber types are unique to the block.

On the coast, if there are immature and mature block combinations that require different timber merchantability specifications by block, then the timber types that are common to more than one block will need to be assigned unique timber type numbers.

Position 76

Code "C" for Call Grade Net Factor Cruise.

Position 77

Input an "A" in this column if the cruise or stump cruise will be 100 % measure. The cruise tally card, card type 9 plot size will be replaced by the type areas in the map area statement, card type D.

Position 78 Stump Diameter Measurement Type

Code "C" for centimetres.

Code "R" for rads.

Stump height must be in centimetres.

Position 79 Diameter Measurements

Code "I" for inside bark.

Position 80

Code "S" for stump cruise.

7.3 Card Type C

Position 1 Type Description

This card contains the type number (corresponds to positions 19 and 20 on Card Type 9), the map or stratum label for the type and the area of the type in hectares for every type island within the Cutting Block, Cutting Permit, Timber Sale, Berth or Lease.

Positions 2 to 10

Common to Card Type A and B.

Positions 11 to 13

These columns are not in use.

Positions 14 to 15 Type Number

This is the number given to similar type islands within the sale. Each Map Label, which differs in some respect, requires a new Type Number with the numbers starting at 1 for the unit under consideration. Several type islands with the same map label will have the same type number. The type numbers must be zero filled (e.g., 01, 02, etc.).

Map Label (Positions 16 to 27)

Major Species

A species is major if it comprises 20 percent or more of the total Gross volume.

Positions 16 to 17 Species #1

Leading species in terms of gross volume for the type.

Positions 18 to 19 Species #2

Second leading species in terms of gross volume.

Positions 20 to 21 Species #3

Third leading species in terms of gross volume.

Positions 22 to 23 Minor Species

A minor species comprises less than 20 percent of the gross volume for the type. A new type number should be assigned very infrequently when the only difference in the stratum is the first minor species.

Position 24 Age Class

Code	Age Class Limits
1	1-20 years
2	21-40 years
3	41-60 years
4	61-80 years
5	81-100 years
6	101-120 years
7	121-140 years
8	141-250 years
9	250+ years

Position 25 Height Class (metres)

Code	Height Class Limits (metres)
1	0-10.4
2	10.5-19.4
3	19.5-28.4
4	28.5-37.4
5	37.5-46.4
6	46.5-55.4
7	55.5-64.4
8	64.5 +

Position 26 Stocking Class

Code	Description
0	Immature Stands Mature Stands
1	Mature Residual-Disturbed 26 to 75 percent by area or volume
2	Stocking Class 1 to 76 or more trees per hectare 27.5 cm + DBH.
3	Stocking Class 2 - Fewer than 76 trees per hectare 27.5 cm + DBH.

Position 27 Site Class

Site is determined for all productive forest types by the application of sample tree age and height measurements to the site index tables in Appendix 9.

	Code
G	good site
M	medium site
P	poor site
L	low site

The site is established on the first species in order of predominance regardless of the percentage composition of the stand or the number of species in the label.

Position 28 Type Identity

The recognized classes of cover on forest land are Immature, Mature, Mature Residual, Not Satisfactorily Restocked (NSR), Non-commercial (NC), Non-Productive Forest and Disturbed-Stocking Doubtful (DSD).

However, program will only accept code 1, 2 or 3.

A map note may distinguish the various types of Non-Forest Lands but only one code (6) is assigned to this classification.

Code	Identity	Description
1	Immature (Imm.)	Coniferous trees younger than 121 years with the exception of deciduous which must be younger than 41 years to be classed as immature.
2	Mature (Mat.)	Coniferous trees older than 120 years with the exception of deciduous species where the age break is more than 40 years.
3	Mature Residual (Mat. R.)	Types disturbed 26 to 75 percent; supporting remnants of the original forest stand where the most significant element of the surviving stand is classed as mature.
4	NSR	Denuded areas that do not meet minimum stocking requirements of approximately 750 healthy, well-distributed seedlings or juvenile stems per hectare.

In cases where there is reasonable doubt as to whether the area is NSR the category DSD should be used. Ground examination to verify NSR areas is desirable.

Code	Identity	Description
5	Non-Commercial (NC)	This cover class is used very sparingly being confined almost exclusively to deciduous brush growing on productive sites. On occasion it may be used to describe stands usually disturbed, of very low quality that cannot be, as a practical matter, classified as commercial, NSR or DSD.
6	Non-Productive Forest	Forest land of very low productivity presenting no commercial possibilities in the foreseeable future.
7	Disturbed, Stocking Doubtful (DSD)	Denuded areas where there is reasonable doubt as to whether the area is NSR.

Positions 29 to 88

Record the merchantable timbered hectares for each timber type (stratum) and silviculture treatment unit in the cutting block, cutting permit, Timber Sale or Timber Licence to the nearest 0.1 ha.

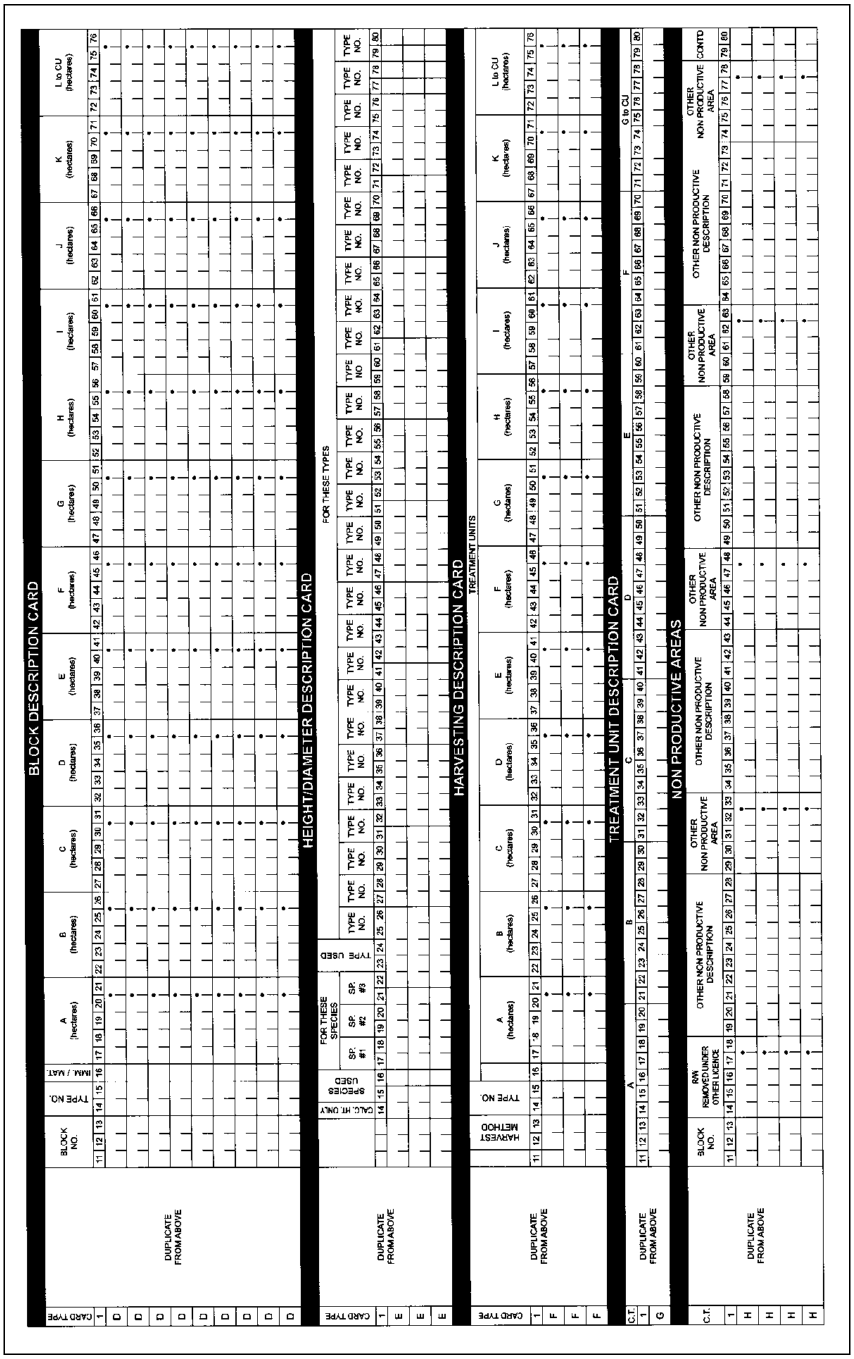


Figure 7.2 Reverse Side of Map Area Statement Form (FS 121 HVA 2005/06).

7.4 Card Type D

Position 1 Block Description

The sampling plan and the appraisal is made on the basis of the Timber Sale or Cutting Permit which may consist of several separate sub-units, namely blocks or settings. If for operational purposes an estimate by species is required of the net volume for each type in these sub-units (blocks) the Card Type D must have an entry for each type separately within each block. The number of blocks entered must equal the numerical entry in positions 11 to 13 of Card Type A.

Positions 2 to 10

Common to all Card Types.

Positions 11 to 13 Block No.

Enter the Block Number within the Cutting Permit or Timber Sale. Each block identified must have a unique number or letter.

Position 14 to 15 Type No.

Enter the Type Number of a type island, which is contained or partially contained by this Block. The numbers must correspond to Type Numbers defined by a previous card C. The type No. must be zero filled (e.g., 01, 02, etc.).

Position 16 Coast Block Maturity Indicator

I	Immature
M	Mature

If the percent immature in the block summary or appraisal summary of the post reduction compilation is 50 percent or more, then the block must be compiled to immature merchantability requirements by coding this indicator as I. If the percent immature is reported as less than 50 percent, then the block must be compiled to mature merchantability requirements by coding this indicator as M.

Position 17 to 21, 22 to 26, etc.

Enter the number of merchantable hectares of the block, which is part of this type and silviculture treatment unit. The sum of all of the areas for one type should equal the area specified for that type on the Card Type C.

The number of Silviculture Treatment Units (STUs) has been expanded from 12 to 99 STUs effective June 1, 2005.

7.5 Card Type E

Position 1

Height/DBH Description - Stump Cruises & Severely Damaged Stands

This card is not needed if there is a sufficient number of sample trees (20 or more) to calculate a height/DBH equation for a species within a stratum or forest type. However, this card must be used for any of the following situations, which occur usually through the minor position of the species in the type or the type itself in the Cutting Permit. This usually means the collection of enough sample heights to establish a curve becomes impractical.

1. The sample trees for one major species occurring in two or more types (keep in mind the rules in Section 3.5.3.4) can be combined into one equation, which will be applied against all trees of that species for the designated types.
2. The sample heights for two or more different species exhibiting similar growth characteristics can be combined into one equation so that all trees of the species indicated will have their heights calculated by this one equation.
3. One species may be so minor that no sample heights were taken and this card can designate which height equation should be used to calculate heights for this species. It is recommended that all minor species sample trees be measured or estimated where gathering enough height samples is not practical.

Examples:

HEIGHT/DIAMETER DESCRIPTION

CARD TYPE			CALC. HT. ONLY	SPECIES USED	FOR THESE SPECIES SP. #1	SP. #2	SP. #3	TYPE USED	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.
1	*EXAMPLE*	11 12 13	14	15 16	17 18	19 20	21 22	23 24	25 26	27 28	29 30	31 32	33 34	35 36	37 38	39 40	41 42	43 44	45 46
E		1.	0	F	B			01											
E	DUPLICATE FROM ABOVE	2.	0	PA	PW	PY		03	04										
E		3.	1	PA	L			03											
E		4.	0	F	C	H	B	01	02	03	04								
E			0	F	S	PL	CT	01	02	03	04								
E			0	F	B1			01	02	03	04								
E																			
E																			
E																			

Figure 7.3 Height/Diameter Description Card.

Example 1.	One height/diameter equation will be produced from all the F and B sample trees (Card Type 3) submitted in Type 1. This equation will be labelled as an equation for F in Type 1. All F and B trees (Card Type 2) in Type 1 with no heights will have their heights calculated by this one equation.
Example 2.	One height/diameter equation will be produced from all the Pa, Pw and Py sample trees (Card Type 3) submitted in Type 3 and 4. This equation will be labelled as an equation for Pa in Type 3 and will have characteristics implied by the Site Code and Type Identity specified for Type 3. All Pa, Pw and Py trees (Card Type 2) in Type 3 and 4 with no heights will have their heights calculated by this one equation.
Example 3.	The height/diameter equation for PA in Type 3 is to be used to calculate the tree heights of all L and Pa trees in Type 3 with no heights.

If examples 2 and 3 were submitted in the same compilation, a height/diameter equation used would be produced from the grouped set of data defined by example 2. Example 3 would use this equation as described above. In addition, example 3 cannot request that the equation for species Pw or Py of Types 3 or 4 be used or that the equation for species Pa, Pw or Py of Type 4 be used because this equation is labelled for species Pa of Type 3.

Example 4.	When wanting to make one curve for all the species and there are too many species for one line, it can be continued on the next line(s). The first species and first type on each line must be repeated (otherwise they will each be treated as separate curves). The program will combine all these lines (in the example) and make one curve. The column 14 can be either 0 or 1.

Position 2 to 10

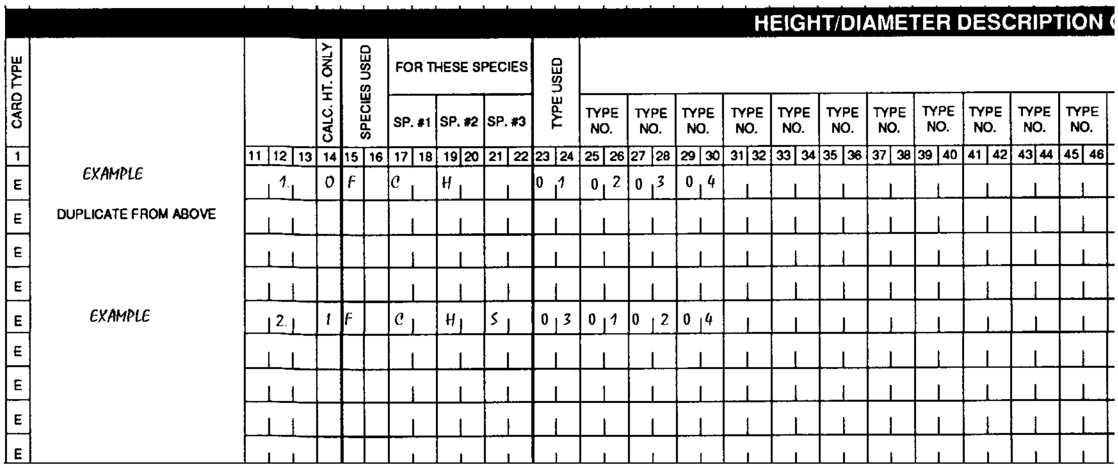
Common to all Card Types.

Position 11 to 13

Not used.

Position 14 Calculated Height Only

Code	
0 or blank	The sample trees from all the species (columns 15 to 22) and all the types (columns 23...) will be grouped together to calculate one height/diameter equation. The height from this curve will be used for all the plot trees of these same species and types.
1	Sample trees from only the species used (columns 15 to 16), and only the type used (columns 23 to 24) will be used to make an equation. The heights from this equation will then be applied to all the species (columns 15 to 22) and all the types (columns 23...).



HEIGHT/DIAMETER DESCRIPTION

CARD TYPE		11 12 13	CALC. HT. ONLY 14	SPECIES USED 15 16	FOR THESE SPECIES SP. #1 17 18	SP. #2 19 20	SP. #3 21 22	TYPE USED 23 24	TYPE NO. 25 26	TYPE NO. 27 28	TYPE NO. 29 30	TYPE NO. 31 32	TYPE NO. 33 34	TYPE NO. 35 36	TYPE NO. 37 38	TYPE NO. 39 40	TYPE NO. 41 42	TYPE NO. 43 44	TYPE NO. 45 46
1																			
E	EXAMPLE	1	0	F	C	H		0 1	0 2	0 3	0 4								
E	DUPLICATE FROM ABOVE																		
E																			
E																			
E	EXAMPLE	2	1	F	C	H	S	0 3	0 1	0 2	0 4								
E																			
E																			
E																			
E																			

Figure 7.4 Height/Diameter Description Card.

Card column *14* makes the difference in how the equation will be formulated.

Example 1.	if (column 14) is 0 it means; the sample trees from *all* the species listed (F, C, H) and *all* the types listed (1, 2, 3, 4) will be grouped together to make a curve. The heights for all F, C, H in types 1, 2, 3, 4 on card type 2 will be applied from this curve.
Example 2.	if column 14 is *1* it means: the sample trees from the first species- F - (columns 15 and 16) in the first type -3- (columns 23 and 24) *only* will be used to make a curve. The heights from this curve will *then* be applied to *all* the species in *all* the types as listed on that line.

Position 15 to 16 Species Used

If only one species is involved, enter that species. If more than one species is involved, enter the major species. All trees of the species in positions 17 to 22 and type No. in positions 23 to 80 will use this same equation.

Position 17, 18, 19 to 20, 21 to 22 For These Species

Enter the species, if any, which are to be grouped with the species entered in the Species Used position.

Position 23 to 24 Type Used

If only one type is involved, enter that type. If more than one type is involved, enter the type that has the Site Code and Type Identity (Card Type C fields) values which best describe the whole group being combined.

Positions 25 to 26, 27 to 28, ..., 78 to 80 for These Types

Enter the types, if any, whose species are to be involved in the grouping.

Type numbers must be zero filled (e.g., 01, 02, etc.).

7.6 Card Type F

Position 1 Harvesting Method Description

The sampling plan and the appraisal is made on the basis of the cutting authority area which may consist of several separate sub-units, namely Harvesting Methods.

Position 2 to 10

Common to all Card Types.

Position 11

This column is not in use.

Position 12 to 13 Harvesting Method

Enter the Harvesting Method Code within the cutting authority area.

SL	=	heli selection – land drop	Coast
SW	=	heli selection – water drop	Coast
FL	=	heli single standing stem – land drop	Coast
FW	=	heli single standing stem – water drop	Coast
HW	=	helicopter clear-cut - water	Coast
HL	=	helicopter clear-cut - land	Coast
HC	=	helicopter clear-cut	Interior
HS	=	helicopter selective	Interior
CC	=	cable clear-cut	Both
CS	=	cable selective	Both
LC	=	sky line clear-cut	Both
LS	=	sky line selective	Both
HO	=	horse	Interior

SC	=	ground system-clear-cut	Both
SS	=	ground system - selective	Both
SP	=	specified operation	Interior

Position 14 and 15 Type No.

Enter the Type Number of a type island, which is contained or partially contained by this Method. The numbers must correspond to Type Numbers defined by a previous Card Type C. The type No. must be zero filled (e.g., 01, 02, etc.).

Position 16

Not used.

Position 17 to 21, 22 to 26, etc.

Enter the number of merchantable hectares of the Harvest Method, which is part of this type and silviculture treatment unit. The sum of all of the areas for one type should equal the area specified for that type on the Card Type C.

7.7 Card Type G

Silviculture Treatment Unit Description - Positions 11 - 20, 21 - 30, etc.

Enter up to ninety-nine user coded descriptions so that individual treatment unit summaries will be identified by the coded descriptions.

7.8 Card Type H

Road Rights-of-way and Non-productive Area Descriptions.

Position 1

Card Type.

Postions 2 - 10

Common to all Card Types.

Postions 11 - 13

Block numbers.

Postions 14 – 18

Rights-of-way areas (hectares) removed under other licence.

Postions 19 – 28, 38 – 43, etc.

Other non-productive descriptions.

Postions 29 – 33, 44 – 48, etc.

Other non-productive area (hectares) removed from the gross block area.

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Stump Cruising 8

8.1 Introduction

The methods described in this chapter are prioritised by safety considerations and the most accurate answer obtainable.

- all species, including deciduous, must be tallied,
- all stumps and/or felled trees, including non-merchantable (species and size) must be tallied,
- timber merchantability specifications will be based on whether the unauthorized timber harvesting (UTH) occurred in Coastal or Interior administrative areas. Refer to Chapter 7,
- if the volume can be isolated through the official scale, then utilize the scale volume plus a residue and waste volume for the area, and
- if there are situations that arise and the following methods do not apply, contact the Regional Cruising Coordinator in the respective forest region.

8.1.1 General Procedures

The standards provide the basis for the sampling system to be used, and the rules for consistent and accurate measurement and compilation of the stumps and tree heights.

The application of a 100 percent stump cruise of an area is currently the most accurate method of volume determination available to the Ministry of Forests and Range in the absence of any timber due to unauthorized harvesting. The 100 percent stump cruise methodology eliminates the chance of statistical variation that may be attributed to plot sampling.

The regression coefficients and equations used in the conversion of stump diameter to diameter breast height (dbh) are listed in the February, 1989 FRDA publication "Stump and Breast Height Diameter Tables for British Columbia Tree Species", report #062. Crown cutting authorities specify a 30 cm stump height,

The following information must be provided with the volume estimate:

- the source of the tree heights – the sample tree heights must originate from the same BEC subzone and the same timber type,
- data listing or plot summaries and evidence of data reconciliation,
- age in 10s reported on tally card, to determine which loss factors were used in the compilation,

- traverse sheets should all be signed and type of instruments used recorded,
- the notes recorded correctly and ground slope recorded which is required to calculate horizontal distance.(i.e., HD = Cos(1/Tan(slope%/100)), and
- maximum closing error allowed is 1 percent. However, if the UTH is a 100 percent cruise an area measurement is not required to compile volume. An area is required if there will be a penalty rate set on a per hectare basis or if the stump cruise is a fixed area plot sample.

The reliability of the estimate is a function of the following:

- the degree of fit of the stump to dbh conversion equations, volume equations, loss factors and height curves to the harvest area,
- the non-sampling error (fieldwork), and
- the accurate transfer of data to the compilation program.

8.1.2 Stump Cruising - Volume Calculations

The detailed compilation of stump cruise data is as follows:

- the species, age and Forest Inventory Zone (FIZ) that the stump cruise area is located in determines the regression coefficients used in the regression equation that is used to convert the stump diameter inside bark(dib) and stump height measured from the point of germination (POG) to an equivalent dbh outside bark (dob). Refer to Figure 3.11 and Figure 8.1 for point of germination illustrations. The stump dib may be measured in centimetres (cm) or radius class units (1 rad = 2 cm) and the stump height is measured in cm. The POG is used for measuring stump height because the stump to dbh conversion equations are based on POG.

Tree heights are measured from an adjacent and similar timber type for each major species (comprising 20 percent or more of the volume on the area) in the stump cruise and these are used to produce height diameter curves by the compilation program. Minor species (comprising less than 20 percent of the volume on the area) can be grouped with a major species within the same forest type or have their own height curve produced provided that there are 20 or more height samples collected. The compilation program analyzes various mathematical descriptions of the curve and selects the curve with the lowest standard error of the estimate for volume.

- The tree data is now in standing tree format. The tree volume is calculated by the Kozak taper equation in the compilation program that has specific coefficients for the species and the FIZ group that the area is located in. The equation produces a gross tree volume for the tree from the dbh outside bark (dob) and height that is assigned to the tree from the height diameter curve, and

- the net volume factors for decay, waste and breakage (DWB) by FIZ, species, diameter class, and risk group are then applied to reduce the gross volume to a net merchantable volume. Reference is the Ministry of Forests publication - "Metric Diameter class Decay, Waste and Breakage Factors, All Forest Inventory Zones - 1976". This is the volume from the measured stump height (cm) to a minimum top dib (cm) specified in the cruise control card or Map Area Statement minus an allowance for DWB. The DWB deductions are based on Ministry of Forests Inventory decay and taper data collected for all commercial species and the data is partitioned into Forest Inventory Zones. In some circumstances local factors apply to a portion of a FIZ. All volumes are reported in cubic metres by species and summed.

8.1.3 Sampling Errors

Potential sources of sampling errors are:

- variation between the decay, waste and breakage for the Forest Inventory Zone versus the actual site. The age in 10s and tree classes recorded on the stump cruise tally cards determine the maturity class and risk group,

- variation between the equation to convert from stump diameter to dbh versus the actual dbh. The standard error for spruce noted in FRDA report 062 is as follows:

> Spruce: 1.46 cm - coefficients are based on a sample of 3054 trees in FIZ's K and L.

- variation between the calculated tree volume based on the volume equation and the actual volume. The only way to measure this variation is to fall/buck and scale trees from the same timber type that was harvested and perform a taper study, and

- variation between the height diameter curve and the actual tree heights for the harvested trees. The important factors are that the timber type used for the source of the tree height data is similar to the harvested timber type and the full range of diameter classes measured in the stump cruise are represented in the height curves.

8.2 Boundaries

- Locate legal survey posts and confirm the boundary location. Re-establish cut block boundaries from original traverse notes if necessary,
- closed traverse the UTH area to the tolerances set out in Section 3.6.3.1 of the Cruising Manual (CM) under cruise based allowable errors, and
- if the unauthorised harvest will result in an administrative penalty under Section 117 of the Forest Practices Code Act, then a closed traverse of the area will be required since the penalty levied is in dollars per hectare.

8.3 Measurement Methods

The following methods are listed in order of preference. If stumps are lower than 30 cm height at the point of germination (POG), record the actual height as the additional volume removed will be included with the UTH volume in the compilation.

8.3.1 Method 1: Areas Less than 10 ha

Conduct a 100 percent cruise of the trees if the trees are still full length. If the trees have been bucked into log lengths, scale them as per scaling procedures outlined in the Scaling Manual.

If the UTH area is within a homogeneous pine or pine and spruce timber type of a density of 1 000 stems per hectare or more and greater than 3 ha, method 2 may be used.

8.3.2 Method 2: Areas Greater than or Equal to 10 ha

The sampling intensity must be sufficient that a sampling error of plus or minus 8 percent is achieved at the 95 percent confidence interval.

If the sampling error cannot be achieved, establish 400 m2 (0.04 ha) plots at an intensity to cover at least 10 percent of the area. A grid spacing of 60 m should be sufficient to ensure a plot coverage of 10 percent of the area.

Establish 400 m^2 (11.28 m radius) fixed area plots on a systematic grid. Record all of the necessary information for each tree represented by an "in the plot stump"(i.e., pith of stump is within 11.28 m of plot centre).

8.4 Tree Heights

Tree heights must be selected from a similar timber type and nearest adjacent area wherever possible. Adjacent height curve equations from existing data may be acceptable if the data is validated in the field.

8.4.1 Stump Cruise Tally Sheet (FS 205S)

8.4.1.1 Card Type 9

Record the Enforcement Action Administrative Review and Appeals (ERA) system case file number (i.e., DPA960001) in the licence and cutting permit header box. The first three characters identify the administrative organization unit, the next two characters identify the fiscal year, and the last four characters identify the number of the incident in the Administrative Organizational Unit (AOU) for the reporting year. The ERA file number must be recorded in the locality description boxes in Card Type A of the Map Area Statement.

Complete the FS 205S stump cruise tally sheet and sign and date each one.

Code column 26 of each stump cruise tally sheet with a unique letter (A to Z) and/or number (0 to 9). This code will simplify the field data reconciliation of the cruise compilation. Also see Section 7.2 of the Cruising Manual for the correct coding of the map area statement stump cruise codes.

If the stump cruise is 100 percent measure, do not enter a plot size in the fixed area plot size on card type 9. Enter an "A" in column 77 of the map area statement. This field will be overridden by the type areas in the map area statement, card type D.

The stump cruise tally sheet, Card Type 3 tree heights must be assigned unique tree numbers from the Card Type 2s on the same tally sheet. The tree heights may be entered on a separate tally sheet if necessary, however the plot must be used in the determination of the plot size calculation and assigned a unique plot number.

8.4.1.2 Card Type 3

Position 2 – 24

Common to Card Type 1 and 2.

Position 25 and 26 Tree Number

Sample trees must be numbered 99, 98, 97, etc. to prevent confusion with stumps numbered on the plot.

Position 27 – 29 Total Height

Enter the calculated height plus correction if any as arrived at from the readings in the green shaded columns in the right-hand columns.

Position 30 and 31 Species

As per "Tree Details" (see Section 6.3.2).

Position 32 – 35 DBH

As per "Tree Details" (see Section 6.3.2).

Position 36 C/C Crown Class

Enter the Crown class for the tree by number code as shown in the box on the reverse side of the field sheet.

1 = Dominant (D)	Trees with crowns extending above the general level of the crown canopy. They are somewhat larger than the average and have well developed crowns, which may be somewhat crowded on the sides.
2 = Codominant (C-D)	Trees with crowns forming the general level of the crown canopy. The crown is generally smaller than that of the dominant trees, and usually more crowded on the sides.
3 = Intermediate (Int.)	Trees with crowns below, but still extending into the general level of the canopy. The crowns are usually small and quite crowded on the sides.
4 = Overtopped (O)	Trees with crowns entirely below the level of the canopy.

Position 37 – 39 Total Age (see Section 3.5.9.1)

The age of at least three codominant sample trees for each major species must be established for each forest type if the age of the forest type is as follows:

- coniferous – 90 to 150 years,
- deciduous – 20 to 60 years, or
- aspen/cottonwood (FIZ K and L) – 50 to 170 years.

In order to do this, measure the total height for each tree that will be sampled for age (total height is from "high-side" to the trees top or highest point). If the age of the forest type is not within the above limits, the age of at least one codominant sample tree for each major species must be established for each forest type.

Each age is calculated as follows:

1. Boring Height – always 1.3 m above high-side (breast height).
2. Breast Height Age – enter the age of the tree measured at the boring height according to the ring count (pith counts for one year).
3. Correction – use the Site Index Curves and Tables for BC in Appendix 9.. Go to the bottom of the appropriate Site Index Table and note the "Years to bh" (Years to boring height) correction value based on the top height and counted age at DBH for the tree.
4. Total Age – the sum of the Breast Height Age and the Correction.

Position 40 Partial Cutting

L	Leave tree.
Blank or C	Cut tree.

8.4.2 Major Species (20 percent or more of the UTH area gross volume)

A minimum of 20 tree heights per major species per timber type evenly distributed throughout the full range of diameters at breast height (DBH) represented on the UTH area.

8.4.3 Minor Species (less than 20 percent of the UTH area gross volume)

The following options are listed in the order of preference.

8.4.3.1 Option 1

Select a minimum of 10 tree heights per minor species per timber type and evenly distributed throughout the full range of stump diameters measured on the UTH area. This data will be used to produce a height diameter curve.

8.4.3.2 Option 2

Combine the minor species with another species within the same timber type and with a similar height/diameter relationship.

8.4.3.3 Option 3

In situations where only a few trees of a high value species are present, consider the following method.

Measure two or more standing trees of the same species and 5 cm diameter class outside bark at the equivalent stump height as the stump measurement. Calculate the average for the measured tree heights for assignment for the minor species stump.

8.5 Timber Available For Measuring

This method can be used if the timber is safe to measure and the cruiser or scaler can confirm which tree originated from which stump.

The following points apply to all options under Section 8.5.

8.5.1 Tally Card - FS 205S

Use the FS 205S stump cruise tally sheet unless the timber is being scaled. If the timber is scaled, use the FS 161 residue and waste tally sheet.

Record the Enforcement Action Administrative Review and Appeals (ERA) system case file number (i.e., DPA960001) in the licence and cutting permit header box. The first three characters identify the administrative organization unit (AOU), the next two characters identify the fiscal year, and the last four characters identify the number of the incident in that AOU for the reporting year. The ERA file number must be recorded in the locality description boxes in Card Type A of the Map Area Statement.

Code column 26 of each stump cruise tally sheet with a unique letter (A to Z) or number (0 to 9). This code will simplify the field data reconciliation of the cruise compilation. Also see Section 7.2 of the Cruising Manual (CM) for the correct map area statement stump cruise codes.

8.5.2 Field Measurements

If performing a cruise of the felled trees, complete the FS 205 cruise tally sheet as you would for a regular fixed area cruise and record all of the necessary information including pathological indicators and quality remarks. The cruiser must sign and date each tally card.

Record the total length of each tree in the height field and include the height of the stump in the total tree length.

Record the dbh of the felled trees and take the stump height into account when determining dbh. Use the FS 205S stump tally sheet if the decision is made to measure the stump heights and diameters. Record the total tree lengths in the margin of the tally sheet beside each stump tally.

All stumps and corresponding trees must be numbered. Each stump and its corresponding tree must be numbered with the same unique number.

8.6 All Stumps Removed From the UTH Area (i.e., Land Cleared, Road has Been Built)

8.6.1 Option 1

Perform a variable plot cruise or fixed area cruise in the adjacent timber as per the Cruising Manual to determine the net volume per hectare.

Measure the length of the timber edge along the UTH area and equally space the plots along that edge.

8.6.2 Option 2

Use adjacent cruise information for the net volume per hectare if the timber types were the same on the forest cover map.

8.6.3 Option 3

Use aerial photographs (approximate scale 1:3000 is recommended) taken before (pre) and after (post) the UTH occurred. Ensure that pre and post aerial photos are enlarged to the same scales for photo interpretation. Use the following procedure to determine a volume estimate for the UTH:

1. A qualified photo interpreter should be utilized to identify the tree count by species removed from the UTH cleared area based on the pre-harvest and post harvest aerial photographs. The UTH boundary must be transposed to the aerial photographs using legal map references and iron pin (legal references) found on site.

2. Field staff must attend the site and measure tree heights and diameters at breast height (dbh) for all species identified on the pre-harvest aerial photos as cut from the UTH area. Selected measured trees of various heights must be stem mapped with bearing and distance recorded to points on the ground that are visible on the post-logging aerial photograph. This will assist the photo interpreter in determining the tree heights of the cut trees on the pre-harvest aerial photographs.

3. The tree height and dbh data collected for the removed trees must be plotted onto a height diameter curve by species (x-axis dbh, y-axis height). The height/diameter relationship can now be used to interpolate tree diameters for the tree heights provided by the photo interpreter for the removed trees.

4. Using the tree heights provided by the photo interpreter and the diameters interpolated from the height diameter curve, compute a merchantable volume for the UTH using the cruise compilation program.

8.7 Portions Of Trees Removed (i.e., Shake Blocks or Special Forest Products Removed From a Segment Of Tree(s))

Use the residue and waste tally sheet FS 161 to record the missing and remaining portions of the tree using scaling procedures as per the Scaling Manual. Code the missing portion(s) as "A" for remaining and "U" for missing under the "Waste/Residue Class" column. These codes will permit segregation of the removed and remaining volumes in the Block Type Summary Report of the residue and waste systems reports.

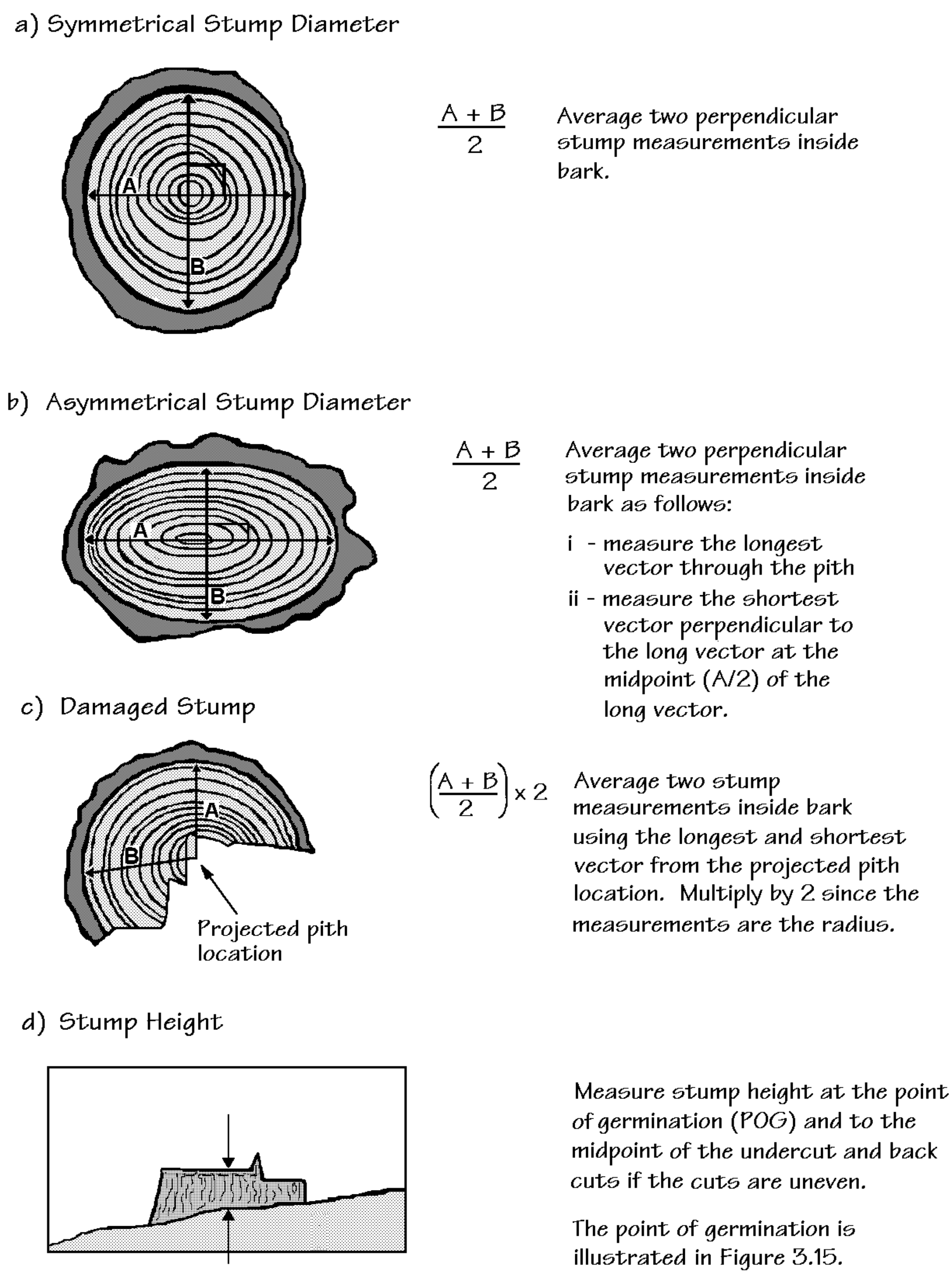
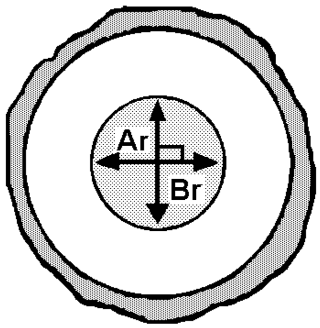


Figure 8.1 Examples of Recommended Stump Measurements.

a) Stumps with Heartrot > 50% of stump diameter

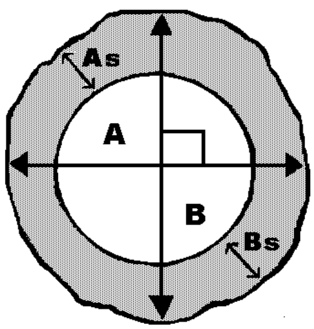


i determine stump diameter inside bark using long and short vectors - $\frac{A + B}{2}$

ii determine the rot diameter using long and short vectors - $\frac{Arot + Brot}{2}$

iii if the rot diameter is greater than 1/2 the stump diameter, record scar or scar & frost crack (refer to Section 8.6.4.1) to ensure that the stump is compiled as Risk Group 2.

b) Dead Stumps



i determine stump diameter inside bark using long and short vectors - $\frac{A + B}{2}$

ii determine average thickness of the sap rot - $\frac{As + Bs}{2}$

iii if the average sap rot thickness is 1/6 or more of the average stump diameter, record the stump as a tree class 4 (dead useless). If not, record the stump as tree class 3 (will be compiled as highest risk group).

Figure 8.2 Examples of Risk Group Determinations for Stumps.

BRITISH COLUMBIA

STUMP CRUISE TALLY SHEET

58	59	60	61
YEAR		MONTH	

CT	LICENCE NO.	C.P. NO.	BLOCK	STRIP	PLOT	Ø/C	TYPE NO.	AGE 10'S	HT. (m)	PLOT TYPE	PLOT CARD SEQ		MAIN PLOT SIZE HECTARES or B.A.F.	F/H/B	D.B.H. LIMIT	SUB-PLOT SIZE HECTARES or B.A.F.	F/H/B	D.B.H. LIMIT	HARV. METHOD	SLOPE PERCENT
1	2 3 4 5 6 7	8 9 10	11 12 13	14 15	16 17	18	19 20	21 22	23 24	25	26		27 28 29 30 31 32 33 34 35	36	37 38 39	40 41 42 43 44 45 46 47	48	49 50 51 52	53 54	55 56 57
9																				

	STUMP NO.	STUMP HEIGHT (cm only)	SPECIES	D.S.H. ☐ cms ☐ rads INSIDE BARK	TREE CLASS	CONK	SCAR	FROSTCRACK		STUMP NO.	STUMP HEIGHT (cm only)	SPECIES	D.S.H. ☐ cms ☐ rads INSIDE BARK	TREE CLASS	CONK	SCAR	FROSTCRACK		STUMP NO.	STUMP HEIGHT (cm only)	SPECIES	D.S.H. ☐ cms ☐ rads INSIDE BARK	TREE CLASS	CONK	SCAR	FROSTCRACK
1	23 24 25 26	27 28 29	30 31	32 33 34 35	36	37	39	41	1	23 24 25 26	27 28 29	30 31	32 33 34 35	36	37	39	41	1	23 24 25 26	27 28 29	30 31	32 33 34 35	36	37	39	41
2									2									2								

FS 205S HVA 2001/02

Please be advised that this information may be released under the *Freedom of Information and Protection of Privacy Act*.

Figure 8.3 FS 205S Ministry of Forests Stump Cruise Tally Sheet.

	STUMP NO.	STUMP HEIGHT (cm only)	SPECIES	D.S.H. ☐ cms ☐ rads INSIDE BARK	TREE CLASS	CONK	SCAR	FROSTCRACK		STUMP NO.	STUMP HEIGHT (cm only)	SPECIES	D.S.H. ☐ cms ☐ rads INSIDE BARK	TREE CLASS	CONK	SCAR	FROSTCRACK		STUMP NO.	STUMP HEIGHT (cm only)	SPECIES	D.S.H. ☐ cms ☐ rads INSIDE BARK	TREE CLASS	CONK	SCAR	FROSTCRACK
1	23 24 25 26	27 28 29	30 31	32 33 34 35	36	37	39	41	1	23 24 25 26	27 28 29	30 31	32 33 34 35	36	37	39	41	1	23 24 25 26	27 28 29	30 31	32 33 34 35	36	37	39	41
2									2									2								

SAMPLE TREE DETAILS

	TREE NO.	TOTAL HEIGHT (m)	SPECIES	D.B.H. (cm)	C/C	TOTAL AGE	SEL	COUNTED AGE	COR	S.H.	HEIGHT CALCULATIONS TOP	BOT	TOT	SD	S	HD	HT	COR
1	25 26	27 28 29	30 31	32 33 34 35	36	37 38 39	40											
3																		

	TREE NO.	TOTAL HEIGHT (m)	SPECIES	D.B.H. (cm)	C/C	TOTAL AGE	SEL	COUNTED AGE	COR	S.H.	HEIGHT CALCULATIONS TOP	BOT	TOT	SD	S	HD	HT	COR
1	25 26	27 28 29	30 31	32 33 34 35	36	37 38 39	40											
3																		

ECOSYSTEM	DATE Y M D	CRUISED BY (PRINT)	CHECKED BY (PRINT)
SNOW DEPTH	DATE Y M D	SIGNATURE (I certify that this is a true statement of sampling done by me at the place shown.)	SIGNATURE

Figure 8.4 FS 205S Ministry of Forests Stump Cruise Tally Sheet (side 2 of 2).

Coast Forest Region - Regional Guidelines 9

9.1 Coast Forest Region Operational Cruising Requirements

9.1.1 Information Sources Regarding Policy and Procedures

Current cruising policies and procedures are outlined in the following publications and circulars:

1. Ministry of Forests and Range, *Cruising Manual*.
2. Coast Forest Region Operational Cruising Requirements (Chapter 9.1 of the *Cruising Manual*) and *Coast Call Grade Net Factor Standards and Procedures*:

   http://www.for.gov.bc.ca/hva/manuals/cgnf.htm

3. Information letters from the Coast Forest Region as a result of the Coastal Cruising Seminars.
4. Ministry of Forests and Range Policy Manual.
5. *Forest Act*.

9.1.2 Tenures Requiring an Operational Cruise

All tenures subject to a stumpage appraisal must normally be cruised. The regional executive director may grant exemption to this requirement in specific cases.

9.1.3 Submission of Cruise Plans

9.1.3.1 Individual Cruise Plans

Licensees must submit cruise plans to the Ministry of Forests and Range district office 30 days prior to commencement of a cruise. This includes submission of cruise plans for all amendments to existing cutting permits and for all blocks that have more than four plots added to the old cruise information. The 30 days will commence on the date the plan is received (stamped) at the district office.

Cruise plans must be submitted to the appropriate district containing all mandatory information listed below.

District staff are not required to approve or disapprove cruise plans.

Submission of cruise plans is required to allow the district to know how much cruising is being done, when and where, so they can conduct the necessary check cruising.

The following information is mandatory on a cruise plan:

- tenure, including block numbers,
- area (ha) by block,
- inventory timber types (i.e, HB 941-M)
- plot grid (i.e., 100 m by 100 m),
- number of measure and count plots or ratio of measure plots to count plots,
- dates of cruising,
- cruise plan map,
- access (vehicle, helicopter, boat, plane, etc.)
- block maturity (if known), and
- who the cruiser(s) will be (if known).

All other information is optional, unless specified by contract, but will assist the district or BC Timber Sales (BCTS) in carrying out a check cruise.

Cruise plans must be submitted to the appropriate district manager containing all mandatory information listed above. The Provincial Cruise Plan form is located in this manual, in the chapter called Forms, however, any form that includes the necessary information is acceptable.

Cruise plans may be faxed to the district office.

> The scale of the cruise plan map cannot exceed 1:5 000.

9.1.4 Acceptability of Cruise Data

9.1.4.1 Check Cruising

9.1.4.1.1 Benefit of the Doubt

Cruising and its related measurements can involve subjectivity.

Decisions based on opinion or a range of acceptable values, where no clear decision can be made based on fact, will be accepted based on the adage “the benefit of the doubt goes to the operator". Due diligence must be recognized by the check cruiser. Due diligence is the standard of care that a reasonably prudent person would take in those particular circumstances. The intent of "Benefit of the Doubt" is not to condone poor quality work errors.

Once a cutting authority area has been selected for check cruising, the licensee must bring along or supply the district with a map and field notes which allow the ministry check cruiser to check actual plot locations, timber types, POC(s) and tie-point(s).

The plots to be checked must be randomly selected without reviewing the cards to determine which plots will be checked, or the results on the checked plots cannot be applied to the rest of the plots for that cruise.

If the check cruiser decides to only check a specific part of a cruise (i.e., timber type, type of plot, cruiser) the results of that check cruise can only be applied to that part of the cruise that was specifically checked (i.e., timber type, type of plot, cruiser).

With the submission of cruise plans in accordance with the 30-day rule, the Ministry of Forests and Range will have the capability to initiate and carry out a check cruise while the cruisers are on site. This does not preclude a check cruise at any time after the cruise is completed.

Where the cruise plan has been submitted 30 days prior to commencement of cruising, and no check is carried out while the cruisers are on site, the basic field data will not normally be contested at a later date, subject to "Use of Older Cruise Data" below.

The tolerance for species identification is changed to:

Species Identification	
Trees Checked	**Allowable Error**
1 to 50	1 tree incorrectly identified
51 to 100	2 trees incorrectly identified
101 to 150	3 trees incorrectly identified

9.1.4.2 Use of Older Cruise Data

1. In mature stands where increment is very slow and decay would offset the growth after the cruise was carried out, the cruise data will be considered acceptable if the cruising was done within the last ten (10) years.

2. In immature stands, cruise data will be considered acceptable if the fieldwork was completed within the past five (5) years.

3. New cruise data must be collected if there is a major change in the stand condition as a result of fire, insect, disease or wind throw (refer to Section 9.1.11 - Cruising Damaged Stands and Exceptional Circumstances).

Notwithstanding the above, policy changes may necessitate cruise data to be updated.

Where there is doubt as to the applicability of the cruise data, it is the prerogative of the District Manager to request evidence that the cruise data still accurately depicts the stand parameters.

When a re-cruise is necessary, it will be mandatory that a cruise plan be submitted to the District Manager.

9.1.5 Technical Criteria

All distances in this circular are horizontal distances (corrected for slope).

9.1.5.1 Sampling Error Requirements

Where the sampling error requirement is achieved and cruise grades will not be used in the appraisal, there is no required minimum number of trees per plot.

Where cruise grades will be used in the appraisal the minimum tree count must be met even if the sampling error requirement has been achieved.

When the count plots are used in conjunction with full measure plots, all information must be used for determining if the sampling error requirement has been met, provided that a ratio of three (3) count plots to one (1) full measure plot is not exceeded.

The procedure for dealing with potential orphan (not recorded in a measure plot) species in a count plot during the fieldwork, is to record the measure information for all instances of that orphan species in the first count plot that you encounter that minor species. Move the tree(s) into the nearest measure plot in the same timber type. Record the tree number as 99, 98, etc.

If the orphan species is subsequently measured in a measure plot, then return the count plot orphan tree(s) to their respective count plot and remove the measure data for those trees from the plot card. Consideration will be given to waiving the sampling error if the minimum sampling error requirement is exceeded due to the shift in the tree count.

The options for dealing with an orphan (not recorded in a measure plot) species in a count plot after completion of the fieldwork are:

- Change the orphan species to a species with a similar tree form and value (if available) or,
- Delete all the count plots in that timber type from the compilation, or
- Return to the field and convert the count plot orphan tree to a measure tree and move it to a measure plot.

The standards for judging whether the sampling error requirement was met will be the standards in place at the time the cutting authority area was cruised.

Scale Based - Clear-cut and Partial-cut

> Sampling Error Requirement = 15 percent sampling error at two (2) standard errors (95 percent confidence level).

The sampling error requirement will be waived where:

1. For cutting authorities of 20 ha or larger in size:

    a. A 100 meter by 100 meter, systematic grid has been established, a ratio of one count plot to one full measure plot has not been exceeded and the minimum tree count requirement of an average of 4.0 trees per plot has been met.

    b. A 70 meter by 70 meter, systematic grid has been established, a ratio of one count plot to one full measure plot has not been exceeded and the minimum tree count requirement of an average of 2.0 trees per plot has been met.

c. A 50 meter by 50 meter, systematic grid has been established, a ratio of one count plot to one full measure plot has not been exceeded and the minimum tree count requirement of an average of 1.0 trees per plot has been met.

2. For cutting authorities less than 20 ha in size:

a. A 100 meter by 100 meter, systematic grid of full measure plots has been established and the minimum tree count requirement of an average of 4.0 trees per plot has been met.

b. A 70 meter by 70 meter, systematic grid of full measure plots has been established and the minimum tree count requirement of an average of 2.0 trees per plot has been met.

c. A 50 meter by 50 meter, systematic grid of full measure plots has been established and the minimum tree count requirement of an average of 1.0 trees per plot has been met.

- Excludes live useless and dead useless trees.

If more than one cruise plot grid is used in a cutting authority then the minimum tree count requirement must be achieved individually for each of the grids before the sampling error is waived.

> The number of trees per plot is calculated to the nearest tenth and not rounded up to the nearest whole number (i.e., 3.6 does not round up to 4).

Cruise Based Sales

Cruise based sales will only be approved when the Regional Executive Director, or delegated district manager is satisfied that:

1. The loss factors, taper equations, and grade/quality standards proposed for use are appropriate, and that

2. Utilization will be improved compared to scale based sales, or

3. Administration will be simplified.

Sampling Error Requirement = 8 percent sampling error at two (2) standard errors (95 percent confidence level).

Count plots may be used in determining if the above requirement has been met. Proposed cruise based sales where the timber is very valuable or patchy, will be reviewed by the Regional Executive Director or designate, to determine if the above requirement should be accepted or changed.

For more information on cruise-based sales and their requirements, refer to Section 8.16 of the *Ministry of Forests and Range Policy Manual*, which is located on the Internet at:

http://www.for.gov.bc.ca/tasb/manuals/policy/resmngmt/rm8-16.htm

9.1.5.2 Sampling Patterns

The cruise grid must be square or rectangular and oriented in cardinal directions (N-S, & E-W) (unless otherwise approved by the district in a cruise plan). Do not use a staggered grid.

To determine your plot locations start at the most south-westerly point of the block and measure in one-half (1/2) of your grid distance at N45E to set your base plot. Using the base plot lay your plot grid on the map oriented in cardinal directions (N-S & E-W) to determine your plot locations. You can start anywhere on the edge of the block and tie-in to the nearest plot. Plot locations determined by plot grids that cover the entire map sheet and UTM grids are preferred. The district must approve use of a different method for randomly determining your base plot.

The direction of travel between plots is at the discretion of the cruiser, but must be clear to the ministry check cruiser.

Collection of slope information necessitates the implementation of fully systematic cruise designs in order to assure representative sampling over the entire cutting area.

A minimum of two (2) full measure plots per cutting authority area is required.

A minimum of one (1) full measure plot per timber type is required although two or more is strongly recommended. Plots should proportionally represent timber type areas.

9.1.5.3 Plot Data

All information on the Ministry of Forests and Range cruise tally sheet (FS 205) relevant to the appraisal and compilation of the data must be collected.

It is recommended that quality remarks (live limb, stub, knots, and spiral grain) be collected on all cruises in case they end up being required for appraisal purposes.

Where age collection is necessary, sufficient ages must be taken to record the appropriate tree class for proper loss factor determination.

Quality Remarks

Quality remarks (live limb, stub, knots and spiral grain) should be collected on all cruises, but will not be grounds for rejecting a cruise on cutting authorities where the cruise grades will not be used in the appraisal.

Quality remarks that exceed the allowable non-sampling errors in Section 3.6 of the *Cruising Manual* will be grounds for rejecting a cruise where the cruise grades will be used in the appraisal (i.e., BCTS sales, woodlots, helicopter standing stem and cutting authorities with eighty (80) percent or greater second growth).

It is strongly recommended that quality remarks be called accurately on all cutting authorities in case cruise grades end up being required for the appraisal. Not calling quality remarks on the initial cruise could result in having to re-visit the cutting authority area.

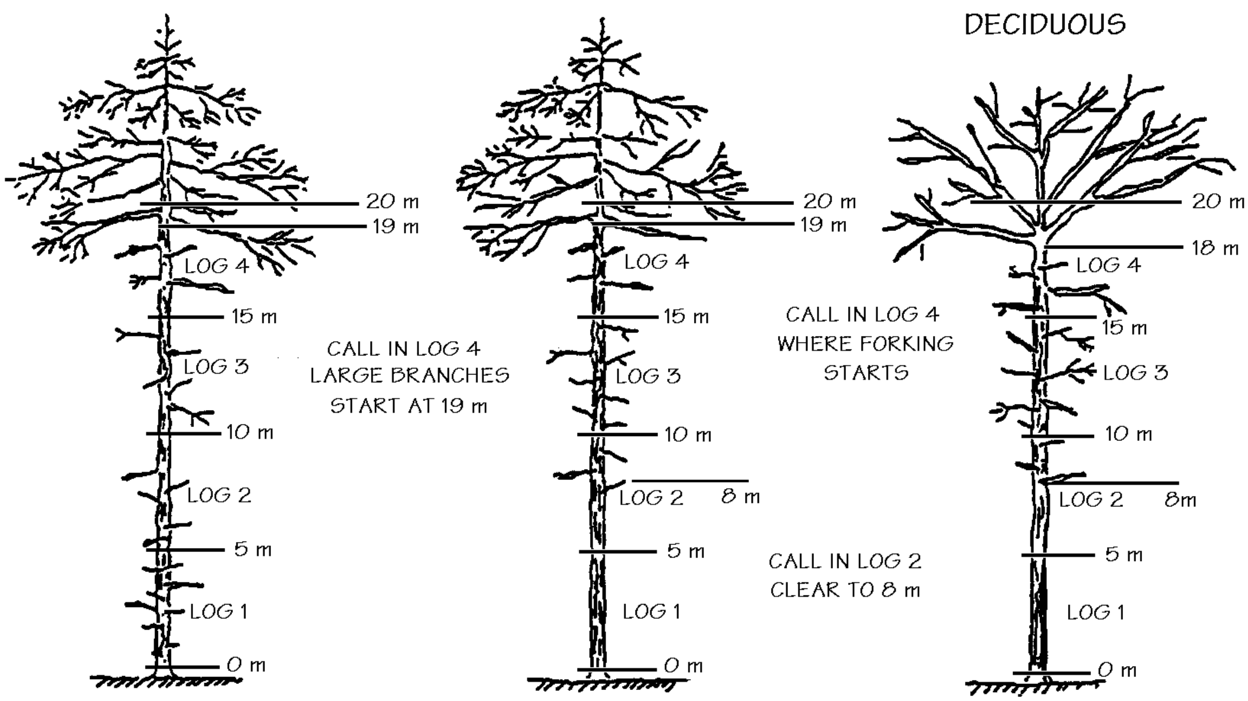


Figure 9.1 Example of Live Limb.

Live Limb (Grade Change)

Live limb (grade change) is defined as the 5 meter log where quality changes from:

- no knots to knots or knot indicators,
- from small knots to large knots, or
- from well spaced knots to excessive knots.

The purpose of recording live limb is to identify the first grade change as you move up the tree.

This will assist the log grade algorithm to better determine the cruise grade distribution produced by the cruise compilation program.

If the branching is consistent in frequency and size from the base of the tree to the timber merchantability specifications top diameter of the tree, record live limb as a one (1).

The grades on trees smaller than 55 cm dbh are not affected by the live limb code.

On deciduous trees, live limb is recorded as the 5 meter log where the natural forking starts.

Pathological Indicators

Pathological Indicators located above 10 cm top diameter (inside bark) are not to be recorded.

If the pathological indicator is close to the 10 cm top diameter, use your judgement and call it either above or below.

Benefit of the doubt goes to the cruiser.

Fork or Crook versus Dead or Broken Top

If there is a merchantable log (3 meters long to the timber merchantability specifications top diameter) above the crook, you call the injury a fork or crook.

If a merchantable log does not exist above the crook, call it a dead or broken top. Definite forking is always called a fork or crook and not a dead or broken top.

Benefit of the doubt goes to the cruiser.

9.1.5.4 Prism Size (Basal Area Factor)

Any prism size (BAF) may be used provided that a prism is available for use during a check cruise.

The same prism size (BAF) should be used throughout a timber type but since the use of more than one prism size (BAF) does not necessarily constitute bias, each situation (where more than one prism is used in a timber type) should be assessed individually.

However, prism size (BAF) cannot be changed at plot centre to include or exclude certain trees, or to achieve a pre-determined number of trees in a plot, as that constitutes bias.

9.1.5.5 Heights

The 100 Percent Height Method must be used on all scale and cruise based tenures.

Use of the Sample Height (height curve) Method is only allowed for stump cruises and stands which are severely damaged due to wind shear or shatter due to freezing (i.e., most of the trees have their tops broken off). Use of the sample height method must be identified in the cruise plan and approved by the district.

9.1.5.6 Field Marking and Procedures

Tie Points

The cruise must be tied to at least one (1) and preferably two (2) tie points. They must be good photo ties, falling corners, GPS positions, or unique map locations. Tie points must be linked to the cruise grid with an accurate traverse.

The use of axes has long been an accepted practice in timber cruising. Safety concerns have been raised regarding the mandatory use of axes in timber cruising. Therefore, the use of axes in timber cruising is not mandatory. Using an axe to blaze reference trees, sound trees to assess percent decay or chop into trees to determine their percent soundwood content is at the discretion of the cruiser or their employer. Please note that the check cruiser may use an axe to make their final determination.

Point of Commencement (POC)

Mark your POC on the boundary or edge of the area being cruised and tie-in to the nearest plot on the plot grid.

Cruise Lines (Striplines)

Cruise lines should be tied to the block boundary, where available.

Cruise lines should be established using a compass with a clinometer and tape, or an electronic measuring device.

Good quality, legible strip notes which clearly indicate what was done, why it was done and who did it are important for determining accurate plot locations and timber type boundaries.

Plot Centres

Plot centre must be marked (i.e., wire flag, stake, spike, etc.) for all plots (full measure and count). Moving plots centre (i.e., to a tree or rock) is not permitted.

If the plot centre falls within the area being sampled the plot must be established.

The strip and plot number must be marked on the plot centre and/or the reference tree.

A reference tree must identify the bearing and distance to plot centre. The information on the reference tree must also be noted on the cruise card in case the information is missing or unreadable.

Slope

Record the most severe plot slope measurement from plot centre to a point 15 meters slope distance. The plot slope reading must be taken within the harvest area and can’t be taken from a conventional harvest method area into a helicopter harvest method area if the harvest method boundary is known when the fieldwork is performed.

~~Plot slope is now a significant factor in appraising all harvest methods with the exception of helicopter.~~

It is recommended that a ribbon be hung at the point where the plot slope was taken since plot slope measurements will be closely monitored during check cruises.

Plot slope must be recorded in both measure and count plots.

~~Plot slope is now a factor in appraising all harvest methods with the exception of helicopter.~~

Tree Identification

All trees determined to be within a measure plot will be numbered, where safely possible, with paint or a tag with the number facing plot centre.

The diameter at breast height (dbh) will be marked at 1.3 m above the ground on the high side with a paint stripe facing plot centre.

For count plots, number the first tree and paint an arrow on that tree showing the direction of travel. Number enough trees so that plot can be checked.

Borderline tree measurements must be recorded on the cruise card or on the tree. Trees measured out should be marked with OUT or an X on the stem facing plot centre.

Block Boundary

In situations where the road is the block boundary and only the road centreline has been established, the centreline of the road will be considered the block boundary for the purpose of determining whether a plot is established or if any trees need to be doubled as per the Walkthrough Method.

9.1.5.7 Diameter at Breast Height Measurement (DBH)

1. Coniferous Species

    a. Mature

        A stand of timber that has an average age greater than 120 years.

        Minimum DBH is 17.5 cm at 1.3 m above the ground on the high side.

    b. Immature

        A stand of timber that has an average age less than 121 years.

Minimum DBH is 12.0 cm at 1.3 m above the ground on the high side.

2. Deciduous Species

   a. Mature

      A stand of timber that has an average age greater than 40 years.

      Minimum DBH is 17.5 cm at 1.3 m above the ground on the high side.

   b. Immature

      A stand of timber that has an average age less than 41 years.

      Minimum DBH is 12 cm at 1.3 m above the ground on the high side.

> Age in Tens must be recorded on each cruise card to help ensure that the block is correctly compiled as mature or immature and that the correct loss factors are used for each tree in the compilation.

Second Growth Clarification

> Effective April 1, 1999 the *Coast Appraisal Manual* revised the definition of second growth timber to the following:
>
> Second growth coniferous timber, for the purposes of timber pricing, is defined as being less than 141 years old.
>
> The volume of mature and second growth timber will be compiled on a tree basis and the percentage of the total coniferous cutting authority area volume represented by the second growth timber will be calculated.
>
> Using this calculated percentage, any cutting authority area that contains 80 percent or greater second growth coniferous timber volume will be appraised as second growth timber using a Second Growth Average Market Value schedule.

We must be careful not to confuse the above definition of second growth coniferous timber with immature. Only trees under 121 years old are considered to be immature. Trees between 121 years and 140 years old, while now defined as second growth for appraisal purposes, will remain as mature trees for determination of loss factors, timber merchantability specifications and grade algorithms.

In order to compile cruise plots correctly, please note the following:

1. All trees less than 141 years old contribute to the second growth percentage for appraisal purposes.
2. All trees from 121 to 140 years old will be compiled using mature loss factors.
3. If over 50 percent of the net volume in a block is in trees over 120 years old it is considered a mature block and will be compiled accordingly (17.5 cm dbh and 15 cm top).
4. If the plot contains any trees that are from 121 to 140 years old, record the age in tens as 13 or 14 and record those trees as tree class 1, 2 or 3. Trees greater than 140 years old will be classed as tree class 5 (veteran) or tree class 7 (veteran dead potential) while trees less than 121 years old will be recorded as tree class 8 (immature) or tree class 9 (immature dead potential).
5. Using the age in tens and appropriate tree class, all trees less than 141 years old will contribute to the second growth volume. All trees less than 121 years old will be compiled with older immature loss factors. All trees over 120 years old will use mature loss factors for determination of net volume.

9.1.5.8 Block Label - Mature and Immature

Each block must be compiled as mature or immature. All types within a block must be cruised and compiled to the same timber merchantability specifications (immature or mature).

Net volume will be the determining factor as to whether the block will be compiled as immature or mature.

Blocks that are definitely mature can be cruised to mature standards while blocks that are definitely immature or borderline immature/mature must be cruised and compiled to immature standards and net volume (50.1%+) used to determine whether the final compilation will be done to immature or mature timber merchantability specifications.

9.1.5.9 Plot Establishment

Half Plots

Half plots are not approved for use in the Coast Forest Region.

Edge Effect Bias

Variable Plot (VP) Sampling involves a circle placed around the centre of each tree. In VP sampling the size of the circle around the tree is determined by the size of the tree and the Plot Radius Factor (PRF) of the prism you are using. If the sample point (plot centre) falls within the trees circle the tree is tallied.

When trees are near the edge of the area being sampled part of the trees circle may fall outside the area being sampled. If we do not correct for this problem these trees have smaller change of being sampled which distorts the estimated number of those trees and the effect of their characteristics.

The Walkthrough Method is the only option available for dealing with edge effect in the Coast Forest Region.

Use full sweeps on timber type boundaries.

Border Plots

Border plots are not approved for use in the Coast Forest Region.

Walkthrough Method

Measure the distance from the plot centre to the centre point (face) of the tree and then from the centre point (face) on the opposite side (180º) of the tree measure an equal distance (on the same bearing) beyond the centre of the tree. If that point is outside the area being sampled, tally the tree details twice, under two separate tree numbers and mark both tree numbers on the tree. If that point is still in the area being sampled, tally the tree once. It doesn't matter whether you travel outside the area being sampled when measuring the equal distance beyond the tree; it only matters whether or not you end up in the area being sampled.

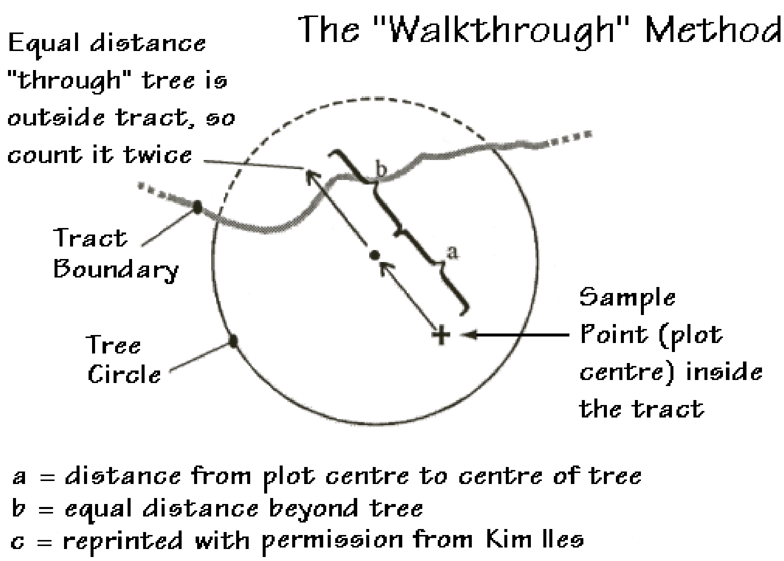


Figure 9.2 The Walkthrough Method.

A tree that should have been tallied once but was tallied twice will be recorded as one extra tree for check cruising purposes. A tree that should have been tallied twice but was only tallied once will be recorded as a missed tree for check cruising purposes.

A missed tree that would have been tallied twice is recorded as two missed trees for check cruising purposes. An extra tree (should not have been recorded) that was tallied twice will be recorded as two extra trees for check cruising purposes.

9.1.6 Timber Typing

Timber typing should be based on pre-stratified (map or air photo) type lines. Timber typing based on field data must be supported by field notes. A cruise may be rejected due to obviously wrong or biased timber typing.

If the district determines that the timber typing is wrong or biased they can require the licensee to correct the timber typing and if necessary, recompile the cutting authority.

If the district believes there was intentional bias or manipulation of date in any portion of the cruise the matter will be referred to Compliance and Enforcement staff for investigation.

Any area, containing merchantable timber that will be harvested, must be cruised and compiled as part of a cutting authority.

Forest types must not be less than 1.0 hectares and must be contiguous. Areas of timber, less than 1.0 hectares in size, cannot be considered a separate timber type unless the timber is truly unique. Truly unique is defined as areas of immature timber in a mature stand, areas of mature timber in an immature stand, areas of deciduous timber in a coniferous stand or areas of coniferous timber in a deciduous stand or a patch of pure Cedar in a Hemlock Balsam type or a patch of pure Hemlock Balsam in a Cedar type. If forest types less than one hectare are used then they must document the types in the final cruise map, notify the district check cruiser and note it in the covering letter for the appraisal submission.

A non-productive area can be less than one hectare in size, but typing out of non-productive areas must be consistent (i.e., if a 0.5 ha non-productive area is typed out then all non-productive areas 0.5 ha and larger must be typed out). A plot that falls within a typed out non-productive area must be dropped and a plot that is influenced by a typed out non-productive area must be established using the Walkthrough Method.

9.1.7 Cruising of Cutting Authority Area Amendments

> Please refer to the section on Changed Circumstances in the current *Coast Appraisal Manual*.

The following criteria will be used to determine if an amendment to a cutting authority area requires cruising:

1. If the amendment will cause the cutting authority area to be reappraised, then all amendments (which have not been cruised) will have to be cruised using the same grid from the cutting authority area and the entire cruise recompiled.

2. All other amendments do not have to be cruised.
3. If the cutting authority has not been appraised at the time of the amendment the amendment must be cruised by extending the grid from the cutting authority area.

Amendments must be submitted to the forest district with the following information:

- size (ha) of amendment,
- map,
- volume by species, and
- appraisal information (i.e., roads, bridges and any other required information).

9.1.8 Cruise Reports

If the cruise is rejected, the cruise data will replace the original data for those plots checked. If the cruise passes, the check cruise data will not replace the original cruise data unless it has a significant impact on the appraisal (i.e., a missed or extra tree in a cutting authority with less than twenty trees in the cruise plots) or both the district and licensee agree to make the changes.

Schedule "A" (Timber Licence) and "B" (Crown) Land Splits

Schedule "A" and "B" lands in a Tree Farm Licence (TFL) can be cruised, compiled and appraised together, but a separate summary page is required for both.

Schedule "A" and "B" lands not in a TFL can be cruised together, but must have separate compilations because they must be appraised separately.

Rights-of-Way Within the Block

Rights-of-way within the cutblocks must be cruised and compiled unless the right-of-way volume has been removed.

The area and net volume of rights-of-way(s) within the block must be included for appraisal purposes unless the rights-of-way(s) volume has been removed under a different timber mark, or assigned a different timber mark.

All plots established within the external boundaries of the block (excluding reserves) are to be used in the compilation. When the rights-of-way volume inside the block has been removed under a different mark, remove the area of the rights-of-way, but use the plots in the compilation.

Record R/W areas that are not part of the cutting authority in card Type H of the Map Area Statement.

9.1.9 Re-compilations

All cruises must be compiled using the most recent version of a compilation program (approved by the Ministry of Forests and Range) at the time of the appraisal submission.

Border plots can be accepted in the compilation if they were established before June 1, 2005.

9.1.10 Cruising Damaged Stands and Exceptional Circumstances

Cruising standards and techniques must be indicated on the cruise plan and may be amended by the District Manager.

9.1.11 Sampling in Unsafe Conditions

Unsafe working conditions can arise in cruising of salvage logging areas, and in certain other situations.

For unsafe working conditions, it is recommended that the cruise plots in the unsafe area be dropped and cruise information from the fringes of the unsafe area, or similar timber in the cutting authority area, or similar timber in the vicinity of the cutting authority area be used for appraisal purposes.

Tables

Table 1 Correction Table for Chaining Short Horizontal Distances

% Slope	Chainage Plus Slope Allowance								
				Horizontal Distance in Metres					
	5	10	15	20	25	30	35	40	45	50
10	5.02	10.05	15.07	20.10	25.12	30.15	35.17	40.20	45.22	50.25
12	5.04	10.07	15.11	20.14	25.18	30.22	35.25	40.29	45.32	50.36
14	5.05	10.10	15.15	20.20	25.24	30.29	35.34	40.39	45.44	50.49
16	5.06	10.13	15.19	20.25	25.32	30.38	35.45	40.51	45.57	50.64
18	5.08	10.16	15.24	20.32	25.40	30.48	35.56	40.64	45.72	50.80
20	5.10	10.20	15.30	20.40	25.50	30.59	35.69	40.79	45.89	50.99
22	5.12	10.24	15.36	20.48	25.60	30.72	35.84	40.96	46.08	51.20
24	5.14	10.28	15.43	20.57	25.71	30.85	35.99	41.14	46.28	51.42
26	5.17	10.33	15.50	20.66	25.83	31.00	36.16	41.33	46.50	51.66
28	5.19	10.38	15.58	20.77	25.96	31.15	36.35	41.54	46.73	51.92
30	5.22	10.44	15.66	20.88	26.10	31.32	36.54	41.76	46.98	52.20
32	5.25	10.50	15.75	21.00	26.25	31.50	36.75	42.00	47.25	52.50
34	5.28	10.56	15.84	21.12	26.41	31.69	36.97	42.25	47.53	52.81
36	5.31	10.63	15.94	21.26	26.57	31.88	37.20	42.51	47.83	53.14
38	5.35	10.70	16.05	21.40	26.74	32.09	37.44	42.79	48.14	53.49
40	5.39	10.77	16.16	21.54	26.93	32.31	37.70	43.08	48.47	53.85
42	5.42	10.85	16.27	21.69	27.12	32.54	37.96	43.38	48.81	54.23
44	5.46	10.93	16.39	21.85	27.31	32.78	38.24	43.70	49.16	54.63
46	5.50	11.01	16.51	22.01	27.52	33.02	38.53	44.03	49.53	55.04
48	5.55	11.09	16.64	22.18	27.73	33.28	38.82	44.37	49.92	55.46
50	5.59	11.18	16.77	22.36	27.95	33.54	39.13	44.72	50.31	55.90
52	5.64	11.27	16.91	22.54	28.18	33.81	39.45	45.08	50.72	56.36
54	5.68	11.36	17.05	22.73	28.41	34.09	39.78	45.46	51.14	56.82
56	5.73	11.46	17.19	22.92	28.65	34.38	40.11	45.84	51.58	57.31
58	5.78	11.56	17.34	23.12	28.90	34.68	40.46	46.24	52.02	57.80
60	5.83	11.66	17.49	23.32	29.15	34.99	40.82	46.65	52.48	58.31
62	5.88	11.77	17.65	23.53	29.42	35.30	41.18	47.06	52.95	58.83
64	5.94	11.87	17.81	23.75	29.68	35.62	41.55	47.49	53.43	59.36
66	5.99	11.98	17.97	23.96	29.95	35.94	41.94	47.93	53.92	59.91
68	6.05	12.09	18.14	24.19	30.23	36.28	42.33	48.37	54.42	60.46
70	6.10	12.21	18.31	24.41	30.52	36.62	42.72	48.83	54.93	61.03
72	6.16	12.32	18.48	24.64	30.81	36.97	43.13	49.29	55.45	61.61
74	6.22	12.44	18.66	24.88	31.10	37.32	43.54	49.76	55.98	62.20
76	6.28	12.56	18.84	25.12	31.40	37.68	43.96	50.24	56.52	62.80
78	6.34	12.68	19.02	25.36	31.71	38.05	44.39	50.73	57.07	63.41
80	6.40	12.81	19.21	25.61	32.02	38.42	44.82	51.22	57.63	64.03
82	6.47	12.93	19.40	25.86	32.33	38.80	45.26	51.73	58.19	64.66
84	6.53	13.06	19.59	26.12	32.65	39.18	45.71	52.24	58.77	65.30
86	6.59	13.19	19.78	26.38	32.97	39.57	46.16	52.76	59.35	65.95
88	6.66	13.32	19.98	26.64	33.30	39.96	46.62	53.28	59.94	66.60
90	6.73	13.45	20.18	26.91	33.63	40.36	47.09	53.81	60.54	67.27
92	6.79	13.59	20.38	27.18	33.97	40.76	47.56	54.35	61.15	67.94
94	6.86	13.72	20.59	27.45	34.31	41.17	48.04	54.90	61.76	68.62
96	6.93	13.86	20.79	27.72	34.66	41.59	48.52	55.45	62.38	69.31
98	7.00	14.00	21.00	28.00	35.00	42.00	49.00	56.01	63.01	70.01
100	7.07	14.14	21.21	28.28	35.36	42.43	49.50	56.57	63.64	70.71
102	7.14	14.28	21.43	28.57	35.71	42.85	49.99	57.14	64.28	71.42
104	7.21	14.43	21.64	28.86	36.07	43.28	50.50	57.71	64.92	72.14
106	7.29	14.57	21.86	29.15	36.43	43.72	51.00	58.29	65.58	72.86
108	7.36	14.72	22.08	29.44	36.80	44.16	51.52	58.87	66.23	73.59
110	7.43	14.87	22.30	29.73	37.17	44.60	52.03	59.46	66.90	74.33

Table 2 Plot Radii Slope Allowance

Table 2 - Plot Radius - Page T-3								
% Slope	**Plot Radii Plus Slope Allowance**							
	0.005 ha	0.008 ha	.010 ha	0.02 ha	0.04 ha	0.06 ha	0.08 ha	0.1 ha	0.2 ha
	3.99	5.05	5.64	7.98	11.28	13.82	15.96	17.84	25.23
10	4.01	5.08	5.67	8.02	11.34	13.89	16.04	17.93	25.36
12	4.02	5.09	5.68	8.04	11.36	13.92	16.07	17.97	25.41
14	4.03	5.10	5.70	8.06	11.39	13.95	16.12	18.01	25.48
16	4.04	5.11	5.71	8.08	11.42	14.00	16.16	18.07	25.55
18	4.05	5.13	5.73	8.11	11.46	14.04	16.22	18.13	25.64
20	4.07	5.15	5.75	8.14	11.50	14.09	16.28	18.19	25.73
22	4.09	5.17	5.77	8.17	11.55	14.15	16.34	18.27	25.83
24	4.10	5.19	5.80	8.21	11.60	14.21	16.41	18.35	25.95
26	4.12	5.22	5.83	8.25	11.66	14.28	16.49	18.43	26.07
28	4.14	5.24	5.86	8.29	11.71	14.35	16.57	18.53	26.20
30	4.17	5.27	5.89	8.33	11.78	14.43	16.66	18.63	26.34
32	4.19	5.30	5.92	8.38	11.84	14.51	16.76	18.73	26.49
34	4.21	5.33	5.96	8.43	11.91	14.60	16.86	18.84	26.65
36	4.24	5.37	5.99	8.48	11.99	14.69	16.96	18.96	26.82
38	4.27	5.40	6.03	8.54	12.07	14.78	17.07	19.08	26.99
40	4.30	5.44	6.07	8.59	12.15	14.88	17.19	19.21	27.17
42	4.33	5.48	6.12	8.66	12.23	14.99	17.31	19.35	27.36
44	4.36	5.52	6.16	8.72	12.32	15.10	17.44	19.49	27.56
46	4.39	5.56	6.21	8.78	12.42	15.21	17.57	19.64	27.77
48	4.43	5.60	6.26	8.85	12.51	15.33	17.70	19.79	27.99
50	4.46	5.65	6.31	8.92	12.61	15.45	17.84	19.95	28.21
52	4.50	5.69	6.36	8.99	12.71	15.58	17.99	20.11	28.44
54	4.53	5.74	6.41	9.07	12.82	15.71	18.14	20.27	28.67
56	4.57	5.79	6.46	9.15	12.93	15.84	18.29	20.45	28.92
58	4.61	5.84	6.52	9.23	13.04	15.98	18.45	20.62	29.17
60	4.65	5.89	6.58	9.31	13.15	16.12	18.61	20.80	29.42
62	4.69	5.94	6.64	9.39	13.27	16.26	18.78	20.99	29.69
64	4.74	6.00	6.70	9.47	13.39	16.41	18.95	21.18	29.95
66	4.78	6.05	6.76	9.56	13.52	16.56	19.12	21.38	30.23
68	4.83	6.11	6.82	9.65	13.64	16.71	19.30	21.57	30.51
70	4.87	6.16	6.88	9.74	13.77	16.87	19.48	21.78	30.80
72	4.92	6.22	6.95	9.83	13.90	17.03	19.67	21.98	31.09
74	4.96	6.28	7.02	9.93	14.03	17.19	19.85	22.19	31.39
76	5.01	6.34	7.08	10.02	14.17	17.36	20.05	22.41	31.69
78	5.06	6.40	7.15	10.12	14.31	17.53	20.24	22.63	32.00
80	5.11	6.47	7.22	10.22	14.45	17.70	20.44	22.85	32.31
82	5.16	6.53	7.29	10.32	14.59	17.87	20.64	23.07	32.63
84	5.21	6.60	7.37	10.42	14.73	18.05	20.84	23.30	32.95
86	5.26	6.66	7.44	10.53	14.88	18.23	21.05	23.53	33.28
88	5.31	6.73	7.51	10.63	15.03	18.41	21.26	23.76	33.61
90	5.37	6.79	7.59	10.74	15.18	18.59	21.47	24.00	33.94
92	5.42	6.86	7.66	10.84	15.33	18.78	21.69	24.24	34.28
94	5.48	6.93	7.74	10.95	15.48	18.97	21.90	24.48	34.63
96	5.53	7.00	7.82	11.06	15.64	19.16	22.12	24.73	34.97
98	5.59	7.07	7.90	11.17	15.79	19.35	22.35	24.98	35.33
100	5.64	7.14	7.98	11.29	15.95	19.54	22.57	25.23	35.68
102	5.70	7.21	8.06	11.40	16.11	19.74	22.80	25.48	36.04
104	5.76	7.29	8.14	11.51	16.27	19.94	23.03	25.74	36.40
106	5.81	7.36	8.22	11.63	16.44	20.14	23.26	26.00	36.77
108	5.87	7.43	8.30	11.75	16.60	20.34	23.49	26.26	37.14
110	5.93	7.51	8.38	11.86	16.77	20.54	23.73	26.52	37.51
112	5.99	7.58	8.47	11.98	16.94	20.75	23.96	26.79	37.88
114	6.05	7.66	8.55	12.10	17.11	20.96	24.20	27.05	38.26

116	6.11	7.73	8.64	12.22	17.28	21.17	24.44	27.32	38.64
118	6.17	7.81	8.72	12.34	17.45	21.38	24.69	27.59	39.02
120	6.23	7.89	8.81	12.47	17.62	21.59	24.93	27.87	39.41
122	6.29	7.97	8.90	12.59	17.79	21.80	25.18	28.14	39.80
124	6.36	8.04	8.98	12.71	17.97	22.02	25.42	28.42	40.19
126	6.42	8.12	9.07	12.84	18.15	22.23	25.67	28.70	40.59
128	6.48	8.20	9.16	12.96	18.32	22.45	25.92	28.98	40.98
130	6.54	8.28	9.25	13.09	18.50	22.67	26.18	29.26	41.38
132	6.61	8.36	9.34	13.22	18.68	22.89	26.43	29.54	41.78
134	6.67	8.44	9.43	13.34	18.86	23.11	26.69	29.83	42.18
136	6.74	8.52	9.52	13.47	19.04	23.33	26.94	30.12	42.59
138	6.80	8.61	9.61	13.60	19.22	23.55	27.20	30.40	43.00
140	6.86	8.69	9.70	13.73	19.41	23.78	27.46	30.69	43.41

Radii for plot sizes smaller than those given in the table can be measured by holding the tape horizontally.

Table 3 Distribution of "t"

Degrees of Freedom	0.05 (95 % Confidence Interval)
1	12.706
2	4.303
3	3.182
4	2.776
5	2.571
6	2.447
7	2.365
8	2.306
9	2.262
10	2.228
11	2.201
12	2.179
13	2.160
14	2.145
15	2.131
16	2.120
17	2.110
18	2.101
19	2.093
20	2.086
21	2.080
22	2.074
23	2.069
24	2.064
25	2.060
26	2.056
27	2.052
28	2.048
29	2.045
30	2.042
31 – 67	2.000
68 – 112	1.980
113 +	1.960

Stump and Breast Height Diameter Tables for the British Columbia Merchantable Tree Species (Tables 4 to 8)[1]

The following tables (Tables 4 to 8) are designed to be used in the estimation of diameters breast height outside bark (DBH) from stump diameter inside bark (DSIB) measured at a fixed height above ground level (SH). Each table was derived from a regression equation that was fitted on butt diameter measurements of the same trees that were used in the Ministry of Forests and Range metric volume equations.

The regression equations are of the following form:

$$DBH = DSIB + b_0 DSIB(2.3 - SH) + b_1 DSIB \ln\left[(SH + 1.0)/2.3\right]$$

where DBH and DSIB are in centimetres. SH is measured in metres and can range from 0.15 to 1.05 m. For a given stump cruise, all DSIB measurements should be at a given stump height to facilitate computer compilation.

The constant b_0 and b_1 for the various species and zones are listed in Table 4. A map of the British Columbia forest inventory zones is shown in Appendix 3.

[1] A. Kozak, Faculty of Forestry, University of British Columbia and S. A. Omule, Research Branch, Ministry of Forests, February 1989.

Table 4 Constants for Species and Zones

Species	Age*	Zone[b]	No. of Observations	B_0	B_1	SEE[c]
Douglas-fir	MAT.	ABC	2027	0.192451	0.656977	5.24
Douglas-fir	IMM.	ABC	1180	0.155107	0.564107	1.77
Douglas-fir	ALL	D-L	9978	0.189385	0.712098	3.62
Red Cedar	MAT.	ABC	1988	0.032043	0.585026	5.70
Red Cedar	IMM.	ABC	1297	0.055116	0.706639	2.98
Red Cedar	ALL	D-L	4669	0.059052	0.655006	4.16
Red Cedar	ALL	A-QCI	200	0.0297088	.404490	5.96
Hemlock	MAT.	ABC	4058	0.064571	0.534355	4.68
Hemlock	IMM.	ABC	2167	0.077996	0.438284	1.73
Hemlock	ALL	D-L	5466	0.100771	0.504787	2.94
Hemlock	ALL	A-QCI	323	0.0508525	0.360565	6.50
Spruce	MAT.	ABC	1197	0.021123	0.530663	8.23
Spruce	IMM.	ABC	980	0.046301	0.580005	4.23
Spruce	ALL	D-J	13755	0.065728	0.575037	3.11
Spruce	ALL	KL	11494	0.062808	0.442810	1.46
Spruce	ALL	A-QCI	184	0.0299746	0.413498	6.48
Balsam	ALL	ABC	2548	0.057484	0.573054	4.84
Balsam	ALL	D-J	11760	0.073625	0.477491	2.02
Balsam	ALL	KL	2307	0.073358	0.431277	1.24
Yellow-Cedar	ALL	A-L	905	0.037211	0.460492	2.03
Yellow Cedar	ALL	A-QCI	106	0.0217802	0.289677	3.61
White Pine	ALL	ABC	275	0.057377	0.561538	3.32
White Pine	ALL	D-L	774	0.056953	0.449184	1.76
Lodgepole pine	ALL	A-J	8318	0.056984	0.374589	1.23
Lodgepole pine	ALL	KL	5259	0.051075	0.337046	0.91
Yellow pine	ALL	A-L	2023	0.154163	0.638001	3.18
Larch	ALL	A-J	2520	0.190001	0.682016	4.06
Larch	ALL	KL	811	0.078977	0.532930	0.91
Cottonwood	ALL	A-J	996	0.117130	0.565108	3.91
Cottonwood	ALL	KL	2137	0.136074	0.498340	1.80
Alder	ALL	A-L	1556	0.055705	0.374983	1.34
Maple	ALL	A-L	416	0.064992	0.421552	0.72
Birch	ALL	A-J	923	0.070797	0.455765	1.60
Birch	ALL	KL	750	0.070901	0.407800	0.84
Aspen	ALL	A-J	2204	0.103886	0.492890	1.55
Aspen	ALL	KL	4100	0.097907	0.469721	1.50
Whitebark pine	ALL	A-L	148	0.036171	0.482541	1.66

*Age: IMM. = immature, up to 120 years old, MAT. = mature, more than 120 years old, ALL = all ages.

[b]Zone: A = North and central coast region, B = Southern coast region, C = South Coast transition belt, D = South western interior dry belt, E = West Kootenay region, F = East Kootenay region, G = central Columbia region, interior wet belt, H = Nechako, Fraser plateau region, I = Central interior, J = North west plateau region, Stikine, Skeena, K = North Central Region, Cassiar, Omineca, L = North eastern plains region.

[c]SEE: = Standard error of estimated DBH, for all diameter classes (cm).

Note - QCI = Queen Charlottes PSYU

Table 5 Butt Taper - Mature - FIZ A, B and C – Coast

dbh (ob)	F*		C*		H*		B		S*		Y	
(cm) @ 1.3 m	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob
06	6	7	8	9	7	8	8	8	8	8	7	8
08	8	9	11	11	10	10	10	10	11	11	10	10
10	10	12	14	14	12	13	13	13	14	14	12	13
12	12	14	17	17	15	15	15	16	16	17	15	15
14	14	17	19	20	17	18	18	18	19	19	17	18
16	16	19	22	22	19	20	20	21	22	22	20	20
18	18	21	25	25	22	23	23	23	24	25	22	23
20	20	24	27	28	24	25	25	26	27	27	25	25
22	22	26	30	31	27	28	28	29	30	30	27	28
24	24	28	33	34	29	30	31	31	33	33	30	31
26	26	31	36	37	32	33	33	34	35	36	32	33
28	28	33	38	39	34	35	36	36	38	38	35	36
30	30	35	41	42	36	38	38	39	41	41	37	38
32	32	38	44	45	39	40	41	41	43	44	39	41
34	34	40	47	48	41	43	43	44	46	47	42	43
36	36	43	49	51	44	45	46	47	49	49	44	46
38	38	45	52	54	46	48	48	49	51	52	47	48
40	40	47	55	56	49	50	51	52	54	55	49	51
42	42	50	58	59	51	53	53	54	57	58	52	53
44	44	52	60	62	53	55	56	57	60	60	54	56
46	46	54	63	65	56	58	58	60	62	63	57	59
48	48	57	66	68	58	60	61	62	65	66	59	61
50	50	59	69	70	61	63	64	65	68	69	62	64
55	55	65	75	77	67	69	70	71	74	75	68	70
60	59	71	82	84	73	76	76	78	81	82	74	76
65	64	77	89	92	79	82	83	84	88	89	80	83
70	69	83	96	99	85	88	89	91	95	94	86	89
75	74	89	103	106	91	94	95	97	101	103	92	95
80	79	94	110	113	101	102	104	108	108	110	99	102
85	84	100	116	120	103	107	108	110	115	116	105	108
90	89	106	123	127	109	113	114	117	122	123	111	114
95	94	112	130	134	115	120	121	123	129	130	117	121
100	99	118	137	141	121	126	127	130	135	137	123	127
105	104	124	144	148	127	132	133	136	142	144	129	133
110	109	130	151	155	134	138	140	142	149	151	136	140
115	114	136	158	162	140	145	146	149	156	158	142	146
120	119	142	164	169	146	151	152	155	162	164	148	153

* Mature - Forest Inventory Zones - A, B, C, - Coast (table shows diameter at stump height of 0.3 m).

dbh (ob)	Pw		Pl		Ac		Alder		Maple		Birch	
(cm) @ 1.3 m	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob
06	8	8	7	7	7	7	7	7	7	7	7	7
08	10	10	9	10	9	10	9	9	9	10	9	10
10	13	13	11	12	11	12	11	12	11	12	11	12
12	15	16	13	14	13	14	13	14	14	14	14	15
14	18	18	16	17	15	17	16	17	16	17	16	17
16	20	21	18	19	18	19	18	19	18	19	18	19
18	23	23	20	21	20	21	20	21	20	22	20	22
20	25	26	22	24	22	24	22	24	23	24	23	24
22	28	28	24	26	24	26	25	26	25	26	25	27
24	30	31	27	28	26	28	27	28	27	29	27	29
26	33	34	29	31	29	31	29	31	29	31	30	31
28	35	36	31	33	31	33	31	33	32	34	32	34
30	38	39	33	36	33	36	33	35	34	36	34	36
32	40	41	36	38	35	38	36	38	36	38	36	39
34	43	44	38	40	37	40	38	40	38	41	39	41
36	45	46	40	43	40	43	40	42	41	43	41	43
38	48	49	42	45	42	45	42	45	43	45	43	46
40	50	52	44	47	44	47	45	47	45	48	45	48
42	53	54	47	50	46	50	47	49	47	50	48	51
44	55	57	49	52	48	52	49	52	50	53	50	53
46	58	59	51	54	51	55	51	54	52	55	52	55
48	60	62	53	57	53	57	54	56	54	57	55	58
50	63	65	56	59	55	59	56	59	56	60	57	60
55	69	71	61	65	60	65	61	65	62	66	62	66
60	76	77	67	71	66	71	67	71	68	72	68	72
65	82	84	72	77	71	77	72	76	73	78	74	78
70	88	90	78	83	77	83	78	82	79	84	79	84
75	94	97	83	89	82	89	84	88	84	90	85	90
80	101	103	89	95	88	95	89	94	90	96	91	96
85	107	110	94	100	93	101	95	100	96	102	96	102
90	113	116	100	106	99	107	100	106	101	108	102	108
95	102	123	106	112	104	113	106	112	107	114	108	115
100	126	129	111	118	110	118	111	118	112	120	113	121
105	132	135	117	124	115	124	117	123	118	126	119	126
110	139	142	122	130	121	130	123	129	124	131	125	133
115	145	148	128	136	126	136	128	135	129	137	131	139
120	151	155	133	142	132	142	134	141	135	143	136	145

* Mature - Forest Inventory Zones - A, B, C, - Coast (table shows diameter at stump height of 0.3 m).

Table 6 Butt Taper - All Ages - FIZ D to J – Interior

dbh (ob)	F		C		H		B		S		Pw	
(cm) @ 1.3 m	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob
06	6	7	8	8	7	7	7	7	8	8	7	7
08	8	10	11	11	9	9	9	10	10	11	9	10
10	10	12	14	14	11	12	11	12	13	13	12	12
12	12	15	16	17	13	14	14	15	15	16	14	15
14	14	17	19	19	15	17	16	17	17	18	16	17
16	17	20	22	22	18	19	18	19	20	21	19	20
18	19	22	24	25	20	21	21	22	22	24	21	22
20	21	25	27	28	22	23	23	24	25	26	23	25
22	23	27	30	31	24	26	25	27	27	29	26	27
24	25	30	32	33	26	28	27	29	30	32	28	30
26	27	32	35	36	29	31	30	31	32	34	30	32
28	29	35	38	39	31	33	32	34	35	37	33	35
30	31	37	40	42	33	35	34	36	37	39	35	37
32	33	40	43	44	35	38	37	39	40	42	37	39
34	35	42	46	47	37	40	39	41	42	45	40	42
36	37	45	48	50	39	42	41	44	45	47	42	44
38	39	47	51	53	42	45	43	46	47	50	44	47
40	41	49	54	55	44	47	46	48	50	53	47	49
42	43	52	56	58	46	50	48	51	52	55	49	52
44	45	54	59	61	48	52	50	53	55	58	51	54
46	47	57	62	64	50	54	53	56	57	60	54	57
48	49	59	65	67	53	56	55	58	60	63	56	59
50	51	62	67	69	55	59	57	60	62	66	58	62
55	57	68	74	76	60	65	63	66	69	72	64	68
60	62	74	81	83	66	71	69	73	75	79	70	74
65	67	80	87	90	71	77	74	79	81	85	76	80
70	72	87	94	97	77	82	80	85	87	92	82	86
75	77	93	101	104	82	88	86	91	93	98	88	92
80	82	99	108	111	88	94	92	97	100	105	93	99
85	87	105	114	118	93	100	97	103	106	112	99	105
90	93	111	121	125	99	106	103	109	112	118	105	111
95	98	117	128	132	104	112	109	115	118	125	110	117
100	103	124	134	139	110	118	114	121	125	131	117	123
105	108	130	141	145	115	124	120	127	131	138	122	129
110	113	136	148	152	121	130	126	133	137	144	128	136
115	118	142	155	159	126	135	132	139	143	151	134	142
120	123	148	161	166	131	141	137	145	149	157	140	148

All Ages - Forest Inventory Zones - D to J - Interior (table shows diameter at stump height of 0.3 m).

dbh (ob)	Pl		Py		Larch		Ac		Birch		Aspen	
(cm) @ 1.3 m	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob
06	7	7	6	7	6	8	7	7	7	7	7	7
08	9	10	9	10	8	11	9	10	9	10	9	10
10	11	12	11	12	10	14	11	12	11	12	11	12
12	13	14	13	15	12	16	13	14	14	15	13	14
14	16	17	15	17	14	19	15	17	16	17	15	17
16	18	19	17	20	16	22	18	19	18	19	17	19
18	20	21	19	22	18	24	20	21	20	22	19	21
20	22	24	21	25	20	27	22	24	23	24	22	24
22	24	26	23	27	22	30	24	26	25	27	24	26
24	27	28	25	30	24	33	26	28	27	29	26	29
26	29	31	28	32	26	35	29	31	30	31	28	31
28	31	33	30	35	28	38	31	33	32	34	30	33
30	33	36	32	37	30	41	33	35	34	36	32	36
32	36	38	34	40	32	43	35	38	36	39	35	38
34	38	40	36	42	34	46	37	40	39	41	37	40
36	40	43	38	45	36	49	40	43	41	43	39	43
38	42	45	40	47	38	52	42	45	43	46	41	45
40	44	47	42	50	40	54	44	47	45	48	43	48
42	47	50	45	52	42	57	46	50	48	51	45	50
44	49	52	47	55	44	60	48	52	50	53	48	52
46	51	54	49	57	46	62	51	54	52	55	50	55
48	53	57	51	59	48	65	53	57	55	58	52	57
50	56	59	53	62	50	68	55	59	57	60	54	60
55	62	65	58	68	56	75	60	65	62	66	59	66
60	67	71	64	74	61	81	66	71	68	72	65	72
65	72	77	69	81	66	88	71	77	74	78	70	77
70	78	83	74	87	71	95	77	83	79	84	76	83
75	83	89	80	93	76	102	82	89	85	90	81	89
80	89	95	85	99	81	109	88	95	91	96	86	95
85	94	100	90	105	86	115	93	101	96	102	92	101
90	100	106	95	111	91	122	99	107	102	108	97	107
95	106	112	101	118	96	129	104	113	108	115	103	113
100	111	118	106	124	101	136	110	118	113	121	108	120
105	117	124	111	130	106	143	115	124	119	127	113	125
110	122	130	117	136	111	149	121	130	125	133	119	131
115	128	136	122	142	116	156	126	136	131	139	124	137
120	133	142	127	149	121	163	132	142	136	145	130	143

All Ages - Forest Inventory Zones - D to J - Interior (table shows diameter at stump height of 0.3 m).

Table 7 Butt Taper - All Ages - FIZ K and L - Interior

(Table shows diameter at stump height of 0.3 m)

dbh (ob)	H		B		S		Pl	
(cm) @ 1.3 m	dib	dob	dib	dob	dib	dob	dib	dob
06	7	7	7	7	7	7	7	7
08	9	9	9	9	9	10	9	9
10	11	12	11	12	12	12	11	12
12	13	14	13	14	14	15	13	14
14	15	17	16	17	16	17	15	16
16	18	19	18	19	18	19	18	18
18	20	21	20	21	21	22	20	21
20	22	23	22	24	23	24	22	23
22	24	26	24	26	25	27	24	25
24	26	28	27	28	28	29	26	28
26	29	31	29	31	30	31	29	30
28	31	33	31	33	32	34	31	32
30	33	35	33	35	34	36	33	34
32	35	38	36	38	37	39	35	37
34	37	40	38	40	39	41	37	39
36	39	42	40	42	41	43	40	41
38	42	45	42	45	44	46	42	44
40	44	47	44	47	46	48	44	46
42	46	50	47	50	42	51	46	48
44	48	52	49	52	50	53	48	50
46	50	54	51	54	53	56	51	53
48	53	56	53	57	55	58	53	55
50	55	59	56	59	57	60	55	57
55	60	65	61	65	63	66	61	63
60	66	71	67	71	69	72	66	69
65	71	77	72	77	75	78	71	75
70	77	82	78	82	80	84	77	80
75	82	88	83	88	86	91	82	86
80	88	94	89	94	92	97	88	92
85	93	100	94	100	97	103	93	98
90	99	106	100	106	103	109	99	103
95	104	112	106	112	109	115	104	109
100	110	118	111	118	115	121	110	115
105	115	124	117	124	120	127	115	121
110	121	130	122	130	126	133	121	126
115	126	135	128	135	132	139	126	132
120	131	141	133	141	138	145	132	138

dbh (ob)	Larch		Ac		Birch		Aspen	
(cm) @ 1.3 m	dib	dob	dib	dob	dib	dob	dib	dob
06	7	8	6	7	7	7	7	7
08	9	10	8	9	9	9	9	10
10	12	13	10	11	11	12	11	12
12	14	15	12	14	13	14	13	14
14	16	18	14	16	15	16	15	17
16	19	20	16	18	18	19	17	19
18	21	23	18	20	20	21	19	22
20	23	25	20	23	22	23	22	24
22	26	28	22	25	24	26	24	26
24	28	30	24	27	26	28	26	29
26	31	33	26	29	29	30	28	31
28	33	35	28	32	31	33	30	34
30	35	38	30	34	33	35	32	36
32	38	40	32	36	35	38	35	38
34	40	43	34	39	37	40	37	41
36	43	45	36	41	40	42	39	43
38	45	48	39	43	42	45	41	45
40	47	50	41	45	44	47	43	48
42	49	53	43	48	46	49	45	50
44	52	55	45	50	48	52	47	53
46	54	58	47	52	51	54	50	55
48	56	60	49	54	53	56	52	57
50	59	63	51	57	55	59	54	60
55	64	69	56	62	61	64	59	66
60	70	75	61	68	66	70	65	72
65	76	81	66	74	72	76	70	78
70	82	88	71	79	77	82	75	84
75	88	94	76	85	83	88	81	90
80	94	100	81	91	88	94	86	96
85	100	106	86	96	94	100	92	102
90	105	113	91	102	99	105	97	108
95	111	119	96	108	105	111	102	114
100	117	125	101	113	110	117	108	120
105	123	132	106	119	116	123	113	126
110	129	138	111	125	121	129	119	132
115	135	144	116	130	127	135	124	138
120	140	150	121	136	132	141	129	144

Table 8 Butt Taper - Immature - FIZ A, B and C - Coast

(Table shows diameter at stump height of 0.3 m)

dbh (ob)	F		C		H		S	
(cm) @ 1.3 m	dib	dob	dib	dob	dib	dob	dib	dob
06	6	7	9	9	7	7	8	8
08	8	10	11	12	9	10	11	11
10	10	12	14	15	11	12	13	13
12	12	14	17	18	13	14	16	16
14	14	17	20	20	16	17	18	19
16	16	19	23	23	18	19	21	21
18	18	21	26	26	20	21	24	24
20	20	24	28	29	22	24	26	27
22	22	26	31	32	24	26	29	29
24	24	29	34	35	27	28	32	32
26	26	31	37	38	29	31	34	34
28	28	33	40	41	31	33	37	37
30	30	36	42	44	33	36	39	40
32	32	38	45	47	35	38	42	42
34	34	40	48	50	38	40	45	45
36	36	43	51	53	40	43	47	48
38	38	45	54	55	42	45	50	50
40	41	48	57	58	44	47	53	53
42	43	50	59	61	46	50	55	56
44	45	52	62	64	49	52	58	58
46	47	55	65	67	51	54	60	61
48	49	57	68	70	53	57	63	64
50	51	59	71	73	55	59	66	66
55	56	65	78	80	61	65	72	73
60	61	71	85	87	66	71	79	79
65	66	77	92	95	72	77	85	86
70	71	83	99	102	77	83	92	93
75	76	89	106	109	83	89	99	99
80	81	95	112	117	88	95	105	106
85	86	101	120	124	94	101	112	113
90	91	107	127	131	99	106	118	119
95	96	113	134	138	105	112	125	126
100	101	119	142	146	110	118	131	132
105	106	125	149	153	116	124	138	139
110	111	131	156	160	121	130	144	146
115	116	137	163	168	127	136	151	152
120	121	142	170	175	133	142	158	159

Table 9 to 16

Tables 9 to 16 do not exist at this time.

Table 17 Cruise Compilation Loss Factor Table

The loss factor tables listed in this manual will be used for appraisal cruises. This list is the reference for Cruise Compilation and the auditing of Cruise Compilations. Refer to the following web utility to find the Forest Inventory Zone and Special Cruise Number to cross reference to Table 17.

Map View can be accessed on the Internet at:

Mapview Site

PSYU Cross Reference Procedure

1. Click on the Navigation tab and select an attribute - like a place name, map sheet, TFL, etc.

2. Click on the “Vegetation tab” and select “Forest Cover”.

3. Magnify the map scale to less than 1:100,000.

4. Click on the "Identify Visible" icon and click on the map location to reveal the "Identify Results" attributes.

5. Find the FIZ and special cruise number (SCN) in the list of attributes.

6. Find the SCN and the corresponding PSYU code in Table 17.

1. Tree Farm Licences

The TFL loss factors are the same as those approved by the Chief Forester in the Management Plans (MP). This manual will be updated as new Management Plan's result in loss factors changes. All "local" factors noted below apply only to mature volumes (i.e., 121 years or greater). Timber Licences in the TFL’s use the TFL loss factors and Timber Licences outside of the TFL will use the *Metric Diameter Class Decay, Waste And Breakage Factors 1976*.

All loss factors referenced in the following lists refer to the Ministry of Sustainable Resources Management publication entitled: *Metric Diameter Class Decay, Waste And Breakage Factors 1976.*

Coast Forest Region

TFL 6	Kingcome locals for Cedar and Hemlock. All others FIZ "B"
TFL 10	All FIZ "B"
TFL 19	Nootka local for mature Hemlock. All others FIZ "B"
TFL 25	Area #1 (Dean PSYU) - Kingcome locals for Cedar and Hemlock. All others FIZ "A" Area #2 (Quadra PSYU) - Kingcome locals for Cedar and Hemlock. All others FIZ "B" Area #3 (South Island) - All FIZ "B" Area #4 (Old TFL 24 – Queen Charlotte Is.) – use FIZ A for all species and maturity classes.
TFL 26	Vancouver locals for Hemlock and Balsam. All others FIZ "C".
TFL 37	Kingcome locals for mature cedar and hemlock for decay and waste. All other species use FIZ "B" decay and waste. Company breakage factors for all species and maturity classes.
TFL 38	Soo locals for Hemlock and Balsam. All others FIZ "B"
TFL 39 Blocks 1, 2, 4, 5	Company decay and waste factors for mature. All other maturity classes are FIZ "B". Mature is 121 years +.
Blocks 3, 6 and 7	Company decay and waste factors and FIZ "A" breakage factors for mature. All other maturity classes are FIZ "A" (Queen Charlotte Islands).
TFL 43	Northern Blocks - Use FIZ "A" - Kingcome locals for Cedar and Hemlock. Homathko Block - Use FIZ “B”. Fraser Block - Dewdney (Chilliwack) locals for Hemlock and Balsam. All others FIZ "C"
TFL 44	Company decay and waste factors and FIZ "B" breakage factors for mature. All other maturity classes are FIZ "B". Mature is 121 +.
TFL 45	Area #1 (old TFL 17) - Kingcome locals for Cedar and Hemlock. All others FIZ "A". Area #2 (old TFL 36) - All FIZ "B".

TFL 46	Nootka local for Hemlock. All others FIZ "B".
TFL 47	Area #1 (majority) - Kingcome locals for Cedar and Hemlock. All others FIZ "B". Area #2 (4 small islands) - Kingcome locals for Cedar and Hemlock. All others FIZ "A". Area #3 - Haida Gwaii (formerly Queen Charlottes) - All FIZ "A".
TFL 54	Nootka locals for hemlock. All others FIZ "B".

Northern Interior Forest Region

TFL 1	Skeena (Terrace) - locals for Balsam. All others FIZ "A" or "J".
TFL 41	Skeena (Terrace) - locals for Hemlock and Balsam. All others FIZ "A".
Old TFL 51	(Now Cranberry TSA).
Skeena (Kitwanga)	locals for Hemlock and Balsam. All others FIZ "J".
TFL 30	Monkman locals for Cedar, Hemlock, Balsam, and Spruce. All others FIZ "I"
TFL 42	Stuart locals for Balsam and Spruce. All others FIZ "I"
TFL 48	All FIZ "L"
TFL 53	Naver locals for Hemlock, Balsam and Spruce. All others FIZ "H, I"

Southern Interior Forest Region

TFL 15	All FIZ "D".
TFL 18	Raft locals for Cedar and Hemlock. All others FIZ "G".
TFL 33	Eagle locals for Cedar and Hemlock. All others FIZ "G".
TFL 35	All FIZ "D" or "G".

TFL 49	Area #1 (old TFL's 9 and 32) - Okanagan locals for Fir, Cedar and Hemlock. All others FIZ "D". Area #2 (old TFL 16) - Kamloops local for Fir. All others FIZ "D".
TFL 3	Slocan locals for Cedar and Hemlock. All others FIZ "G".
TFL 8	Kettle locals for Spruce and Lodgepole Pine. All others FIZ "E".
TFL 13	All FIZ "F".
TFL 14	Lardeau locals for mature Cedar and Hemlock. All others FIZ "G".
TFL 23 - as located South of Highway 1	Nakusp locals for Cedar and Hemlock. All others FIZ "G".
TFL 55	Arrowhead locals for Cedar and Hemlock. All others FIZ "G".
TFL 56	Arrowhead locals for Cedar and Hemlock. All others FIZ "G".
TFL 5	All FIZ "H".
TFL 52	Cottonwood locals for Cedar, Hemlock, Balsam and Spruce. All others FIZ "I".

2. Other Tenures

For all tenures other than TFL's the appropriate loss factor tables are determined as per: *Metric Diameter Class Decay Waste And Breakage Factors 1976.*

The only authorized exceptions are:

1. The deletion of Stum/Chilko locals for mature Lodgepole Pine. FIZ "H" factors now apply in the Stum and FIZ "B" or "H" in the Chilko PSYU.

2. The use of 10 percent decay, 0 percent waste and 5 percent breakage for all risk groups and diameter classes for cottonwood 41+ years in F.I.Z. A, B and C.

3. <u>Special Cruise Number (SCN) #233</u> - is for Denman, Hornby, Gabriola, Valdes, Galiano, Thetis, Kuper, Mayne, Prevost, Saltspring, North Pender, South Pender, Saturna, Moresby, Portland, Sidney, James and the Saanich Peninsula. Use FIZ C and the Vancouver PSYU.

   <u>SCN #234</u> - is for the E&N Lands within the Quadra PSYU. Use FIZ B and the Quadra PSYU.

SCN #235 - is for the crown portion of the E&N Lands within the South Island Forest District and the Nootka PSYU with the exception of all the Gulf Islands. Use FIZ C and the Vancouver PSYU.

Note - The southern boundary between SCN#233 and SCN #235 runs from the head of Finalyson Arm west for a short distance and then approximately S30W by Empress Mountain and Bluff Mountain to just east of Shirley. The northern boundary between SCN #235 and SCN #234 runs along the boundary between the Nootka and Quadra PSYUs.

4. The Greater Vancouver Water District uses the Vancouver PSYU locals for hemlock and balsam.

5. Those portions of the old TFL 23 block located north of Highway 1 and not included in TFL's 55 and 56 will use the Arrowhead PSYU loss factors.

6. Any cruises that are in the areas that overlap between the Purden and Longworth PSYUs will use the PSYU with the greatest amount of area in the cruise. Contact the Northern Interior Forest Region Cruising Co-ordinator for the region and compartment numbers that occupy the overlap areas.

All references are to mature factors unless otherwise indicated.

3. **Tabular Listing Of Table Numbers**

The following listing is provided for easy reference and compilation edit checks.

	Mature							**OI.**	**MAT.**	
PSYU/ SSA / TSA /TFL	**PSYU#**	**SCN#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
Adams	01	146		95	87					G
Alsek	02	266								K
Arrowhead	03	125		93	89					G
Ashnola	04	181	98							D
Babine	05	134				93	99			H I
Barriere	06	113		95	87					G
Barton Hill	07	182	98							D
Bell Irving	08	190			91					J
Big Bar	09	142	99							D
Big Valley	10	152				92	98			I
Blueberry	11	178								L
Botanie	12	144	98							D
Boundary	13	199								A K
Bowron	14	151		96	90	92	98			I
Burns Lake	15	154								H I
Canoe	16	184		92	86					G
Carp	17	116				91	97			I
Chilko	18	147						98		B H
Cottonwood	19	122		98	90	92	98			I

Not all of the Tree Farm Licence "Identify Results" attrubutes are available at this time.

	Mature							**Ol.**	**MAT.**	
PSYU/ SSA / TSA /TFL	**PSYU#**	**SCN#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
Cranbrook	20	186								F
Creston	21	130								E
Crooked River	22	117				91	97			I
Dean	23	165								A
Dease - Proposed	25	262								K
Dewdney: Chilliwack Portion Yale Portion Harrison Portion	26 - 1 - 2 - 3	193			 99 95 99	 99 98 99				 C D C C
Eagle	27	150		94	85					G
Edgewood	28	126								E G
Fernie	29	161								F
Finlay	30	189					96			I K
Fontas - Proposed	31	198								L
Fort Nelson - Proposed	32	185								L
Granby	33	170								E
Hecate	34	173								A J
Kamloops	35	261	98							D G
Ketchika - Proposed	36	264								K
Kettle	37	124					95		97	E
Kinbasket	38	175		92	86					G

Not all of the Tree Farm Licence "Identify Results" attrubutes are available at this time.

	Mature							Ol.	MAT.	
PSYU/ SSA / TSA /TFL	**PSYU#**	**SCN#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
Kingcome	39	195		99	98					A B
Klappan - Proposed	40	127								K
Kluskus	41	289								H
Kotcho - Proposed	42	191								L
Lac La Hache	43	141	99	98						D G H
Lardeau	44	160		91	84					G
Liard - Proposed	45	145								L
Longworth	46	153		96	90	92	98			G
Moberly	47	177								L
Monkman	48	174		96	90	92	98			I
Morice	49	132		13	12	93	99			H J
Nakusp	50	128		91	84					G
Narcosli - P.H.A. #5	51	137								H
Naver	52	121			90	92	98			H I
Nechako - P.H.A #1	53	168								H I
Nehalliston - P.H.A. #2	54	159								G
Nicola	55	111	98							D
Niskonlith - P.H.A. #2	56	114								D G
Nootka	57	196			96					B
North Thompson	58	158		97	88					G
Okanagan	59	187	98	94	85					D E

Not all of the Tree Farm Licence "Identify Results" attrubutes are available at this time.

	Mature							Ol.	MAT.	
PSYU/ SSA / TSA /TFL	**PSYU#**	**SCN#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
Ootsa	60	155								H
Parsnip	61	149				91	97			I
Peace - P.H.A. #7	62	162								L
Purden	63	119		96	90	92	98			I
Quadra (includes all of the islands in Howe Sound)	64	194								B
Haida Gwaii (formerly Queen Charlotte)	65	166								A
Quesnel Lake	66	109		98	90	92	98			D G H
Raft	67	183		97	88					G
Rivers Inlet	68	103								A
Robson	69	176		96	90	92	98			G
Salmo	70	180								E G
Salmon Arm	71	115		94	85					D G
Shuswap	72	171		95	87					G
Sikanni - Proposed	73	197								L
Similkameen	74	110	98							D
Skeena	75	169								
Terrace Portion	-1				94	96				A J
Kitwanga Portion	-2				93	95				J
Hazelton Portion	-3				92	94				J
Slocan	76	129		91	84					G
Smithers	77	133		13	12	93	99			I J

Not all of the Tree Farm Licence "Identify Results" attrubutes are available at this time.

	Mature							Ol.	MAT.	
PSYU/ SSA / TSA /TFL	**PSYU#**	**SCN#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
Soo	78	156			97	97				C
Spallumcheen	79	112		94	85					G
Stikine	80	172			91					K
Stuart Lake	81	135				91	97			I
Stum	82	140	99					98		H
Takla	83	188				91	97			I
Taku - Proposed	84	263								K
Upper Kootenay	85	131								F
Vancouver (includes Furry CK SSA)	86	179			99	99				C
Wapiti	87	192								L
Westlake	88	118				92	98			H I
Williams Lake	89	123	99							D H
Willow River	90	120			90	92	98			I
Windermere	91	136								F
Yalakom	92	143	99							D
Special Sale Area										
Fort St James	S02	243				91	97			I
Prince George - Quesnel	S04	251	99			92	98			H I G
Tree Farm Licence										
TFL 1 - Terrace	01	301				96				A J
TFL 3	03	303		91	84					G

Not all of the Tree Farm Licence "Identify Results" attrubutes are available at this time.

	Mature							**OI.**	**MAT.**	
PSYU/ SSA / TSA /TFL	**PSYU#**	**SCN#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
TFL 5	05	305								H
TFL 6	06	306		99	98					B
TFL 8	08	308					95		97	E
TFL 10	10	310								B
TFL 13	13	313								F
TFL 14	14	314		91	84					G
TFL 15	15	315								D
TFL 18	18	318		97	88					G
TFL 19	19	319			96					B
TFL 23	23	323		91	84					G
TFL 25	25	343								
Dean PSYU	-1			99	98					A
Quadra PSYU	-2			99	98					B
South Island	-3									B
Haida Gwaii (formerly Queen Charlotte Is.) (Old TFL 24)	-4									A
TFL 26	26	342			99	99				C
TFL 30	30	325		96	90	92	98			I
TFL 33	33	339		94	85					G
TFL 35	35	332								D G
TFL 37	37	347		99	98	Kingcome Locals and company breakage factors				B

Not all of the Tree Farm Licence "Identify Results" attrubutes are available at this time.

	Mature							**Ol.**	**MAT.**	
PSYU/ SSA / TSA /TFL	**PSYU#**	**SCN#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
TFL 38	38				97	97				B
TFL 39 Blks 1,2,4,5	39	344	Company DW & FIZ "B" breakage factors for mature.							B
Blks 3,6 & 7	39	344	Company DW & FIZ "A" breakage factors for mature.							A
TFL 41	41	341			94	96				A
TFL 42	42	458				91	97			I
TFL 43	43	469								
Northern Blocks	-1	469		99	98					A
Fraser Block	-2	469			99	99				C
Homathko Block	-3	469								B
TFL44	44	471	Company DW & FIZ "B" breakage factors for mature.							B
TFL 45	45	456								
old TFL 17	-1	456		99	98					A
old TFL 36	-2	456								B
TFL 46	46	457			96					B
TFL 47	47	470								
majority	-1	470		99	98					B
4 small islands	-2	470		99	98					A
Haida Gwaii (formerly Queen Charlottes)	-3	470								A

Not all of the Tree Farm Licence "Identify Results" attrubutes are available at this time.

	Mature							**OI.**	**MAT.**	
PSYU/ SSA / TSA /TFL	**PSYU#**	**SCN#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
TFL 48	48	474								L
TFL 49	49	472								
old TFL 9 & 32	-1		98	94	85					D
old TFL 16	-2		98							D
TFL 51 - Kitwanga (Cranberry TSA)	51	473	93	95						J
TFL 52	52	477		98	90	92	98			I
TFL 53	53	476			90	92	98			H, I
TFL 54	54	478			96					B
TFL 55	55	479		93	89					G
TFL 56	56	481		93	89					G
Watersheds										
G. Van. W. D.	01	354			99	99				C

Not all of the Tree Farm Licence "Identify Results" attrubutes are available at this time.

Parks	PSYU#	SCN#	FIZ	Parks	PSYU#	SCN#	FIZ
Apex Mountain	01	648	D	Manning	22	542	D
Birkenhead Lake	02	684	C	Monashee	23	666	G
Bowron Lake	03	650	G	Mount Assiniboine	24	548	F
Boya Lake	04	791	K	Mount Edziza	25	690	J
Cape Scott	05	1000	A	Mount Revelstoke	26	503	G
Cathedral	06	760	D	Mount Robson	27	549	G
Champion Lakes	07	511	E	Mount Seymour	28	550	C
Crooked River	08	774	I	Muncho Lake	29	595	L
Cultus Lake	09	515	C	Naikoon	30	1067	A
Darke Lake	10	516	D	Pacific Rim	31	676	B
Elk Falls	11	519	B	Sasquatch	32	619	C
Eneas Lakes	12	755	D	Silver Star	33	757	D
Garibaldi	13	525	C	Skagit River	34	688	C D
Glacier	14	501	G	Stagleap	35	704	E
Golden Ears	15	674	C	Stone Mountain	37	596	L
Hamber	16	564	G	Strathcona	38	590	B
Kikomun Creek	17	698	F	Tweedsmuir	39	567	H
Kokanee Glacier	18	535	G	Wells Gray	40		G
Kootenay	19	502	G	White Pelican	41	568	H
Liard River Hot Springs	20	594	L	Yoho	42	504	G
Little Qualicum Falls	21	539	B	Other - not specified	99	675	

Not all of the Tree Farm Licence "Identify Results" attrubutes are available at this time.

Tree Class Modification Of Loss Factor Tables

Tree Classes for Determination of Decay, Waste and Breakage Factors

Coniferous All Forest Inventory Zones				**Lodgepole Pine All Forest Inventory Zones**			
Age in	**Tree Classes**			**Age in**	**Tree Classes**		
10's	1, 2, 3, 4, 6	5, 7	8, 9	10's	1, 2, 3, 4, 6	5, 7	8, 9
2	YI	M	YI	2	YI	M	YI
3	YI	M	YI	3	YI	M	YI
4	YI	M	YI	4	YI	M	YI
5	YI	M	YI	5	YI	M	YI
6	YI	M	YI	6	YI	M	YI
7	YI	M	YI	7	OI	M	YI
8	YI	M	YI	8	OI	M	YI
9	OI	M	YI	9	OI	M	YI
10	OI	M	YI	10	OI	M	YI
11	OI	M	YI	11	OI	M	YI
12	OI	M	YI	12	OI	M	YI
13	M	M	OI	13	M	M	OI
14	M	M	OI	14	M	M	OI
15	M	M	OI	15	M	M	OI
16	M	M	OI	16	M	M	OI
..	.	.	..	..	.	.	..
25	M	M	OI	25	M	M	OI

Deciduous F.I.Z. A - L Except Aspen and Cottonwood F.I.Z. K & L				**Aspen & Cottonwood F.I.Z. K & L**			
Age in	**Tree Classes**			**Age in**	**Tree Classes**		
10's	1, 2, 3, 4, 6	5, 7	8, 9	10's	1, 2, 3, 4, 6	5, 7	8, 9
2	YI	M	YI	2	YI	M	YI
3	OI	M	YI	3	YI	M	YI
4	OI	M	YI	4	YI	M	YI
5	M	M	OI	5	OI	M	YI
6	M	M	OI	6	OI	M	YI
7	M	M	OI	7	OI	M	YI
8	M	M	OI	8	OI	M	YI
9	M	M	OI	9	M	OM	OI
10	M	M	OI	10	M	OM	OI
11	M	M	OI	11	M	OM	OI
12	M	M	OI	12	M	OM	OI
13	M	M	OI	13	M	OM	OI
14	M	M	OI	14	M	OM	OI
15	M	M	OI	15	M	OM	OI
16	M	M	OI	16	M	OM	OI
..	.	.	..	..	.	.	..
26	M	M	OI	26	OM	OM	OI

YI = Young Immature OI = Older Immature M = Mature OM = Over Mature

FOREST INVENTORY ZONE SERIES NUMBERS

SPECIES

	Douglas Fir			Western Red Cedar			Hemlock			Balsam			Spruce			Yellow Cedar			White Pine			Lodgepole Pine		
F.I.Z.	YI	OI	M	YI	OI	M	YI	OI	M	YI	OI	M	YI	OI	M	YI	OI	M	YI	OI	M	YI	OI	M
A	01	02	10	01	02	10	01	02	10	01	02	10	01	02	10	01	02	10	01	02	10	01	02	10
B	01	02	10	01	02	11	01	02	14	01	02	11	01	02	10	01	02	10	01	02	10	01	02	10
C	01	02	11	01	02	12	01	02	11	01	02	11	01	02	10	01	02	10	01	02	10	01	02	10
D	03	04	12	03	04	14	03	04	13	05	06	14	03	04	12	01	02	10	03	04	11	01	04	13
E	03	04	13	03	04	14	03	04	13	05	06	14	03	04	12	01	02	10	03	04	11	01	04	13
F	03	04	13	03	04	14	03	04	13	05	06	14	03	04	12	-	-	-	03	04	11	01	04	13
G	03	04	13	03	04	14	03	04	13	05	06	14	03	04	12	01	02	10	03	04	11	01	03	12
H	03	04	12	03	04	14	03	04	13	05	06	13	03	04	11	-	-	-	03	04	11	01	03	12
I	03	04	14	03	04	14	03	04	13	05	06	13	03	04	11	-	-	-	-	-	-	01	03	12
J	-	-	-	03	04	13	03	04	12	03	04	12	03	04	13	01	02	10	-	-	-	01	03	11
K	-	-	-	-	-	-	03	04	12	05	06	13	03	04	11	-	-	-	-	-	-	01	03	12
L	-	-	-	-	-	-	-	-	-	05	06	13	03	04	11	-	-	-	-	-	-	01	03	12

	Yellow Pine			White Bark Pine			Larch			Cottonwood				Alder			Broadleaf Maple			Birch			Aspen			
F.I.Z.	YI	OI	M	YI	OI	M	YI	OI	M	YI	OI	M	OM	YI	OI	M	YI	OI	M	YI	OI	M	YI	OI	M	ON
A	-	-	-	01	02	10	-	-	-	01	02	10	-	01	02	10	01	02	10	01	02	10	01	02	10	-
B	-	-	-	01	02	10	-	-	-	01	02	10	-	01	02	10	01	02	10	01	02	10	01	02	10	-
C	01	02	10	01	02	10	-	-	-	01	02	10	-	01	02	10	01	02	10	01	02	10	01	02	10	-
D	01	02	10	03	04	11	01	02	10	01	02	11	-	-	-	-	-	-	-	01	02	11	01	02	10	-
E	01	02	10	03	04	11	01	02	10	01	02	11	-	-	-	-	-	-	-	01	02	11	01	02	10	-
F	01	02	10	03	04	11	01	02	10	01	02	11	-	-	-	-	-	-	-	01	02	11	01	02	10	-
G	01	02	10	03	04	11	01	02	10	01	02	11	-	-	-	-	-	-	-	01	02	11	01	02	10	-
H	-	-	-	03	04	11	01	02	10	01	02	11	-	-	-	-	-	-	-	01	02	11	01	02	10	-
I	-	-	-	03	04	11	01	02	10	01	02	11	-	-	-	-	-	-	-	01	02	11	01	02	10	-
J	-	-	-	03	04	11	-	-	-	01	02	11	-	01	02	10	-	-	-	01	02	11	01	02	10	-
K	-	-	-	-	-	-	01	02	10	03	04	12	13	01	02	10	-	-	-	01	02	11	04	03	11	12
L	-	-	-	-	-	-	01	02	10	03	04	12	13	-	-	-	-	-	-	01	02	11	04	03	11	12

Note – Species prefix codes are: Fir – 1 / Cedar – 2 / Hemlock – 3 / Balsam – 4 / Spruce – 5 / Yellow Cedar – 6 / White Pine – 7 / Lodgepole Pine – 8 / Yellow Pine – 9 / Larch – 10 / Cottonwood – 11 / Alder – 12 / Maple – 13 / Birch – 14 / Aspen – 15 / Whitebark Pine – 16
Example – FIZ A, Mature Fir = Table 110
Aspen M (mature) and OM (over-mature)
See Table 17 for Local Loss Factor Table Numbers for a specific PSYU/SSA/TSA/TFL.

Figure T.1 Forest Inventory Zone Series Numbers.

Table 18 Risk Group Ratings by Pathological Indicators

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
Cw	All FIZ	Immature	1-80	Any indicator		
		Old Immature	81-120	No indicators	Any indicator	
	FIZ D to I	Mature	121+	No indicators or large rotten branch	Any other indicators	
	FIZ A, B, C J	Mature	121+	No indicators or either frost crack or fork/crook	Any other indicator(s)	
	Exceptions	Mature	121+	Height ≥ 40.5 m.	Height < 40.5 m.	Bowron, Longworth, Monkman, Purden, Robson PSYU's and TFL30
CY	All FIZ	Immature	1-80	Any indicator		
	All FIZ	Old Immature	81-120	No indicators	Any indicator	
	All FIZ	Mature	121+	No indicators	Any indicator	

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
Fd	All FIZ	Immature	1-80	Any indicator		
	FIZ A, B, C	Old Immature	81-120	Any indicator		
	FIZ D to I	Old Immature	81-120	No indicators	Any indicator	
	FIZ A, B, C	Mature	121+	No Indicators or 1 of dead/broken top or large rotten branch or frost crack	Any other indicator other than conk or blind conk	Conk or blind conk
	FIZ D, H	Mature	121+	No Indicators or 1 of mistletoe or large rotten branch or frost crack	Any other category or combination	
	FIZ E, F, G	Mature	121+	No Indicators or 1 of large rotten branch or mistletoe	Any other category or combination	
	FIZ I	Mature	121+	No Indicators or 1 of dead/broken top, mistletoe,large rotten branch, or frost crack	Any other category or combination(s) other than conk or blind conk	Conk or blind conk

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
B	All FIZ	Immature	1-80	Any indicator		
		Old Immature	81-120	No indicators	Any indicator	
		Mature	121+	No indicator or forks/crooks	3 or less indicators	Conk or blind conk or 4 or more other indicators
H	All FIZ	Immature	1-80	Any Indicator		
	All FIZ	Old Immature	81-120	No indicators	Any indicator	
	FIZ A	Mature	121 +	D or B Top, large rotten branch,mistletoe, frost crack, fork/crook or scar	2 or 3 indicators	4 or more categories or conk or blind conk
	FIZ B, C	Mature	121 +	D or B Top and/or mistletoe	frost crack or fork/crook or scar or indicators in 2 or 3 categories	4 or more categories or rotten branch, conk, or blind conk
	Kingcome Local & TFLs 6, 25, 37, 43, 45, and 47	Mature	121 +	No indicators or one or both of D or B top or mistletoe	frost crack, fork/crook, sca or rotten branch or 2 or more categories	4 or more categories or conk or blind conk
	FIZ D to K	Mature	121 +	No indicators	No more than 3 of any indicator other than conk/blind conk	Conk/blind conk or 4 O more of any other indicators

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
PL	All FIZ	Immature	1 - 60	Any indicator		
	All FIZ	Old Immature	61 - 120	No indicators	Any indicator	
	FIZ A, B, C	Mature	121 +	No indicators	Any indicator	
	FIZ D to L	Mature	121 +	No indicators	Any other than conk/blind conk	Conk/blind conk
Pw	All FIZ	Immature	1 - 80	Any indicator		
and		Old Immature	81 - 120	No indicators	Any indicator	
Pa		Mature	121 +	No indicators	Any indicator	
Py	All FIZ	Immature	1 - 80	Any indicator		
		Old Immature	81 - 120	No indicators	Any indicator	
		Mature	121 +	Fork/crook	Any indicator other than fork/crook	

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
S	All FIZ	Immature	1 - 80	Any indicator		
	FIZ A, B, C	Old Immature	81 - 120	Any indicator		
	FIZ D to L	Old Immature	81 - 120	No indicators	Any indicator	
	FIZ A, B, C	Mature	121 +	D or B Top, rotten branch mistletoe, frost crack, fork/crook, scar	More than 1 indicator or Conk or Blind conk	
	FIZ D to L	Mature	121 +	No indicators	Any other than conk/blind conk	Conk/blind conk
L	All FIZ	Immature	1 - 80	Any indicator		
		Old Immature	81 - 120	No indicators	Any indicator	
		Mature	121 +	No indicators	Any other than conk or blind conk	Conk or blind conk

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
Ac	FIZ A to J	Immature	1-20	Any indicator		
	FIZ K, L	Immature	1-40	Any indicator		
	FIZ A to J	Old Immature	21 - 40	Any indicator		
	FIZ K, L	Old Immature	41 - 80	Fork/crook	Any other than fork/crook	
	FIZ A to J	Mature	41 +	Any indicator		
	FIZ K, L	Mature	81 - 140	Fork/crook	Any other than fork/crook	
	FIZ K, L	Over Mature	141 +	Any indicator		

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
At	FIZ A to J	Immature	1-20	Any indicator		
	FIZ K, L	Immature	1-40	Any indicator		
	FIZ A to J	Old Immature	21 - 40	Any indicator		
	FIZ K, L	Old Immature	41 - 80	Any indicators other than conk or blind conk	Conk or blind conk	
	FIZ A to J	Mature	41 +	No indicators	Any	
	FIZ K, L	Mature	81 - 140	Fork/crook	Any other than fork/crook o conk or blind conk	Conk or Blind Conk
	FIZ K, L	Over Mature	141 +	Any indicator		
E	All FIZ	Immature	1 - 20	Any indicator		
		Old Immature	21 - 40	Any indicator		
		Mature	41 +	No indicators	Any Indicator	

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
D	All FIZ	Immature	1 - 20	Any indicator		
		Old Immature	21 - 40	Any indicator		
		Mature	41 +	Any indicator		
Mb	All FIZ	Immature	1 - 20	Any indicator		
		Old Immature	21 - 40	Any indicator		
		Mature	41 +	No indicators	Any indicator	

Table 19 Sound Wood Factors for Saprot

	Saprot Depth - cm														
*Diameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
20	0.81	0.64	0.49	0.36	0.25	0.16	0.09	0.04	0.01						
25	0.85	0.71	0.58	0.46	0.36	0.27	0.19	0.13	0.08	0.04	0.01				
30	0.87	0.75	0.64	0.54	0.44	0.36	0.28	0.22	0.16	0.11	0.07	0.04	0.02		
35	0.89	0.78	0.69	0.60	0.51	0.43	0.36	0.29	0.24	0.18	0.14	0.10	0.07	0.04	0.02
40	0.90	0.81	0.72	0.64	0.56	0.49	0.42	0.36	0.30	0.25	0.20	0.16	0.12	0.09	0.06
45	0.91	0.83	0.75	0.68	0.60	0.54	0.47	0.42	0.36	0.31	0.26	0.22	0.18	0.14	0.11
50	0.92	0.85	0.77	0.71	0.64	0.58	0.52	0.46	0.41	0.36	0.31	0.27	0.23	0.19	0.16
55	0.93	0.86	0.79	0.73	0.67	0.61	0.56	0.50	0.45	0.40	0.36	0.32	0.28	0.24	0.21
60	0.93	0.87	0.81	0.75	0.69	0.64	0.59	0.54	0.49	0.44	0.40	0.36	0.32	0.28	0.25
65	0.94	0.88	0.82	0.77	0.72	0.66	0.62	0.57	0.52	0.48	0.44	0.40	0.36	0.32	0.29
70	0.94	0.89	0.84	0.78	0.73	0.69	0.64	0.60	0.55	0.51	0.47	0.43	0.40	0.36	0.33
75	0.95	0.90	0.85	0.80	0.75	0.71	0.66	0.62	0.58	0.54	0.50	0.46	0.43	0.39	0.36
80	0.95	0.90	0.86	0.81	0.77	0.72	0.68	0.64	0.60	0.56	0.53	0.49	0.46	0.42	0.39
85	0.95	0.91	0.86	0.82	0.78	0.74	0.70	0.66	0.62	0.58	0.55	0.52	0.48	0.45	0.42
90	0.96	0.91	0.87	0.83	0.79	0.75	0.71	0.68	0.64	0.60	0.57	0.54	0.51	0.47	0.44
95	0.96	0.92	0.88	0.84	0.80	0.76	0.73	0.69	0.66	0.62	0.59	0.56	0.53	0.50	0.47
100	0.96	0.92	0.88	0.85	0.81	0.77	0.74	0.71	0.67	0.64	0.61	0.58	0.55	0.52	0.49
105	0.96	0.93	0.89	0.85	0.82	0.78	0.75	0.72	0.69	0.66	0.62	0.60	0.57	0.54	0.51
110	0.96	0.93	0.89	0.86	0.83	0.79	0.76	0.73	0.70	0.67	0.64	0.61	0.58	0.56	0.53

* Use estimated diameter inside bark at the top of first third of tree.

Tree Volumes by Third

1st Third	50%	= 1/2
2nd Third	33%	= 1/3
3rd Third	17%	= 1/6

Useful Formulas

Volume of Tree	= 1/3 $\pi R^2 L$, where R = tree dbh and L = tree length
Volume of Cylindrical Rot	= $\pi R^2 L$, where R = the radius of the rot and L = rot length
Volume of Conical Rot	= 1/3 $\pi R^2 L$, where R = the radius of the rot and L = rot length
% Sound	= $100 - \dfrac{\text{Volume of Rot}}{\text{Volume of Tree or Log}}$

Figure T.2 Sound wood factors for saprot.

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Forms

The following forms with FS numbers are provided in a fillable format that can be downloaded from the Internet. The FS 693 Provincial Cruise Plan and FS 698 Provincial Comparative Cruise Checklist are the only forms that are available to the public. The FS 694 Provincial Cruise Plan and Map Check List, FS 695 Provincial Office Check of Field Cruise Data, FS 696 Provincial Field Check Cruise Summary, and FS 697 Provincial Compilation Check Form are available for in service only.

The sites are located under:

Internet	http://www.for.gov.bc.ca/pscripts/ISB/FORMS/forms.asp
Intranet (In Service)	http://wwwinternal.for.gov.bc.ca/iscripts/ISB/FORMS/forms.asp

FS 693 Provincial Cruise Plan

PROVINCIAL CRUISE PLAN

TENURE: C.P.:	CRUISE BASE OR SCALE BASE
Base Map #	

A. ATTENTION:

District Manager: | Cruise Area (ha):

Licensee: | Contact:

Geographic Location:

TSA: | PSYU: | FIZ: | Inv. Reg. No: | Comp't. No:

Coast: | Immature: | Mature: | Both:

B. CRUISING AGENCY:		COMPILING AGENCY:	
Agency Name: Cruiser Names (if known): Address:		Name: Address:	

C. TENTATIVE CRUISE DATES:			
From:		To:	
Proposed Years of Logging:		Access:	

D. HARVESTING SYSTEM:

Harvesting System:

Systematic Grid:

1. Segregate silv. System (patch clearcut, seed tree, note avg. opening size).

E. PLOT NO:

Measure Plots: | Count Plots: | Estimated C.V.: | S.E. Waived (Y/N):

Grid Spacing (in m) | by | 200 x 200 m if cruise < 250 ha
250 x 250 m if cruise ≥ 250 ha

PLOT TYPE: Prism/Relascope: | Fixed Area: | Plot Size (ha):

F. MINIMUM DIAMETER LIMITS:	COAST		INTERIOR	
	Mature	Immature	Species (cm to)	Exemption (cm)
Field Tally				
Compilation - Appraisal (cm)				
Compilation - Cutting Permit (cm)				

G. MARKING	Ribbon Colour	Paint Colour	Axe Blaze	Other (tags)
Boundaries				
Baseline				
Strips				
Plot Centre				
Tie Points				
Non Forest Types				
Riparian Areas				
Wildlife Tree Patches				
Other				

H. TREE HEIGHTS: (TOTAL HEIGHT METHOD IS MANDATORY)

Height Estimation Method (ocular, vertex, etc.) | Height Measuring Instrument (clino, hypsometer, etc.)

I. OTHER:

Comments:

Note The original traverse notes must be provided to Forest Service staff upon request.:

Signed: | Authorized Licensee Representative | RPF/RFT/ATC or ATE Number | Date:

Are block(s) in an approved Forest Stewardship or Forest Development Plan?

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Figure F.1 FS 693 - Provincial Cruise Plan (Page 1 of 2).

SECTIONS J, K, L (TO BE FILLED OUT WHEN REQUIRED)

J. STRATIFIED SYSTEMATIC SAMPLING: (Calculate sampling requirements for each timber type)

				A	B	C	D	E	F	G	H
Type No.	Type Description	BEC Subzone /Variant	Plot/Prism size	Type Area (ha)	Average m^3/ha	Estimated Vol/Type m^3	Type Vol. % of Total Vol.	Estimated Type CV	Weighted Type CV	Total Plots/CP	Grid Spacing
1										Refer to	
2										Sections	
3										2.4, 2.5	
4										Provincial	
5										Cruising	
6										Manual	
7											
			Tot. Ha's		Tot. Vol.		Tot. Weighted CV				

EXPLANATION OF FORMULA

C = A X B

D = $\frac{C}{\text{Sum C1...7}}$ X 100

E = cruising manual, section 2.62

Variable Plot F = D X E

Fixed Plot F = A X E

G = cruising manual section 2.4, 2.5

H = $\sqrt{\frac{\text{Total hectares x 10,000}}{\text{G (number of plots)}}}$

K. SOURCE OF CV ESTIMATES

Type 1: ______

Type 2: ______

Type 3: ______

Type 4: ______

Type 5: ______

Type 6: ______

Type 7: ______

L. INSTRUCTIONS FOR SECTIONS

A Enter district and tenure information.
B Enter the name and address of the cruising and compiling agencies.
C Enter the tentative start and completion dates of the field work.
D Enter yes beside applicable headings.
E Enter the number of plots and the grid spacing.
F Enter the diameter limits measured and compiled to, and prism BAF.
G Enter the colour(s) of paint and flagging used, and the type of blazing and plot tags.
H Enter the appropriate height estimation method, and height measuring instrument used.
I Enter remarks if required. Signature and date are mandatory.
J OPTIONAL. Enter data ONLY if stratified systematic sampling is used. Type description – include: species/ age class/ height class/ site quality.
K OPTIONAL. Enter source of CV estimates.

ATTACH: CRUISE PLAN MAP. Drawn to 1:5,000 or 1:10,000 scale, topography, (streams and roads), air photo numbers, strips and baselines, plot locations, boundaries, area in the merch and total by cut block, label the cut block (mature or immature). MUST BE SUBMITTED WITH THIS FORM.

AERIAL PHOTOGRAPH: Submit a copy with timber typing.

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Figure F.2 FS 693 - Provincial Cruise Plan (Page 2 of 2).

FS 694 Provincial Cruise Plan and Map Check List

TENURE:	
C.P.:	
CRUISE AREA (ha):	
BASE MAP #:	

PROVINCIAL
CRUISE PLAN AND MAP CHECK LIST

		YES	NO	N/A
A.	**TENURE and CRUISING AGENCY INFORMATION (Cruise Design -- Parts A to C)**			
1.	Licensee's name shown?			
2.	Tenure and Cutting Permit numbers shown?			
3.	TSA, PSYU, FIZ, Region and Compartment Numbers indicated.			
4.	Cruising and Compiling Agencies indicated.			
B.	**HARVESTING and SAMPLING SYSTEM INFORMATION (Cruise Design -- Parts D to G, J and K)**			
11.	Harvesting and sampling system acceptable? (Part D)			
12.	Number of plots and plot type acceptable? (Part E)			
13.	Diameter Limits acceptable? (Part F)			
14.	Boundary marking acceptable? (Part G)			
C.	**TREE HEIGHTS AND HEIGHT METHOD (Cruise Design -- Part H)**			
15.	Tree height measuring instrument and estimation method indicated?			
D.	**CRUISE PLAN MAP and PLOT ESTABLISHMENT INFORMATION (Cruise Plan Map)**			
16.	Tenure Information adequate? (I.e. Licence, CP, FIZ zone, UTM Grid No's, Reg. and Compt. No's...etc..)			
17.	Acceptable map scale? (1:5 000; 1:10 000)			
18.	Map area statement clearly shown? (Timber type descriptions and areas indicated?)			
19.	Timber types on the cruise plan map and forest cover map of the cruise and surrounding area provided?			
20.	Minimum of 2 plots per type?			
21.	Sufficient number of plots per type or 1.0 plots per hectare and SE waived?			
22.	Consistent plot and/or strip spacing within each type? (**Maximum grid - 200m if cruise < 250 ha or 250m if cruise ≥ 250 ha**).			
23.	Plots well distributed within each type?			
24.	Prism and/or fixed area plot size consistent in each type?			
25.	Cut block boundaries and forest types clearly delineated on map?			
26.	Baseline established and tied to a well defined geographical feature or a legal survey mark if possible.			
27.	P.O.C. established?			
28.	Strips tied to cutblock boundaries?			
29.	Plots and strips clearly marked?			

Note: There may be some exceptions to the above criteria. If in doubt check Chapters 2 and 3 of the *Cruising Manual*, or contact the Regional Cruising Coordinator.

Remarks: ______________________________

Accepted:	**Rejected:**	**Date:**
Action:		
Signature:		
Approval/rejection letter sent by:		**Date:**

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Figure F.3 FS 694 - Provincial Cruise Plan and Map Check List.

FS 695 Provincial Office Check of Field Cruise Data

PROVINCIAL
OFFICE CHECK OF FIELD CRUISE DATA

TENURE:	C.P.:

A. CRUISE PLAN and FINAL CRUISE MAP	YES	NO
1. Is Cruise Plan approved?		
2. Was the Cruise Plan followed?		
3. Is the **FINAL** Cruise Map acceptable		

B. PLOT CARDS	YES	NO
4. Are all of the plot cards submitted?		
5. Is each plot card properly filled out?		
6. Is each plot card **SIGNED** and **DATED**? (*Cruising Manual*, Section 3.1.1)		
7. Is the prism (or fixed area plot) size consistent within each timber type?		
8. Do the plot locations by type, strip and cutblock concur with the final cruise map?		
9. If count plots are used, indicate the count/measure ratio	COUNT	MEASURE

C. MERCHANTABLE STEM COUNT:

PRISM CRUISES (*Cruising Manual*, Section 2.1.2.1) Double the tree count in border and half plots. — **"Minimum"** average of **5.0** merchantable trees per plot if SE 15% not achieved (does not include tree classes 4 and 6).

FIXED AREA CRUISES — **"Recommended"** average tree count is **not less than 10.0**.

	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7	TOTAL
10. Total Number of Plots								
11. Average Number of stems per plot.								
12. No. Plots with < than the recommended average stem no.								

D. AGES – TREE CLASSES	YES	NO
13. Are adequate age samples collected?		
14. Are age/height corrections done properly?		
15. Are 95% of all trees in the correct maturity class for loss factor deductions?		

Remarks:

Accepted:	Rejected:	Date:
Action:		
Signature:		
Approval/rejection letter sent by:		Date:

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Figure F.4 FS 695 - Provincial Office Check of Field Cruise Data.

FS 696 Provincial Field Check Cruise Summary

PROVINCIAL
FIELD CHECK CRUISE SUMMARY

TENURE: ______ C.P.: ______

IS CHECK CRUISE REQUIRED? ______________ (Note: **If no**, inform licensee.)

Cruised by: ______ Cruise Date: ______ # plots: ______

Checked by: ______ Check Date: ______ # plots: ______

A. PLOT ESTABLISHMENT & DISTANCE MEASUREMENT:	NUMBER (IF REQUIRED	ACCEPTABLE (Y/N)	NOT CHECKED
1. Distance AND Bearings between plots			
2. Distance AND Bearings for Reference Trees			
3. Boundaries checked: (*Indicate Yes, No or NOT Checked*)			
B. SPECIES IDENTIFICATION: - (Section 3.6.3.1, 2)			
4. % of Stems incorrectly identified:			
C. NUMBER OF STEMS: - (Section 3.6.3.1, 1)			
5. Stem count difference for tree classes 1,2,3,5,7,9 (1 STEM IN 50 allowed)			
6. Live and dead useless stem count difference (1 in 50 allowed) - Interior			
D. BREAST HEIGHT: - (Section 3.6.3.1, 7)			
7. Total Number of Stems Checked:			
8. Number of Stems **> 5% HIGH**			
9. Number of Stems **< 5% LOW**			
10. Average Error of All Samples:			
E. DIAMETERS: - (Section 3.6.3.1, 7)			
11. Number of Diameters Checked			
12. % of Diameters in Error by **> ± 2%:**			
13. Average Absolute Variation of all Diameters Checked:			
F. PATHOLOGICAL INDICATORS/DAMAGE CODES: - (Section 3.6.3.1, 4 and 5)			
14. Number of Trees with **> 1 Risk Group Change**			
15. % Risk Group changes — all trees			
16. % trees checked with incorrect fire/blowdown/insect codes			
G. HEIGHT SAMPLES: - (Section 3.6.3.1, 3)			
17. Number of Heights Checked			
18. % Average Absolute Variation of all of Heights Checked			
H. AGES: - (Section 3.6.3.1, 6)			
19. 95% of ALL trees in correct maturity class for loss factor deductions			
I. QUALITY (Coast Immature Only): – (Section 3.6.3.2)			
20. i. % trees with path incorrectly coded in 1st and 2nd third			
ii. % of quality indicators ± 1 code change			
iii. Knots and knot indicators - # of 5 m log quarters > 2 quarters difference			
Note Spiral grain – code > 4 does not require checking			
J. PLOT SLOPE: - (Section 3.6.3.3)			
21. i. At least 90% plots within +/- 5 plot slope % (Y/N)			
ii. Average Variation of all check plots within +/- 5 slope % (Y/N)			
K. REMARKS: - (Section 3.6.2, 3.6.5)			

Accepted:	Rejected:	Date:
Action:		
Signature:	Forest District:	
Approval/rejection letter sent by:		Date:

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NOTE: ANY UNACCEPTABLE FINDINGS MAY BE GROUNDS FOR REJECTION.

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Figure F.5 FS 696 - Provincial Field Check Cruise Summary.

FS 697 Provincial Compilation Check Form

PROVINCIAL
COMPILATION CHECK FORM

TENURE: ________ C.P.: ________

A. CRUISE/TENURE INFORMATION	YES	NO
1. Was this cruise field checked?		
2. Licensee		
3. Forest District		
4. a) Forest Inventory Zone (FIZ)		
b) Forest Sustained Yield Unit (PSYU)		
c) Forest Inventory Region No.		
d) Forest Inventory Compartment No.		
B. MAP AREA STATEMENT	**YES**	**NO**
5. Net Merchantable Area agree with appraisal?		
6. a) Do the map merchantable areas agree with compilation and appraisal?		
b) Do the number and area of the Cutblocks on the map agree with the compilation and appraisal?		
c) Do the number and area of the Timber Types on map agree with compilation?		

COMPILATION DATA

C. COMPILATION VERSION	YES	NO
7. Is the compilation version correct?		
D. SAMPLE ERROR ACHIEVEMENT (Total Volume Compilation)	**YES**	**NO**
8. SE % ACHIEVED? (See Section 2.1.2 Cruising Manual)		
9. If SE % NOT ACHIEVED, have minimum number of trees/plot and 1 plot per hectare been achieved?		
E. FIR LRFs	**YES**	**NO**
10. a) Type of Compilation...... **WET** or **DRY** **Belt Fir** (see Chapter 7, Position 14 of the Cruising Manual)		
11. b) Proper Fir LRF's used? **(Wet Belt/Dry Belt)** - (see LRF Reports)		
F. PLOT SUMMARIES AND LOSS FACTORS	**YES**	**NO**
12. Have the correct Forest Inventory Loss Factors been used for each species? (Table 17 & Figure T.1 of Cruising Manual)		
13. Are the plots in the compilation and appraisal only from the harvest area?		
G. REDUCTION COMPILATIONS (Factored, Partial Cut, etc)	**YES**	**NO**
14. Total (Full) volume compilation submitted (NO REDUCTIONS)?		
15. Factored compilation consistent with source documentation?		
H. APPRAISAL DATA SHEET --- CRUISE DATA	**YES**	**NO**
16. Is the cruise data entered on the Appraisal Data Sheet the same as the compilation?		

REMARKS :

Accepted:	Rejected:	Date:
Action:		
Signature:		
Approval/rejection letter sent by:		Date:

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Figure F.6 FS 697 - Provincial Compilation Check Form.

FS 698 Provincial Comparative Cruise Checklist

PROVINCIAL
COMPARATIVE CRUISE CHECKLIST

FOREST REGION ____________

FOREST DISTRICT ________

NEW CUTTING AUTHORITY (NCA): ____________ NEW C.P.: ____________

PARENT LICENCE ____________ PARENT C.P.: ____________

PARENT TIMBER TYPE(S) (1) ______ (2) ______ (3) ______

NCA TIMBER TYPE(S) (1) ______ (2) ______ (3) ______

A.	GEOGRAPHICAL INFORMATION and CRUISE MAP		ACCEPTABLE (Y/N)
1.	Location map provided shows the proximity of parent and new cruises?		
2.	Is the NCA Cruise Plan Map acceptable (- systematic grid?)		
	ZONE DATA ACCEPTABILITY	*Parent Cutting Authority*	*New Cutting Authority (NCA)*	
3.	Biogeoclimatic (BEC) Subzone			
4.	PSYU			
5.	Forest Inventory Zone (FIZ)			
6.	Wet or Dry Belt			

B.	FIELD DATA	ACCEPTABLE (Y/N)
7.	PARENT TIMBER CRUISE FIELDWORK DATE *(Mature must be < 10 years / Immature < 5 years)*	
8.	Does the parent cruise meet the *Cruising Manual* standards (SE % or 1 plot/hectare and 5.0 trees/plot)?	
9.	Does number of plots/type in NCA meet or exceed the standards required in the comparative cruising matrix in Section 2.1.2.2?	
10.	Is the data collected to the *Cruising Manual* standards?	
11.	Is there an average of 5.0 trees per plot in the NCA cruise?	
12.	Are at least 2 ages measured of co-dominant and dominant trees per plot in the new cruise?	

C.	COMPILATION			ACCEPTABLE (Y/N)
13.	Cruise compilation version - parent and NCA must be compiled on the most recent version?			
14.	Are all summary pages submitted for the parent and new cruise?			
		Parent Cutting Authority	*New Cutting Authority (NCA)*	
15.	Timber Merchantability Specifications			
16.	Major Species Composition (± 5%)			
17.	Minor Species Composition (± 10%)			
18.	Merchantable Vol/ha (± 10% differnce)			
19.	Maturity Class			
20.	% immature by TYPE			
21.	Lumber Recovery Factors (± 5 LRF Points)			
22.	Merchantable Vol/Tree (± 10%)			
23.	**If NCA cruise is LESS THAN 0.20 m^3/tree, the parent cruise MUST BE LESS THAN 0.20 m^3/tree. If NCA cruise is GREATER THAN 0.20 m^3/tree, the parent cruise MUST BE GREATER THAN 0.20 m^3/tree.**			
24.	Recompiled cruise Sampling Error(%)			

REMARKS:

Submitted by Licensee: (signature)	
Approved by District Manager: (signature)	
Approval/rejection letter sent by:	Date:

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Figure F.7 FS 698 – Provincial Comparative Cruise Checklist.

Acknowledgements

1. The colour photographs that are in Section A.4.4 were contributed by the Canadian Forest Service.

2. The Forms, Risk group rating tables and Interior Site Index Tables were compiled by the Kamloops Forest Region.

3. The Down Tree Matrix was provided by the Kamloops Forest District.

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Appendices

Appendix 1 Age and Height Class Limits

Table A.1 Age Class Limits

Age and Height Limits for Age in Tens					
Age	**Limits**	**Age**	**Limits**	**Age**	**Limits**
10	1-10	100	91-100	190	181-190
20	11-20	110	101-110	200	191-200
30	21-30	120	111-120	210	201-210
40	31-40	130	121-130	220	211-220
50	41-50	140	131-140	230	221-230
60	51-60	150	141-150	240	231-240
70	61-70	160	151-160	250	241-250
80	71-80	170	161-170	260	251-260
90	81-90	180	171-180	270	261-270

Height Class Limits for Height in Threes					
Height	**Limits**	**Height**	**Limits**	**Height**	**Limits**
3	0.0-4.4	24	22.5-25.4	45	43.5-46.4
6	4.5-7.4	27	25.5-28.4	48	46.5-49.4
9	7.5-10.4	30	28.5-31.4	51	49.5-52.4
12	10.5-13.4	33	31.5-34.4	54	52.5-55.4
15	13.5-16.4	36	34.5-37.4	57	55.5-58.4
18	16.5-19.4	39	37.5-40.4	60	58.5-61.4
21	19.5-22.4	42	40.5-43.4	63	61.5-64.4

Appendix 2 Magnetic Declination 2008

Region	Location	Latitude	Longitude	Declination 2008 Degree, Min.	Declination 2008 Decimal Deg.
		(in degrees, minutes)			
Coastal	Chilliwack	49° 10'	121° 57'	17° 24' E	17.4° E
Coastal	Haney	49° 13'	122° 36'	17° 34' E	17.6° E
Coastal	Abbotsford	49° 03'	122° 17'	17° 27' E	17.5° E
Coastal	Vancouver	49° 15'	123° 07'	17° 42' E	17.7° E
Coastal	Squamish	49° 45'	123° 07'	17° 49' E	17.8° E
Coastal	Powell River	49° 51'	124° 32'	18° 10' E	18.2° E
Coastal	Campbell River	50° 01'	125° 20'	18° 23' E	18.4° E
Coastal	Port McNeill	50° 35'	127° 06'	18° 51' E	18.9° E
Coastal	Gold River	49° 41'	126° 07'	18° 27' E	18.5° E
Coastal	Nanaimo	49° 10'	123° 56'	17° 52' E	17.9° E
Coastal	Tofino	49° 07'	125° 53'	18° 15' E	18.3° E
Coastal	Duncan	48° 47'	123° 42'	17° 44' E	17.7° E
Coastal	Port Alberni	49° 14'	124° 48'	18° 05' E	18.1° E
Coastal	Sayward	50° 23'	125° 58'	18° 36' E	18.6° E
Coastal	Holberg	50° 39'	128° 01'	18° 59' E	19.0° E
Coastal	Port Renfrew	48° 33'	124° 25'	17° 50' E	17.8° E
Coastal	Massett	54° 01'	132° 06'	20° 21' E	20.4° E
Coastal	Haida Gwaii (formerly Queen Charlotte City)	53° 15'	132° 07'	20° 05' E	20.1° E
Coastal	Klemtu	52° 35'	128° 31'	19° 41' E	19.7° E
Coastal	Hagensborg	52° 23'	126° 33'	19° 19' E	19.3° E
Coastal	Security Bay	51° 22'	127° 28'	19° 09' E	19.2° E
Coastal	Alison Sound	51° 15'	127° 00'	19° 02' E	19.0° E
Coastal	Pemberton	50° 19'	122° 48'	17° 54' E	17.9° E
Coastal	Boston Bar	49° 52'	121° 26'	17° 29' E	17.5° E
Coastal	Stuart Island	50° 22'	125° 08'	18° 26' E	18.4° E
Coastal	Sewell Inlet	52° 53'	131° 59'	19° 57' E	20.0° E
Coastal	Franklin River	49° 00'	124° 45'	18° 01' E	18.0° E
Coastal	Rivers Inlet	51° 41'	127° 15'	19° 13' E	19.2° E
Coastal	Prince Rupert	54° 18'	130° 20'	20° 23' E	20.4° E
Northern	Burns Lake	54° 14'	125° 46'	19° 58' E	20.0° E
Northern	Houston	54° 27'	126° 37'	20° 08' E	20.1° E
Northern	Smithers	54° 47'	127° 11'	20° 18' E	20.3° E
Northern	Hazelton	55° 14'	127° 35'	20° 30' E	20.5° E
Northern	Terrace	54° 31'	128° 36'	20° 19' E	20.3° E
Northern	Stewart	55° 57'	130° 00'	20° 52' E	20.9° E
Northern	Lower Post	59° 55'	128° 30'	22° 51' E	22.9° E
Northern	Bob Quinn Lake	56° 58'	130° 15'	21° 15' E	21.3° E
Northern	Dease Lake	58° 26'	130° 00'	21° 59' E	22.0° E
Northern	Atlin	59° 35'	133° 41'	22° 39' E	22.7° E
Southern	Valemount	52° 50'	119° 15'	17° 58' E	18.0° E
Southern	McBride	53° 18'	120° 10'	18° 26' E	18.4° E
Northern	Hixon	53° 25'	122° 35'	19° 06' E	19.1° E
Northern	Prince George	53° 55'	122° 45'	19° 23' E	19.4° E
Northern	Bear Lake (Hart Hwy)	54° 30'	122° 41'	19° 41' E	19.7° E
Northern	Vanderhoof	54° 01'	124° 01'	19° 39' E	19.7° E
Northern	Kenny Dam	53° 35'	124° 57'	19° 34' E	19.6° E

Region	Location	Latitude	Longitude	Declination 2007 Degree, Min.	Declination 2008 Decimal Deg.
		(in degrees, minutes)			
Northern	Ft. St. James	54° 26'	124° 15'	19° 54' E	19.9° E
Northern	Takla Landing	55° 29'	125° 58'	20° 32' E	20.5° E
Northern	Manson Creek	55° 40'	124° 29'	20° 31' E	20.5° E
Northern	Aiken Lake	56° 26'	125° 45'	20° 56' E	20.9° E
Northern	Bear Lake (Driftwood)	56° 12'	126° 51'	20° 51' E	20.9° E
Northern	Mackenzie	55° 18'	123° 10'	20° 11' E	20.2° E
Northern	Fort Ware	57° 26'	125° 38'	21° 20' E	21.3° E
Northern	Ingenika Point	56° 47'	124° 54'	21° 02' E	21.0° E
Northern	Ingenika Mine	56° 42'	125° 11'	21° 01' E	21.0° E
Northern	Dawson Creek	55° 46'	120° 14'	19° 29' E	19.5° E
Northern	Chetwynd	55° 42'	121° 38'	19° 59' E	20.0° E
Northern	Tumbler Ridge	55° 07'	121° 00'	19° 30' E	19.5° E
Northern	Fort St. John	56° 15'	120° 51'	19° 56' E	19.9° E
Northern	Beaton River (settl.)	57° 23'	121° 25'	20° 33' E	20.6° E
Northern	Pink Mountain	57° 02'	122° 31'	20° 45' E	20.8° E
Northern	Fort Nelson	58° 48'	122° 43'	21° 25' E	21.4° E
Northern	Muncho Lake	58° 56'	125° 46'	22° 01' E	22.0° E
Northern	Nelson Forks	59° 30'	124° 01'	22° 01' E	22.0° E
Southern	Chase	50° 49'	119° 41'	17° 25' E	17.4° E
Southern	Lillooet	50° 40'	121° 56'	17° 50' E	17.8° E
Southern	Merritt	50° 07'	120° 47'	17° 25' E	17.4° E
Southern	Princeton	49° 28'	120° 30'	17° 09' E	17.2° E
Southern	Penticton	49° 30'	119° 35'	16° 58' E	17.0° E
Southern	Vernon	50° 16'	119° 16'	17° 09' E	17.2° E
Southern	Salmon Arm	50° 42'	119° 16'	17° 17' E	17.3° E
Southern	Kamloops	50° 40'	120° 19'	17° 30' E	17.5° E
Southern	Clearwater	51° 39'	120° 02'	17° 47' E	17.8° E
Southern	Beaverdell	49° 26'	119° 05'	16° 50' E	16.8° E
Southern	Castlegar	49° 19'	117° 39'	16° 26' E	16.4° E
Southern	Cranbrook	49° 30'	115° 46'	15° 53' E	15.9° E
Southern	Creston	49° 06'	116° 31'	16° 01' E	16.0° E
Southern	Flathead	49° 22'	114° 37'	15° 22' E	15.4° E
Southern	Golden	51° 18'	116° 58'	16° 49' E	16.8° E
Southern	Grand Forks	49° 02'	118° 27'	16° 33' E	16.6° E
Southern	Invermere	50° 31'	116° 02'	16° 17' E	16.3° E
Southern	Kaslo	49° 55'	116° 54'	16° 24' E	16.4° E
Southern	Mica Creek	52° 00'	118° 34'	17° 30' E	17.5° E
Southern	Nakusp	50° 14'	117° 48'	16° 46' E	16.8° E
Southern	Nelson	49° 29'	117° 17'	16° 23' E	16.4° E
Southern	Revelstoke	50° 59'	118° 12'	17° 07' E	17.1° E
Southern	Sparwood	49° 43'	114° 53'	15° 35' E	15.6° E
Southern	Quesnel Townsite	52° 59'	122° 30'	18° 52' E	18.9° E
Southern	Farwell Canyon	51° 49'	122° 34'	18° 22' E	18.4° E
Southern	Mid - Horsefly Lake	52° 24'	121° 02'	18° 17' E	18.3° E
Southern	100 Mile House Townsite	51° 39'	121° 17'	18° 03' E	18.1° E
Southern	Chilanko Forks Settlement	52° 07'	124° 04'	18° 46' E	18.8° E

Internet Site: http://gsc.nrcan.gc.ca/geomag/field/mdcalc_e.php

Appendix 3 Forest Inventory Zones

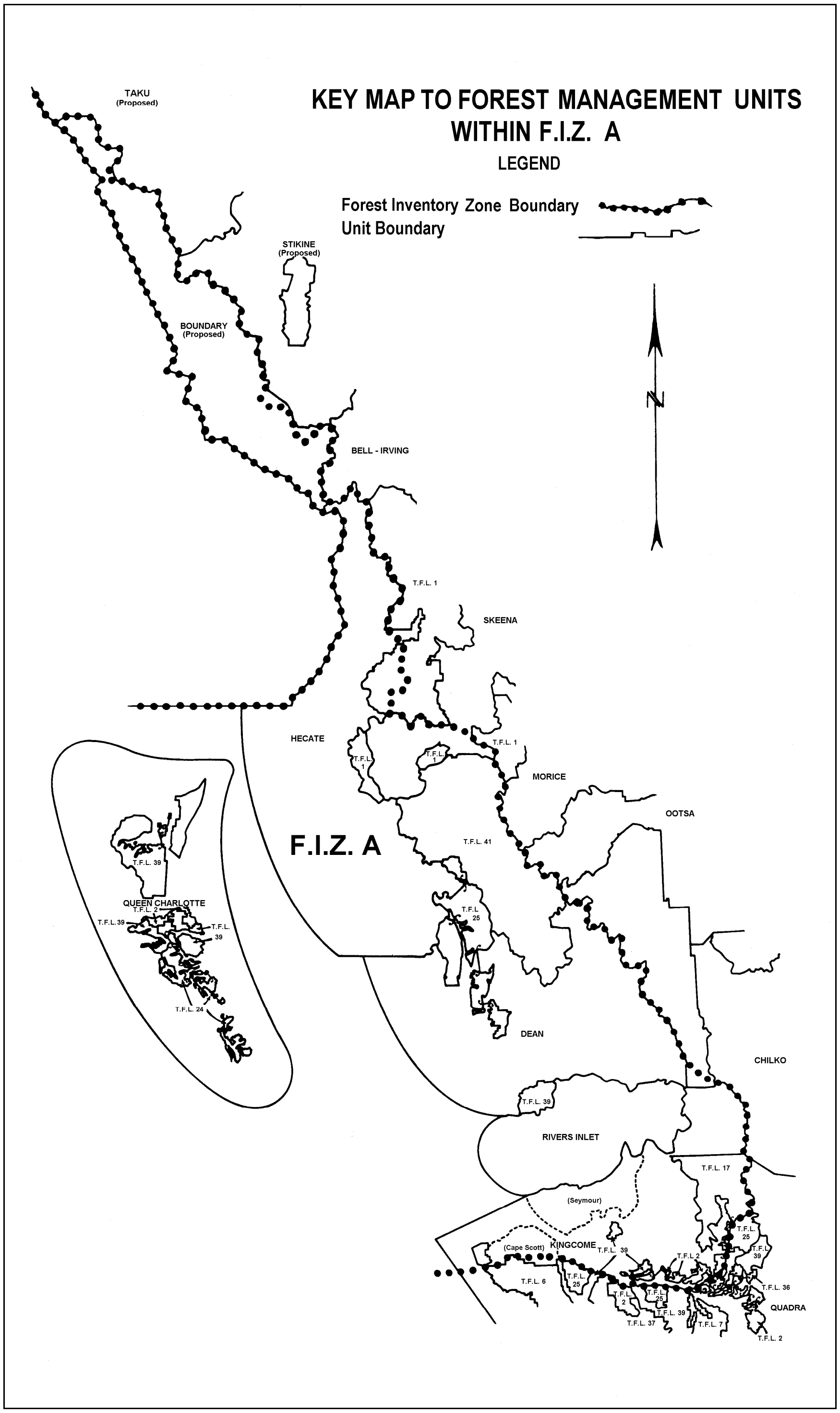


Figure A.1(a) Forest Inventory Zones.

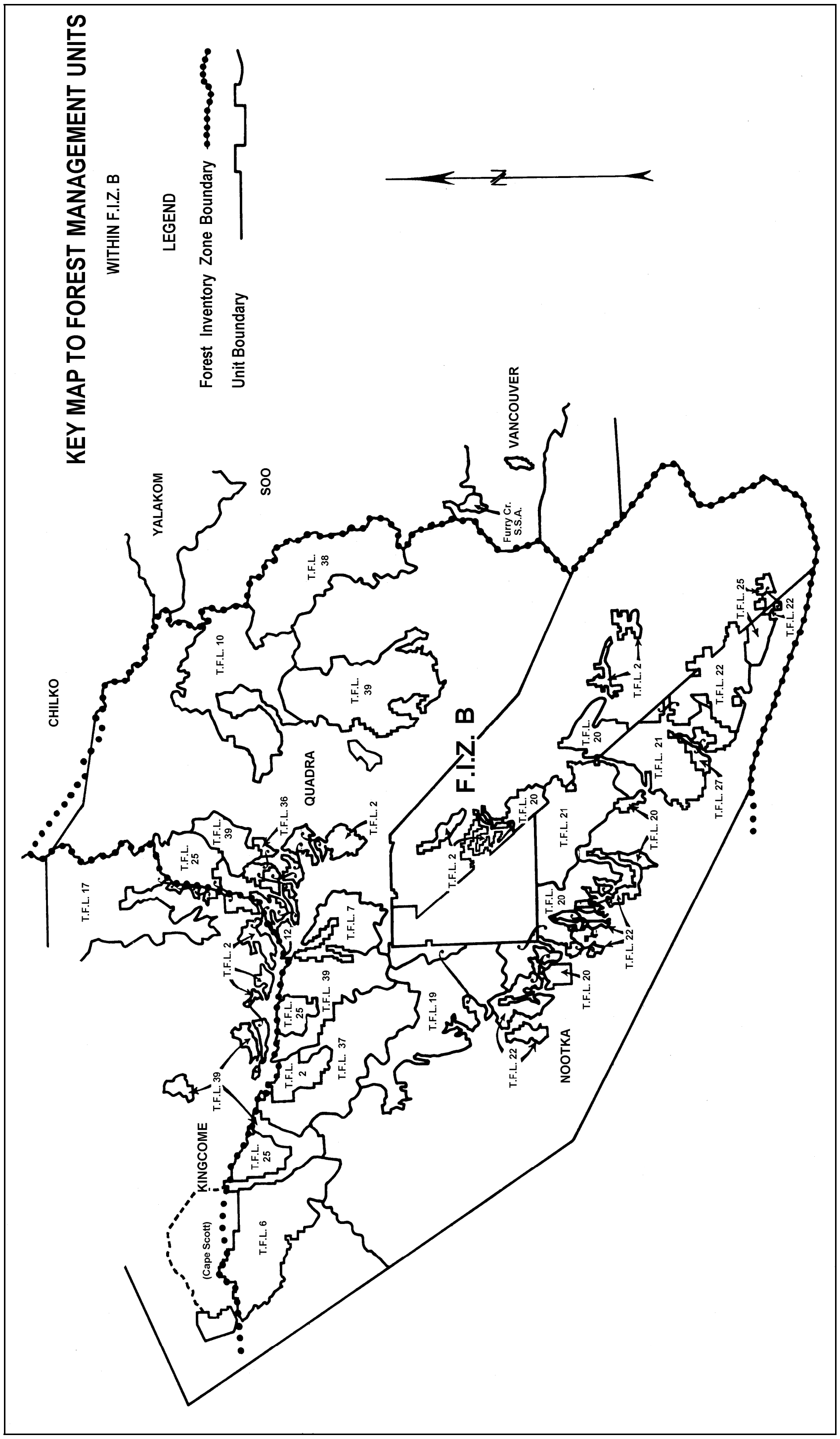


Figure A.1(b) Forest Inventory Zones.

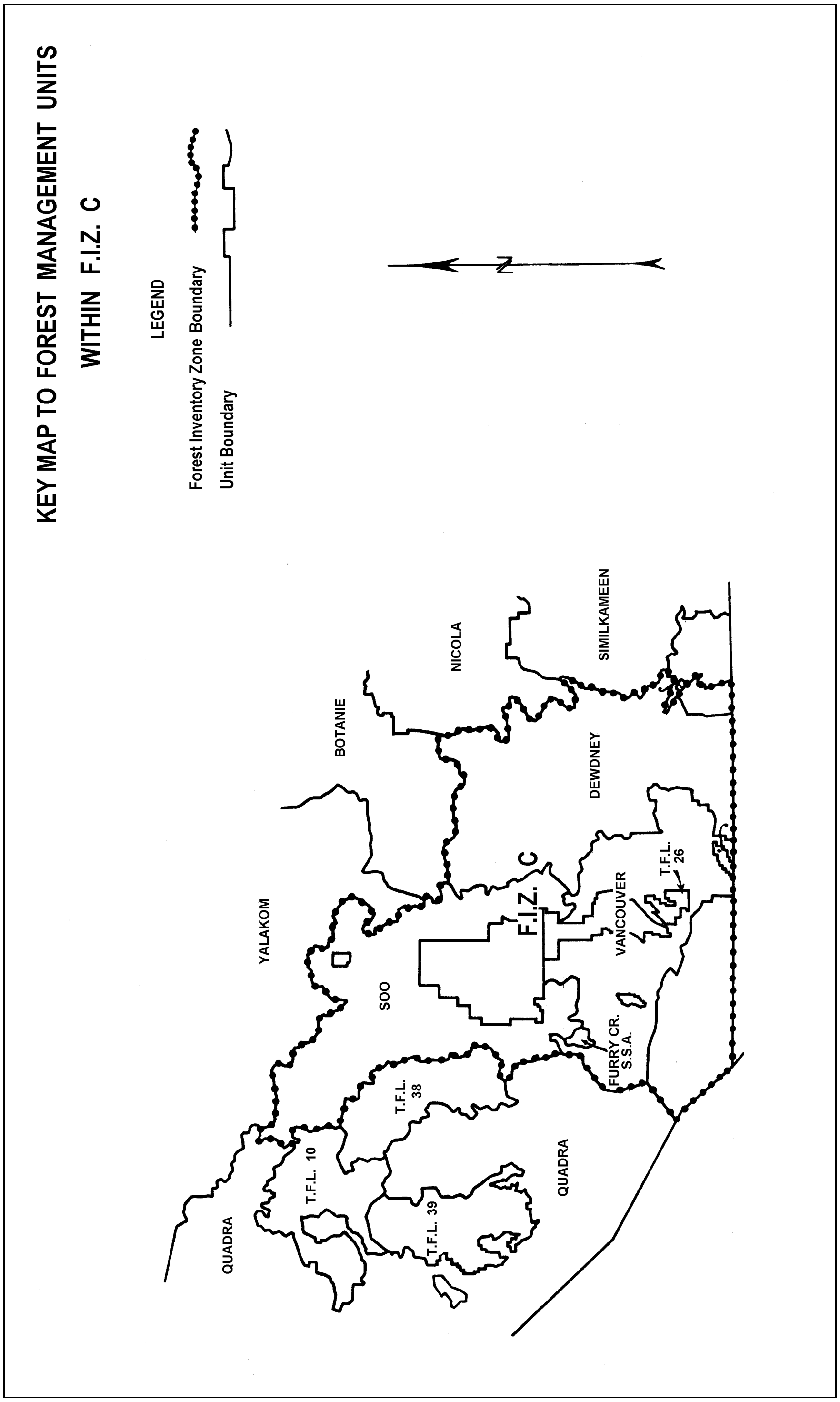


Figure A.1(c) Forest Inventory Zones.

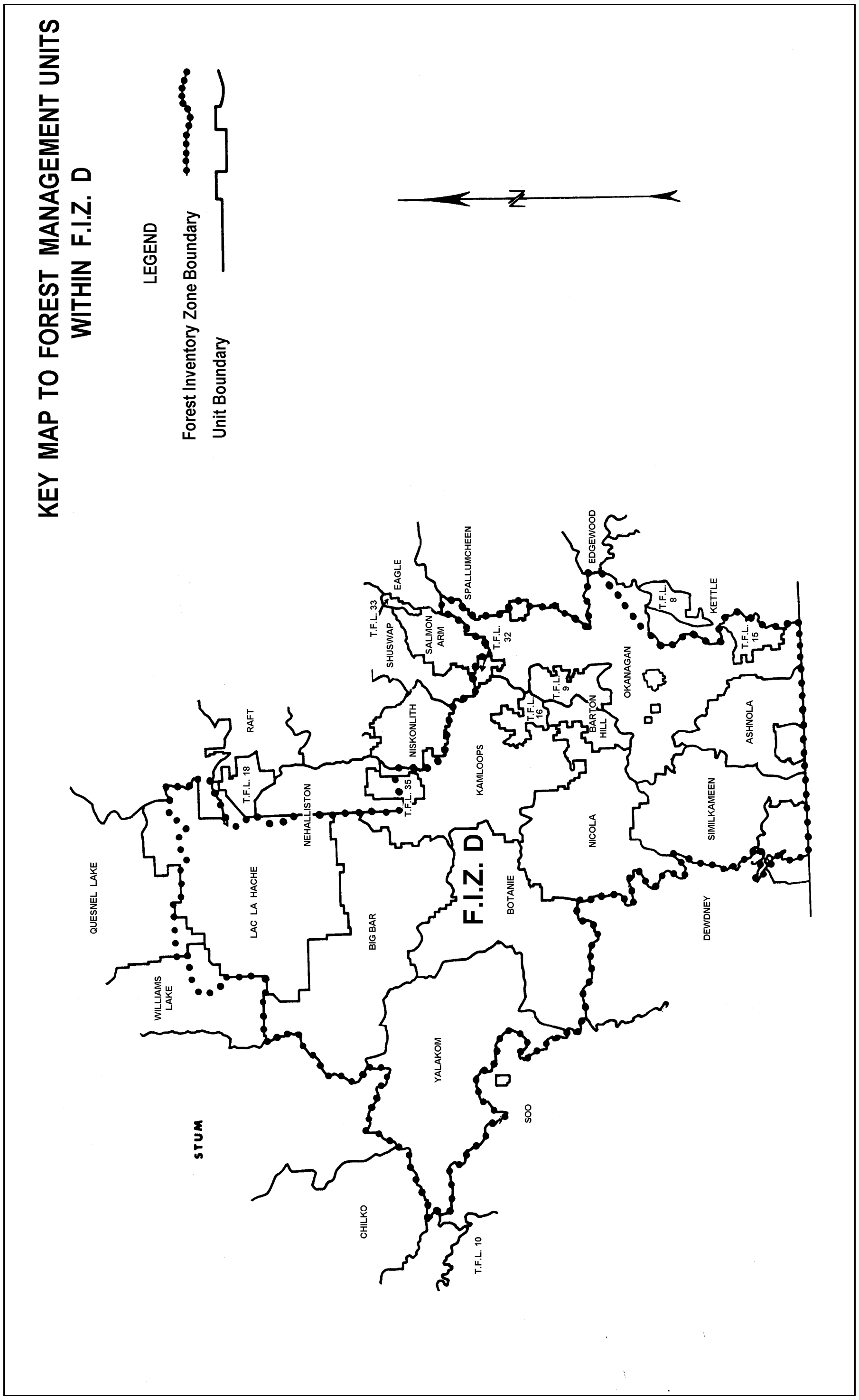


Figure A.1(d) Forest Inventory Zones.

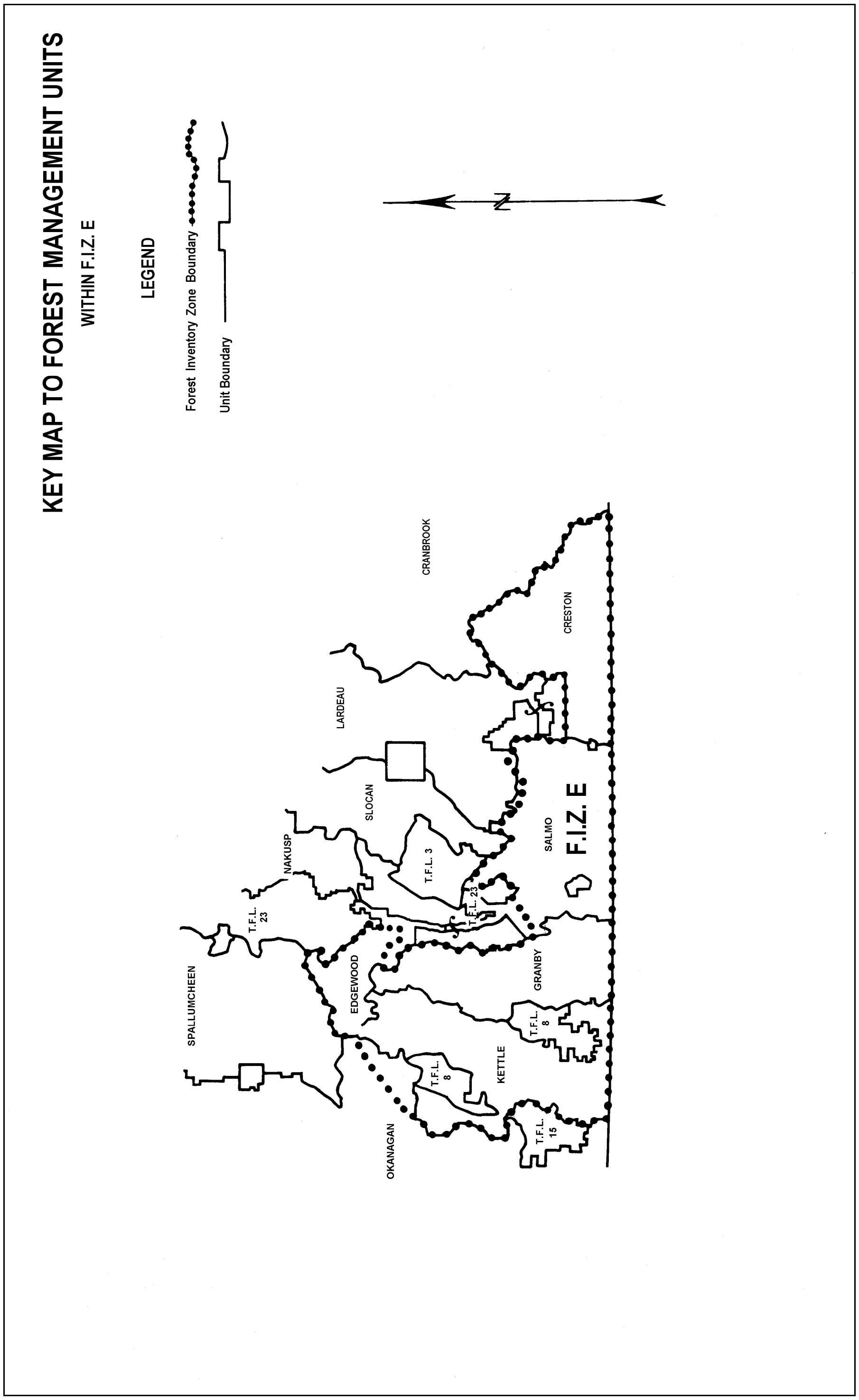


Figure A.1(e) Forest Inventory Zones.

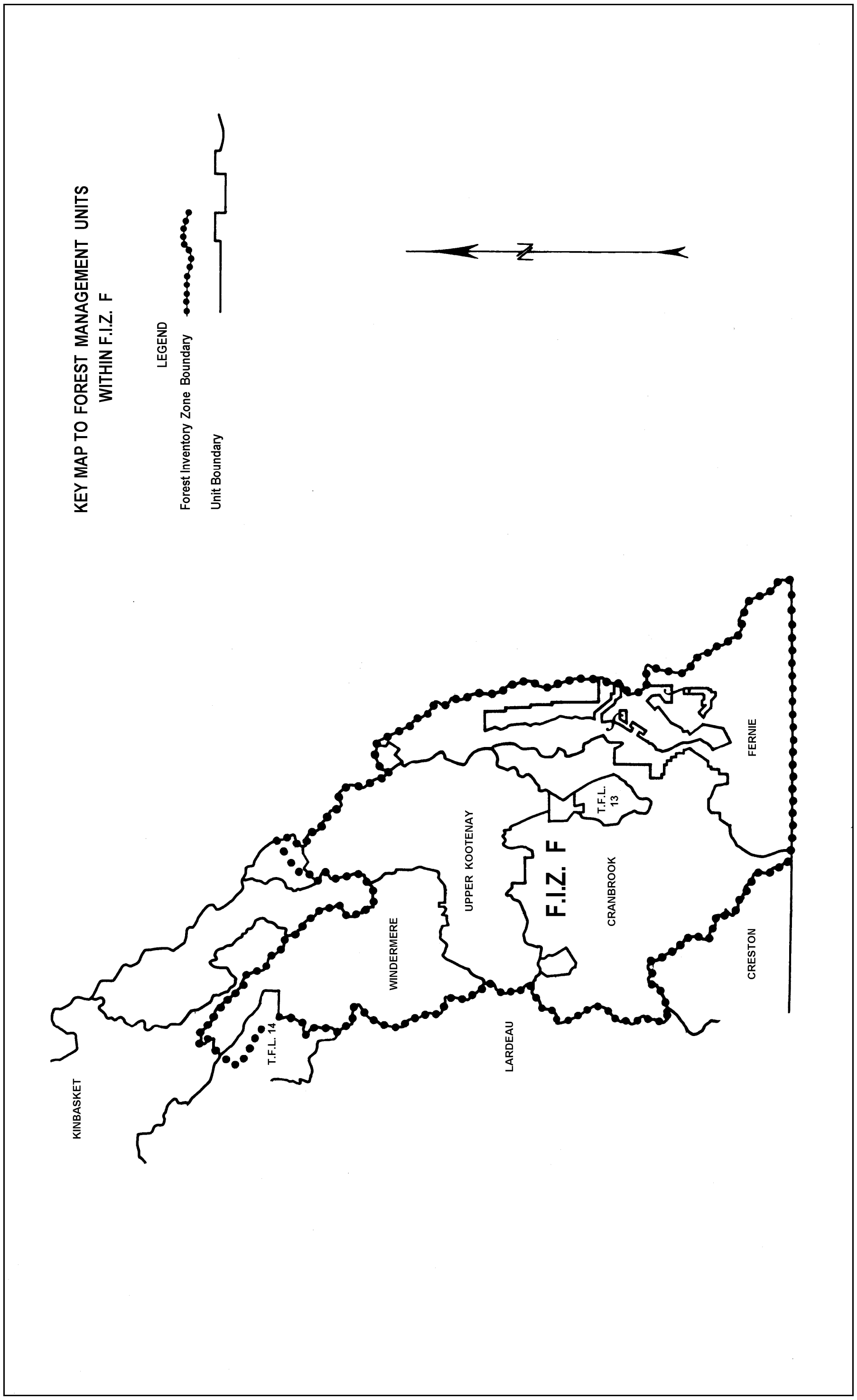


Figure A.1(f) Forest Inventory Zones.

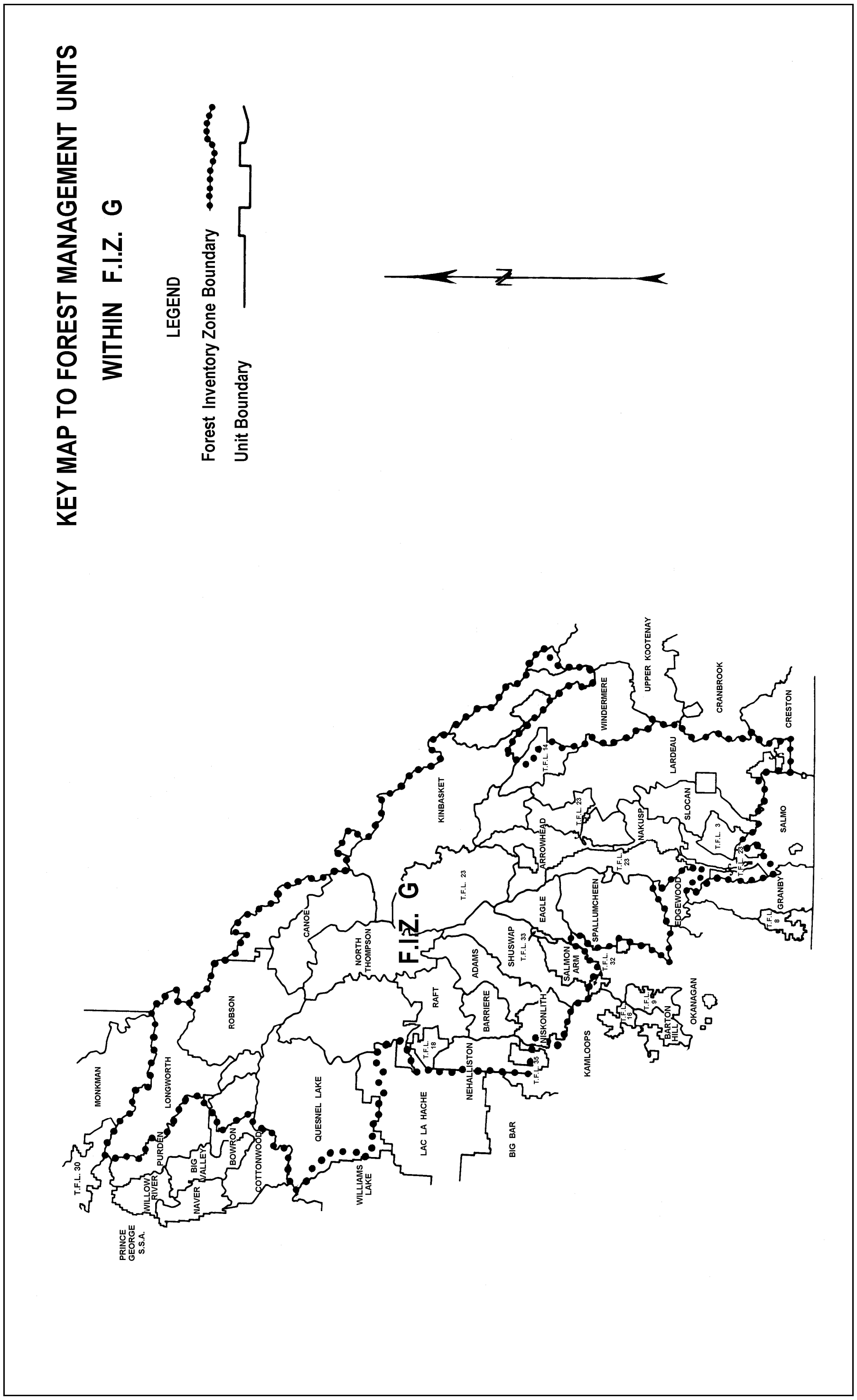


Figure A.1(g) Forest Inventory Zones.

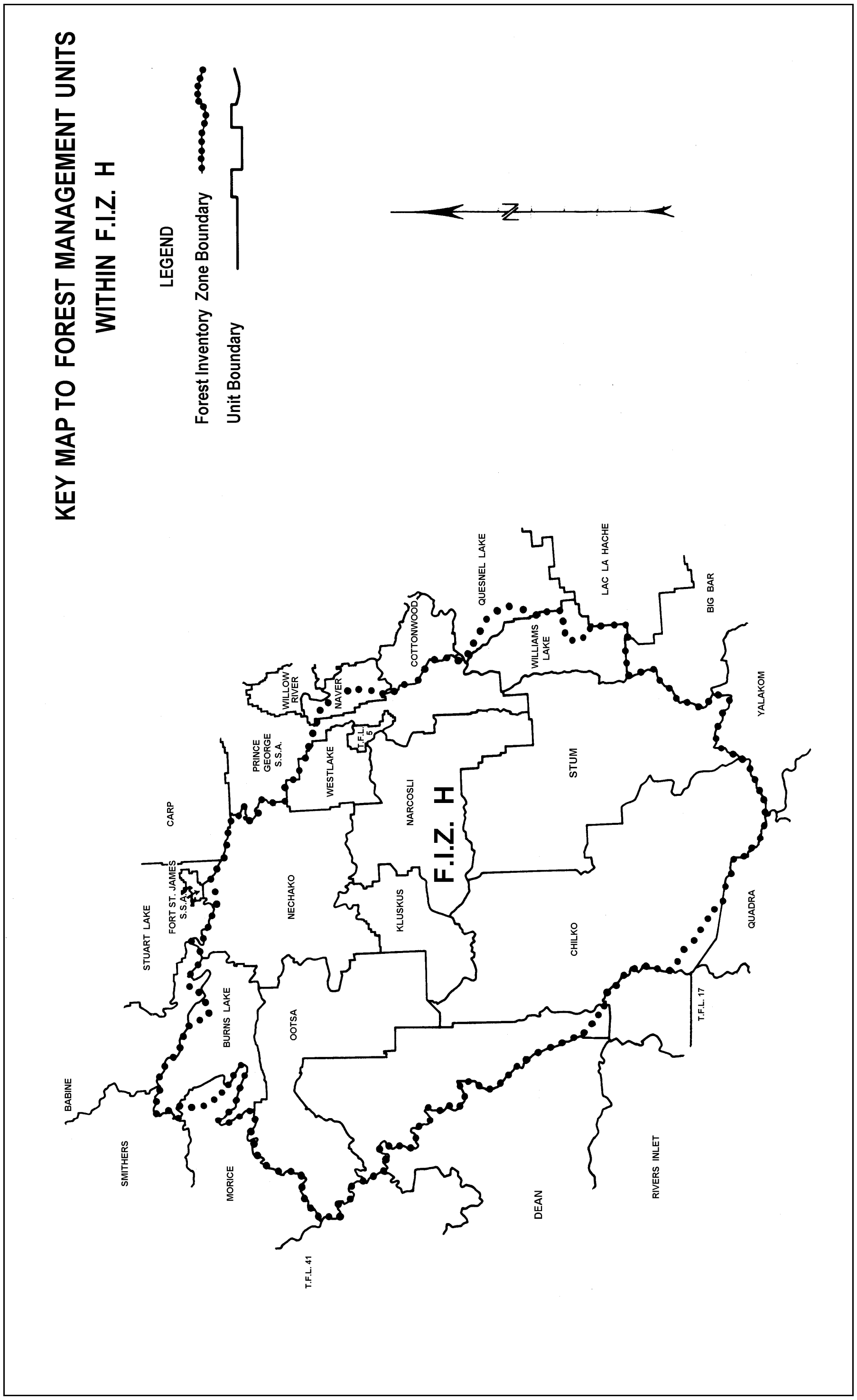


Figure A.1(h) Forest Inventory Zones.

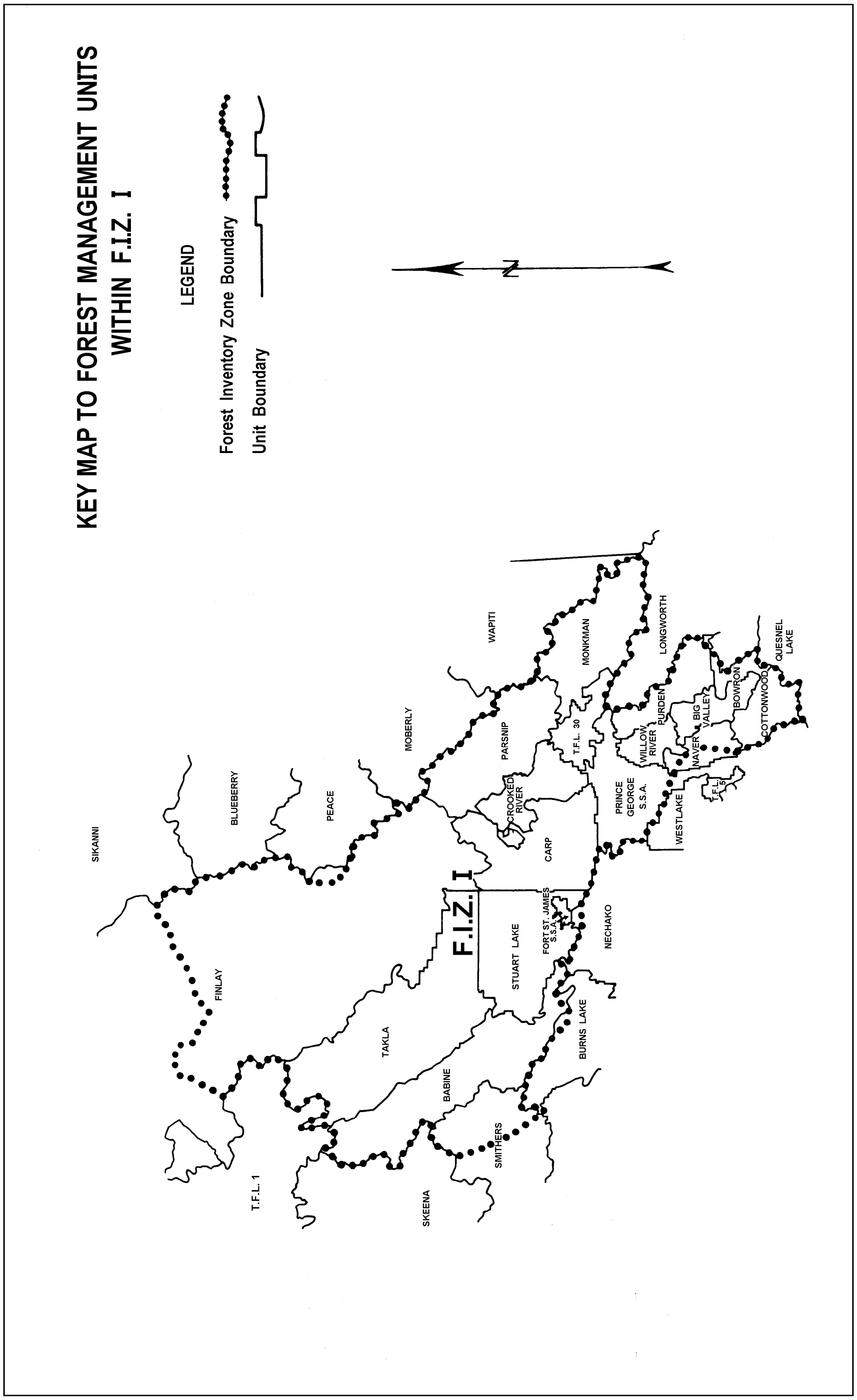


Figure A.1(i) Forest Inventory Zones.

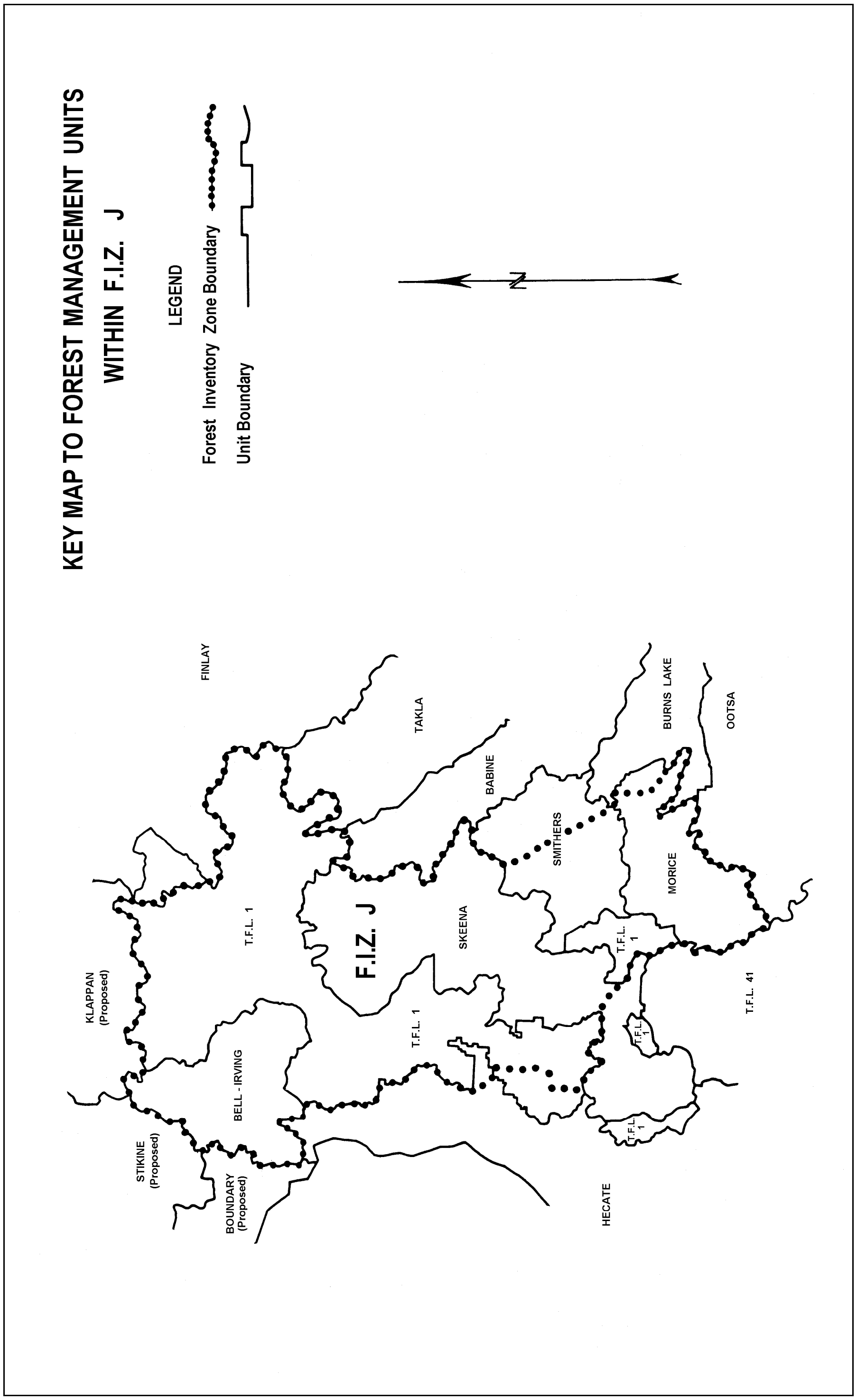


Figure A.1(j) Forest Inventory Zones.

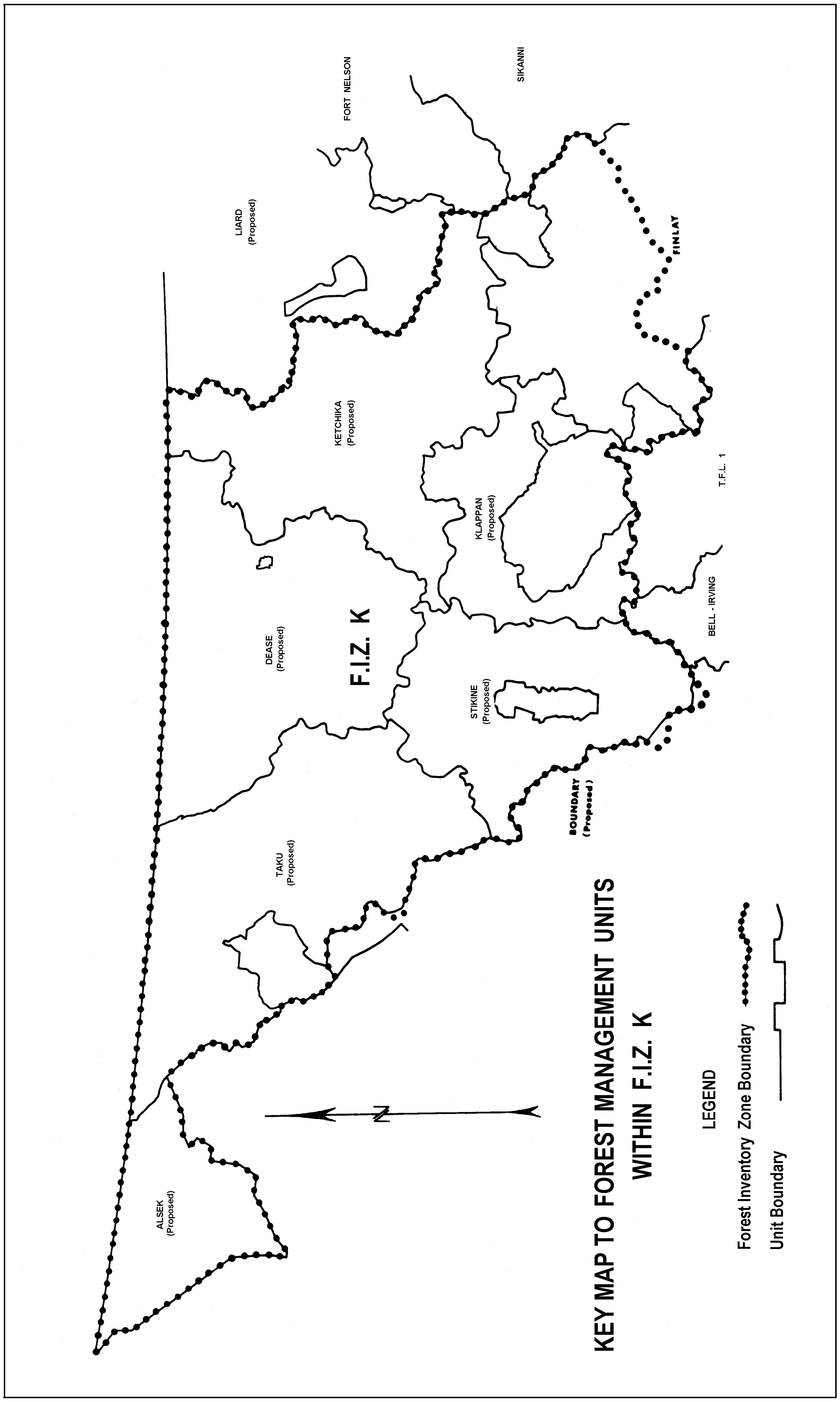


Figure A.1(k) Forest Inventory Zones.

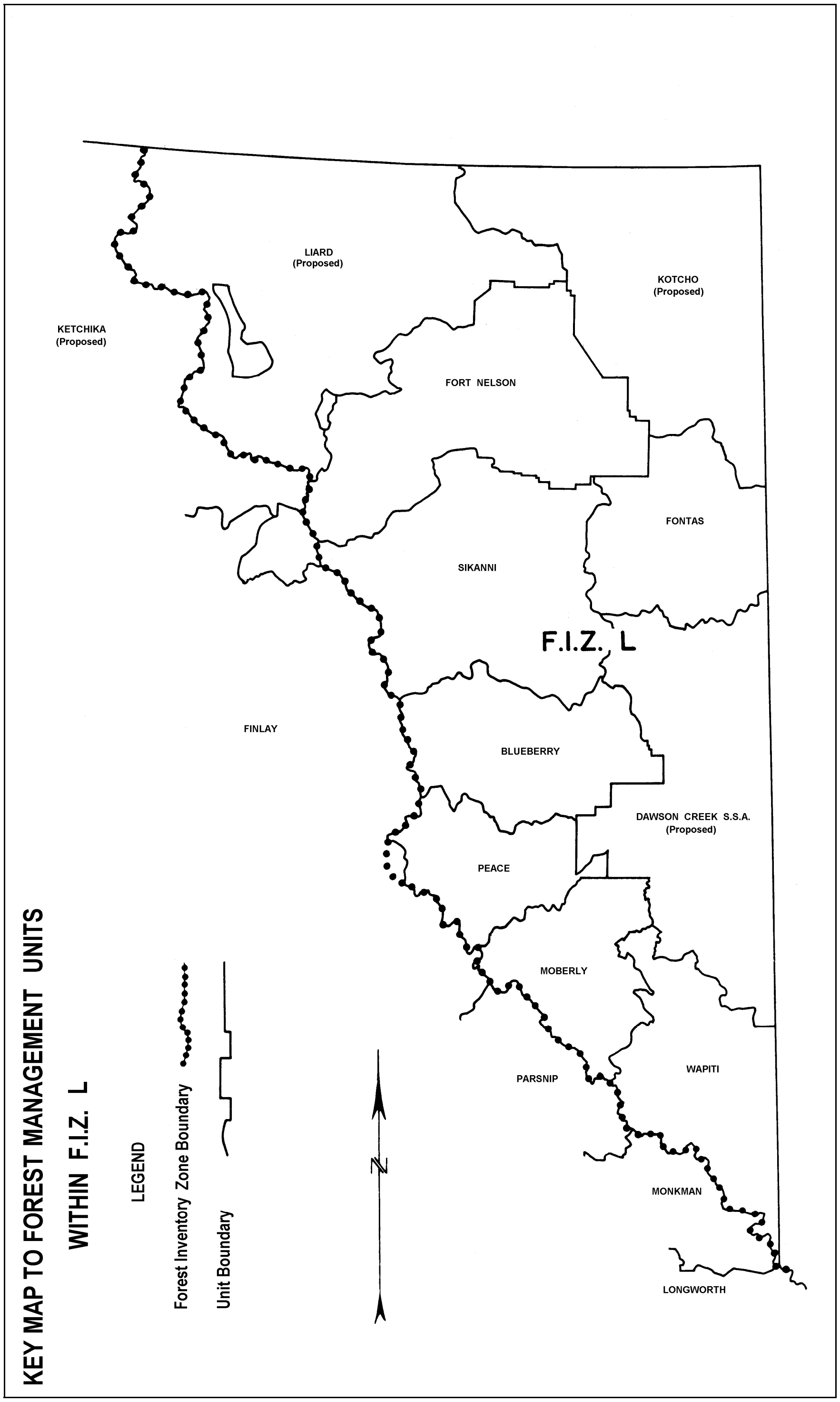


Figure A.1(l) Forest Inventory Zones.

Appendix 4 Pathological Classification of Trees

Within mature stands, or stands approaching maturity, (i.e., older immature stands) individual trees contain varying amounts of decay. Thus, in stands of this type the estimation of cull is subject to considerable error. Therefore, it would be advantageous to know which trees are likely to contain decay, particularly those which are likely to contain excessive amounts of decay. Recent pathological studies have shown that two broad classes of living trees are clearly recognizable in stands of this character. As the classification of trees is made on the basis of the presence or absence of external signs of decay, it is anticipated that each class of tree so defined will represent a different potential loss factor within the stand.

A.4.1 Class of Trees

All living trees measured on each sample plot will be classed as:

- residual, or
- suspect.

A.4.1.1 Suspect Trees

Suspect trees are living trees which bear one or more of the following external indications of decay, on or immediately adjacent to the trunk of the tree within the limits specified.

1. Conks.
2. Blind conks (swollen knots).
3. Scars.
4. Fork or pronounced crook.
5. Frost crack.
6. Trunk infections or mistletoe.
7. Rotten branches.
8. Dead or broken top.

> "Suspect" classifications will be made on the basis of the above signs of decay only; no other abnormalities are to be used.
>
> See Table 18 for Pathological Occurrence by Species and Forest Inventory Zones.

A.4.1.2 Residual Trees

Residual trees are living trees which bear none of the external indications of decay listed above.

It must be pointed out that these signs and defects are expressive of decay in the stand, rather than in individual trees. The amount of decay indicated by signs will be subject to considerable variation within species and individual trees. For example, frost cracks may be highly significant as indicators of decay on a particular species in the stand as a whole, but not as significant on individual trees.

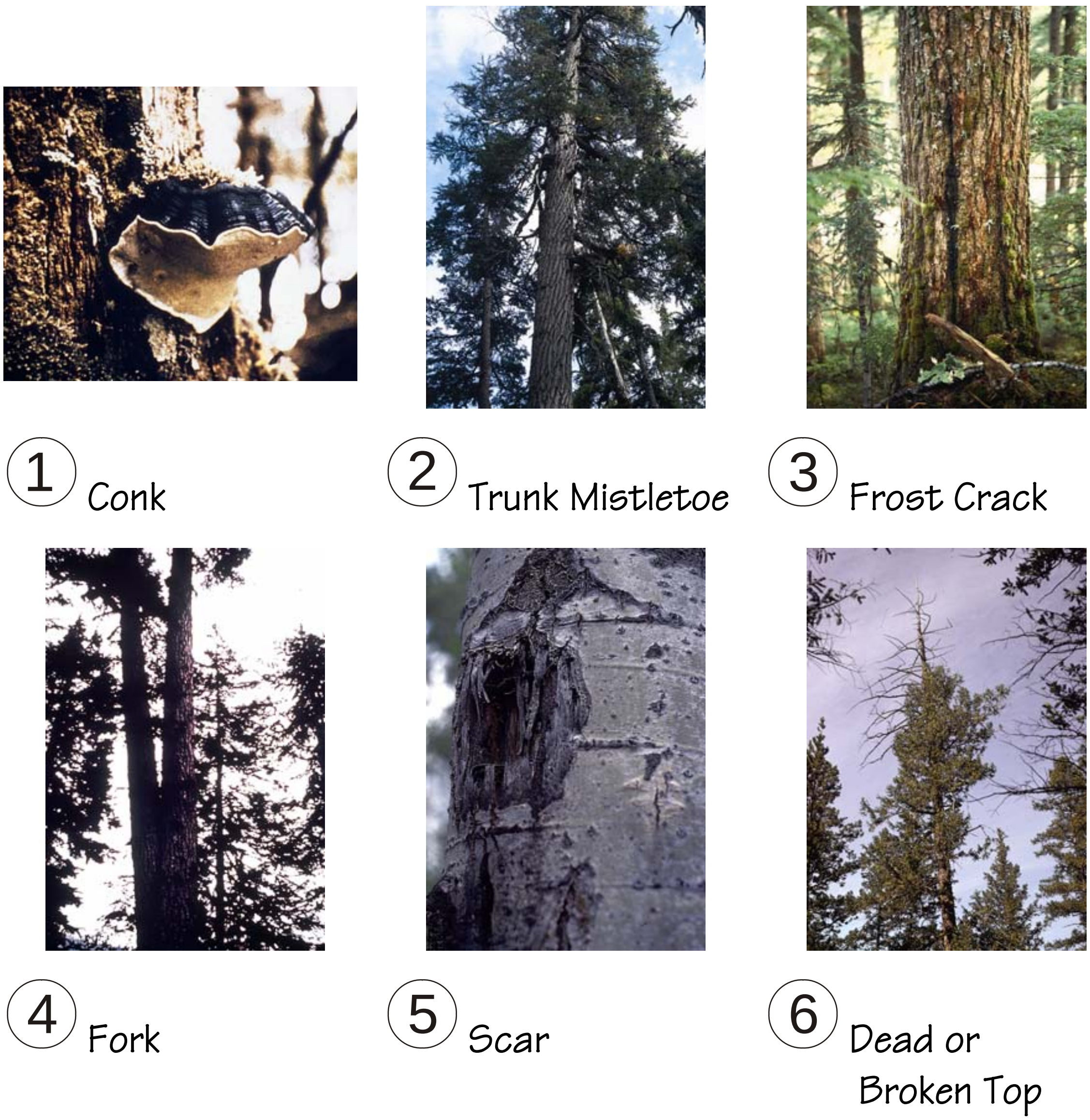


Figure A.2 Suspect Trees.

A.4.2 Signs and Defects Indicative of Decay in Standing Trees

The following is a brief description and explanation of the external indications of decay listed in Section A.4.1.1. Coast-Pathological indicators must be recorded on all live and dead potential trees. Interior-Pathological indicators must be recorded on all live and dead potential white pine, hemlock and balsam trees. Conk and blind conk must be recorded on all dead potential Lodgepole pine trees. Refer to Figure A.14 for a diagram. Do not record pathological indicators above 10 cm diameter. Not shown are large rotten branches and blind conks.

Secondary Leaders

Record all pathological indicators on secondary leaders if the leader is alive and of merchantable size. Conks of an identifiable heart rot fungi may be called on non-merchantable live secondary leaders. Do not record any pathological indicators on dead secondary leaders.

Record pathological indicators on dead, merchantable secondary leaders for cedar and cypress only.

Record all pathological indicators on dead potential trees for the coastal log grade algorithm except do not record sap rot fungi as conk.

A.4.2.1 Conks

Conks are the fruiting bodies (sporophores) of decay fungi and are definite and reliable indicators of decay. Conks occur anywhere on the main stem, branches and exposed roots of the tree but appear most frequently around knots and on the underside of both dead branch stubs and live branches. For current cruising purposes, only specific root, butt and heart rot conks are suspect indicators. Slash conks are not suspect indicators (see Figure A.6 for a list of host species for selected decay fungi).

It is important to be able to differentiate between the fruiting of slash fungi that occur on dead branches and wounds of living trees and those that occur on the roots, live branches and trunks of living trees. It is necessary to be able to recognize the conks of the major heart rotting fungi found on living conifers and hardwoods. On conifers, the main conks to recognize are, *Echinodontium tinctorium, Phellinus (Fomes) pini, Phaeolus (Polyporous) schweinitzii and Fomitopsis (Fomes) pinicolii.* On hardwoods, the main conks are Phellinus igniarius and Phellinus tremulae. See the following host list for major and some minor heartwood decay species.

The major heart rot conks are hard, thick, woody-like perennial structures and form singly at branch stubs or in small clusters on the underside of living branches. An exception is the mushroom-shaped to bracket-like sporophore of *P. schweinitzii* that is annual but may persist for more than two years. Before calling conks on living branches in the upper crown, there must be fruiting bodies of the heart rot fungus evident in the stand. Slash conks that occur on dead wood of living trees can be both annual (small, thin, leathery) and perennials, are often more numerous and occur anywhere on the tree. The slash conks that occur on old exposed wounds are not allowed as suspect indicators. An exception is the conk of *F. pinicola*, which is common on dead trees but may also occur on large, old wounds as studies have found its occurrence indicates significant decay. However, *F. pinicola* that occurs on dead branches is not a suspect indicator.

Conks vary in size and shape and therefore are hard to spot, particularly when they are just developing or occur on the upper trunk. Conks of *E. tinctorium* and *Phellinus pini*, frequently appear as a small hoof-like or shelf-like structure on the underside of dead branch stubs on the middle and/or lower trunk of an infected tree. Moss-covered branch stubs and burls often resemble conks, particularly when viewed from directly below; it is important therefore to view the tree from the side before making a decision.

Conks of Phaeolus schweinitzii

P. schweinitzii is the cause of brown cubical root and butt rot of most conifers but Douglas-fir and spruce are the most susceptible. The fruiting bodies may occur:

- on the base of a tree,
- on the ground up to 2 m from the tree where no exposed roots are evident, or
- on the exposed roots.

If a conk is mid-way between:

1. Two living susceptible trees only one tree is considered to be infected.
2. A highly susceptible species (e.g., Douglas-fir) and a less susceptible species (e.g., red cedar), the most susceptible species is considered to be infected.
3. A living tree and a stump showing brown cubical rot, and it is not on a root of the live tree, it is assumed to be associated with the stump.

Figure A.3 Example of Schweinitzii.

A.4.2.2 Blind Conks

Blind conks are pronounced swellings or depressions around knots caused mainly by *P. pini* on conifers and *P. tremulae* on aspen and if identified correctly, are definite indicators of decay (see Figure A.4). The swelling or depression results from the tree attempting to heal over an abortive conk; a newly developing conk; or a point from which an old conk has dropped. Non-typical forms may appear as small branch holes or branch stubs at the base of trees. This form is often found in over-mature Douglas-fir and balsam species in the coast-interior transition zone (e.g., Boston Bar). Therefore over-mature trees with basal branch stubs should be examined for blind conk.

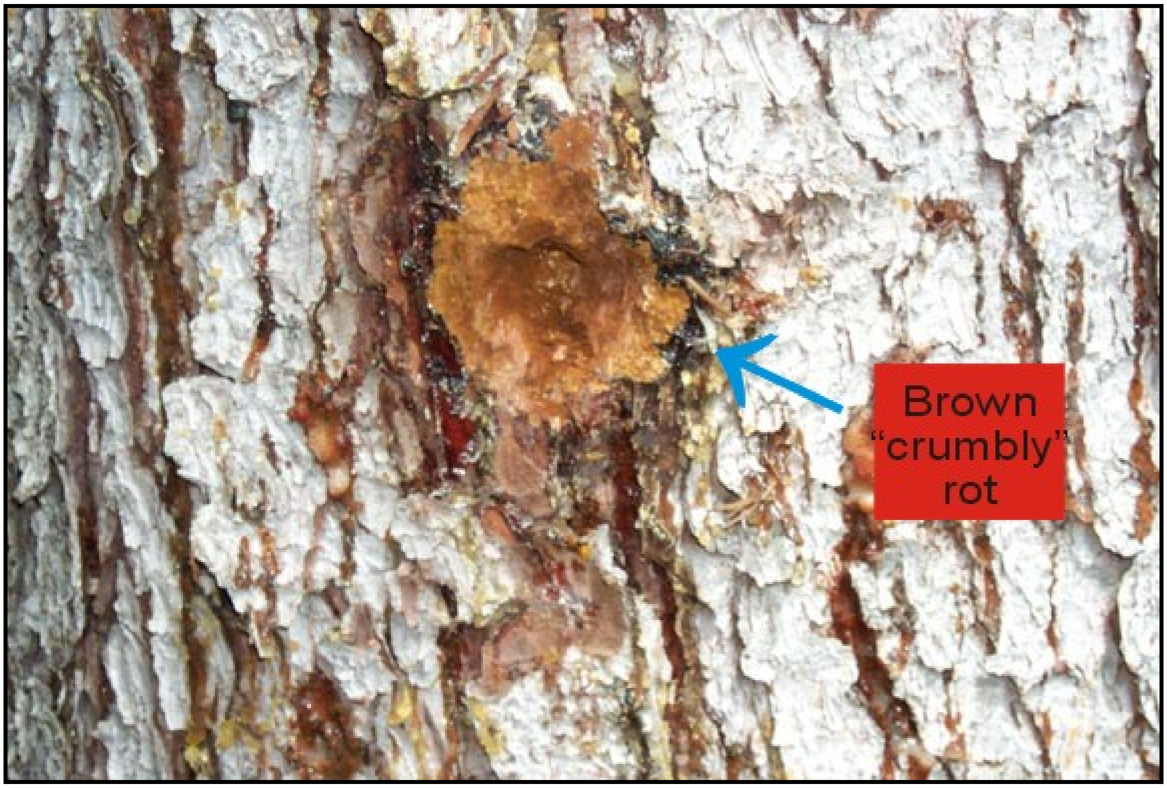


Figure A.4 Example of Blind Conk in a Knot.

Figure A.5 Non-blind Conk in a Knot.

Accessible indicators: must be verified by cutting with an axe or equivalent implement. This will reveal a bright yellow or buff-colour of the conk.

Inaccessible indicators:

- call only those indicators which have a high chance of being blind conk such as large swollen knots and large caved-in knots. They must be similar to the ones that have been identified in the stand, and

- do not call small knots and knot indicators on any species.

Large holes left by fallen large rotten branches may not be blind conk suspect indicators.

Root and butt rots

Armillaria spp.

- *Abies amabilis*
- *A. grandis*
- *A. lasiocarpa*
- *Chamaecyparis lawsoniana*
- *Larix decidua*
- *L. leptolepis*
- *L. occidentalis*
- *Picea abies*
- *P. engelmannii*
- *P. glauca*
- *P. sitchensis*
- *Pinus contorta*
- *P. monticola*
- *P. muricata*
- *P. nigra*
- *P. pinaster*
- *P. ponderosa*
- *P. radiata*
- *P. resinosa*
- *P. sylvestris*
- *Pseudotsuga menziesii*
- *Taxus brevifolia*
- *Thuja plicata*
- *Tsuga heterophylla*
- *Alnus rubra*
- *Betula papyrifera*
- *Populus X canadensis*
- *P. nigra*
- *P. tremuloides*
- *P. trichocarpa*
- *Quercus garryana*
- *Salix* sp.

Heterobasidion annaosum

- *Abies amabilis*
- *A. grandis*
- *Picea glauca*
- *P. sitchensis*
- *Pseudotsuga menziesii*
- *Thuja plicata*
- *Tsuga heterophylla*
- *Acer macrophyllum*
- *Alnus rubra*

Phellinus weirii

- *Abies amabilis*
- *A. grandis*
- *A. lasiocarpa*
- *Chamaecyparis nootkatensis*
- *Larix occidentalis*
- *Picea sitchensis*
- *Pinus contorta*
- *P. monticola*
- *P. ponderosa*
- *Pseudotsuga menziesii*
- *Thuja plicata*
- *Tsuga heterophylla*

Phaeolus schweinitzii

- *Larix* spp.
- *Picea* spp.
- *Pinus* spp.
- *Pseudotsuga menziesii*
- *Thuja plicata*
- *Tsuga heterophylla*

Inonotus tomentosus

- *Abies amabilis*
- *Picea engelmannii*
- *P. glauca*
- *P. sitchensis*
- *Pinus contorta*
- *P. monticola*
- *Tsuga heterophylla*

Rhizina undulata

- *Larix occidentalis*
- *Picea engelmannii*
- *P. glauca*
- *P. sitchensis*
- *Pinus contorta*
- *Pseudotsuga menziesii*
- *Tsuga heterophylla*

Heart rots

Echinodontium tinctorium

- *Abies* spp.
- *Thuja plicata*
- *Tsuga heterophylla*
- *T. mertensiana*

Phellinus igniarius

- *Acer* spp.
- *Alnus* spp.
- *Arbutus menziesii*
- *Betula* spp.
- *Cornus nuttallii*
- *Malus* spp.
- *Populus* spp.
- *Salix lasiandra*

Phellinus pini

- *Abies* spp.
- *Larix occidentalis*
- *Picea* spp.
- *Pinus* spp.
- *Pseudotsuga menziesii*
- *Thuja plicata*
- *Tsuga heterophylla*
- *T. mertensiana*

Stereum sanguinolentum

- *Abies amabilis*
- *A. grandis*
- *A. lasiocarpa*
- *Larix occidentalis*
- *Picea glauca*
- *P. sitchensis*
- *Pinus contorta*
- *P. monticola*
- *P. ponderosa*
- *Pseudotsuga menziesii*
- *Thuja plicata*
- *Tsuga heterophylla*
- *T. mertensiana*

Figure A.6 Host List.

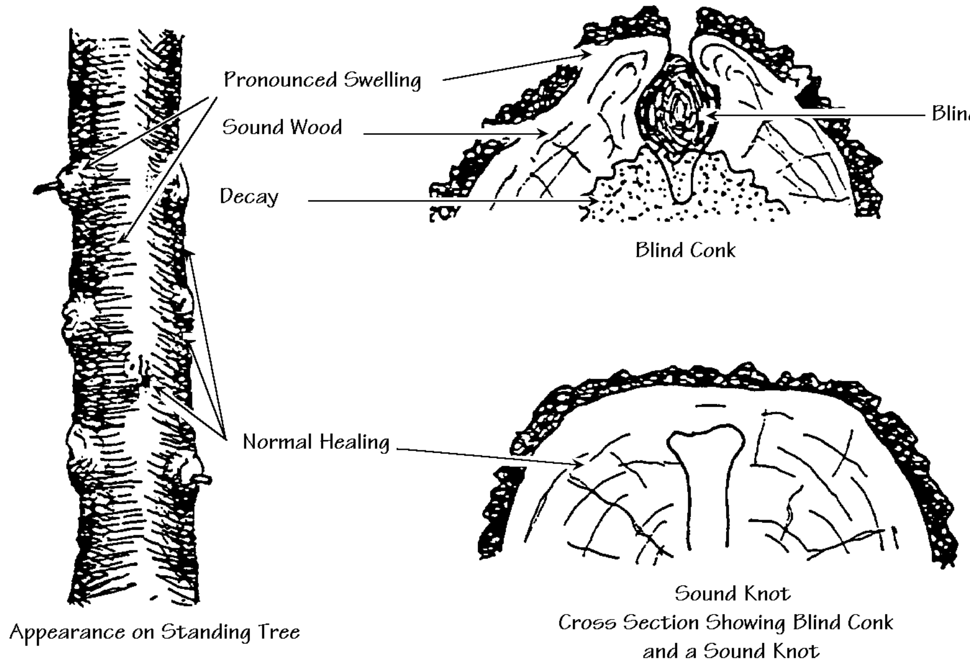


Figure A.7 Blind Conk and Sound Knot.

A.4.2.3 Scars

A scar is an injury caused by external forces which has damaged the cambial layers of the tree and exposes either the sap wood or heartwood (or both) to potential attack by wood rotting fungi. These wood rotting fungi are ever present in forest stands and are carried widely by air currents.

Forms of scars - both open and closed scars will be called.

Open scars:

- open scars appear as areas of exposed wood of varying sizes and shapes (see Figure A.10), and
- scars are slow to heal over and the wood tissues of the tree may remain exposed for a considerable time allowing entrance of wood rotting fungi.

For root scars to be eligible calls, the scar must be on the portion of the root that is exposed before it enters the ground.

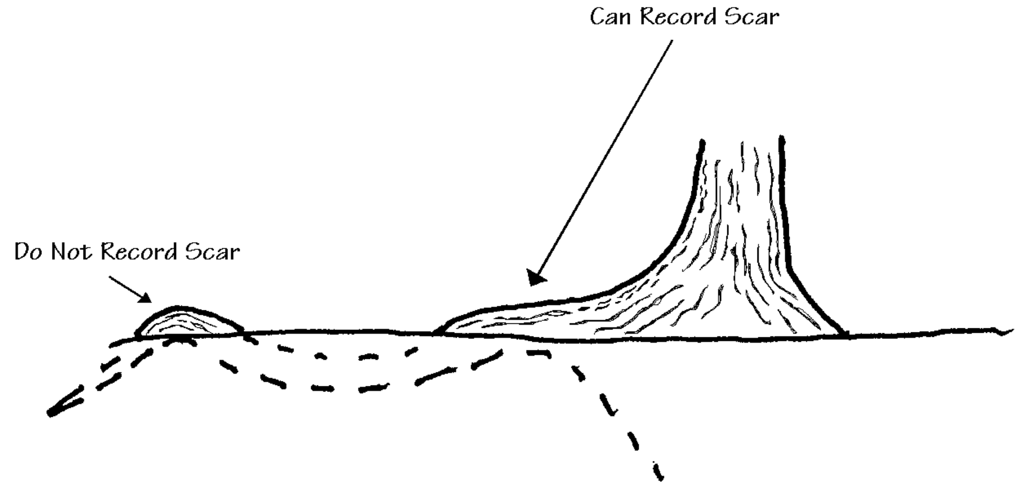


Figure A. 8 Root Scars.

Closed scars:

- closed scars appear as slight to pronounced indentations of the bark in the case of early scarring which has healed over, or as pronounced scar tissue or callous growth in the case of later scarring. The latter type of scars frequently show considerable resin flow (see Figure A.9).

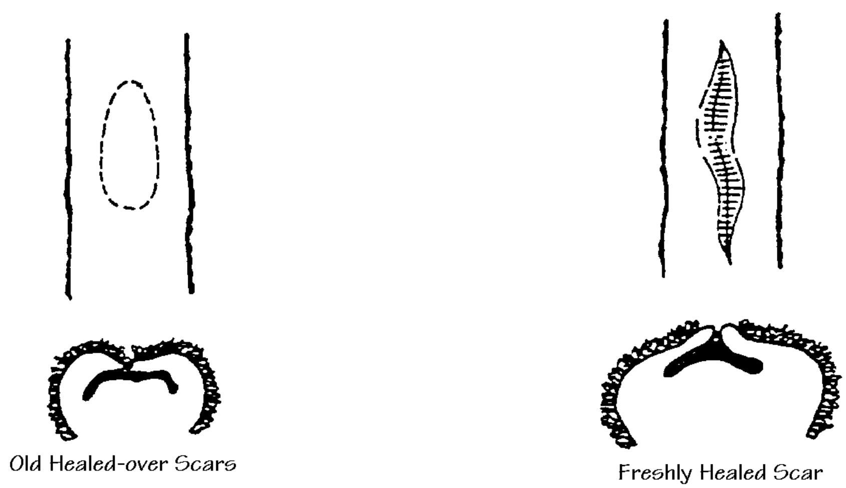


Figure A.9 Closed Scars.

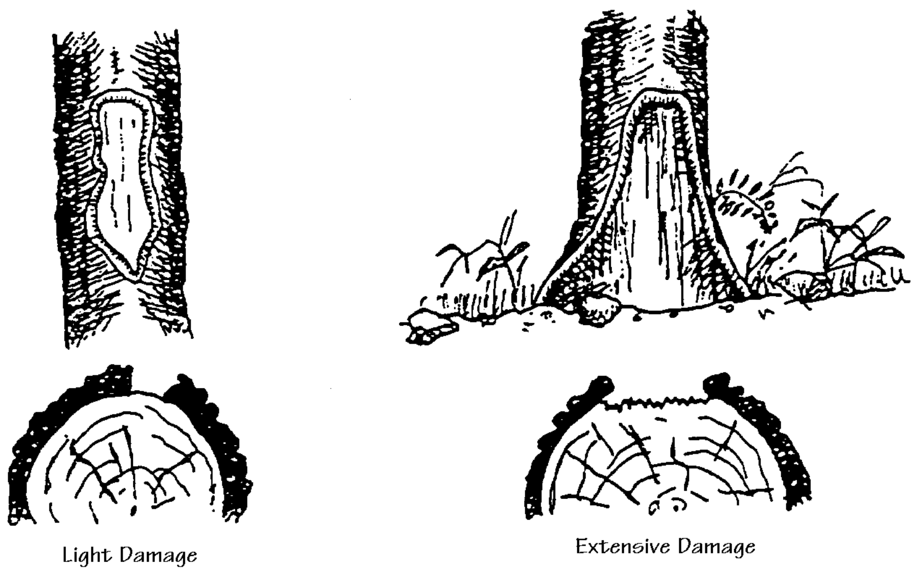


Figure A.10 Open Scars.

The volume and decay studies of the past thirty years identified only scars visible to the naked eye without the use of binoculars or other lens. The scars were assessed without chopping into the indicator. To be compatible with these initial assessments, the same methodology must therefore be followed today. This also is the most practical method of observation at present.

A scar may or may not have visible decay associated with it.

The decay studies have scars with both decay and no decay in the data base.

Causes of scars:

Scars may be caused by many external forces, such as:

1. Fire:

   - old fire scars that have healed over appear typically as slight ridging of the bark and may have very old callous tissue on the bark, whereas more recent fire scars or ones resulting from severe damage appear as open catfaces or hollowing of the stem,

   - fire scars are usually confined to the base of the tree, and

   - fire scars may be important indicators of decay. Trees growing in forest stands (i.e., south or west facing slopes with pioneer species such as Fir or Lodgepole

Pine) having a history of fire should be examined carefully for evidence of charred wood in root crotches or on exposed roots.

2. Lightning:

   - lightning can cause extensive damage to the top and stem of the tree. It typically appears as narrow to wide strips of torn wood, often extending down the entire length of the tree and often in the form of a spiral around the stem.

3. Damage by a falling tree:

   - trees are frequently scarred by other trees falling against them. Scars of this type are common in selectively logged stands or decadent stands where windfall trees are more common.

4. Machinery damage:

   - machinery can cause extensive damage, especially where selective logging has occurred, and

   - these scars are usually confined to the lower trunk, but they may also occur on the upper trunk when damage is caused by rigging lines.

5. Blazes:

   - blazes are entry points for decay fungi if they penetrate into the cambium layer.

6. Breakage of branches, secondary leaders or suckers from the bole of the tree:

   - high winds or heavy snows may cause the above to break from the main stem creating exposed wood.

7. Falling rocks (see Figure A.12):

   - rock slides or individual rock movement can cause extensive damage to trees in their path,

   - scars caused by rocks are usually confined to the basal portion of the trunk on the uphill side, and

   - falling rocks may in some instances scar trees a considerable height above the ground, either due to snow levels at the time of injury or bouncing rocks on steeper slopes.

8. Animal/bird damage:

   - wood must be exposed,

- bear, moose, deer etc. can cause damage by removing areas of bark and cambium from the trunks of many trees,
- rodents and beavers also cause damage to trees by gnawing on areas of the trunk,
- woodpecker holes of considerable size provide entrance for wood rotting fungi, however, sap sucker holes are *not* scars, and
- care must be taken to exclude superficial damage caused by these agents.

9. Cankers caused by fungi (see Figure A.11):

- only cankers with exposed weathered wood are called, and
- cankers caused by fungi result in the death of localized areas of bark and cambium on the trunks of trees. Eventually the dead bark is sloughed off exposing the underlying wood. There is usually evidence of repeated callous growth, and for this reason cankers are frequently mistaken for mechanical scars. Cankers are usually flattened and elongated, and may be indefinite in contour. The exposed wood is often stained and impregnated with resin. Fruiting bodies of the fungus may also be in evidence.

The calling of scars as pathological indicators:

- a scar which extends from the first or second third of the tree into the upper 1/3 of the tree on which the top is dead will be classified as a scar "4" by convention, and
- scars occurring completely below the point of germination either on the lower trunk or root collar adjacent to the trunk will be classified as a scar.

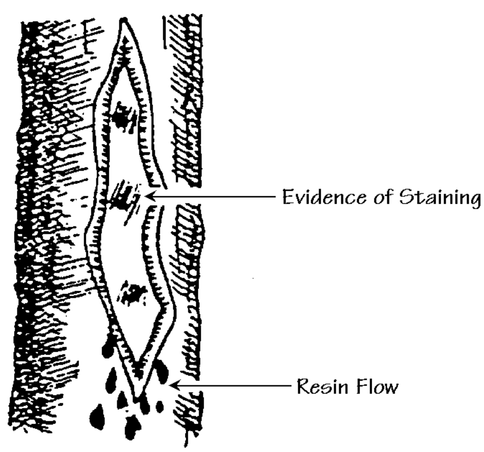


Figure A.11 Cankers Caused byFungi.

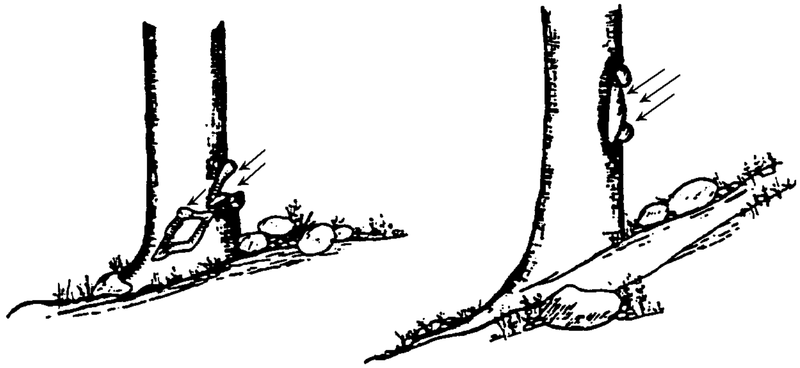


Figure A.12 Scars Caused by Rock Slides and Falling Rocks.

Age of scar:

- a scar shall be not recent in origin. This is interpreted as the injury having not occurred within approximately the past five years,
- the scar or catface should show greyed or weathered wood. Weathered wood shall be described as:
  - dried and some "sun checking" evident,
  - usually associated with change of wood colour to a greyish tone,
  - callous growth should also be evident where the tree is attempting to grow over the scar, and
  - decay does not have to be evident.

Location of scar:

- a scar should be called if the damage occurs on any portion of the trunk of the main stem or on the secondary leader (only if the secondary leader contains a merch log),
- a scar which extends from the first or second third of the tree into the upper 1/3 of the tree on which the top is dead will be classified as a scar "4" by convention. The objective is not to double call the pathological indicators in the upper 1/3 of the tree,
- scars occurring completely below the point of germination, either on the trunk or an exposed root adjacent to the trunk, will be classified as a scar, and
- do not record scars above 10 cm top diameter.

Abnormalities similar to scars but not classified as scars:

Black knots:

- black knots frequently develop around unhealed knots and wounds. A superficial saprophytic fungus, which feeds on the exuded sap, causes the blackness. Black knots are quite sound and when cut into with an axe do not signify decay.

Burls and galls:

- burls and galls develop from abnormal cell growth in trees and are not associated with scarring, however scars occurring on burls and galls will be called.

Dry side:

- dry side results from the death of the cambium through bruising by other trees or by other physiological causes. Dry side may appear as a narrow to wide strip or as a localized area on the side of a tree. The bark remains over the affected area and provides protection against wood rotting fungi. Dry side is not a scar unless the bark has sloughed (is missing).

Sap sucker holes:

- sap sucker holes are superficial in extent and have no established significance for causing decay.

Insect borings:

- borings by bark beetles or other insects are generally recent in origin and they are not pathological indicators.

A.4.2.4 Fork or Pronounced Crook

A fork or crook is the result of damage to the main leader of the tree where one or more lateral limbs take over as the main stem. Fork or crook is called if severe enough to indicate that the original injury exposed the wood and provided an entrance point for decay fungi. Fork or crook are to be called between the root collar and the minimum top diameter specified in the cutting authority document.

Forks are called for any of the following conditions:

1. The main stem is markedly forked to indicate that 2 or more leaders have resulted from serious damage to the original leader (see Figure A.13, Example A and B).

2. The diameter of the main stem changes excessively from its normal taper to indicate that a serious injury has occurred. For cruising purposes, the diameter change must be at least 10 percent (see Figure A.12, Example C and D).

3. Where there is not evidence of a broken top in the stem at the fork/crook position and neither of the leaders are merchantable, record fork/crook.

Crooks are called if:

1. There is at least a 10 percent diameter change in the bole above and below the crook (see Figure A.13, Example F).

2. The offset is severe enough to indicate that damage occurred to the main stem. For cruising purposes, the offset must be at least 50 percent of the diameter of the tree at the crook (see Figure A.13, Example E).

Some forks and crooks are not called (see Figure A.28). Forks and Crooks may be a growth characteristic of the tree species (for example deciduous species) or may have developed from malformation of the terminal leader due to insect or mistletoe attack. In addition, a fork may be confused with a branch. Forks or crooks which are not called are as follows:

1. Crooks with a minor offset (for cruising purposes, an offset less than 50 percent of the diameter of the tree at the crook).

2. Small sharply angled branches or spikes (for cruising purposes, less than a 10 percent change in the diameter of the main stem).

3. Natural forking in deciduous tree species.

4. If the damage is less than 5 years old and/or occurs above the minimum timber merchantability specifications specified in the Timber Utilization Policy (Coast or Interior).

5. Flattening of the top of the tree caused by wind or natural outgrowth.

6. Candelabra branches in coniferous species.

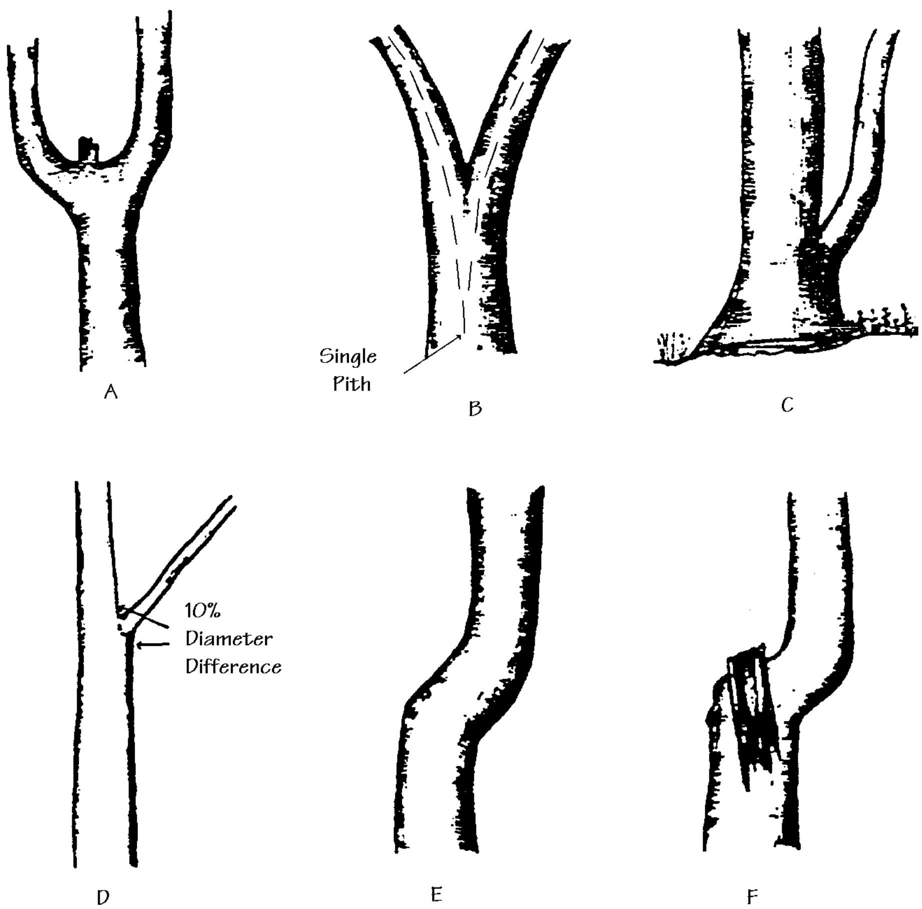


Figure A.13 Types of Forks and Crooks Which are Recorded.

Examples A and B illustrate forks which occur in the merchantable portion of the trunk. Example C illustrates forks which occur on the basal portion of trees. Examples E and F illustrate pronounced crook.

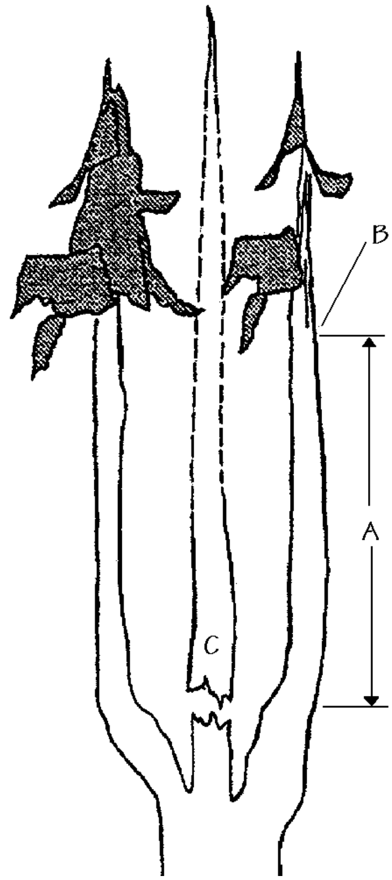


Figure A.14 Fork or Crook and/or Dead or Broken Top.

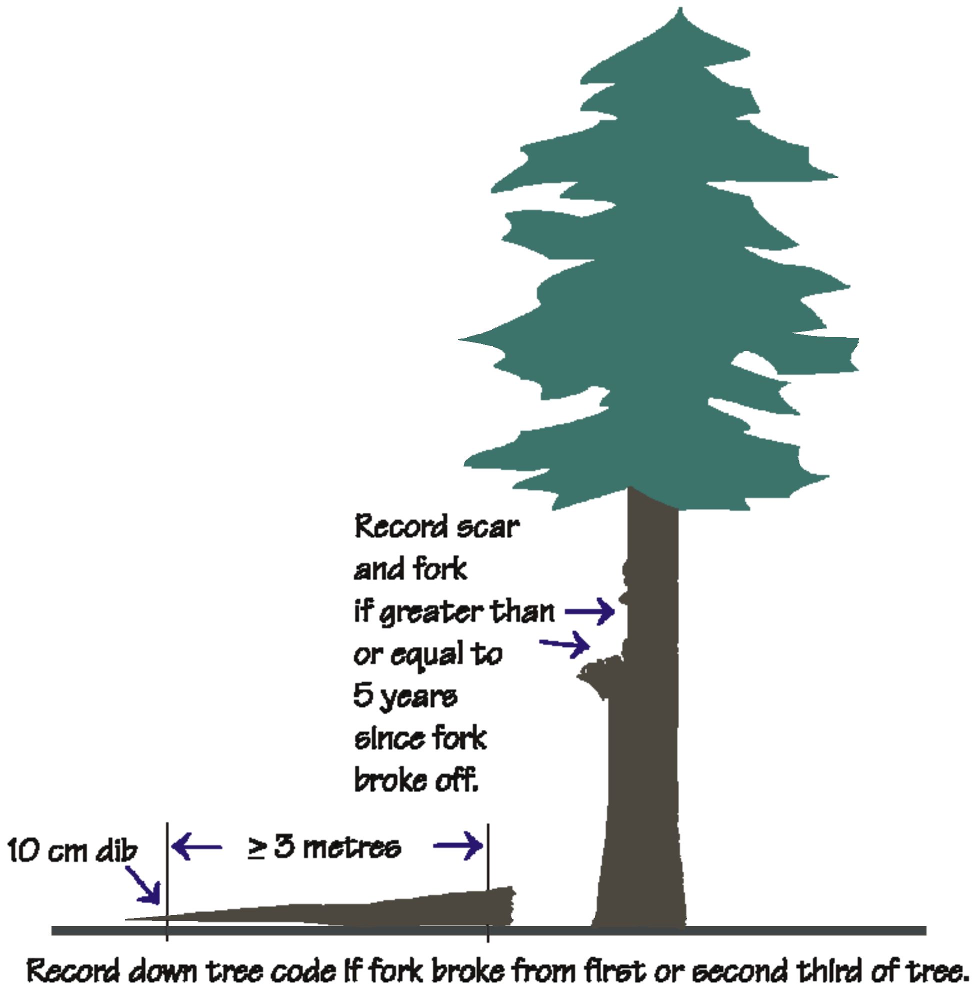
1. If the ‘forked’ leaders exceed the dimensions of a log as defined by the merchantability specifications (i.e., “A” is estimated to be greater than 3 m, and “B” is greater than 10 cm dib then record a fork) call the pathological defect as a ‘fork’.

2. If the leader material is relatively small in size (i.e., less than 3 m in length) call the defect as a “dead or broken top”.

3. In no instance should you “double call” any pathological indicators (i.e., either call a fork or a dead top, not both!).

   ‘A’ is estimated length of log that could be obtained from the ‘forked’ leader.
   ‘B’ is estimated to 10 cm top.
   ‘C’ is dead top or broken top.

If a merchantable fork has broken off and has been on the ground for greater than or equal to 5 years, the fork and scar may be recorded.



SEGMENT OF CRUISE TALLY CARD (FS 205)

Tree Number	Height	Species	DBH	Tree Class	Conk	Blind Conk	Scar	Fork/Crook	Frost Crack	Mistletoe	Rotten Branch	Dead/Broken Top	Down Tree
01	40.0	F	60.0	2			1	2					E

Figure A.15 Fork/crook.

Record a down tree code (clean break) since the fork is long enough to produce a merchantable log. Record fork and scar if the injury is at least 5 years old. See Figure A.40 or the back of the cruise tally card (FS 205) for the down tree codes. See Section A.4.2.3 for details regarding the coding of scars and see Section A.4.2 for details regarding the coding of pathology on secondary leaders.

A.4.2.5 Frost Cracks

- frost cracks result from deep radial splitting of the trunk caused by uneven expansion of the wood after sudden and pronounced drops in temperature,
- the cracks usually originate at the base of the trunk and extend up the tree following the longitudinal grain of the tree (see Figure A.16),
- frost cracks are often repeatedly opened by wind stresses or by low temperatures which freeze the moisture within the cracks and expands and splits the tree further,
- repeated healing of the wood produces considerable callous tissue giving the wood a pronounced ribbed appearance, and
- frost cracks must have occurred at least 5 years previously before they can be recorded.

Frost cracks are often associated with severe basal decay.

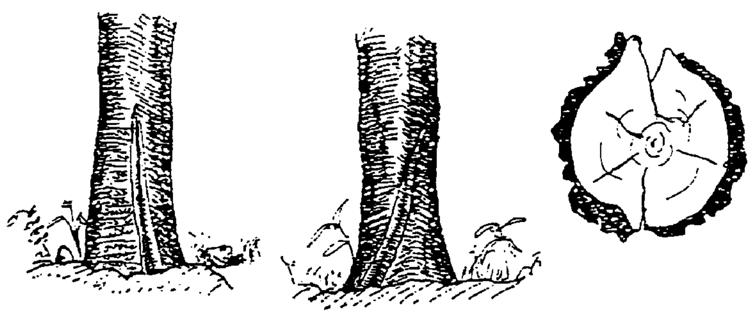


Figure A.16 Appearance of Frost Crack on Standing Trees.

A.4.2.6 Mistletoe Trunk Infections

Trunk infections of mistletoe are indicated either by abnormal swelling or malformations of the trunk at the point of infection, or by clusters of dead and broken branches on the trunk or on hypertrophied branches immediately adjacent to the trunk (see Figure A.17).

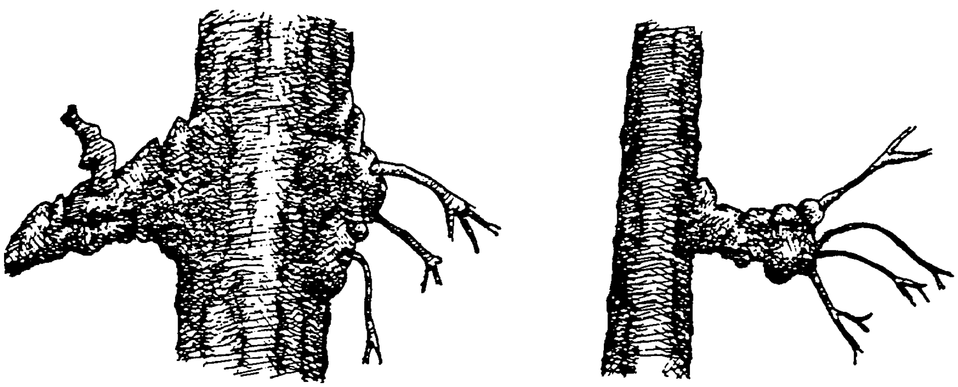


Figure A.17 Trunk Infections of Mistletoe.

Wood-rotting fungi gain entrance to the trunk through the dead hypertrophied branches or branch stubs where the swelling is on, or adjacent to the trunk.

Do not include mistletoe on living limbs or limbs that are swollen only at some distance from the trunk. Include only those branch infections in which the swelling has clearly extended to trunk (Figure A.18).

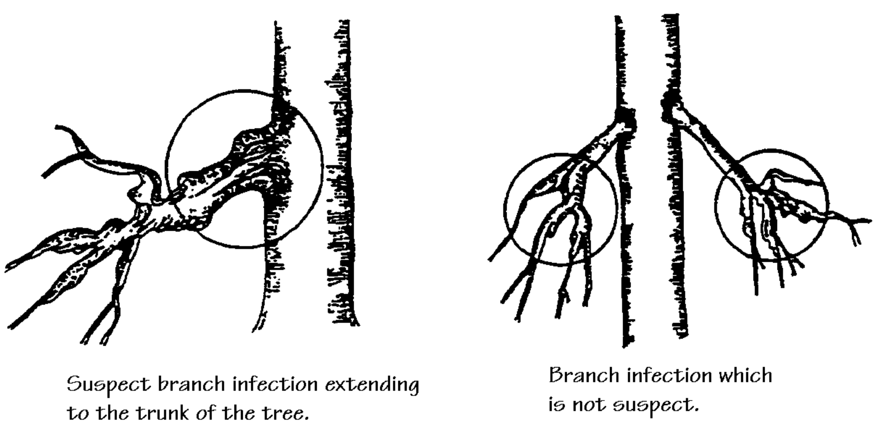


Figure A.18 Branch Infections of Mistletoe.

A.4.2.7 Large Rotten Branches

Large rotten branches are dead branches that are large (over 10 cm DIB) and are clearly decayed. These branches are usually broken off within a couple of metres of the trunk. Decayed heartwood close to or at the branch base should be obvious. The branches may be found at any position on the tree, but are generally confined to a position below the base of the live crown. This indicator is typically found on overmature trees (see Figure A.19).

Large rotten branches should not be confused with the normal decay of dead branches. It should be associated with large branches that have broken off, exposing a large heartwood surface to decay producing fungi, thereby potentially infecting the adjacent trunk.

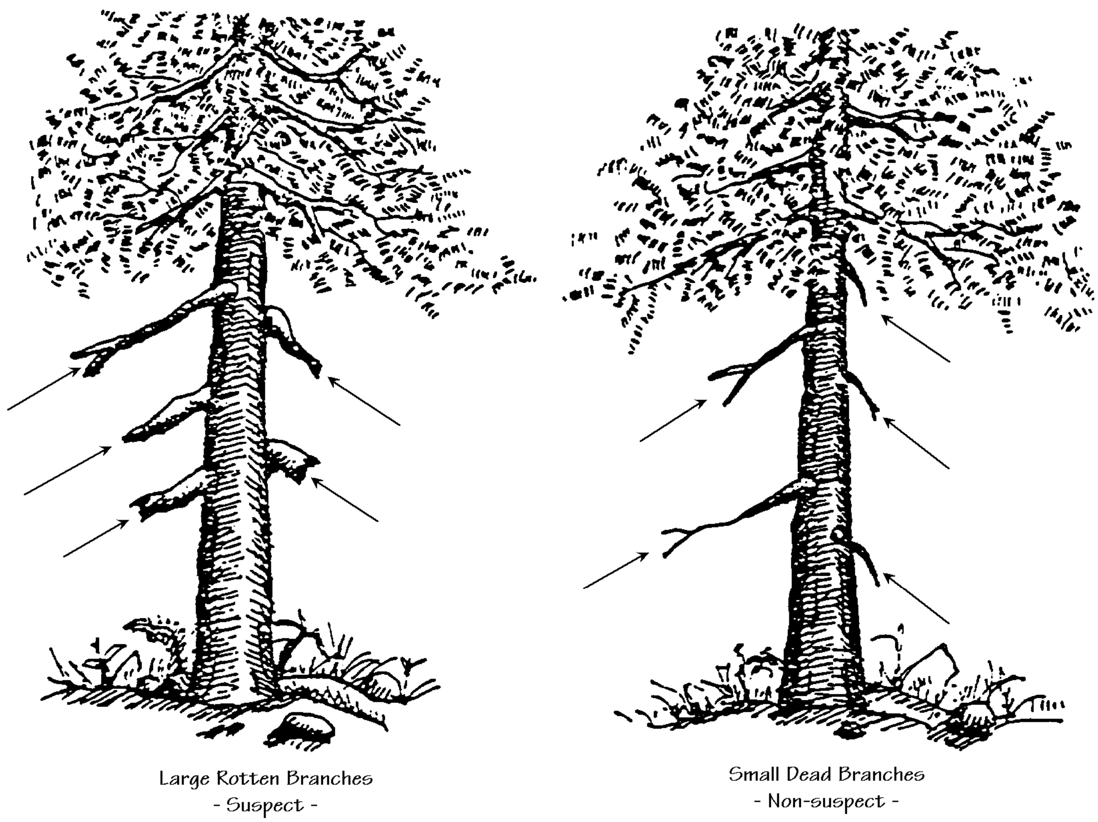


Figure A.19 Rotten Branches.

A.4.2.8 Dead or Broken Top

Definition:

- where the tree top or complete stem has died due to various physiological causes.

Causes of dead tops

Dead tops may be caused by several factors such as:

- insect attack,
- drought conditions,
- sun scald, and
- physiological death.

The calling of dead tops:

- a dead top must be obviously weathered, indicating that death occurred at least five (5) years ago and below the 10 cm top before it will be called as a pathological indicator, and

Causes of broken tops

- wind breakage,
- snow damage, and
- damage from falling trees, etc.

Broken tops must be obviously weathered (see scar criteria) before being called as a pathological indicator.

Standing trees that are broken in the bottom third will have a windthrow damage code assigned. In this instance, do not record a dead or broken top in the first third unless the broken top occurred at least 5 years previously.

If a fork is present at a broken top position, record the fork if a merchantable log (3 m long and 10 cm top) can be recovered from the fork. If the fork is not of merchantable size, record the d or b top. Do not call both indicators (see Figure A.14).

If a candelabra is present at a broken top position, record d or b top.

Flat topped trees

When trees attain their potential height for a specific site, the tendency for the top of the crown to flatten out is prevalent especially in certain species such as Douglas fir. This flattening of the crown is not indicative of damage to the tree and will not be called as a pathological indicator.

A.4.3 Abnormalities which are not Recorded

The following abnormalities are not indicative of decay and are, therefore, not recorded.

A.4.3.1 External Evidence of Butt Rot not Associated with Suspect Abnormalities

Butt rot may be evident in exposed roots or within root crotches. However, unless one or more of the suspect abnormalities appears on the tree, such trees will not be classed as Suspect, it is defect of this nature which contributes to the decay loss factor associated with the Residual tree class.

A.4.3.2 Flutes

Pronounced flutes on the trunk are a common growth characteristic of many species. They have no decay significance except in the case of interior cedar where the fold may hide an open scar leading to a hollow or decayed tree centre (Figure A.20).

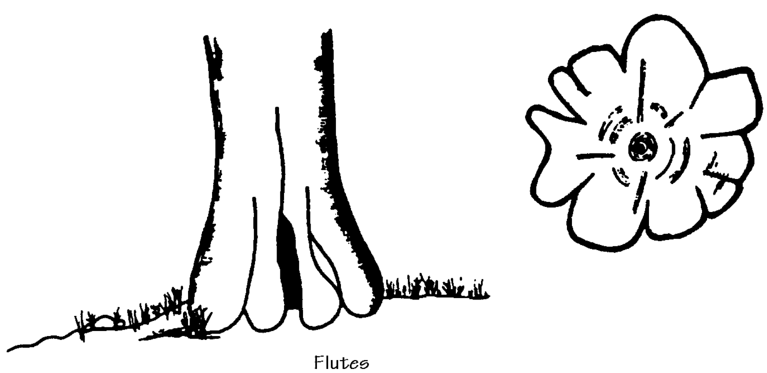


Figure A.20 Flutes.

A.4.3.3 Candelabra Branches

"Candelabra" branches develop as a result of abnormal branch growth and as such are confused with Suspect forking. Branching of this type has no decay significance. It is important to note that candelabra branches do not originate as a fork in the trunk of a tree (Figure A.21). Do not call defect on candelabras.

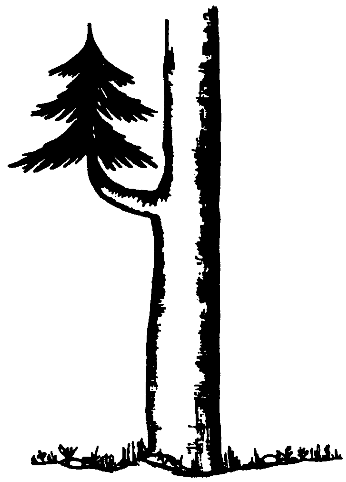


Figure A.21 Candelabra Branches.

A.4.3.4 Branch Fans

Branch fans which appear most commonly as 'fans' of branches originating from burl-like swellings on the trunks (Figure A.22) are not Suspect.

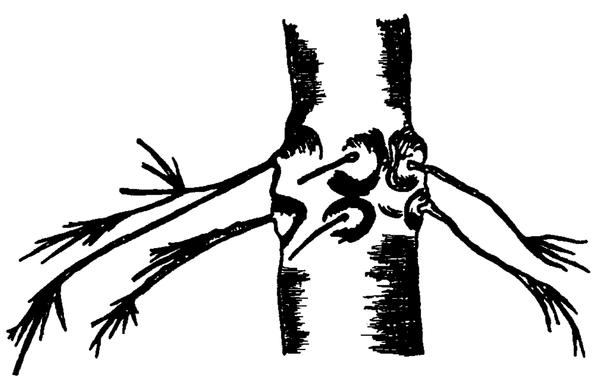


Figure A.22 Branch Fans.

A.4.3.5 Black Knots

Black knots frequently develop around unhealed knots and wounds. The blackened appearance develops from a superficial saprophytic fungus which feeds on the exuded sap. Black knots are quite sound when cut into with an axe and have no decay significance (Figure A.23).

Figure A.23 Black Knots.

A.4.3.6 Burls and Galls

Burls and galls develop from abnormal cell growth in trees and although formidable in appearance, have no decay significance (Figure A.24).

Scars will be tallied on burls.

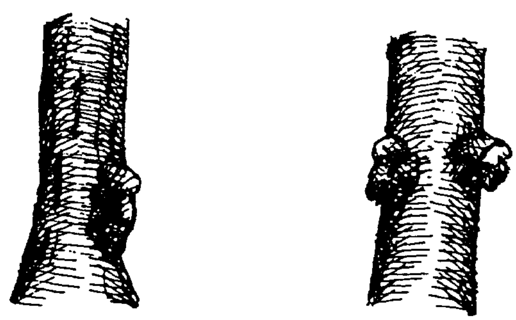


Figure A.24 Burls and Galls.

A.4.3.7 Sweep

Sweep which is a slight curvature or distortion of the trunk has no decay significance (Figure A.25).

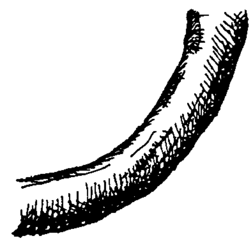


Figure A.25 Sweep.

A.4.3.8 Exposed Roots

Exposed roots and buttress roots have no established decay significance unless scarring is present above mean ground level (Figure A.26).

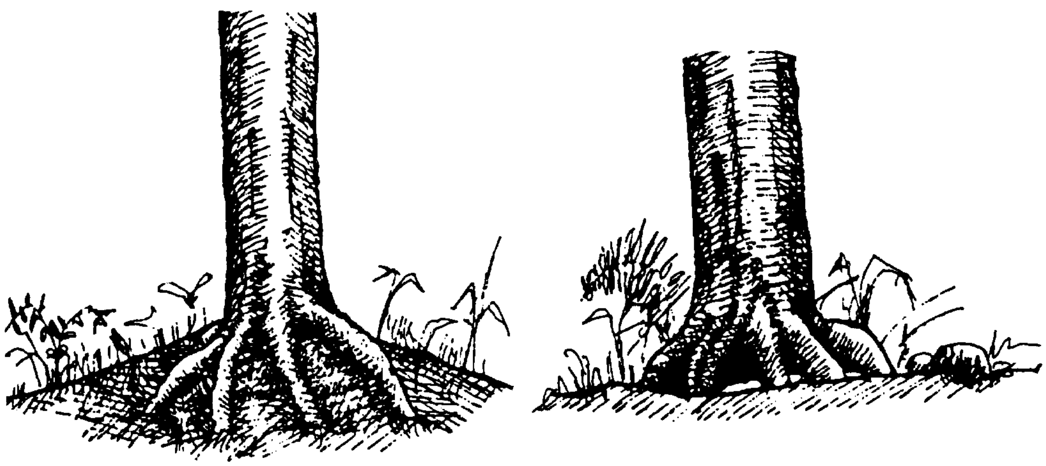


Figure A.26 Exposed Roots.

A.4.3.9 Other

Spiral Grain

Spiral grain is a growth characteristic of trees and has no decay significance.

Dry Side

Dry side results from the death of the cambium resulting from bruising by other trees or from other physiological causes. Dry side appears as a narrow to wide strip down the side of the tree or as small localized areas. The bark often remains intact over the dead areas. Although dry side may be responsible for the complete rejection, or degrade of a pole tree, it has no established decay significance. Dry side is not a scar unless the bark has sloughed (is missing).

Sap Sucker Holes

Sap sucker holes are superficial in extent and have no established decay significance. They are in marked contrast to Suspect scarring caused by woodpeckers (Figure A.27).

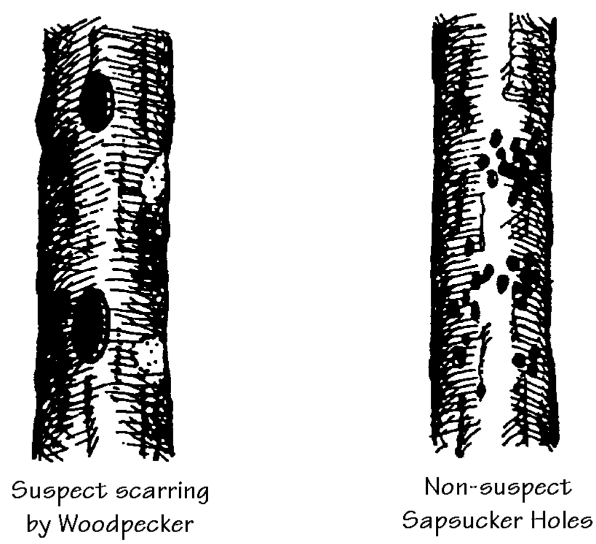


Figure A.27 Bird Damage.

Insect Borings

Borings by bark beetles or other insects have no established decay significance and will not be classed as Suspect.

Non-Suspect Forking

Figure A.28 shows two types of non-Suspect forking most commonly occurring in deciduous trees. Deciduous trees with "U" shaped forks containing a dead branch are definitely suspect. Non-Suspect forking is more "V" shaped.

Trees growing in clumps, such as birch, should not be classed as suspect on this characteristic alone.

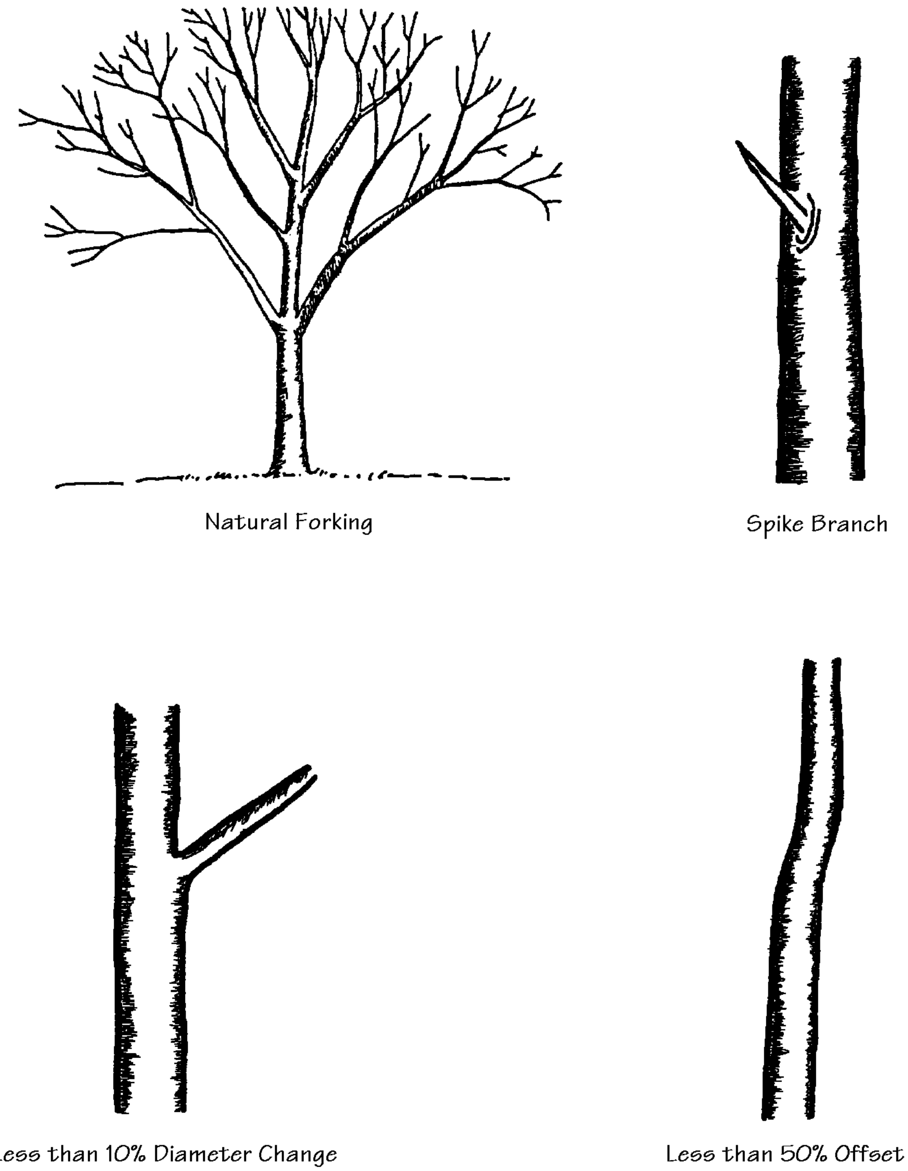


Figure A.28 Illustrates Forks and Crooks Which are Not Suspect.

A.4.4 Some Common Decays of Forest Tree Species in British Columbia

Brief descriptions of some of the major decays of commercial tree species in British Columbia have been included as an aid to their identification in the field. Pathological studies have shown that although most tree species are subject to attack by a large number of wood-rotting fungi only a few are of major significance. Descriptions of eleven of these have been included.

A.4.4.1 Indian Paint Fungus

(1) Echinodontium tinctorium showing the dark, furrowed upper surfact and a grey, spiny lower surface.

Cross section showing the brown stringy nature of decay caused by E. tinctorium. (2)

(3) E. tinctorium on living hemlock associated with dead branches.

(2) Longitudinal section of brown stringy rot caused by E. tinctorium.

Figure A.29 Indian Paint Fungus.

Scientific name (fungus):	Echinodontium tinctorium (Ell. & Ever).
Common name (decay):	Brown stringy trunk rot.
Hosts:	Reported on a large number of coniferous hosts. Of major importance in British Columbia only on western hemlock, alpine fir and amabilis fir. Reported from the coast only at higher elevations and in the north.
Sporophores:	Perennial, hard, woody, sessile, ungulate: upper surface black, furrowed; context brick-red; lower surface grey.
Decay:	The incipient stage may appear as a light yellow to brown or water-soaked stain. Later, the wood darkens to a reddish-brown to brownish-yellow colour. Small rust-coloured spots and occasionally red streaks may develop. Finally, the wood is reduced to a brown, fibrous, string mass.
Entrance:	Infections occur in living branches after 35 to 45 years, but normally do not become established in the trunk for another 100 years. Conditions affecting entry into the trunk are unknown.

A.4.4.2 Pine Root Fungus

1 Upper and lower surfaces respectively of bracket-like sporophores of Fomes annosus, the pine root fungus.

2 Resupinate sporophore of F. annosus on the under surface of an exposed root.

3 Cross section of advanced decay caused by F. annosus showing the white spongy nature of the rot.

2 Longitudinal section of decay caused by F. annosus showing the numerous elongated pits. Black flecks, commonly associated with advance decay rot are not evident here.

Figure A.30 Pine Root Fungus.

Scientific name (fungus):	Heterobasidion annosum (Fr.:Fr.) Bref.
Common name (decay):	Annosus root and butt rot
Hosts:	Occurs on most hardwoods and conifers. Common in western hemlock. Range is generally west of the coast mountains and in the ICH biogeoclimatic zone.
Sporophores:	Perennial, woody to leathery, sessile, ungulate or bracket-like to resupinate; upper surface dark-coloured to black, zones, margin acute; context white to cream coloured, poroid, pores small and regular.
Decay:	The incipient stage may appear as a reddish-brown stain. In the advanced stage the wood is reduced to a white stringy or spongy mass containing numerous black flecks running parallel to the grain. In the final stage the wood may be completely destroyed.
Entrance:	Roots and scars.
Activity:	Heartwood and occasionally sapwood decomposition of lignin and to a lesser or slower extent cellulose. Generally confined to the roots and butt sections.
Remarks:	Sporophores generally produced on dead material or on the undersurface of roots exposed to the atmosphere. Capable of causing extensive root rot in young stands. Also occurs as a common decay of mature timber.

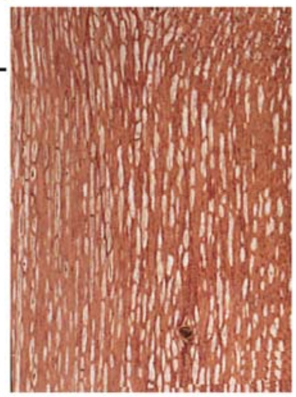
A.4.4.3 Picture Conk

Figure A.31 Picture Conk.

Scientific name (fungus):	Ganoderma Applanatum (Pers.) Pat. Fomes applanatus Pers.
Common name (decay):	White mottled rot, Applanatus rot.
Hosts:	Known to occur on conifers, but more frequent on hardwoods in all regions of BC.
Sporophores:	Perennial, leathery to woody, sessile, applanate; upper surface light brown to grey, often shiny; context dark brown; lower surface white, turning dark brown when bruised; poroid, pores regular.
Decay:	The incipient stage may appear as a light stain or infected wood may have a bleached appearance and be difficult of detection. In the advanced stage the decay is characterized by a mottled appearance. The wood is white or light coloured, soft and spongy, and often contains zone lines and accumulations of mycelium.
Entrance:	Scars.
Activity:	Heartwood and sapwood decomposition of lignin and to a lesser and slower extent cellulose. May occur in the butt or trunk.
Remarks:	Sporophores develop infrequently on living trees. The lower surface of fresh sporophores may be permanently marked on contact (the picture conk). Brownish spores may be carried to the upper surface giving a dusty brown appearance to the sporophore.

A.4.4.4 Conk Fungus

(1) Typical sporophores of Fomes pini, the conk fungus.



(2) Cross section of advanced decay caused by F. pini showing the honeycomb nature of the rot.

(3) Fruiting body on living Douglas fir.

(2) Fruiting body on dead branch.

Figure A.32 Conk Fungus.

Scientific name (fungus):	Phellinus pini (There:fr) Ames. Fomes pini (Thore) Lloyd, formerly referred to as Trametes pine (Thore) Fr.
Common name (decay):	Conk rot, white-pitted rot, red ring rot, pecky rot, honeycomb rot, etc.
Hosts:	Occurs essentially on all conifers in British Columbia, very common in hemlock, spruce and Douglas fir. Also known to occur on hardwoods.
Sporophores:	Perennial, wood to punky, sessile, ungulate, occasionally effused-reflexed if on branches; upper surface dark brown, furrowed; context cinnamon brown; lower surface light brown, poroid, pores regular to daedaloid.
Decay:	The incipient stage may appear as a reddish stain. Later small white, spindle-shaped pits develop parallel to the grain.
Entrance:	Unknown - probably branches and wounds.
Activity:	A lignin destroying heartrot, mostly occurring in the trunk.
Remarks:	One of the most important decay fungi in British Columbia. Of greater importance on good sites. Conks develop on living trees and provide a valuable index to hidden defect. Also recognized through the occurrence of blind conks (punk knots) which constitute early or abortive stages in the development of sporophores.

A.4.4.5 Red Belt Fungus

(1) The read belt fungus, Fomes pinicola, showing the bracket-like nature of the sporophore.

(2) Typical sporophores of F. pinicola on recently killed western hemlock.

(3) Section of decay caused by F. pinicola showing the typical brown cubical formations and white mycellal felts.

Figure A.33 Red Belt Fungus.

Scientific name (fungus):	Fomitopsis pinicola (SW.:Fr) P. Karst. Fomes pinicola (sw.) Cke.
Common name (decay):	Brown crumbly rot.
Hosts:	Common on most conifers and hardwoods.
Sporophores:	Perennial, woody to leathery, sessile, variable, ungulate, bracket-like, occasionally effused-reflexed; upper surface dark brown to black, outer margin often reddish or otherwise lighter in colour; context cream to light brown; lower surface white, often tinged with yellow; poroid, pores small and regular.
Decay:	The incipient stage may appear as a light brown discolouration. Later the wood breaks into small brown cubes which are soft and crumbly. White felts of mycelium may be formed in the shrinkage cracks.
Entrance:	Scars, dead tops, insect injuries, etc.
Activity:	A cellulose-destroying trunk rot, occurring in the heartwood or sapwood.
Remarks:	Very common in dead trees, slash, and other forest litter, thus occasionally known as the scavenger fungus. May be associated with decay in living trees, frequently gaining entrance through scars. Also an important rot contributing to the deterioration of killed stands, especially by fire and insects. Sporophores develop infrequently on living trees.

A.4.4.6 Velvet -Top Fungus

1 Sporophore of P. Schweinitzii attached to an underground root and growing through the duff.

Cross section of decay caused by P. Schweinitzii showing the typical dark brown cubical formations. 2

3 Longitudinal section of decay caused by P. Schweinitzii showing the dark brown cubical formations.

Figure A.34 Velvet-top Fungus.

Scientific name (fungus):	Phaelous schweinitzii (Fr.:Fr.) Pat. Polyporus schweinitzii Fr.
Common name (decay):	Brown cubical butt rot.
Hosts:	On conifers, common in Douglas fir, spruce and pine. Occasionally found on hardwoods found in all regions in BC.
Sporophores:	Annual, spongy to leathery, stipitate; upper surface reddish-brown; velvety with concentric rings and a light yellow margin; context yellow-green to light brown; lower surface yellow-green turning brown when bruised; pores regular to daedaloid.
Decay:	The incipient stage may be difficult to detect, often appearing as a light yellow stain. At a late stage the wood becomes brittle and breaks into large cubes, reddish-brown in colour. An odour of anise is often associated with advanced decay.
Entrance:	Roots.
Activity:	A cellulose-destroying heartrot, generally confined to the roots and basal log.
Remarks:	Very general distribution throughout North America. Occurs in trees of all ages. Young trees may be killed outright, older trees become subject to windfall. Sporophores develop on roots and freshly felled trees and provide a valuable index of infection.

A.4.4.7 Sulphur Fungus

(1) Typical sporophore of P. Sulphureus, showing the fan-shaped nature.

Sporophores of P. sulphureus fruiting at the base of an infected tree. (2)

(3) Cross section of decay caused by P. sulphureus showing the typical brown cubical formation and thick white mycelial felt in the shrinkage cracks.

Longitudinal section of brown cubical trunk rot caused by P. sulphureus showing the white mycelial felts. (2)

Figure A.35 Sulphur Fungus.

Scientific name (fungus):	Laetiporus sulphureus (Bull.:Fr) Murrill. Polyporus sulphureus (bull.)
Common name (decay):	Brown cubical trunk rot.
Hosts:	Common on most hardwoods and conifers, including oak, true fir, Douglas fir and spruce in all regions in BC.
Sporophores:	Annual, spongy to leathery, sessile or stalked (stem eccentric), applanate to bracket-like; upper surface orange-yellow; context white; lower surface sulphur-yellow; poroid, pit regular. Old sporophores white and brittle.
Decay:	The incipient stage may appear as a light brown stain. Later the wood breaks into small brown cubes. The decay may have a 'rippled' appearance in longitudinal section and white mycelial felts may develop in the shrinkage cracks.
Entrance:	Scars, dead branch stubs.
Activity:	A cellulose decomposing heartrot and occasionally saprot. May occur in the butt or trunk, generally the latter.
Remarks:	Sporophores develop infrequently on living trees but are easily recongnized by their shape, size and colour. They decompose quickly following insect attack and weathering and seldom remain on the host past one season.

A.4.4.8 Spongy Butt Rot Complex

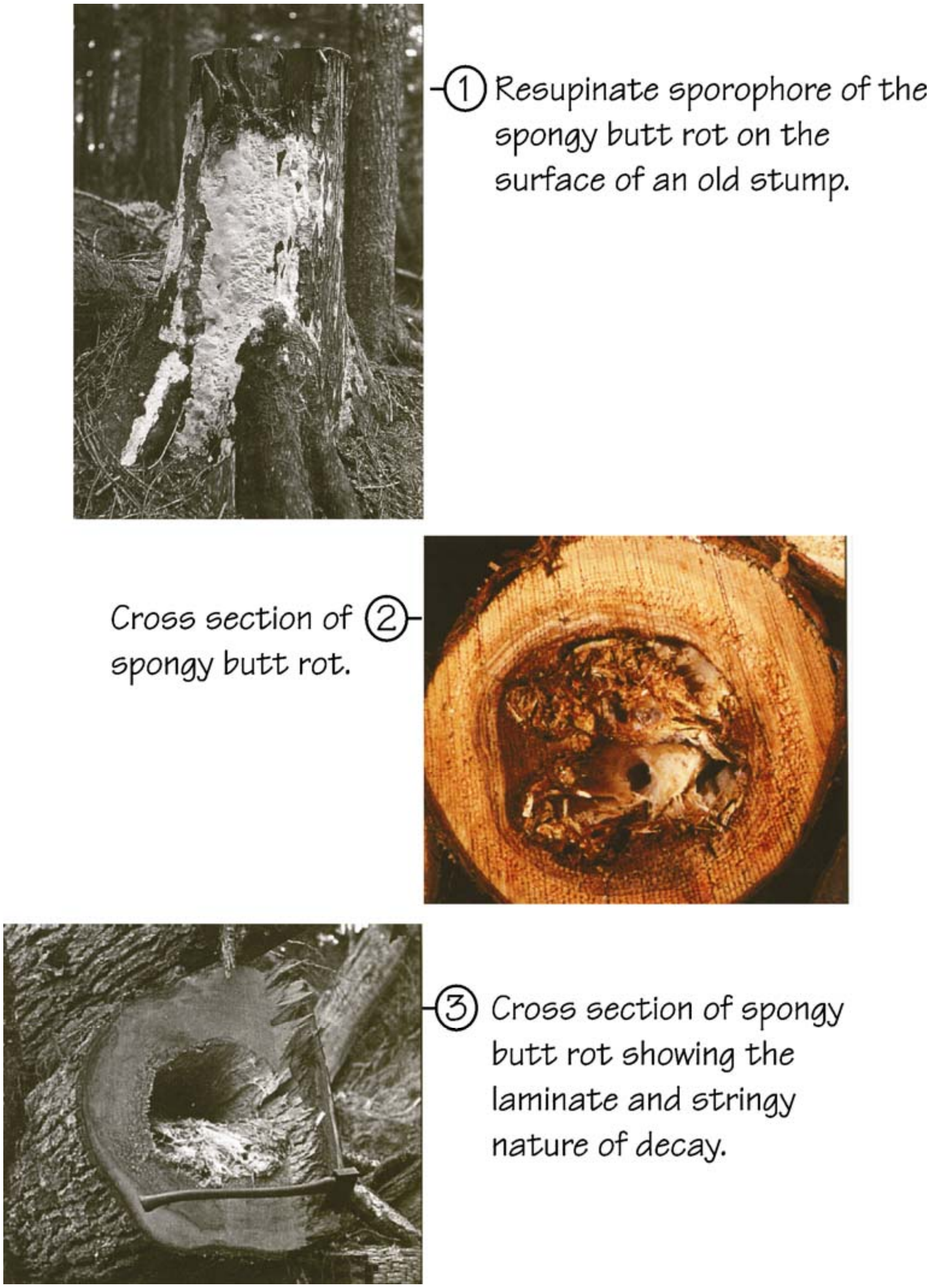


Figure A.36 Spongy Butt Rot Complex.

Scientific name (fungus):	The three fungi most commonly involved in the complex are Corticium galactinum (Fries) Bur, Odontia bicolor (Alb. and Schw. ex. Fr.) Bres., and Poria subacida (Beck) Sacc.
Common name (decay):	Spongy butt rot, feather rot, white stringy butt rot.
Hosts:	Occurs in conifers and hardwoods. Common in true fir, spruce and hemlock found in all regions of BC.
Sporophores:	Superficially similar in the three species: annual to perennial, resupinate, white, yellow or buff. The surface of C. galactinum smooth and waxy, O. bicolor cracked with age and covered with short fragile evenly-distributed teeth and P. subacida small pores.
Decay:	The incipient stage may appear as a light stain. Later, small white pits develop and coalesce to form masses of white spongy fibres containing small black flecks. The annual rings may separate to form a laminate decay. Finally, the wood is reduced to a spongy mass.
Entrance:	Roots.
Activity:	A lignin and to a slower or lesser extent cellulose decomposing heartrot and saprot generally confined to the roots and butt.
Remarks:	Poria subacida which formerly was considered the sole causal fungus is in some hosts now believed to be the least important of the fungi commonly associated with the disease. White spongy butt rot is widely distributed throughout North America; common in mature age classes. Sporophores of the three fungi associated with this rot are generally on the undersurface of old logs.

A.4.4.9 Bleeding Conk

(1) Typical sporophores of the bleeding conk, Stereum sanguinolentum, showing the thin, crust-like nature of the fruiting body.

(2) Typical sporophore of the bleeding conk, Stereum sanguinolentum, showing the thin, crust-like nature of the fruiting body.

Figure A.37 Bleeding Conk.

Scientific name (fungus):	Stereum sanguinolentum A. & S. ex. Fr.
Common name (decay):	Red heart rot.
Hosts:	Occurs on conifers. Very common in true fir, pine and white spruce. Found throughout the range of hosts in British Columbia.
Sporophores:	Annual, leathery, resupinate to effused-reflexed, forming thin crust-like layers; lower surface grey to light brown, turning blood red when bruised, surface roughened.
Decay:	The incipient stage is firm and appears as a reddish brown stain, in the advanced stage, the wood becomes light brown to reddish-brown, dry and friable. Mycelial sheets, white to buff in colour, may develop.
Entrance:	Broken tops and scars of living trees.
Activity:	A lignin and generally to a slower or less extent cellulose destroying heartrot, generally found in the trunk.
Remarks:	A very important decay-producing fungus, also occurs commonly as a slash destroyer. Sporphores develop occasionally on living trees, but are of limited value as indicators of defect owing to their infrequent occurrence, small size and colour.

A.4.4.10 False Tinder Fungus

Figure A.38 False Tinder Fungus.

Scientific name (fungus):	Phellinus igniarius (L.:Fr) Quél. Fomes igniarius (L.) Gill.
Common name (decay):	White trunk rot or white heart rot.
Hosts:	Occurs mainly on hardwoods. Common in aspen and birch.
Sporophores:	Perennial conks are usually hoof-shaped, but sometimes shelflike and may obtain a width of 20 cm or more. The upper surface is greyish-black to black, dull or shiny, smooth when younger becoming rough and cracked with age. Undersurface is brown with mouths of tubes small and circular in outline. Context or interior of conk is rusty-brown, often interspersed with silver-grey flecks.
Decay:	Incipient stage has yellowish-white spots, streaks, or larger areas in the heartwood, the whole usually surrounded by a yellowish-green to brownish-black zone. In the advanced stage the wood is light in weight, soft, whitish, and rather uniform in texture with fine black lines running throughout. In aspen, the incipient wood is faintly coloured from light pink to straw-brown, in the intermediate stage of decay, the wood is straw to chocolate-brown, but is still hard and firm; and in the advanced stage all soft, punky wood irrespective of colour is included.
Entrance:	Unknown - probably branches and wounds.
Activity:	Sporophores from on standing trees and on slash; the presence of a single sporophore generally indicates a considerable volume of decay.

A.4.4.11 Poria Obliqua

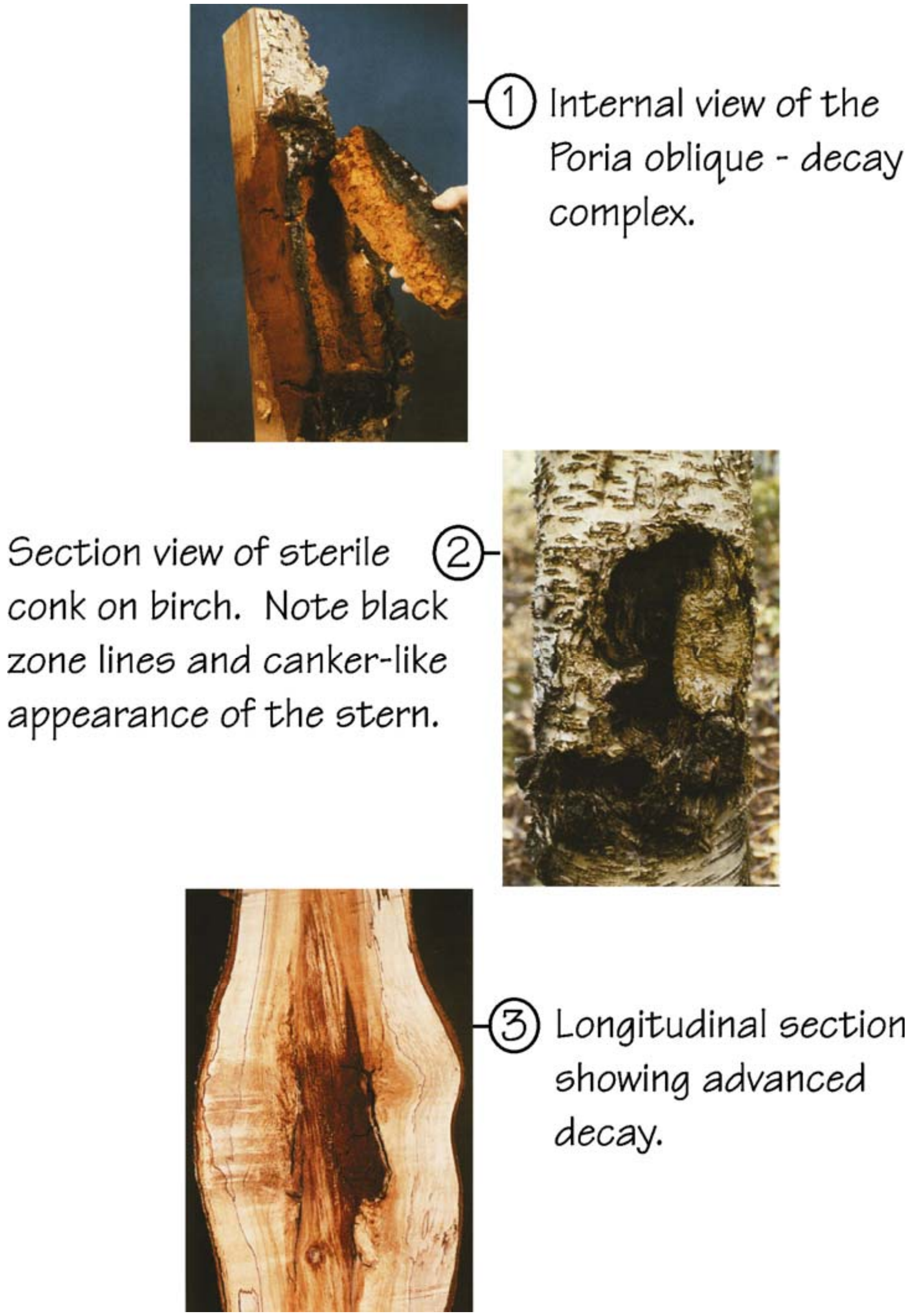


Figure A.39 Poria Obliqua.

Scientific name (fungus):	Poria obliqua (pers.) Bres.
Hosts:	Occurs on hardwoods. This sample was found on wester paper birch (Betula papyrifera).
Decay:	A heart rot in living birches similar to that caused by Fomes igniarius. Fine black zone lines are a feature of the advanced stage (Example 3).
Appearance:	Black, warty, rough, clinkerlike sterile conks are produced on living trees, appearing to issue from knots and wounds. The conks in this illustration appears in the centre of a conspicuous canker. The context or interior of the conk is rusty-brown.

Appendix 5 Abbreviations and Symbols

Basal area factor	BAF
Close utilization	CU
Coefficient of variation	CV
Decay and breakage	DB
Decay, waste 2 and breakage	DW2B
Diameter at breast height	dbh
Diameter at stump height	dsh
Diameter inside bark	dib
Diameter outside bark	dob
Plot radius factor	PRF
Standard deviation	S.D.
Standard error	S.E.

Appendix 6 Damaged Stands

Trees are assigned damage codes so as to apply volume and value adjustments. Each tree is assessed and coded as it appears at the time of the cruise with no attempt to predict the future condition of the trees. Where damage is tallied it will be compiled and reported.

Damaged tree volumes and LRF's are adjusted using the loss factors. In addition, the cruise compilation reports identify tree volume within the damaged code categories so as to enable cost and value adjustments in appraisal.

Each code has a different effect in compilation. Damage codes result in the modification of risk group and corresponding adjustments to net volume.

Depending on the patchiness of the beetle attack, or fire and wind damage, consideration should be given when drawing up the sampling plan as to whether these patches should be treated as "types" and be a part of the stratification.

A.6.1 Pest Damage

The following section applies for all cruises. Standard cruising methods as outlined in the *Cruising Manual* are to be followed with all beetle attack trees on the sale area coded in accordance with the *Bark Beetle Code*.

A.6.1.1 Bark Beetle Codes[1]

When Bark Beetle codes are recorded, the compilation program modifies the risk group. The compilation reports state the volume affected by this damage.

Trees are coded as they appear at the time of the cruise with no attempt to guess what the future condition of the trees will be.

[1] L. Safranyik, D.M. Shrimpton, H.S. Whitney, Management of Lodgepole Pine to Reduce Losses from Mountain Pine Beetle, 1974, Forestry Technical Report 1, Environment Canada.

A.6.1.2 Bark Beetle Descriptions

The most common and destructive infestation the cruiser will encounter are caused by the following bark beetles.

Mountain pine beetle attacks lodgepole, ponderosa and white pine (however, whitebark, limber and exotic pines could also be infested).[2]

Douglas fir beetle attacks Douglas fir and sometimes western larch.[3]

Spruce beetle attacks mainly white and Englemann spruce in the Interior.[4]

Western pine beetle attacks ponderosa pine.

Western balsam bark beetle attacks mainly subalpine fir (*Abies lasiocarpa*).

See the following web sites for photos and descrptions of common forest pests:

http://www.for.gov.bc.ca/hfp/publications/00198/ and

http://www.pfc.cfs.nrcan.gc.ca/diseases/hforest/

A.6.1.3 Attack Codes for Balsam, White Pine, Yellow Pine and Lodgepole Pine

Code	Description
1	Green Attack
2	Red Attack
3	Grey Attack

These attack codes (based on crown and bole symptoms) are applicable to:

- The mountain pine beetle (Dendroctonus ponderosae) and the lodgepole pine beetle (Dendroctonus murrayannae) in lodgepole pine (Pinus contorta-PL), yellow pine (Pinus ponderosa-PY) and white pine (Pinus monticola-PW).

[2] R.O. Wood, Foliage Changes of Three Pine Species, Pacific For. Res. Centre, Internal Report BC-17.

[3] L.H. McMullen, 1977, Douglas Fir Beetle, Pacific For. Res. Centre, Pest Leaflet A.

[4] C.B. Cottrel, 1978, Spruce Beetle, Pacific For. Res. Centre, Pest Leaflet B.

- The western pine beetle (Dendroctonus brevicomis) in yellow pine (Pinus ponderosa-PY).
- The western balsam bark beetle (Dryocoetes cofusus) in alpine fir (Abies lasiocarpa-BL).

Green Attack Code 1

Since the mountain pine beetle and the western pine beetle normally complete their life cycles in one year, the Green Attack code will represent trees that have been infested ten to twelve months or less. The crown is green but pitch tubes are evident on the lower bole and the inner bark will contain characteristic gallery patterns and immature stages of the beetles. Successfully attacked trees usually die within a few weeks following initial attack even though their crowns may stay green up to twelve months. How long the crown of an infested tree stays green depends on climate, soil, topography and tree species. White pine and yellow pine infested by mountain pine beetle often start discolouring by fall or mid-spring.

Red Attack Code 2

This code represents trees that, on average, had been attacked during the previous two seasons. The crowns first fade to straw colour, then to red and finally to rust colour before the needles fall off the tree. By the time the foliage is rust coloured, the beetles have usually left these trees to infest green trees. The boles of many trees in this category may be heavily worked by woodpeckers, making them susceptible to checking.

Grey Attack Code 3

This code will represent trees that are dead and have grey needles except Abies Lasiocarpa, which can have grey or red needles. The bole of the older kills will have much checking and loose bark. However, pitch tubes on the bark of the lower bole and/or bark beetle galleries under the bark will be readily discernible.

The western pine beetle has a different gallery pattern than the mountain pine beetle, but infested trees go through the same sequence of foliage changes after attacks by either beetle. Therefore, the same attack code is applicable.

The western balsam bark beetle usually completes its life cycle in two years. Therefore, both green and red attacked trees will contain brood. Also quite often there is no evidence of pitch tubes on the trunk of infected trees. Therefore, the boles of balsam fir need to be examined at close range for signs of boring dust in the crevices of the bark and/or small round holes in the bark that signify entry or emergence by this beetle. Thus, in the green infected stage, attacked trees are quite difficult to find.The western pine beetle has a different gallery pattern than the mountain pine beetle, but infested trees go through the same sequence of foliage changes after attacks by either beetle. Therefore, the same attack code is applicable.

The western balsam bark beetle usually completes its life cycle in two years. Therefore, both green and red attacked trees will contain brood. Also quite often there is no evidence of pitch tubes on the trunk of infected trees. Therefore, the boles of balsam fir need to be examined at close range for signs of boring dust in the crevices of the bark and/or small round holes in the bark that signify entry or emergence by this beetle. Thus, in the green infected stage, attacked trees are quite difficult to find.

Lodgepole Pine Beetle Attack Code Definition

Green Attack Code 1 (Risk Group 2)	Trees attacked have green needles, but other colours may also be present. Green attack must contain greater than or equal to 5% green coloured needles.
Red Attack Code 2 (Risk Group 2)	Trees attacked have red, fading and possibly some grey needles. Red includes straw to rust colour. Red attack must contain less than 5% green needles and greater than or equal to 5% red needles.
Grey Attack Code 3 (Risk Group 2)	Trees attacked have grey or no needles. Grey attack must have less than 5% red needles.

A.6.1.4 Blister Rust Code 4 (Risk Group 2, White Pine)

Normally used in stands where white pine is a major species (more than 20 percent of the volume) which is seriously infected with blister rust. This code can be used in a normal old growth H-C type containing a few scattered PW veterans.

All other insect attack codes take precedence over Blister Rust, Code 4.

A.6.1.5 Attack Codes for Spruce, Douglas Fir

Code	Description
5	Green Strip Attack – S and F
6	Green Full Attack – S and F
7	Grey Attack – S and F
8	Red Attack – Fir only

The first three codes are applicable to the spruce and fir beetle. Spruce foliage turns yellowish for a brief period in the winter season following an attack before the needles drop off the tree. Therefore, the species was not included in the red attack. Infested trees with faded crowns should be included in the green (dead) full attack.

Green Strip Attack Code 5 (Path/Tree Class = Risk Group, Fir and Spruce)

The trees in this code will be infested in a strip on the lower bole where broods either failed or succeeded in completing their development. In either case, the attacks did not kill the trees. These trees will live on, at least until subsequent attacks (which can happen quite often) completely girdle the bole. In the case of Douglas fir, strip attacked (green in well established infestations are usually much less common than Green fully attacked trees. The loss factors are unaffected by this code.

Green Fully Attacked Code 6 (Risk Group 2, Fir and Spruce)

The trees in this code still have green foliage but the attack by the bark beetles has completely girdled the tree. Some of these trees will have a considerable amount of their bark removed by woodpeckers lowering the value because of checks and splits.

In the case of Douglas fir, the beetle usually has a one year life cycle. The attack is usually in May and June. The crowns of infested trees stay green from a few months to a year after attack. Do not code as Tree Class 3. The compilation program will downgrade these trees to Risk Group 2.

Grey Attack Code 7 (Highest Risk Group and has to be dead, Fir and Spruce)

This code represents trees which are dead and have gray needles. Little or no foliage is left, the boles of the older kills may have much checking and loose bark. The compilation program downgrades these trees to the highest risk group.

Red Attack Code 8 (Risk Group 2, Fir)

This code is reserved for Douglas fir where the red foliage remains on the tree for an average of two years. For bole and crown symptoms of infestation, consult the publication on Douglas fir Beetle[3] under the headings Damage and Detection. The compilation program downgrades these trees to Risk Group 2. If they have conk or blind conk they will be compiled as Risk Group 3.

A.6.1.6 Defoliators (Path/Tree Class = Risk Group, All Species)

This damage category includes hemlock looper, budworms, moths and other defoliators. If the classification is doubtful, assess the cambium on the north side at DBH.

- Code X - trees with living cambium. Tree classes 1, 2, 5, 6, 8, and
- Code Y - trees with dry cambium. All tree classes are allowed.
- All other insect attack codes take precedence over defoliator, codes x and y except code 4, Blister Rust.

A.6.2 Fire Damage

Standard cruising methods as outlined in the *Cruising Manual* are to be followed in conjunction with the following classifications and their codes.

A.6.2.1 Light Damage - Code A

Damage consisting of scorched bark and foliage but no charring in the merchantable portion of the stem. Bark scorching greater than or equal to 5 years after the date that the fire was declared mopped up by the Ministry of Forests and Range does not qualify for the fire damage coding.

Classification: The risk group will be determined by the tree class and pathology.

A.6.2.2 Moderate Damage - Code B

Damage of any age consisting of some shallow charring of wood fibre in the merchantable portion of the stem.

Classification: Assign the tree class and record the pathological indicators as normal. The compilation program will down grade risk group 1 trees to risk group 2.

A.6.2.3 Heavy Damage - Code C

Damage of any age consisting of extensive shallow charring or deep charring in the merchantable portion of the stem. Multiple deep checks in trees less than 30 cm DBH also qualify for heavy damage.

Classification: Assign the tree class and record the pathological indicator as normal. The compilation program will down grade these trees to the highest risk group.

> Trees are coded as they appear at the time of the cruise only and not at the anticipated time of harvesting.

Definitions:

Merchantable section	is the section of the stem between 30 cm stump and the 10 cm top diameter.
Charring	is the actual destruction of wood by fire. There must be identifiable damage to a surface area greater than100 cm^2.
Shallow charring	is charring which is greater than 100 cm^2 in surface area and less than one-third of the radius of the tree.
Extensive shallow charring	is charring in the bottom third of the tree that has 3 or more areas (each at least 100 cm^2) of exposed and charred wood fibre or the cumulative total of charred areas is greater than 300 cm^2.
Deep charring	is where charring is deeper than one-third of the radius of the tree.
Multiple deep checks	is where more than 1 check is deeper than one-third of the radius of the tree.

1. Surface checking may occur as the result of fire damage but this does not affect tree classification.
2. Trees are coded as they appear at the time of the cruise and not at the anticipated time of harvesting.

A.6.3 Down Trees

The following Damage Codes will be entered in column 63 of the Tally Sheet (FS 205).

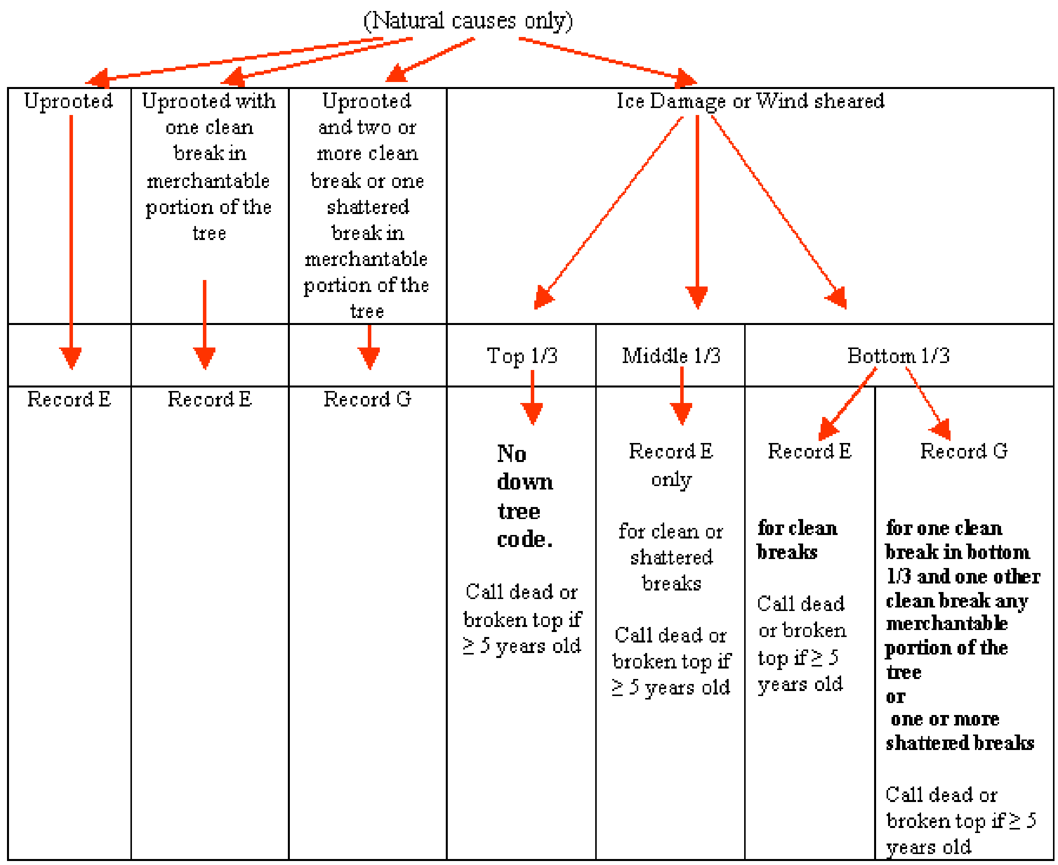
Code	Condition of Down Trees
E	The tree may have one clean break in the merchantable portion of the stem. The compilation program will assign the risk group by tree class and pathological indicators.
G	The tree must have two or more clean breaks or one or more shattered breaks within the merchantable portion of the stem. The compilation program will down grade these trees to the highest risk group.

Definitions:

Clean break is a break in the merchantable portion of the stem which can be bucked

	out in a length equivalent to the diameter of the stem at the break.
Shattered break	is a break more severe than a clean break.
Break below stump height	a break not in the merchantable portion of the stem will be coded as an uprooted tree.

Damage Call Matrix for Uprooted, Ice Damaged and Wind Sheared Trees



Note: Record all trees in plot if DBH is in the plot (natural or man influenced)
Damage codes can only be recorded for natural occurrences. No codes for hand felled or mechanical influences.
Do not record uprooted TC 4 or TC 6

Figure A.40 Damage Call Matrix for Uprooted, Ice Damaged and Wind Sheared Trees.

A.6.3.1 Sampling Down Trees

Down trees are defined as trees that have been uprooted, blown down, ice damaged or wind sheared. Standard cruise methods as outlined in the *Cruising Manual* are to be followed consistent with the following criteria:

- fixed or variable plots can be used for both standing and down trees,

- trees will be coded as of the time of cruising,
- do not record uprooted tree class 4 and 6 trees,
- the allowable tree classes for all codes are 1, 2, 3, 5, 7, 8, and 9,
- all trees with red, green or brown needles are classified as living trees,
- all uprooted trees, assign the appropriate down tree code,
- if tree is partially uprooted and supported by another standing tree assign the appropriate down tree code, and
- if tree is partially uprooted and self-supporting do not assign a down tree code.

Examples of Broken or Shattered Trees:

- if < 5 years since the damage and the tree is broken or shattered in the top third *do not* code as a down tree or dead/broken top,
- if ≥ 5 years since the damage and the tree is broken or shattered in the top third larger than the merchantable diameter, code dead or broken top *only*. If broken above the merchantable diameter do not tally down tree code or dead or broken top,
- if < 5 years since the damage and the tree is broken or shattered in the middle third, code E only and do not record dead or broken top,
- if ≥ 5 years since the damage and the tree is broken or shattered in the middle third, code E only and tally dead or broken top in 2nd third, and
- if < 5 years since the damage and the tree is broken in the lower third, code E or G and do not tally a dead or broken top,
- if ≥ 5 years since the damage and the tree is broken in the lower third, code E or G and tally a dead or broken top.

A.6.4 Extremely Damaged Stands (Windthrow, Flood Damaged, Fire, Insects or Disease)

Where damage conditions are such that a stand cruise procedure becomes too costly in terms of recoverable values from the salvageable material, the Regional Manager has the following options of estimating the volume and quality of both the damaged and undamaged wood left on the area:

1. Applying an estimated damage factor (derived either by aerial or ground reconnaissance) to an earlier cruise of the area when the stand was undamaged.

2. Applying an estimated damage factor to volumes derived from the inventory map and average lines for the area.

A.41 Example of Mechanical Damage.

Appendix 7 Interior Dead Potential White Pine Log Grade Algorithm

A.7.1 Assumption

Pathology and surface characteristics on the tree can predict grade (see Figure A.43).

A.7.2 Procedures

1. The compilation program utilizes a matrix for allocation of path in thirds to the 5 metre logs (see Appendix A.10.3 of the *Cruise Compilation Manual*).

2. Pathological indicators are collected as per the manual.

3. Saprot/checks are recorded in the root rot column. At least 50 percent of the log must be suitable for lumber. Sound cores must be at least 10 cm top diameter, and logs less than 15 cm top diameter are allowed only one check 4 cm deep or more to be classified as sawlog. Code the pathological indicator tree third positions 1 to 7 for each third that *does not* qualify as lumber.

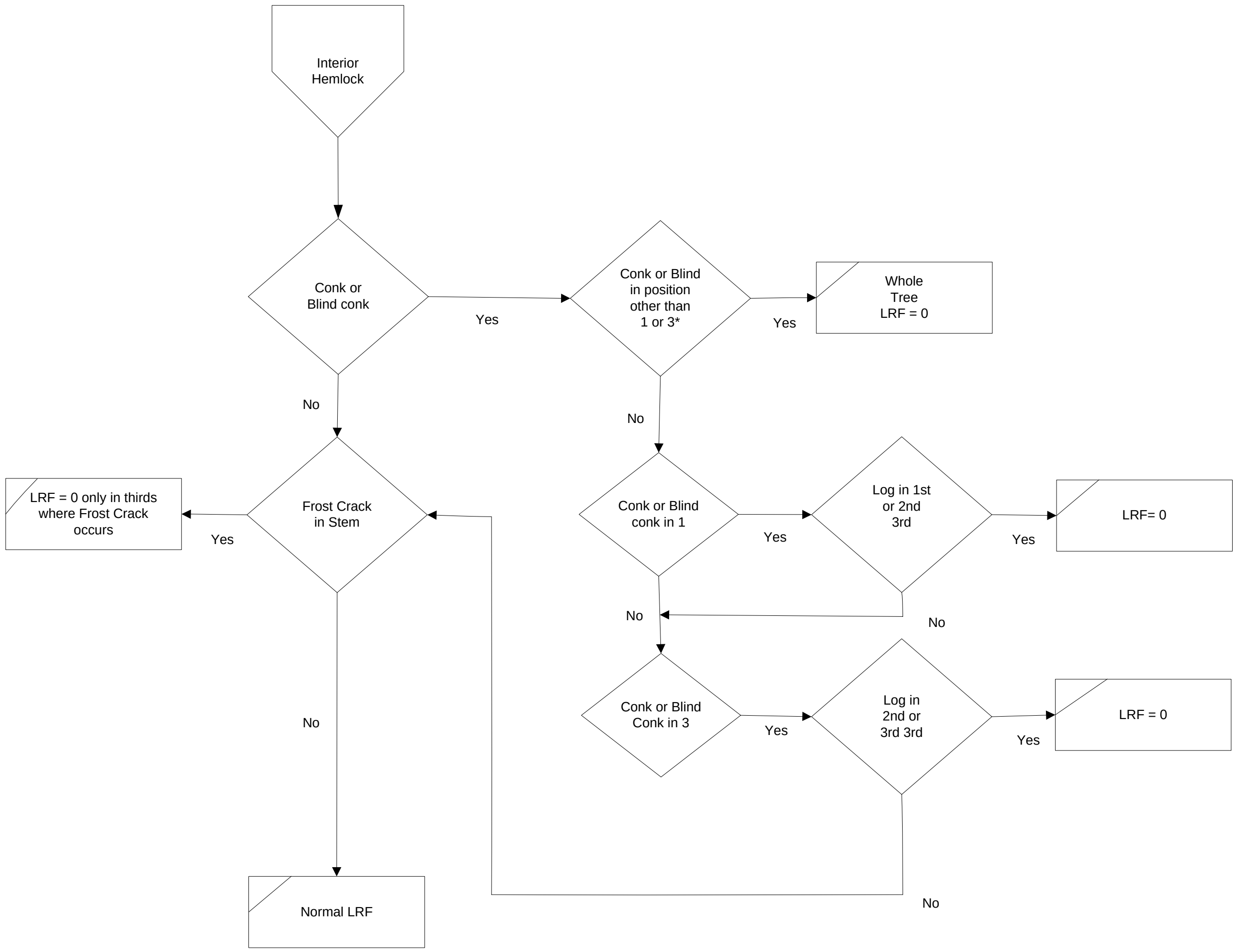


Figure A.42 Interior Hemlock.

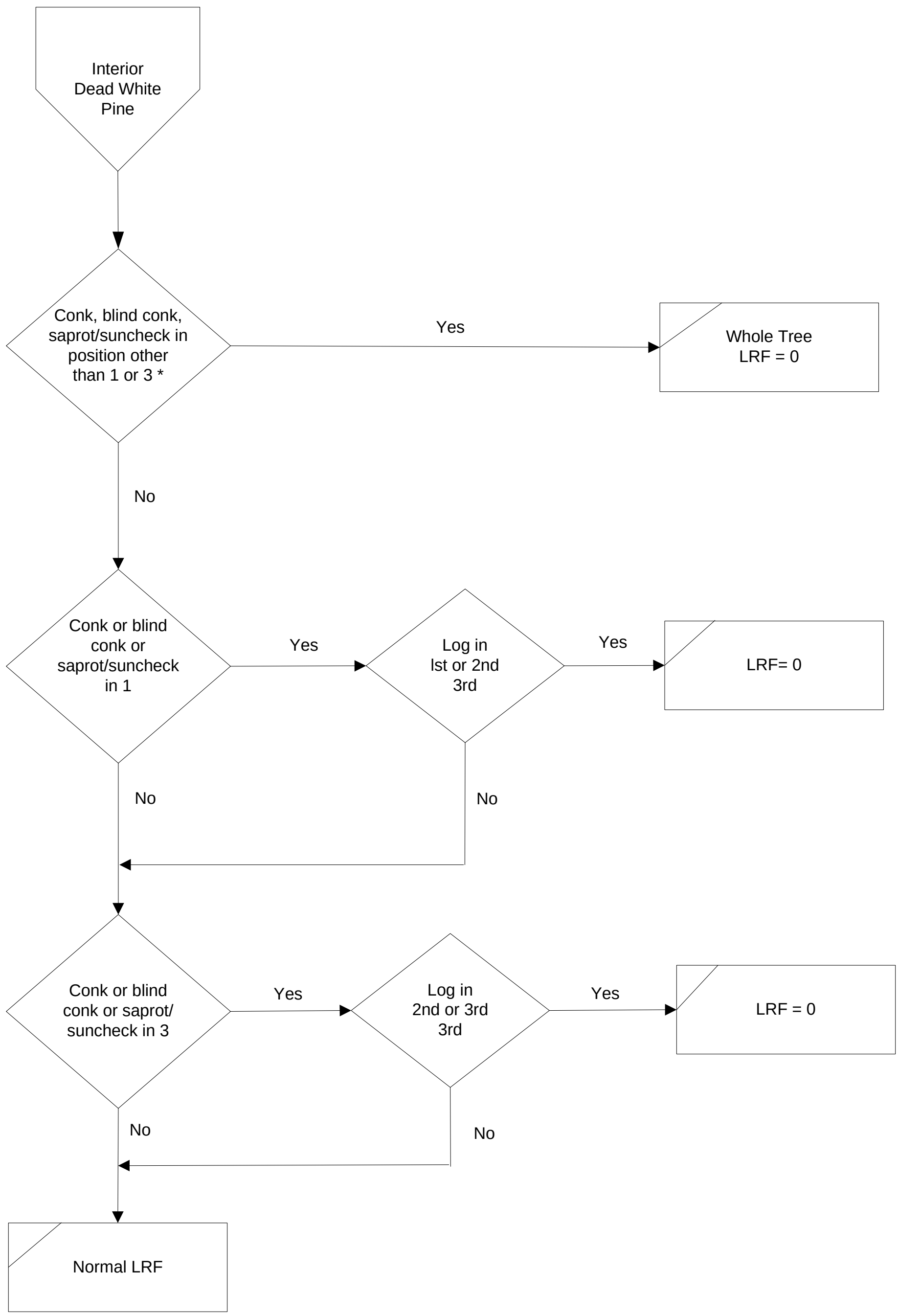


Figure A.43 Dead Potential White Pine Log Grade Algorithm.

Refer to Sections 3.5.6.3 and A.7.2 for details regarding the data collection for dead potential white pine.

Appendix 8 Region and District Codes

Region	**District**	**Number**
Coast Forest Region (RCO)	Campbell River Forest District Chilliwack Forest District North Coast Forest District (Prince Rupert) North Island – Central Coast Forest District (Port McNeill, Hagensborg) Haida Gwaii (formerly Queen Charlotte Island) Forest District South Island Forest District (Port Alberni, Duncan) Squamish Forest District Sunshine Coast Forest District (Powell River, Sechelt)	05 01 08 06 07 04 02 03
Southern Interior Forest Region (RSI)	100 Mile House Forest District Arrow Boundary Forest District (Castlegar, Grand Forks, Nakusp) Cascades Forest District (Merritt, Lillooet, Princeton) Central Cariboo Forest District (Williams Lake, Horsefly, Likely) Chilcotin Forest District (Alexis Creek) Columbia Forest District (Revelstoke, Golden) Headwaters Forest District (Clearwater, McBride) Kamloops Forest District Kootenay Lake Forest District Okanagan Shuswap Forest District (Vernon, Penticton, Salmon Arm) Quesnel Forest District Rocky Mountain Forest District (Cranbrook, Invermere)	08 09 04 06 05 10 01 02 12 03 07 11
Northern Interior Forest Region (RNI)	Fort Nelson Forest District Fort St. James Forest District Kalum Forest District Mackenzie Forest District Nadina Forest District (Burns Lake, Houston) Peace Forest District (Dawson Creek, Fort St. John) Prince George Forest District Skeena Stikine Forest District (Smithers, Dease Lake, Hazelton) Vanderhoof Forest District	06 03 09 04 08 05 01 07 02

British Columbia Timber Sales Offices

Burns Lake	Chilliwack
Kamloops	Nelson
Terrace	Vanderhoof

Campbell River	Dawson Creek
Prince George	Port McNeill
Vernon	Williams Lake

Access the BCTS map at: http://www.for.gov.bc.ca/bcts/maps

Forest Region and District Boundaries - April 1, 2003

RSI · Southern Interior Forest Region (**Kamloops**)

DMH · 100 Mile House Forest District (**100 Mile House**)
DAB · Arrow Boundary Forest District (**Castlegar**, Grand Forks, Nakusp)
DCS · Cascades Forest District (**Merritt**, Lillooet, Princeton)
DCC * Central Cariboo Forest District (**Williams Lake**, Horsefly, Likely)
DCH · Chilcotin Forest District (**Alexis Creek**)
DCO · Columbia Forest District (**Revelstoke**, Golden)
DHW · Headwaters Forest District (**Clearwater**, McBride)
DKA * Kamloops Forest District (**Kamloops**)
DKL * Kootenay Lake Forest District (**Nelson**)
DOS * Okanagan Shuswap Forest District (**Vernon**, Penticton, Salmon Arm)
DQU · Quesnel Forest District (**Quesnel**)
DRM · Rocky Mountain Forest District (**Cranbrook**, Invermere)

* Denotes BC Timber Sales Location

RNI · Northern Interior Forest Region (**Prince George**)

DFN · Fort Nelson Forest District (**Fort Nelson**)
DJA · Fort St. James Forest District (**Fort St. James**)
DKM * Kalum Forest District (**Terrace**)
DMK · Mackenzie Forest District (**Mackenzie**)
DND * Nadina Forest District (**Burns Lake**, Houston)
DPC * Peace Forest District (**Dawson Creek**, Fort St. John)
DPG * Prince George Forest District (**Prince George**)
DSS · Skeena Stikine Forest District (**Smithers**, Dease Lake, Hazelton)
DVA * Vanderhoof Forest District (**Vanderhoof**)

RCO · Coast Forest Region (**Nanaimo**)

DCR * Campbell River Forest District (**Campbell River**)
DCK * Chilliwack Forest District (**Chilliwack**)
DNC · North Coast Forest District (**Prince Rupert**)
DIC * North Island - Central Coast Forest District (**Port McNeill**, Hagensborg)
DQC · Queen Charlotte Islands Forest District (**Queen Charlotte City**)
DSI · South Island Forest District (**Port Alberni**, Duncan)
DSQ · Squamish Forest District (**Squamish**)
DSC · Sunshine Coast Forest District (**Powell River**, Sechelt)

Figure A.44 Forest Region and District Boundaries.

Appendix 9 Site Index Tables for British Columbia – All Species

The site index tables must be used for appraisal cruising.

The tables may be purchased on a waterproof paper from:

Crown Publications
106 Ontario Street
Victoria BC V8V 1M9
Phone: (250) 386-463
Toll Free: 1-877-747-4636

A.9.1 Use of Site Index Tables for BC to Determine the Age Corrections at Breast Height

1. Refer to the most recent Coast and Interior site index tables for the target tree species.

2. Bore the tree at breast-height (1.3 m) above the high-side.

3. Count the growth rings between the cambium and the pith (count the pith as one ring). Enter under "Counted Age" on Card Type 3 (FS 205).

4. From top height and boring height age, determine the site index. Then go to the bottom of the Site Index Table to obtain the "Years to bh" (boring height) age correction.

5. Add this age correction to "Counted Age" to get the total age.

Complete Site Index Tables

A.9.1 Coast

Table of Site Index by Breast Height Age and Height
Species: Fdc – Coastal Douglas-fir

Age @ bh	Top Height (m) 5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	Site Index (m)																
5	35	45	53	59	62	65	67	69									
10	15	20	24	29	33	38	42	47	51	54	57	59	61	63			
15	10	13	16	19	22	24	27	30	33	36	39	42	45	47	50	52	55
20	8	10	12	15	17	19	21	23	25	27	29	31	34	36	38	40	42
25	7	9	10	12	14	16	17	19	21	22	24	26	27	29	31	33	34
30	6	8	9	11	12	14	15	17	18	19	21	22	24	25	27	28	30
35	6	7	8	10	11	12	14	15	16	17	19	20	21	23	24	25	26
40	5	7	8	9	10	11	12	14	15	16	17	18	19	21	22	23	24
45	5	6	7	8	9	11	12	13	14	15	16	17	18	19	20	21	22
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
55	5	6	7	8	9	10	10	11	12	13	14	15	16	17	18	19	20
60	5	6	6	7	8	9	10	11	12	13	14	15	15	16	17	18	19
65	5	5	6	7	8	9	10	11	11	12	13	14	15	16	17	17	18
70		5	6	7	8	9	9	10	11	12	13	13	14	15	16	17	18
75		5	6	7	8	8	9	10	11	11	12	13	14	15	15	16	17
80		5	6	7	7	8	9	10	10	11	12	13	13	14	15	16	17
85		5	6	6	7	8	9	9	10	11	12	12	13	14	15	15	16
90		5	6	6	7	8	9	9	10	11	11	12	13	14	14	15	16
95		5	6	6	7	8	8	9	10	10	11	12	13	13	14	15	15
100		5	5	6	7	8	8	9	10	10	11	12	12	13	14	14	15
105		5	5	6	7	7	8	9	9	10	11	11	12	13	13	14	15
110		5	5	6	7	7	8	9	9	10	11	11	12	13	13	14	15
115		5	5	6	7	7	8	9	9	10	10	11	12	12	13	14	14
120		5	5	6	7	7	8	8	9	10	10	11	12	12	13	14	14
125		5	5	6	6	7	8	8	9	10	10	11	11	12	13	13	14
130		5	5	6	6	7	8	8	9	9	10	11	11	12	13	13	14
135			5	6	6	7	8	8	9	9	10	11	11	12	12	13	14
140			5	6	6	7	7	8	9	9	10	10	11	12	12	13	13
145			5	6	6	7	7	8	9	9	10	10	11	12	12	13	13
150			5	6	6	7	7	8	8	9	10	10	11	11	12	13	13
155			5	6	6	7	7	8	8	9	10	10	11	11	12	12	13
160			5	5	6	7	7	8	8	9	9	10	11	11	12	12	13
165			5	5	6	7	7	8	8	9	9	10	11	11	12	12	13
170			5	5	6	7	7	8	8	9	9	10	10	11	12	12	13
175			5	5	6	6	7	8	8	9	9	10	10	11	12	12	13
180			5	5	6	6	7	8	8	9	9	10	10	11	11	12	13
185			5	5	6	6	7	8	8	9	9	10	10	11	11	12	12
190			5	5	6	6	7	7	8	9	9	10	10	11	11	12	12
195			5	5	6	6	7	7	8	8	9	10	10	11	11	12	12
200			5	5	6	6	7	7	8	8	9	10	10	11	11	12	12

Years to Boring Height

Site Index	Up to 10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 28, 2002
Site Index Equation: Bruce (1981)

Page 1

Table of Site Index by Breast Height Age and Height
Species: Fdc – Coastal Douglas-fir

Top Height (m) 22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	Age @ bh
Site Index (m)																
																5
																10
57	59		62													15
44	46	49	50	52	54	56										20
36	38	40	41	43	45	47	48	50	52	53	55					25
31	33	34	36	37	39	40	42	43	45	46	47	49	50	52	53	30
28	29	30	32	33	34	35	37	38	39	41	42	43	45	46	47	35
25	26	28	29	30	31	32	33	35	36	37	38	39	41	42	43	40
23	25	26	27	28	29	30	31	32	33	34	35	36	37	39	40	45
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	50
21	22	23	24	25	26	27	27	28	29	30	31	32	33	34	35	55
20	21	22	23	23	24	25	26	27	28	29	30	31	32	32	33	60
19	20	21	22	23	23	24	25	26	27	28	29	29	30	31	32	65
18	19	20	21	22	23	23	24	25	26	27	27	28	29	30	31	70
18	19	19	20	21	22	23	23	24	25	26	27	27	28	29	30	75
17	18	19	20	20	21	22	23	24	24	25	26	27	27	28	29	80
17	18	18	19	20	21	21	22	23	24	24	25	26	27	27	28	85
17	17	18	19	19	20	21	22	22	23	24	25	25	26	27	27	90
16	17	18	18	19	20	20	21	22	23	23	24	25	25	26	27	95
16	17	17	18	19	19	20	21	21	22	23	24	24	25	26	26	100
16	16	17	18	18	19	20	20	21	22	22	23	24	24	25	26	105
15	16	17	17	18	19	19	20	21	21	22	23	23	24	25	25	110
15	16	16	17	18	18	19	20	20	21	22	22	23	24	24	25	115
15	15	16	17	17	18	19	19	20	21	21	22	23	23	24	25	120
15	15	16	17	17	18	18	19	20	20	21	22	22	23	24	24	125
14	15	16	16	17	18	18	19	20	20	21	21	22	23	23	24	130
14	15	16	16	17	17	18	19	19	20	21	21	22	22	23	24	135
14	15	15	16	17	17	18	18	19	20	20	21	22	22	23	23	140
14	15	15	16	16	17	18	18	19	19	20	21	21	22	23	23	145
14	14	15	16	16	17	17	18	19	19	20	21	21	22	22	23	150
14	14	15	15	16	17	17	18	18	19	20	20	21	22	22	23	155
14	14	15	15	16	17	17	18	18	19	20	20	21	21	22	23	160
13	14	15	15	16	16	17	18	18	19	19	20	21	21	22	22	165
13	14	15	15	16	16	17	17	18	19	19	20	20	21	22	22	170
13	14	14	15	16	16	17	17	18	18	19	20	20	21	21	22	175
13	14	14	15	15	16	17	17	18	18	19	19	20	21	21	22	180
13	14	14	15	15	16	16	17	18	18	19	19	20	20	21	22	185
13	14	14	15	15	16	16	17	17	18	19	19	20	20	21	21	190
13	13	14	15	15	16	16	17	17	18	19	19	20	20	21	21	195
13	13	14	14	15	16	16	17	17	18	18	19	20	20	21	21	200

Years to Boring Height

Site Index	Up to 10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

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Table of Site Index by Breast Height Age and Height
Species: Fdc – Coastal Douglas-fir

Age @ bh	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
	Top Height (m) / Site Index (m)															
5																
10																
15																
20																
25																
30																
35	49	50	51													
40	44	45	46	48	49	50	51									
45	41	42	43	44	45	46	47	48	49	50						
50	38	39	40	41	42	43	44	45	46	47	48	49	50			
55	36	37	38	39	40	41	42	42	43	44	45	46	47	48	49	50
60	34	35	36	37	38	39	39	40	41	42	43	44	45	46	47	47
65	33	34	34	35	36	37	38	39	39	40	41	42	43	44	44	45
70	32	32	33	34	35	36	36	37	38	39	40	40	41	42	43	44
75	31	31	32	33	34	34	35	36	37	38	38	39	40	41	41	42
80	30	30	31	32	33	33	34	35	36	36	37	38	39	39	40	41
85	29	30	30	31	32	33	33	34	35	35	36	37	38	38	39	40
90	28	29	30	30	31	32	32	33	34	35	35	36	37	37	38	39
95	28	28	29	30	30	31	32	32	33	34	34	35	36	36	37	38
100	27	28	28	29	30	30	31	32	32	33	34	34	35	36	36	37
105	27	27	28	29	29	30	31	31	32	33	33	34	34	35	36	36
110	26	27	27	28	29	29	30	31	31	32	33	33	34	34	35	36
115	26	26	27	28	28	29	30	30	31	31	32	33	33	34	35	35
120	25	26	27	27	28	28	29	30	30	31	32	32	33	33	34	35
125	25	26	26	27	27	28	29	29	30	31	31	32	32	33	34	34
130	25	25	26	26	27	28	28	29	30	30	31	31	32	33	33	34
135	24	25	26	26	27	27	28	29	29	30	30	31	32	32	33	33
140	24	25	25	26	26	27	28	28	29	29	30	31	31	32	32	33
145	24	24	25	26	26	27	27	28	29	29	30	30	31	31	32	33
150	24	24	25	25	26	27	27	28	28	29	29	30	31	31	32	32
155	23	24	25	25	26	26	27	27	28	29	29	30	30	31	31	32
160	23	24	24	25	25	26	27	27	28	28	29	29	30	31	31	32
165	23	23	24	25	25	26	26	27	28	28	29	29	30	30	31	31
170	23	23	24	24	25	26	26	27	27	28	28	29	30	30	31	31
175	23	23	24	24	25	25	26	27	27	28	28	29	29	30	30	31
180	22	23	24	24	25	25	26	26	27	27	28	29	29	30	30	31
185	22	23	23	24	24	25	26	26	27	27	28	28	29	29	30	31
190	22	23	23	24	24	25	25	26	27	27	28	28	29	29	30	30
195	22	22	23	24	24	25	25	26	26	27	27	28	29	29	30	30
200	22	22	23	23	24	25	25	26	26	27	27	28	28	29	29	30

Years to Boring Height

Site Index	Up to 10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

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Table of Site Index by Breast Height Age and Height
Species: Fdc – Coastal Douglas-fir

54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	Age @ bh
Top Height (m) / Site Index (m)																
																5
																10
																15
																20
																25
																30
																35
																40
																45
																50
																55
48	49															60
46	47	48	49	49												65
44	45	46	47	47	48	49										70
43	44	44	45	46	47	47	48	49								75
42	42	43	44	44	45	46	47	47	48	49						80
40	41	42	42	43	44	45	45	46	47	47	48	49				85
39	40	41	41	42	43	43	44	45	45	46	47	47	48			90
39	39	40	40	41	42	42	43	44	44	45	46	46	47	48	48	95
38	38	39	40	40	41	42	42	43	43	44	45	45	46	47	47	100
37	38	38	39	40	40	41	41	42	43	43	44	44	45	46	46	105
36	37	38	38	39	39	40	41	41	42	42	43	44	44	45	45	110
36	36	37	38	38	39	39	40	41	41	42	42	43	44	44	45	115
35	36	36	37	38	38	39	39	40	41	41	42	42	43	43	44	120
35	35	36	37	37	38	38	39	39	40	41	41	42	42	43	43	125
34	35	36	36	37	37	38	38	39	39	40	41	41	42	42	43	130
34	35	35	36	36	37	37	38	38	39	40	40	41	41	42	42	135
34	34	35	35	36	36	37	37	38	39	39	40	40	41	41	42	140
33	34	34	35	35	36	37	37	38	38	39	39	40	40	41	41	145
33	33	34	35	35	36	36	37	37	38	38	39	39	40	40	41	150
33	33	34	34	35	35	36	36	37	37	38	38	39	39	40	40	155
32	33	33	34	34	35	35	36	37	37	38	38	39	39	40	40	160
32	33	33	34	34	35	35	36	36	37	37	38	38	39	39	40	165
32	32	33	33	34	34	35	35	36	36	37	37	38	38	39	39	170
32	32	33	33	34	34	35	35	36	36	37	37	38	38	39	39	175
31	32	32	33	33	34	34	35	35	36	36	37	37	38	38	39	180
31	32	32	33	33	34	34	35	35	36	36	37	37	38	38	39	185
31	31	32	32	33	33	34	34	35	35	36	36	37	37	38	38	190
31	31	32	32	33	33	34	34	35	35	36	36	37	37	38	38	195
30	31	31	32	33	33	34	34	35	35	35	36	36	37	37	38	200

Years to Boring Height

Site Index	Up to 10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

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Figure A.45 Fdc – Coastal Douglas-Fir.

Table of Site Index by Breast Height Age and Height
Species: Hwc – Western Hemlock - Coast

Age @ bh	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	Top Height (m) / Site Index (m)																
10	26	30	33	36	39	42	44	47	49	51	52	54	56	57	58	60	
15	18	20	23	26	28	31	33	35	37	39	41	43	45	46	48	49	51
20	13	15	18	20	22	24	26	28	30	32	33	35	37	38	40	41	43
25	11	13	14	16	18	20	21	23	25	26	28	29	31	32	34	35	37
30	9	11	12	14	15	17	18	20	21	23	24	25	27	28	30	31	32
35	8	9	11	12	13	15	16	17	19	20	21	23	24	25	26	28	29
40	7	8	10	11	12	13	14	16	17	18	19	20	21	23	24	25	26
45	6	8	9	10	11	12	13	14	15	16	17	18	20	21	22	23	24
50	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
55	6	7	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
60	5	6	7	8	9	10	10	11	12	13	14	15	16	17	17	18	19
65	5	6	7	7	8	9	10	11	12	12	13	14	15	16	17	17	18
70	5	6	6	7	8	9	9	10	11	12	13	13	14	15	16	16	17
75	5	5	6	7	8	8	9	10	10	11	12	13	13	14	15	16	17
80		5	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16
85		5	6	6	7	8	8	9	10	10	11	12	12	13	14	14	15
90		5	5	6	7	7	8	9	9	10	11	11	12	13	13	14	15
95		5	5	6	6	7	8	8	9	10	10	11	12	12	13	13	14
100		5	5	6	6	7	7	8	9	9	10	11	11	12	12	13	14
105			5	6	6	7	7	8	8	9	10	10	11	11	12	13	13
110			5	5	6	7	7	8	8	9	9	10	11	11	12	12	13
115			5	5	6	6	7	7	8	9	9	10	10	11	11	12	13
120			5	5	6	6	7	7	8	8	9	10	10	11	11	12	12
125			5	5	6	6	7	7	8	8	9	9	10	10	11	11	12
130			5	5	6	6	7	7	8	8	9	9	10	10	11	11	12
135				5	5	6	6	7	7	8	8	9	9	10	10	11	12
140				5	5	6	6	7	7	8	8	9	9	10	10	11	11
145				5	5	6	6	7	7	8	8	9	9	10	10	11	11
150				5	5	6	6	7	7	7	8	8	9	9	10	10	11
155				5	5	6	6	6	7	7	8	8	9	9	10	10	11
160				5	5	5	6	6	7	7	8	8	9	9	10	10	11
165				5	5	5	6	6	7	7	8	8	9	9	9	10	10
170					5	5	6	6	7	7	8	8	8	9	9	10	10
175					5	5	6	6	7	7	7	8	8	9	9	10	10
180					5	5	6	6	6	7	7	8	8	9	9	10	10
185					5	5	6	6	6	7	7	8	8	9	9	9	10
190					5	5	5	6	6	7	7	8	8	8	9	9	10
195					5	5	5	6	6	7	7	8	8	8	9	9	10
200					5	5	5	6	6	7	7	7	8	8	9	9	10

Years to Boring Height

Site Index	10-13	14-20	21-27	28-34	35-42	43-49	50+
Correct yrs	8	7	6	5	4	3	2

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Wiley (1978)

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Table of Site Index by Breast Height Age and Height
Species: Hwc – Western Hemlock - Coast

23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	Age @ bh
Top Height (m) / Site Index (m)																
																10
52	54	55	56													15
44	46	47	48	50	51	52	54	55								20
38	40	41	42	44	45	46	47	49	50	51	52	53	54			25
34	35	36	37	39	40	41	42	43	45	46	47	48	49	50	51	30
30	31	32	34	35	36	37	38	39	41	42	43	44	45	46	47	35
27	28	29	31	32	33	34	35	36	37	38	39	40	41	43	44	40
25	26	27	28	29	30	31	32	33	34	35	36	37	39	40	41	45
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	50
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	55
20	21	22	23	24	25	26	27	27	28	29	30	31	32	33	34	60
19	20	21	22	22	23	24	25	26	27	28	29	30	30	31	32	65
18	19	20	21	21	22	23	24	25	26	26	27	28	29	30	31	70
17	18	19	20	20	21	22	23	24	24	25	26	27	28	29	29	75
17	17	18	19	20	20	21	22	23	24	24	25	26	27	28	28	80
16	17	17	18	19	20	20	21	22	23	23	24	25	26	27	27	85
15	16	17	17	18	19	20	20	21	22	23	23	24	25	26	26	90
15	16	16	17	18	18	19	20	20	21	22	23	23	24	25	26	95
14	15	16	16	17	18	18	19	20	20	21	22	23	23	24	25	100
14	15	15	16	17	17	18	19	19	20	21	21	22	23	23	24	105
14	14	15	15	16	17	17	18	19	19	20	21	21	22	23	24	110
13	14	14	15	16	16	17	18	18	19	20	20	21	22	22	23	115
13	14	14	15	15	16	17	17	18	18	19	20	20	21	22	22	120
13	13	14	14	15	16	16	17	17	18	19	19	20	21	21	22	125
12	13	14	14	15	15	16	16	17	18	18	19	20	20	21	21	130
12	13	13	14	14	15	16	16	17	17	18	19	19	20	20	21	135
12	12	13	14	14	15	15	16	16	17	18	18	19	19	20	21	140
12	12	13	13	14	14	15	16	16	17	17	18	18	19	20	20	145
11	12	13	13	14	14	15	15	16	16	17	18	18	19	19	20	150
11	12	12	13	13	14	14	15	16	16	17	17	18	18	19	20	155
11	12	12	13	13	14	14	15	15	16	16	17	18	18	19	19	160
11	11	12	12	13	13	14	15	15	16	16	17	17	18	18	19	165
11	11	12	12	13	13	14	14	15	15	16	17	17	18	18	19	170
11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	19	175
11	11	11	12	12	13	13	14	14	15	16	16	17	17	18	18	180
10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	185
10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	190
10	11	11	12	12	12	13	13	14	14	15	15	16	17	17	18	195
10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	200

Years to Boring Height

Site Index	10-13	14-20	21-27	28-34	35-42	43-49	50+
Correct yrs	8	7	6	5	4	3	2

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Table of Site Index by Breast Height Age and Height
Species: Hwc – Western Hemlock - Coast

Age @ bh	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
	Site Index (m)															
10																
15																
20																
25																
30	53	54														
35	48	49	50	51	53											
40	45	46	47	48	49	50	51	52								
45	42	43	44	45	46	47	48	49	50	51	52					
50	39	40	41	42	43	44	45	46	47	48	49	50	51	52		
55	37	38	39	40	41	42	43	44	45	46	47	48	48	49	50	51
60	35	36	37	38	39	40	41	41	42	43	44	45	46	47	48	49
65	33	34	35	36	37	38	39	40	41	41	42	43	44	45	46	47
70	32	33	33	34	35	36	37	38	39	40	41	42	43	43	44	45
75	30	31	32	33	34	35	36	36	37	38	39	40	41	42	43	44
80	29	30	31	32	33	33	34	35	36	37	38	39	40	40	41	42
85	28	29	30	31	31	32	33	34	35	36	36	37	38	39	40	41
90	27	28	29	30	30	31	32	33	34	35	35	36	37	38	39	40
95	26	27	28	29	29	30	31	32	33	33	34	35	36	37	38	39
100	26	26	27	28	29	29	30	31	32	33	33	34	35	36	37	38
105	25	26	26	27	28	29	29	30	31	32	33	33	34	35	36	37
110	24	25	26	26	27	28	29	29	30	31	32	33	33	34	35	36
115	24	24	25	26	27	27	28	29	29	30	31	32	33	33	34	35
120	23	24	24	25	26	27	27	28	29	30	30	31	32	33	33	34
125	23	23	24	25	25	26	27	27	28	29	30	30	31	32	33	34
130	22	23	23	24	25	26	26	27	28	28	29	30	31	31	32	33
135	22	22	23	24	24	25	26	26	27	28	29	29	30	31	32	32
140	21	22	23	23	24	25	25	26	27	27	28	29	30	30	31	32
145	21	22	22	23	23	24	25	25	26	27	28	28	29	30	30	31
150	21	21	22	22	23	24	24	25	26	26	27	28	29	29	30	31
155	20	21	21	22	23	23	24	25	25	26	27	27	28	29	30	30
160	20	21	21	22	22	23	24	24	25	26	26	27	28	28	29	30
165	20	20	21	21	22	23	23	24	25	25	26	27	27	28	29	29
170	19	20	21	21	22	22	23	24	24	25	26	26	27	28	28	29
175	19	20	20	21	21	22	23	23	24	25	25	26	27	27	28	29
180	19	19	20	21	21	22	22	23	24	24	25	26	26	27	28	28
185	19	19	20	20	21	22	22	23	23	24	25	25	26	27	27	28
190	18	19	20	20	21	21	22	22	23	24	24	25	26	26	27	28
195	18	19	19	20	20	21	22	22	23	23	24	25	25	26	27	27
200	18	19	19	20	20	21	21	22	23	23	24	24	25	26	26	27

Years to Boring Height

Site Index	10-13	14-20	21-27	28-34	35-42	43-49	50+
Correct yrs	8	7	6	5	4	3	2

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Table of Site Index by Breast Height Age and Height
Species: Hwc – Western Hemlock - Coast

55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	Age @ bh
Site Index (m)																
																10
																15
																20
																25
																30
																35
																40
																45
																50
																55
50	51															60
48	49	50	51													65
46	47	48	49	50	51											70
45	46	47	47	48	49	50										75
43	44	45	46	47	48	49	50	51								80
42	43	44	45	46	46	47	48	49	50							85
41	41	42	43	44	45	46	47	48	49	50						90
39	40	41	42	43	44	45	46	47	48	49	50	51				95
38	39	40	41	42	43	44	45	46	47	47	48	49	50			100
37	38	39	40	41	42	43	44	45	45	46	47	48	49	50		105
37	37	38	39	40	41	42	43	44	45	45	46	47	48	49	50	110
36	37	37	38	39	40	41	42	43	44	45	45	46	47	48	49	115
35	36	37	38	38	39	40	41	42	43	44	45	45	46	47	48	120
34	35	36	37	38	38	39	40	41	42	43	44	45	46	47	47	125
34	34	35	36	37	38	39	39	40	41	42	43	44	45	46	47	130
33	34	35	35	36	37	38	39	40	41	41	42	43	44	45	46	135
33	33	34	35	36	36	37	38	39	40	41	42	42	43	44	45	140
32	33	34	34	35	36	37	38	38	39	40	41	42	43	44	45	145
31	32	33	34	35	35	36	37	38	39	40	40	41	42	43	44	150
31	32	33	33	34	35	36	36	37	38	39	40	41	42	42	43	155
31	31	32	33	34	34	35	36	37	38	38	39	40	41	42	43	160
30	31	32	32	33	34	35	35	36	37	38	39	40	40	41	42	165
30	30	31	32	33	33	34	35	36	37	37	38	39	40	41	42	170
29	30	31	32	32	33	34	35	35	36	37	38	39	40	40	41	175
29	30	30	31	32	33	33	34	35	36	37	37	38	39	40	41	180
29	29	30	31	32	32	33	34	35	35	36	37	38	39	39	40	185
28	29	30	30	31	32	33	33	34	35	36	37	37	38	39	40	190
28	29	29	30	31	32	32	33	34	35	35	36	37	38	39	40	195
28	28	29	30	31	31	32	33	34	34	35	36	37	37	38	39	200

Years to Boring Height

Site Index	10-13	14-20	21-27	28-34	35-42	43-49	50+
Correct yrs	8	7	6	5	4	3	2

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Figure A.46 Hwc – Western Hemlock - Coast.

A.9.2 Interior

Table of Site Index by Breast Height Age and Height
Species: Fdi – Interior Douglas-fir

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Site Index (m)																						
10	18	22	26	30	34	38	42	46	50														
15	12	15	18	21	24	26	29	32	34	37	40	42	45	48	50								
20	10	12	14	16	18	20	23	25	27	29	31	33	35	37	39	41	43	45	47	49			
25	8	10	12	13	15	17	19	20	22	24	25	27	29	31	32	34	36	37	39	41	42	44	46
30	7	9	10	12	13	15	16	18	19	21	22	23	25	26	28	29	31	32	34	35	36	38	39
35	6	8	9	10	12	13	14	16	17	18	19	21	22	23	25	26	27	29	30	31	32	34	35
40	6	7	8	9	11	12	13	14	15	16	18	19	20	21	22	23	25	26	27	28	29	30	32
45	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24	25	26	27	28	29
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	6	7	8	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23	24	25
60		5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	19	20	21	22	23	24
65		5	6	7	8	8	9	10	11	12	13	13	14	15	16	17	18	19	19	20	21	22	23
70		5	6	6	7	8	9	10	10	11	12	13	14	14	15	16	17	18	18	19	20	21	22
75		5	5	6	7	8	8	9	10	11	12	12	13	14	15	15	16	17	18	19	19	20	21
80		5	5	6	7	7	8	9	10	10	11	12	13	13	14	15	16	16	17	18	19	19	20
85			5	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	17	17	18	19	19
90			5	6	6	7	8	8	9	10	10	11	12	13	13	14	15	15	16	17	17	18	19
95			5	5	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	16	17	18	18
100			5	5	6	7	7	8	9	9	10	11	11	12	12	13	14	14	15	16	16	17	18
105			5	5	6	6	7	8	8	9	10	10	11	12	12	13	13	14	15	15	16	17	17
110			5	5	6	6	7	8	8	9	9	10	11	11	12	13	13	14	14	15	16	16	17
115				5	6	6	7	7	8	9	9	10	10	11	12	12	13	14	14	15	15	16	17
120				5	5	6	7	7	8	8	9	10	10	11	11	12	13	13	14	14	15	16	16
125				5	5	6	7	7	8	8	9	9	10	11	11	12	12	13	14	14	15	15	16
130				5	5	6	6	7	8	8	9	9	10	10	11	12	12	13	13	14	15	15	16
135				5	5	6	6	7	7	8	9	9	10	10	11	11	12	13	13	14	14	15	16
140				5	5	6	6	7	7	8	8	9	10	10	11	11	12	12	13	14	14	15	15
145				5	5	6	6	7	7	8	8	9	9	10	11	11	12	12	13	13	14	14	15
150					5	6	6	7	7	8	8	9	9	10	10	11	11	12	13	13	14	14	15
155					5	5	6	6	7	8	8	9	9	10	10	11	11	12	12	13	14	14	15
160					5	5	6	6	7	7	8	8	9	10	10	11	11	12	12	13	13	14	14
165					5	5	6	6	7	7	8	8	9	9	10	11	11	12	12	13	13	14	14
170					5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	13	13	14	14
175					5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14
180					5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14
185					5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14
190					5	5	6	6	6	7	7	8	8	9	9	10	10	11	12	12	13	13	14
195					5	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13
200					5	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12-13	14-15	16-18	19-22	23-28	29-39	40+
Correct yrs	24	21	18	16	15	14	13	12	11	10	9	8	7	6

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Thrower and Goudie (1992)

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Table of Site Index by Breast Height Age and Height
Species: Fdi – Interior Douglas-fir

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
Site Index (m)																							
																							10
																							15
																							20
47	49																						25
41	42	44	45	47	48	49																	30
36	37	39	40	41	43	44	45	46	48	49	50												35
33	34	35	36	37	39	40	41	42	43	44	46	47	48	49	50								40
30	31	32	33	34	35	37	38	39	40	41	42	43	44	45	46	47	48	49	50				45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
26	27	28	29	30	31	32	33	34	35	36	37	38	39	39	40	41	42	43	44	45	46	47	55
25	26	27	27	28	29	30	31	32	33	34	35	36	36	37	38	39	40	41	42	43	44	45	60
24	24	25	26	27	28	29	30	30	31	32	33	34	35	36	36	37	38	39	40	41	42	42	65
23	23	24	25	26	27	27	28	29	30	31	32	32	33	34	35	36	36	37	38	39	40	41	70
22	22	23	24	25	26	26	27	28	29	30	30	31	32	33	33	34	35	36	37	37	38	39	75
21	22	22	23	24	25	25	26	27	28	28	29	30	31	32	32	33	34	35	35	36	37	38	80
20	21	22	22	23	24	25	25	26	27	28	28	29	30	31	31	32	33	34	34	35	36	36	85
20	20	21	22	22	23	24	25	25	26	27	27	28	29	30	30	31	32	33	33	34	35	35	90
19	20	20	21	22	22	23	24	25	25	26	27	27	28	29	30	30	31	32	32	33	34	34	95
19	19	20	21	21	22	23	23	24	25	25	26	27	27	28	29	29	30	31	32	32	33	34	100
18	19	19	20	21	21	22	23	23	24	25	25	26	27	27	28	29	29	30	31	32	32	33	105
18	18	19	20	20	21	22	22	23	24	24	25	26	26	27	27	28	29	29	30	31	31	32	110
17	18	19	19	20	20	21	22	22	23	24	24	25	26	26	27	28	28	29	30	30	31	32	115
17	18	18	19	19	20	21	21	22	23	23	24	25	25	26	26	27	28	28	29	30	30	31	120
17	17	18	18	19	20	20	21	22	22	23	23	24	25	25	26	27	27	28	29	29	30	30	125
16	17	18	18	19	19	20	21	21	22	22	23	24	24	25	26	26	27	27	28	29	29	30	130
16	17	17	18	18	19	20	20	21	21	22	23	23	24	25	25	26	26	27	28	28	29	29	135
16	16	17	18	18	19	19	20	21	21	22	22	23	24	24	25	25	26	27	27	28	28	29	140
16	16	17	17	18	19	19	20	20	21	21	22	23	23	24	24	25	26	26	27	27	28	29	145
15	16	17	17	18	18	19	19	20	21	21	22	22	23	24	24	25	25	26	26	27	28	28	150
15	16	16	17	17	18	19	19	20	20	21	21	22	23	23	24	24	25	26	26	27	27	28	155
15	16	16	17	17	18	18	19	20	20	21	21	22	22	23	24	24	25	25	26	26	27	28	160
15	15	16	17	17	18	18	19	19	20	20	21	22	22	23	23	24	24	25	26	26	27	27	165
15	15	16	16	17	17	18	19	19	20	20	21	21	22	22	23	24	24	25	25	26	26	27	170
15	15	16	16	17	17	18	18	19	19	20	21	21	22	22	23	23	24	24	25	26	26	27	175
14	15	15	16	17	17	18	18	19	19	20	20	21	21	22	23	23	24	24	25	25	26	27	180
14	15	15	16	16	17	17	18	19	19	20	20	21	21	22	22	23	23	24	25	25	26	26	185
14	15	15	16	16	17	17	18	18	19	19	20	21	21	22	22	23	23	24	24	25	25	26	190
14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	23	23	24	24	25	25	26	195
14	14	15	15	16	16	17	18	18	19	19	20	20	21	21	22	22	23	23	24	25	25	26	200

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12-13	14-15	16-18	19-22	23-28	29-39	40+
Correct yrs	24	21	18	16	15	14	13	12	11	10	9	8	7	6

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Figure A.47 Fdi – Interior Douglas-Fir.

Table of Site Index by Breast Height Age and Height
Species: Hwi – Interior Western Hemlock

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Top Height (m) – Site Index (m)																						
10	24	28	32	35	39	42	45	48															
15	16	19	22	25	27	30	32	34	36	39	41	43	45	46	48	50							
20	12	15	17	19	21	23	25	27	29	31	32	34	36	37	39	40	42	43	45	47	48	49	
25	10	12	14	16	17	19	21	22	24	25	27	28	30	31	33	34	36	37	38	40	41	42	44
30	8	10	12	13	15	16	18	19	20	22	23	25	26	27	28	30	31	32	33	35	36	37	38
35	7	9	10	11	13	14	15	17	18	19	20	22	23	24	25	26	28	29	30	31	32	33	35
40	6	7	9	10	11	12	14	15	16	17	18	19	20	22	23	24	25	26	27	28	29	30	31
45	6	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28	29
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	20	21	22	23	24	25
60		5	6	7	8	8	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22	23	24
65		5	5	6	7	8	9	9	10	11	12	13	14	14	15	16	17	18	19	20	21	22	23
70			5	6	7	7	8	9	10	10	11	12	13	14	14	15	16	17	18	19	20	21	21
75			5	5	6	7	7	8	9	10	10	11	12	13	14	14	15	16	17	18	19	20	20
80				5	6	6	7	8	8	9	10	11	11	12	13	14	15	15	16	17	18	19	20
85				5	5	6	7	7	8	9	9	10	11	12	12	13	14	15	15	16	17	18	19
90				5	5	6	6	7	8	8	9	10	10	11	12	12	13	14	15	16	16	17	18
95					5	5	6	7	7	8	8	9	10	10	11	12	13	13	14	15	16	17	17
100					5	5	6	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	17
105						5	5	6	7	7	8	8	9	10	10	11	12	12	13	14	15	15	16
110						5	5	6	6	7	7	8	9	9	10	11	11	12	13	13	14	15	16
115						5	5	5	6	7	7	8	8	9	10	10	11	12	12	13	14	14	15
120							5	5	6	6	7	7	8	9	9	10	10	11	12	13	13	14	15
125							5	5	6	6	7	7	8	8	9	9	10	11	11	12	13	14	14
130								5	5	6	6	7	7	8	9	9	10	10	11	12	13	13	14
135								5	5	6	6	7	7	8	8	9	9	10	11	11	12	13	14
140								5	5	5	6	6	7	7	8	9	9	10	11	11	12	13	13
145									5	5	6	6	7	7	8	8	9	10	10	11	12	12	13
150									5	5	6	6	6	7	8	8	9	9	10	11	11	12	13
155									5	5	5	6	6	7	7	8	8	9	10	10	11	12	12
160										5	5	6	6	7	7	8	8	9	9	10	11	11	12
165										5	5	6	6	6	7	7	8	9	9	10	11	11	12
170										5	5	5	6	6	7	7	8	8	9	10	10	11	12
175											5	5	6	6	7	7	8	8	9	9	10	11	11
180											5	5	6	6	6	7	7	8	9	9	10	11	11
185											5	5	5	6	6	7	7	8	8	9	10	10	11
190												5	5	6	6	7	7	8	8	9	9	10	11
195												5	5	6	6	6	7	7	8	9	9	10	11
200												5	5	5	6	6	7	7	8	8	9	10	10

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12	13	14	15	16-17	18-19	20-21	22-24	25-29	30-37	38+
Correct yrs	45	34	28	23	19	17	14	13	11	10	9	8	7	6	5	4	3	2

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Nigh (1998)

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Table of Site Index by Breast Height Age and Height
Species: Hwi – Interior Western Hemlock

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
Top Height (m) – Site Index (m)																							
																							10
																							15
																							20
45	46	47	49	50																			25
40	41	42	43	44	46	47	48	49	50														30
36	37	38	39	40	41	42	43	45	46	47	48	49	50										35
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	50							40
30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	48	49	50				45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	55
25	26	27	28	29	30	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	60
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	41	42	43	44	65
22	23	24	25	26	27	28	29	30	31	32	33	33	34	35	36	37	38	39	40	41	42	43	70
21	22	23	24	25	26	27	28	29	30	30	31	32	33	34	35	36	37	38	39	40	41	42	75
20	21	22	23	24	25	26	27	28	29	29	30	31	32	33	34	35	36	37	38	39	40	41	80
20	20	21	22	23	24	25	26	27	28	29	29	30	31	32	33	34	35	36	37	38	39	40	85
19	20	21	21	22	23	24	25	26	27	28	29	30	30	31	32	33	34	35	36	37	38	39	90
18	19	20	21	22	22	23	24	25	26	27	28	29	30	31	32	32	33	34	35	36	37	38	95
18	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	32	33	34	35	36	36	37	100
17	18	19	20	20	21	22	23	24	25	26	27	27	28	29	30	31	32	33	34	35	36	37	105
17	17	18	19	20	21	22	22	23	24	25	26	27	28	29	30	31	31	32	33	34	35	36	110
16	17	18	18	19	20	21	22	23	24	25	25	26	27	28	29	30	31	32	33	34	35	36	115
16	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	29	30	31	32	33	34	35	120
15	16	17	18	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	32	33	34	35	125
15	16	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	30	31	32	33	34	130
14	15	16	17	18	18	19	20	21	22	23	24	25	25	26	27	28	29	30	31	32	33	34	135
14	15	16	16	17	18	19	20	21	22	22	23	24	25	26	27	28	29	30	31	32	33	33	140
14	15	15	16	17	18	19	19	20	21	22	23	24	25	26	27	27	28	29	30	31	32	33	145
13	14	15	16	17	17	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	32	33	150
13	14	15	16	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	32	155
13	14	14	15	16	17	18	19	19	20	21	22	23	24	25	26	27	27	28	29	30	31	32	160
13	13	14	15	16	17	17	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	32	165
12	13	14	15	15	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	170
12	13	14	14	15	16	17	18	19	19	20	21	22	23	24	25	26	27	28	29	30	30	31	175
12	13	13	14	15	16	17	17	18	19	20	21	22	23	24	25	26	26	27	28	29	30	31	180
12	12	13	14	15	16	16	17	18	19	20	21	22	23	23	24	25	26	27	28	29	30	31	185
11	12	13	14	15	15	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	31	190
11	12	13	14	14	15	16	17	18	19	19	20	21	22	23	24	25	26	27	28	29	30	31	195
11	12	13	13	14	15	16	17	18	18	19	20	21	22	23	24	25	26	27	28	29	29	30	200

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12	13	14	15	16-17	18-19	20-21	22-24	25-29	30-37	38+
Correct yrs	45	34	28	23	19	17	14	13	11	10	9	8	7	6	5	4	3	2

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Figure A.48 Hwi – Interior Western Hemlock.

A.9.3 Provincial – Coast and Interior

Table of Site Index by Breast Height Age and Height
Species: Act – Black Cottonwood - Provincial

Age	Top Height (m)											
@ bh	6	7	8	9	10	11	12	13	14	15	16	17
	Site Index (m)											
10	24	27	29	31	33	35	37	39	41	43	44	46
15	18	20	22	24	26	28	29	31	33	34	35	37
20	14	16	18	20	21	23	24	26	27	29	30	31
25	12	13	15	17	18	20	21	22	24	25	26	27
30	10	11	13	14	16	17	18	20	21	22	23	24
35	9	10	11	13	14	15	16	17	19	20	21	22
40	7	9	10	11	12	13	15	16	17	18	19	20
45	7	8	9	10	11	12	13	14	15	16	17	18
50	6	7	8	9	10	11	12	13	14	15	16	17
55	5	6	7	8	9	10	11	12	13	14	15	16
60	5	6	7	8	8	9	10	11	12	13	14	15
65	5	5	6	7	8	9	9	10	11	12	13	14
70		5	6	6	7	8	9	9	10	11	12	13
75		5	5	6	7	7	8	9	10	10	11	12
80			5	6	6	7	8	8	9	10	10	11
85			5	5	6	6	7	8	8	9	10	11
90				5	6	6	7	7	8	9	9	10
95				5	5	6	6	7	7	8	9	9
100				5	5	5	6	7	7	8	8	9
105					5	5	6	6	7	7	8	8
110					5	5	5	6	6	7	7	8
115						5	5	6	6	7	7	8
120						5	5	5	6	6	7	7
125							5	5	6	6	6	7
130							5	5	5	6	6	7
135								5	5	6	6	6
140								5	5	5	6	6
145									5	5	5	6
150									5	5	5	6
155										5	5	5
160										5	5	5
165											5	5
170											5	5
175												5
180												5
185												5
190												
195												
200												

Years to Boring Height

Site Index (m)	All S.I.'s
Correct yrs	2

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Thrower (1992)

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Table of Site Index by Breast Height Age and Height
Species: Act – Black Cottonwood - Provincial

Top Height (m)											Age
18	19	20	21	22	23	24	25	26	27	28	@ bh
Site Index (m)											
47	49	50	52	53	55	56	57	59	60	61	10
38	40	41	42	43	45	46	47	48	49	51	15
33	34	35	36	37	39	40	41	42	43	44	20
29	30	31	32	33	34	35	37	38	39	40	25
26	27	28	29	30	31	32	33	34	35	36	30
23	24	25	26	27	29	30	31	32	33	34	35
21	22	23	24	25	26	27	28	29	30	31	40
19	21	22	23	24	25	26	27	28	29	30	45
18	19	20	21	22	23	24	25	26	27	28	50
17	18	19	20	21	22	23	24	25	26	27	55
16	17	17	18	19	20	21	22	23	24	25	60
15	15	16	17	18	19	20	21	22	23	24	65
14	14	15	16	17	18	19	20	21	22	23	70
13	14	14	15	16	17	18	19	20	21	22	75
12	13	14	15	15	16	17	18	19	20	21	80
11	12	13	14	15	16	16	17	18	19	20	85
11	11	12	13	14	15	16	17	18	19	20	90
10	11	12	12	13	14	15	16	17	18	19	95
10	10	11	12	13	13	14	15	16	17	18	100
9	10	10	11	12	13	14	15	15	16	17	105
9	9	10	11	11	12	13	14	15	16	17	110
8	9	9	10	11	12	12	13	14	15	16	115
8	8	9	10	10	11	12	13	14	15	16	120
7	8	9	9	10	11	11	12	13	14	15	125
7	8	8	9	9	10	11	12	13	14	14	130
7	7	8	8	9	10	10	11	12	13	14	135
7	7	8	8	9	9	10	11	12	12	13	140
6	7	7	8	8	9	10	10	11	12	13	145
6	6	7	7	8	9	9	10	11	12	12	150
6	6	7	7	8	8	9	10	10	11	12	155
6	6	6	7	7	8	8	9	10	11	12	160
5	6	6	7	7	8	8	9	9	10	11	165
5	6	6	6	7	7	8	8	9	10	11	170
5	5	6	6	7	7	8	8	9	9	10	175
5	5	6	6	6	7	7	8	8	9	10	180
5	5	5	6	6	7	7	8	8	9	10	185
5	5	5	6	6	6	7	7	8	8	9	190
5	5	5	5	6	6	7	7	8	8	9	195
	5	5	5	6	6	6	7	7	8	9	200

Years to Boring Height

Site Index (m)	All S.I.'s
Correct yrs	2

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Table of Site Index by Breast Height Age and Height
Species: Act – Black Cottonwood - Provincial

Age @ bh	Top Height (m) 29	30	31	32	33	34	35	36	37	38	39
	Site Index (m)										
10	62	64	65	66	67	68	70	71	72	73	74
15	52	53	54	55	56	57	58	59	61	62	63
20	45	46	47	48	50	51	52	53	54	55	56
25	41	42	43	44	45	46	47	48	49	50	51
30	37	38	39	40	41	42	43	44	45	46	47
35	35	36	37	38	39	40	41	42	43	44	45
40	32	33	35	36	37	37	38	39	40	41	42
45	31	32	33	34	35	36	37	38	39	40	41
50	29	30	31	32	33	34	35	36	37	38	39
55	28	29	30	31	32	33	34	35	36	37	38
60	26	27	28	29	30	31	32	33	34	35	36
65	25	26	27	28	29	30	31	32	33	34	35
70	24	25	26	27	28	29	30	31	32	33	34
75	23	24	25	26	27	28	29	30	31	32	34
80	22	23	24	25	26	27	28	30	31	32	33
85	21	22	23	25	26	27	28	29	30	31	32
90	21	22	23	24	25	26	27	28	29	30	31
95	20	21	22	23	24	25	26	27	28	30	31
100	19	20	21	22	23	25	26	27	28	29	30
105	19	20	21	22	23	24	25	26	27	28	30
110	18	19	20	21	22	23	24	26	27	28	29
115	17	18	19	21	22	23	24	25	26	27	29
120	17	18	19	20	21	22	23	25	26	27	28
125	16	17	18	19	21	22	23	24	25	26	28
130	16	17	18	19	20	21	22	24	25	26	27
135	15	16	17	18	20	21	22	23	24	26	27
140	14	16	17	18	19	20	22	23	24	25	26
145	14	15	16	17	19	20	21	22	24	25	26
150	13	15	16	17	18	19	21	22	23	24	26
155	13	14	15	16	18	19	20	22	23	24	25
160	12	14	15	16	17	18	20	21	22	24	25
165	12	13	14	15	17	18	19	21	22	23	25
170	12	13	14	15	16	18	19	20	22	23	24
175	11	12	13	15	16	17	19	20	21	23	24
180	11	12	13	14	15	17	18	20	21	22	24
185	10	11	12	14	15	16	18	19	21	22	24
190	10	11	12	13	15	16	17	19	20	22	23
195	10	11	12	13	14	16	17	19	20	22	23
200	9	10	11	12	14	15	17	18	20	21	23

Years to Boring Height

Site Index (m)	All S.I.'s
Correct yrs	2

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Table of Site Index by Breast Height Age and Height
Species: Act – Black Cottonwood - Provincial

Top Height (m) 40	41	42	43	44	45	46	47	48	49	50	Age @ bh
Site Index (m)											
75	76	78	79	80	81	82	83	84	85	86	10
64	65	66	67	68	69	70	71	72	73	74	15
57	58	59	60	61	62	63	64	65	66	67	20
52	53	54	55	56	57	58	59	60	61	62	25
48	49	50	51	52	53	54	55	56	57	58	30
46	47	48	49	50	51	52	53	54	55	55	35
43	44	45	46	47	48	49	50	51	52	53	40
42	43	44	45	46	47	48	49	50	51	52	45
40	41	42	43	44	45	46	47	48	49	50	50
39	40	41	42	43	44	45	46	47	48	49	55
37	38	39	40	42	43	44	45	46	47	48	60
36	37	38	39	40	42	43	44	45	46	47	65
35	36	37	39	40	41	42	43	44	45	46	70
35	36	37	38	39	40	41	42	43	44	45	75
34	35	36	37	38	39	40	41	42	43	44	80
33	34	35	36	37	38	39	41	42	43	44	85
32	33	35	36	37	38	39	40	41	42	43	90
32	33	34	35	36	37	38	39	41	42	43	95
31	32	33	35	36	37	38	39	40	41	42	100
31	32	33	34	35	36	37	38	40	41	42	105
30	31	32	34	35	36	37	38	39	40	41	110
30	31	32	33	34	35	37	38	39	40	41	115
29	30	32	33	34	35	36	37	38	40	41	120
29	30	31	32	34	35	36	37	38	39	40	125
28	30	31	32	33	34	36	37	38	39	40	130
28	29	30	32	33	34	35	36	38	39	40	135
28	29	30	31	33	34	35	36	37	38	40	140
27	29	30	31	32	33	35	36	37	38	39	145
27	28	29	31	32	33	34	36	37	38	39	150
27	28	29	30	32	33	34	35	37	38	39	155
26	28	29	30	31	33	34	35	36	38	39	160
26	27	29	30	31	32	34	35	36	37	39	165
26	27	28	30	31	32	33	35	36	37	38	170
26	27	28	29	31	32	33	35	36	37	38	175
25	27	28	29	31	32	33	34	36	37	38	180
25	26	28	29	30	32	33	34	35	37	38	185
25	26	27	29	30	31	33	34	35	37	38	190
24	26	27	29	30	31	33	34	35	36	38	195
24	26	27	28	30	31	32	34	35	36	37	200

Years to Boring Height

Site Index (m)	All S.I.'s
Correct yrs	2

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Figure A.49 Act – Black Cottonwood - Provincial.

Table of Site Index by Breast Height Age and Height
Species: At & E – Trembling Aspen and Birch – Provincial

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Site Index (m)																						
10	18	22	25	29	32	35	38	41	44	46	49												
15	13	16	18	20	23	25	27	29	31	34	36	38	40	42	43	45	47	49					
20	10	12	14	16	18	20	22	23	25	27	29	30	32	33	35	37	38	40	41	43	45	46	48
25	8	10	12	13	15	17	18	20	21	23	24	26	27	28	30	31	33	34	36	37	38	40	41
30	7	9	10	12	13	14	16	17	19	20	21	22	24	25	26	28	29	30	31	33	34	35	36
35	6	8	9	10	12	13	14	15	17	18	19	20	21	23	24	25	26	27	28	30	31	32	33
40	6	7	8	9	11	12	13	14	15	16	17	18	20	21	22	23	24	25	26	27	28	30	31
45	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	27	28	29
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	6	7	8	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
60		5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20	21	22	23	24	25
65		5	6	7	8	8	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22	23	24
70		5	6	6	7	8	9	10	11	11	12	13	14	15	16	17	17	18	19	20	21	22	23
75		5	5	6	7	8	9	9	10	11	12	13	13	14	15	16	17	18	19	19	20	21	22
80			5	6	7	7	8	9	10	11	11	12	13	14	15	16	16	17	18	19	20	21	21
85			5	6	6	7	8	9	9	10	11	12	13	13	14	15	16	17	18	18	19	20	21
90			5	5	6	7	8	8	9	10	11	11	12	13	14	15	15	16	17	18	19	20	20
95			5	5	6	7	7	8	9	10	10	11	12	13	14	14	15	16	17	18	18	19	20
100			5	5	6	7	7	8	9	9	10	11	12	12	13	14	15	16	16	17	18	19	20
105				5	6	6	7	8	8	9	10	11	11	12	13	14	14	15	16	17	18	18	19
110				5	6	6	7	8	8	9	10	10	11	12	13	13	14	15	16	17	17	18	19
115				5	5	6	7	7	8	9	9	10	11	12	12	13	14	15	15	16	17	18	19
120				5	5	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	17	18	18
125				5	5	6	6	7	8	8	9	10	11	11	12	13	14	14	15	16	17	17	18
130					5	6	6	7	8	8	9	10	10	11	12	13	13	14	15	16	16	17	18
135					5	6	6	7	8	8	9	10	10	11	12	12	13	14	15	15	16	17	18
140					5	5	6	7	7	8	9	9	10	11	12	12	13	14	14	15	16	17	17
145					5	5	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	17	17
150					5	5	6	7	7	8	8	9	10	11	11	12	13	13	14	15	16	16	17
155					5	5	6	6	7	8	8	9	10	10	11	12	13	13	14	15	15	16	17
160					5	5	6	6	7	8	8	9	10	10	11	12	12	13	14	15	15	16	17
165					5	5	6	6	7	8	8	9	9	10	11	12	12	13	14	14	15	16	17
170						5	6	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	17
175						5	6	6	7	7	8	9	9	10	11	11	12	13	13	14	15	16	16
180						5	5	6	7	7	8	9	9	10	11	11	12	13	13	14	15	16	16
185						5	5	6	7	7	8	8	9	10	10	11	12	13	13	14	15	15	16
190						5	5	6	7	7	8	8	9	10	10	11	12	12	13	14	15	15	16
195						5	5	6	6	7	8	8	9	10	10	11	12	12	13	14	15	15	16
200						5	5	6	6	7	8	8	9	10	10	11	12	12	13	14	14	15	16

Top Height (m)

Years to Boring Height

Site Index	5	6	7	8-9	10-12	13-17	18-32	33+
Correct yrs	9	8	7	6	5	4	3	2

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Alberta Forest Service (1985)

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Table of Site Index by Breast Height Age and Height
Species: At & E – Trembling Aspen & Birch – Provincial

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
Site Index (m)																							
																							10
																							15
49																							20
42	44	45	46	48	49	50																	25
38	39	40	41	43	44	45	46	47	49	50													30
34	35	37	38	39	40	41	42	43	45	46	47	48	49	50									35
32	33	34	35	36	37	38	39	40	41	43	44	45	46	47	48	49	50						40
30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
27	28	29	30	31	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	55
26	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	44	45	46	60
25	25	26	27	28	29	30	31	32	33	34	35	36	37	38	38	39	40	41	42	43	44	45	65
24	25	26	26	27	28	29	30	31	32	33	34	35	36	36	37	38	39	40	41	42	43	44	70
23	24	25	26	27	27	28	29	30	31	32	33	34	35	35	36	37	38	39	40	41	42	43	75
22	23	24	25	26	27	28	28	29	30	31	32	33	34	35	36	36	37	38	39	40	41	42	80
22	23	23	24	25	26	27	28	29	30	30	31	32	33	34	35	36	37	38	38	39	40	41	85
21	22	23	24	25	26	26	27	28	29	30	31	32	32	33	34	35	36	37	38	39	40	40	90
21	22	23	23	24	25	26	27	28	28	29	30	31	32	33	34	35	35	36	37	38	39	40	95
20	21	22	23	24	25	25	26	27	28	29	30	31	31	32	33	34	35	36	37	37	38	39	100
20	21	22	23	23	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	37	38	39	105
20	21	21	22	23	24	25	25	26	27	28	29	30	31	31	32	33	34	35	36	36	37	38	110
19	20	21	22	23	23	24	25	26	27	28	28	29	30	31	32	33	34	34	35	36	37	38	115
19	20	21	22	22	23	24	25	26	26	27	28	29	30	31	31	32	33	34	35	36	37	37	120
19	20	20	21	22	23	24	25	25	26	27	28	29	29	30	31	32	33	34	35	35	36	37	125
19	19	20	21	22	23	23	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	37	130
18	19	20	21	22	22	23	24	25	26	26	27	28	29	30	31	31	32	33	34	35	36	36	135
18	19	20	21	21	22	23	24	25	25	26	27	28	29	29	30	31	32	33	34	34	35	36	140
18	19	20	20	21	22	23	24	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	145
18	19	19	20	21	22	23	23	24	25	26	27	27	28	29	30	31	32	32	33	34	35	36	150
18	18	19	20	21	22	22	23	24	25	26	26	27	28	29	30	30	31	32	33	34	35	35	155
18	18	19	20	21	21	22	23	24	25	25	26	27	28	29	29	30	31	32	33	34	34	35	160
17	18	19	20	21	21	22	23	24	24	25	26	27	28	28	29	30	31	32	33	33	34	35	165
17	18	19	20	20	21	22	23	23	24	25	26	27	27	28	29	30	31	32	32	33	34	35	170
17	18	19	19	20	21	22	23	23	24	25	26	27	27	28	29	30	31	31	32	33	34	35	175
17	18	19	19	20	21	22	22	23	24	25	26	26	27	28	29	30	30	31	32	33	34	35	180
17	18	18	19	20	21	22	22	23	24	25	25	26	27	28	29	29	30	31	32	33	34	34	185
17	18	18	19	20	21	21	22	23	24	25	25	26	27	28	29	29	30	31	32	33	33	34	190
17	17	18	19	20	21	21	22	23	24	24	25	26	27	28	28	29	30	31	32	32	33	34	195
17	17	18	19	20	20	21	22	23	24	24	25	26	27	27	28	29	30	31	32	32	33	34	200

Top Height (m)

Years to Boring Height

Site Index	5	6	7	8-9	10-12	13-17	18-32	33+
Correct yrs	9	8	7	6	5	4	3	2

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Figure A.50 At - Trembling Aspen - Provincial.

Table of Site Index by Breast Height Age and Height
Species: Ba – Amabilis fir – All Balsam Species - Provincial

Age @ bh	Top Height (m) 5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Site Index (m)													
10	21	24	27	31	33	36	38	41						
15	14	17	20	22	25	27	29	31	33	35	37			
20	11	13	15	18	19	21	23	25	27	29	30	32	33	35
25	9	11	13	15	16	18	20	21	23	24	26	27	29	30
30	8	9	11	13	14	15	17	18	20	21	22	24	25	26
35	7	8	10	11	12	14	15	16	17	19	20	21	22	24
40	6	8	9	10	11	12	13	15	16	17	18	19	20	21
45	6	7	8	9	10	11	12	13	14	15	17	18	19	20
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18
55	5	6	7	7	8	9	10	11	12	13	14	15	16	17
60		5	6	7	8	9	10	10	11	12	13	14	15	16
65		5	6	7	7	8	9	10	11	12	12	13	14	15
70		5	6	6	7	8	9	9	10	11	12	13	13	14
75		5	5	6	7	7	8	9	10	10	11	12	13	13
80			5	6	6	7	8	9	9	10	11	11	12	13
85			5	6	6	7	8	8	9	10	10	11	12	12
90			5	5	6	7	7	8	9	9	10	11	11	12
95			5	5	6	6	7	8	8	9	9	10	11	11
100				5	6	6	7	7	8	9	9	10	10	11
105				5	5	6	7	7	8	8	9	9	10	11
110				5	5	6	6	7	7	8	9	9	10	10
115				5	5	6	6	7	7	8	8	9	10	10
120				5	5	6	6	7	7	8	8	9	9	10
125					5	5	6	6	7	7	8	8	9	10
130					5	5	6	6	7	7	8	8	9	9
135					5	5	6	6	7	7	8	8	9	9
140					5	5	6	6	6	7	7	8	8	9
145					5	5	5	6	6	7	7	8	8	9
150						5	5	6	6	7	7	8	8	9
155						5	5	6	6	7	7	7	8	8
160						5	5	6	6	6	7	7	8	8
165						5	5	5	6	6	7	7	8	8
170						5	5	5	6	6	7	7	8	8
175						5	5	5	6	6	7	7	7	8
180							5	5	6	6	6	7	7	8
185							5	5	6	6	6	7	7	8
190							5	5	5	6	6	7	7	7
195							5	5	5	6	6	7	7	7
200							5	5	5	6	6	6	7	7

Years to Boring Height

Site Index	5-7	8-9	10-12	13-14	15-17	18-19	20-21	22-24	25-26	27-29	30-31	32+
Correct yrs	16	15	14	13	12	11	10	9	8	7	6	5

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Kurucz (1992)

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Table of Site Index by Breast Height Age and Height
Species: Ba – Amabilis fir – All Balsam Species - Provincial

Top Height (m) 19	20	21	22	23	24	25	26	27	28	29	30	31	32	Age @ bh
Site Index (m)														
														10
														15
36														20
31	33	34												25
28	29	30	32	33	34									30
25	26	27	28	30	31	32	33	34						35
23	24	25	26	27	28	29	30	31	32	34				40
21	22	23	24	25	26	27	28	29	30	31	32	33		45
19	20	21	22	23	24	25	26	27	28	29	30	31	32	50
18	19	20	21	22	22	23	24	25	26	27	28	29	30	55
17	18	18	19	20	21	22	23	24	25	26	27	28	29	60
16	17	17	18	19	20	21	22	23	24	24	25	26	27	65
15	16	17	17	18	19	20	21	22	22	23	24	25	26	70
14	15	16	17	17	18	19	20	21	21	22	23	24	25	75
14	14	15	16	17	17	18	19	20	21	21	22	23	24	80
13	14	14	15	16	17	17	18	19	20	21	21	22	23	85
13	13	14	15	15	16	17	18	18	19	20	21	21	22	90
12	13	13	14	15	16	16	17	18	18	19	20	21	21	95
12	12	13	14	14	15	16	16	17	18	18	19	20	21	100
11	12	13	13	14	15	15	16	17	17	18	19	19	20	105
11	12	12	13	13	14	15	15	16	17	17	18	19	19	110
11	11	12	12	13	14	14	15	16	16	17	18	18	19	115
10	11	12	12	13	13	14	15	15	16	16	17	18	18	120
10	11	11	12	12	13	14	14	15	15	16	17	17	18	125
10	10	11	12	12	13	13	14	14	15	16	16	17	18	130
10	10	11	11	12	12	13	14	14	15	15	16	17	17	135
9	10	10	11	12	12	13	13	14	14	15	16	16	17	140
9	10	10	11	11	12	12	13	14	14	15	15	16	16	145
9	10	10	11	11	12	12	13	13	14	14	15	16	16	150
9	9	10	10	11	11	12	12	13	14	14	15	15	16	155
9	9	10	10	11	11	12	12	13	13	14	14	15	16	160
9	9	9	10	10	11	11	12	13	13	14	14	15	15	165
8	9	9	10	10	11	11	12	12	13	13	14	14	15	170
8	9	9	10	10	11	11	12	12	13	13	14	14	15	175
8	9	9	9	10	10	11	11	12	12	13	13	14	15	180
8	8	9	9	10	10	11	11	12	12	13	13	14	14	185
8	8	9	9	10	10	11	11	12	12	13	13	14	14	190
8	8	9	9	10	10	10	11	11	12	12	13	13	14	195
8	8	9	9	9	10	10	11	11	12	12	13	13	14	200

Years to Boring Height

Site Index	5-7	8-9	10-12	13-14	15-17	18-19	20-21	22-24	25-26	27-29	30-31	32+
Correct yrs	16	15	14	13	12	11	10	9	8	7	6	5

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Table of Site Index by Breast Height Age and Height
Species: Ba – Amabilis fir – All Balsam Species - Provincial

Top Height (m) / Site Index (m)

Age @ bh	33	34	35	36	37	38	39	40	41	42	43	44	45	46
10														
15														
20														
25														
30														
35														
40														
45														
50	33													
55	31	32	33											
60	30	30	31	32										
65	28	29	30	31	32	33								
70	27	28	29	29	30	31	32							
75	26	27	27	28	29	30	31	32						
80	25	25	26	27	28	29	30	31	32	32				
85	24	25	25	26	27	28	29	30	30	31	32			
90	23	24	24	25	26	27	28	29	29	30	31	32		
95	22	23	24	24	25	26	27	28	29	29	30	31	32	
100	21	22	23	24	25	25	26	27	28	29	29	30	31	32
105	21	22	22	23	24	25	25	26	27	28	29	29	30	31
110	20	21	22	22	23	24	25	25	26	27	28	29	30	30
115	20	20	21	22	23	23	24	25	26	26	27	28	29	30
120	19	20	21	21	22	23	23	24	25	26	27	27	28	29
125	19	19	20	21	21	22	23	24	24	25	26	27	27	28
130	18	19	20	20	21	22	22	23	24	25	25	26	27	28
135	18	18	19	20	20	21	22	23	23	24	25	26	26	27
140	17	18	19	19	20	21	21	22	23	24	24	25	26	27
145	17	18	18	19	20	20	21	22	22	23	24	25	25	26
150	17	17	18	19	19	20	21	21	22	23	23	24	25	26
155	16	17	18	18	19	20	20	21	22	22	23	24	24	25
160	16	17	17	18	19	19	20	21	21	22	23	23	24	25
165	16	16	17	18	18	19	20	20	21	21	22	23	24	24
170	16	16	17	17	18	19	19	20	20	21	22	23	23	24
175	15	16	16	17	18	18	19	20	20	21	21	22	23	24
180	15	16	16	17	17	18	19	19	20	21	21	22	23	23
185	15	15	16	17	17	18	18	19	20	20	21	22	22	23
190	15	15	16	16	17	17	18	19	19	20	21	21	22	23
195	14	15	15	16	17	17	18	18	19	20	20	21	22	22
200	14	15	15	16	16	17	18	18	19	19	20	21	21	22

Years to Boring Height

Site Index	5-7	8-9	10-12	13-14	15-17	18-19	20-21	22-24	25-26	27-29	30-31	32+
Correct yrs	16	15	14	13	12	11	10	9	8	7	6	5

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Table of Site Index by Breast Height Age and Height
Species: Ba – Amabilis fir – All Balsam Species - Provincial

Top Height (m) / Site Index (m)

47	48	49	50	51	52	53	54	55	56	57	58	59	60	Age @ bh
														10
														15
														20
														25
														30
														35
														40
														45
														50
														55
														60
														65
														70
														75
														80
														85
														90
														95
														100
32														105
31	32													110
30	31	32												115
30	31	31	32											120
29	30	31	32											125
29	29	30	31	32										130
28	29	30	30	31										135
27	28	29	30	31	32									140
27	28	28	29	30	31	32								145
26	27	28	29	30	30	31								150
26	27	27	28	29	30	31	32							155
26	26	27	28	29	29	30	31							160
25	26	27	27	28	29	30	31	32						165
25	25	26	27	28	29	29	30	31						170
24	25	26	27	27	28	29	30	31	32					175
24	25	25	26	27	28	29	29	30	31					180
24	24	25	26	27	27	28	29	30	31	32				185
23	24	25	25	26	27	28	29	30	30	31				190
23	24	24	25	26	27	27	28	29	30	31	32			195
23	23	24	25	26	26	27	28	29	30	30	31	32	33	200

Years to Boring Height

Site Index	5-7	8-9	10-12	13-14	15-17	18-19	20-21	22-24	25-26	27-29	30-31	32+
Correct yrs	16	15	14	13	12	11	10	9	8	7	6	5

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Figure A.51 Ba – Amabilis Fir – All Balsam Species - Provincial.

Table of Site Index by Breast Height Age and Height
Species: Cw – Western Redcedar - Provincial

Age @ bh	Top Height (m) 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	Site Index (m)																
10	22	26	29	32	36	39	41	44	47	49	52	54	56	58			
15	15	18	21	23	26	28	31	33	35	38	40	42	44	46	48	50	52
20	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	41	43
25	10	12	13	15	17	19	20	22	24	25	27	29	30	32	33	35	37
30	9	10	12	13	15	16	18	19	20	22	23	25	26	28	29	31	32
35	8	9	10	12	13	14	16	17	18	19	21	22	23	25	26	27	28
40	7	8	9	11	12	13	14	15	16	18	19	20	21	22	23	25	26
45	6	7	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24
50	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
55	6	7	8	8	9	10	11	12	13	14	15	16	17	18	19	20	21
60	5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20
65	5	6	7	8	9	9	10	11	12	13	14	14	15	16	17	18	19
70	5	6	7	7	8	9	10	11	11	12	13	14	15	15	16	17	18
75	5	6	6	7	8	9	9	10	11	12	12	13	14	15	15	16	17
80	5	5	6	7	8	8	9	10	11	11	12	13	13	14	15	16	16
85	5	5	6	7	7	8	9	9	10	11	12	12	13	14	14	15	16
90		5	6	6	7	8	9	9	10	11	11	12	13	13	14	15	15
95		5	6	6	7	8	8	9	10	10	11	12	12	13	14	14	15
100		5	6	6	7	7	8	9	9	10	11	11	12	13	13	14	15
105		5	5	6	7	7	8	9	9	10	10	11	12	12	13	14	14
110		5	5	6	7	7	8	8	9	10	10	11	11	12	13	13	14
115		5	5	6	6	7	8	8	9	9	10	11	11	12	12	13	14
120		5	5	6	6	7	7	8	9	9	10	10	11	12	12	13	13
125		5	5	6	6	7	7	8	8	9	10	10	11	11	12	13	13
130			5	6	6	7	7	8	8	9	9	10	11	11	12	12	13
135			5	5	6	7	7	8	8	9	9	10	10	11	12	12	13
140			5	5	6	7	7	8	8	9	9	10	10	11	11	12	13
145			5	5	6	6	7	7	8	9	9	10	10	11	11	12	12
150			5	5	6	6	7	7	8	8	9	10	10	11	11	12	12
155			5	5	6	6	7	7	8	8	9	9	10	10	11	12	12
160			5	5	6	6	7	7	8	8	9	9	10	10	11	11	12
165			5	5	6	6	7	7	8	8	9	9	10	10	11	11	12
170			5	5	6	6	7	7	8	8	9	9	10	10	11	11	12
175			5	5	6	6	7	7	8	8	9	9	10	10	11	11	12
180			5	5	6	6	6	7	7	8	8	9	9	10	10	11	11
185			5	5	5	6	6	7	7	8	8	9	9	10	10	11	11
190				5	5	6	6	7	7	8	8	9	9	10	10	11	11
195				5	5	6	6	7	7	8	8	9	9	10	10	11	11
200				5	5	6	6	7	7	8	8	9	9	10	10	11	11

Years to Boring Height

Site Index	5-10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Kurucz (1985)

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Table of Site Index by Breast Height Age and Height
Species: Cw – Western Redcedar - Provincial

Top Height (m) 23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	Age @ bh
Site Index (m)																
																10
54	56															15
45	47	48	50	52	53	55										20
38	40	41	43	44	46	47	49	50	52	53						25
33	35	36	38	39	40	42	43	44	46	47	48	50	51	52		30
30	31	32	34	35	36	37	39	40	41	42	44	45	46	47	48	35
27	28	29	30	32	33	34	35	36	37	39	40	41	42	43	44	40
25	26	27	28	29	30	31	32	33	34	35	37	38	39	40	41	45
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	50
22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	55
20	21	22	23	24	25	26	27	28	28	29	30	31	32	33	34	60
19	20	21	22	23	24	25	25	26	27	28	29	30	30	31	32	65
19	19	20	21	22	23	23	24	25	26	27	28	28	29	30	31	70
18	19	19	20	21	22	22	23	24	25	26	26	27	28	29	30	75
17	18	19	19	20	21	22	22	23	24	25	25	26	27	28	29	80
17	17	18	19	19	20	21	22	22	23	24	25	25	26	27	28	85
16	17	17	18	19	20	20	21	22	22	23	24	25	25	26	27	90
16	16	17	18	18	19	20	20	21	22	22	23	24	25	25	26	95
15	16	17	17	18	19	19	20	21	21	22	23	23	24	25	25	100
15	16	16	17	17	18	19	19	20	21	21	22	23	23	24	25	105
15	15	16	16	17	18	18	19	20	20	21	22	22	23	23	24	110
14	15	15	16	17	17	18	19	19	20	20	21	22	22	23	24	115
14	15	15	16	16	17	18	18	19	19	20	21	21	22	23	23	120
14	14	15	16	16	17	17	18	19	19	20	20	21	22	22	23	125
14	14	15	15	16	16	17	18	18	19	19	20	21	21	22	22	130
13	14	14	15	16	16	17	17	18	18	19	20	20	21	21	22	135
13	14	14	15	15	16	17	17	18	18	19	19	20	21	21	22	140
13	13	14	15	15	16	16	17	17	18	19	19	20	20	21	21	145
13	13	14	14	15	16	16	17	17	18	18	19	19	20	21	21	150
13	13	14	14	15	15	16	16	17	18	18	19	19	20	20	21	155
12	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	160
12	13	13	14	14	15	16	16	17	17	18	18	19	19	20	20	165
12	13	13	14	14	15	15	16	16	17	17	18	19	19	20	20	170
12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	175
12	12	13	14	14	15	15	16	16	17	17	18	18	19	19	20	180
12	12	13	13	14	14	15	15	16	16	17	18	18	19	19	20	185
12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	190
12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	195
12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	200

Years to Boring Height

Site Index	5-10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

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Table of Site Index by Breast Height Age and Height
Species: Cw – Western Redcedar - Provincial

Age @ bh	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
	Top Height (m) / Site Index (m)															
10																
15																
20																
25																
30																
35	50	51														
40	45	46	48	49	50	51										
45	42	43	44	45	46	47	48	49	50							
50	39	40	41	42	43	44	45	46	47	48	49	50				
55	37	38	39	40	40	41	42	43	44	45	46	47	48	49	50	
60	35	36	37	37	38	39	40	41	42	43	44	45	46	47	47	48
65	33	34	35	36	37	37	38	39	40	41	42	43	44	44	45	46
70	32	32	33	34	35	36	37	37	38	39	40	41	42	43	43	44
75	30	31	32	33	34	34	35	36	37	38	38	39	40	41	42	42
80	29	30	31	32	32	33	34	35	35	36	37	38	39	39	40	41
85	28	29	30	31	31	32	33	34	34	35	36	37	37	38	39	40
90	27	28	29	30	30	31	32	33	33	34	35	36	36	37	38	38
95	27	27	28	29	30	30	31	32	32	33	34	35	35	36	37	37
100	26	27	27	28	29	29	30	31	32	32	33	34	34	35	36	36
105	25	26	27	27	28	29	29	30	31	31	32	33	34	34	35	36
110	25	25	26	27	27	28	29	29	30	31	31	32	33	33	34	35
115	24	25	26	26	27	28	28	29	29	30	31	31	32	33	33	34
120	24	24	25	26	26	27	28	28	29	30	30	31	31	32	33	33
125	23	24	25	25	26	26	27	28	28	29	30	30	31	32	32	33
130	23	24	24	25	25	26	27	27	28	29	29	30	30	31	32	32
135	23	23	24	24	25	26	26	27	27	28	29	29	30	31	31	32
140	22	23	23	24	25	25	26	26	27	28	28	29	29	30	31	31
145	22	23	23	24	24	25	25	26	27	27	28	28	29	30	30	31
150	22	22	23	23	24	25	25	26	26	27	28	28	29	29	30	30
155	21	22	23	23	24	24	25	25	26	27	27	28	28	29	30	30
160	21	22	22	23	23	24	25	25	26	26	27	27	28	29	29	30
165	21	21	22	23	23	24	24	25	25	26	27	27	28	28	29	29
170	21	21	22	22	23	23	24	25	25	26	26	27	27	28	29	29
175	21	21	22	22	23	23	24	24	25	25	26	27	27	28	28	29
180	20	21	21	22	23	23	24	24	25	25	26	26	27	27	28	29
185	20	21	21	22	22	23	23	24	24	25	26	26	27	27	28	28
190	20	21	21	22	22	23	23	24	24	25	25	26	26	27	28	28
195	20	20	21	21	22	22	23	24	24	25	25	26	26	27	27	28
200	20	20	21	21	22	22	23	23	24	24	25	26	26	27	27	28

Years to Boring Height

Site Index	5-10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

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Table of Site Index by Breast Height Age and Height
Species: Cw – Western Redcedar - Provincial

55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	Age @ bh
Top Height (m) / Site Index (m)																
																10
																15
																20
																25
																30
																35
																40
																45
																50
																55
49																60
47	48	49														65
45	46	47	48	48	49											70
43	44	45	46	47	47	48	49									75
42	43	43	44	45	46	47	47	48	49							80
40	41	42	43	44	44	45	46	47	47	48						85
39	40	41	41	42	43	44	45	45	46	47	48	48				90
38	39	40	40	41	42	43	43	44	45	46	46	47	48	49		95
37	38	39	39	40	41	42	42	43	44	44	45	46	47	47	48	100
36	37	38	38	39	40	41	41	42	43	43	44	45	46	46	47	105
36	36	37	38	38	39	40	40	41	42	42	43	44	45	45	46	110
35	35	36	37	37	38	39	40	40	41	42	42	43	44	44	45	115
34	35	35	36	37	37	38	39	39	40	41	41	42	43	44	44	120
34	34	35	35	36	37	37	38	39	39	40	41	41	42	43	43	125
33	34	34	35	36	36	37	37	38	39	39	40	41	41	42	43	130
32	33	34	34	35	36	36	37	38	38	39	39	40	41	41	42	135
32	33	33	34	34	35	36	36	37	38	38	39	40	40	41	41	140
32	32	33	33	34	35	35	36	36	37	38	38	39	40	40	41	145
31	32	32	33	34	34	35	35	36	37	37	38	38	39	40	40	150
31	31	32	33	33	34	34	35	36	36	37	37	38	39	39	40	155
30	31	32	32	33	33	34	35	35	36	36	37	38	38	39	39	160
30	31	31	32	32	33	34	34	35	35	36	37	37	38	38	39	165
30	30	31	31	32	33	33	34	34	35	36	36	37	37	38	39	170
29	30	31	31	32	32	33	33	34	35	35	36	36	37	38	38	175
29	30	30	31	31	32	33	33	34	34	35	36	36	37	37	38	180
29	29	30	31	31	32	32	33	33	34	35	35	36	36	37	38	185
29	29	30	30	31	31	32	33	33	34	34	35	36	36	37	37	190
28	29	30	30	31	31	32	32	33	34	34	35	35	36	36	37	195
28	29	29	30	30	31	32	32	33	33	34	34	35	36	36	37	200

Years to Boring Height

Site Index	5-10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

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Figure A.52 Cw – Westerm Redcedar - Provincial.

Table of Site Index by Breast Height Age and Height
Species: Dr – Red Alder - Provincial

Age @ bh	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	Site Index (m)													
10	13	16	18	21	23	26	28	31	33	36	38			
15	10	12	13	15	17	19	21	22	24	26	28	30	31	33
20	8	10	11	13	14	16	17	19	20	22	23	25	26	28
25	7	9	10	11	13	14	15	17	18	19	21	22	23	25
30	7	8	9	11	12	13	14	15	17	18	19	20	21	23
35	7	8	9	10	11	12	13	15	16	17	18	19	20	21
40	6	7	9	10	11	12	13	14	15	16	17	18	19	20
45	6	7	8	9	10	11	12	13	14	15	16	18	19	20
50	6	7	8	9	10	11	12	13	14	15	16	17	18	19
55	6	7	8	9	10	11	12	13	14	15	16	17	18	19
60	6	7	8	9	10	11	12	12	13	14	15	16	17	18
65	6	7	8	9	9	10	11	12	13	14	15	16	17	18
70	6	7	7	8	9	10	11	12	13	14	15	16	17	18
75	6	6	7	8	9	10	11	12	13	14	15	16	17	17
80	6	6	7	8	9	10	11	12	13	14	15	15	16	17
85	5	6	7	8	9	10	11	12	13	14	14	15	16	17
90	5	6	7	8	9	10	11	12	13	13	14	15	16	17
95	5	6	7	8	9	10	11	12	12	13	14	15	16	17
100	5	6	7	8	9	10	11	11	12	13	14	15	16	17

Top Height (m)

Years to Boring Height

Site Index	≤ 6	7-14	15-21	22-28	29+
Correct yrs	5	4	3	2	1

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Nigh and Courtin (1998)

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Table of Site Index by Breast Height Age and Height
Species: Dr – Red Alder - Provincial

20	21	22	23	24	25	26	27	28	29	30	31	32	33	Age @ bh
Site Index (m)														
														10
														15
29	31	32												20
26	27	28	30											25
24	25	26	27	29	30									30
22	24	25	26	27	28	29								35
21	22	24	25	26	27	28	29							40
21	22	23	24	25	26	27	28	29						45
20	21	22	23	24	25	26	27	28	29					50
20	21	21	22	23	24	25	26	27	28					55
19	20	21	22	23	24	25	26	27	28	29				60
19	20	21	22	23	24	24	25	26	27	28				65
19	19	20	21	22	23	24	25	26	27	28	29			70
18	19	20	21	22	23	24	25	26	27	27	28			75
18	19	20	21	22	23	24	24	25	26	27	28			80
18	19	20	21	22	22	23	24	25	26	27	28	29		85
18	19	20	20	21	22	23	24	25	26	27	28	28		90
18	19	19	20	21	22	23	24	25	26	26	27	28		95
18	18	19	20	21	22	23	24	25	25	26	27	28	29	100

Top Height (m)

Years to Boring Height

Site Index	≤ 6	7-14	15-21	22-28	29+
Correct yrs	5	4	3	2	1

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Figure A.53 Dr - Red Alder - Provincial.

Table of Site Index by Breast Height Age and Height
Species: Lw – Western Larch - Provincial

Age	Top Height (m)																						
@ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Site Index (m)																						
10	20	23	26	29	32	35	38	41	44	47	50												
15	15	17	19	22	24	26	28	30	32	34	36	39	41	43	45	47	49						
20	13	14	16	18	19	21	23	25	26	28	30	31	33	35	36	38	40	41	43	45	47	48	50
25	11	12	14	15	17	18	20	21	22	24	25	27	28	30	31	33	34	35	37	38	40	41	43
30	9	11	12	13	15	16	17	18	20	21	22	24	25	26	27	29	30	31	33	34	35	36	38
35	8	9	11	12	13	14	15	16	18	19	20	21	22	23	25	26	27	28	29	30	32	33	34
40	7	8	9	10	12	13	14	15	16	17	18	19	20	21	22	23	25	26	27	28	29	30	31
45	6	7	8	9	10	11	12	13	14	15	17	18	19	20	21	22	23	24	25	26	27	28	29
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23	24	25
60		5	6	7	8	8	9	10	11	12	13	14	15	16	17	18	18	19	20	21	22	23	24
65			5	6	7	8	9	9	10	11	12	13	14	15	16	17	17	18	19	20	21	22	23
70				5	6	7	8	9	10	10	11	12	13	14	15	16	17	17	18	19	20	21	22
75				5	5	6	7	8	9	10	11	11	12	13	14	15	16	17	17	18	19	20	21
80					5	6	6	7	8	9	10	11	12	12	13	14	15	16	17	17	18	19	20
85						5	6	7	8	8	9	10	11	12	13	13	14	15	16	17	18	18	19
90						5	5	6	7	8	9	9	10	11	12	13	14	14	15	16	17	18	19
95							5	6	6	7	8	9	10	11	11	12	13	14	15	15	16	17	18
100								5	6	7	8	8	9	10	11	12	12	13	14	15	16	17	17
105								5	6	6	7	8	9	10	10	11	12	13	14	14	15	16	17
110									5	6	7	8	8	9	10	11	12	12	13	14	15	16	16
115									5	6	6	7	8	9	10	10	11	12	13	13	14	15	16
120										5	6	7	8	8	9	10	11	11	12	13	14	15	15
125										5	6	6	7	8	9	10	10	11	12	13	14	14	15
130											5	6	7	8	8	9	10	11	12	12	13	14	15
135											5	6	7	7	8	9	10	11	11	12	13	14	14
140											5	6	6	7	8	9	9	10	11	12	13	13	14
145												5	6	7	8	8	9	10	11	12	12	13	14
150												5	6	7	7	8	9	10	10	11	12	13	14
155												5	6	6	7	8	9	9	10	11	12	13	13
160												5	5	6	7	8	9	9	10	11	12	12	13
165													5	6	7	8	8	9	10	11	11	12	13
170													5	6	7	7	8	9	10	10	11	12	13
175													5	6	6	7	8	9	10	10	11	12	13
180													5	5	6	7	8	9	9	10	11	12	12
185													5	5	6	7	8	8	9	10	11	12	12
190														5	6	7	8	8	9	10	11	11	12
195														5	6	7	7	8	9	10	11	11	12
200														5	6	7	7	8	9	10	10	11	12

Years to Boring Height

Site Index	5	6	7	8	9	10	11-12	13-14	15-16	17-21	22-27	28-40	41+
Correct yrs	21	18	16	14	13	12	11	10	9	8	7	6	5

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Milner (1992)

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Table of Site Index by Breast Height Age and Height
Species: Lw – Western Larch - Provincial

Top Height (m)																							Age
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	@ bh
Site Index (m)																							
																							10
																							15
																							20
44	46	47	48	50																			25
39	40	41	43	44	45	47	48	49	50														30
35	36	37	39	40	41	42	43	45	46	47	48	49	50										35
32	33	34	35	37	38	39	40	41	42	43	44	45	46	47	49	50							40
30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	40	41	42	43	44	45	46	47	55
25	26	27	28	29	29	30	31	32	33	34	35	36	37	38	39	40	40	41	42	43	44	45	60
24	25	25	26	27	28	29	30	31	32	33	33	34	35	36	37	38	39	40	41	42	42	43	65
23	23	24	25	26	27	28	29	30	30	31	32	33	34	35	36	37	37	38	39	40	41	42	70
22	23	23	24	25	26	27	28	28	29	30	31	32	33	34	34	35	36	37	38	39	40	40	75
21	22	22	23	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	37	38	39	39	80
20	21	22	23	23	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	37	38	38	85
19	20	21	22	23	23	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	37	37	90
19	20	20	21	22	23	24	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	37	95
18	19	20	21	21	22	23	24	25	25	26	27	28	29	29	30	31	32	33	34	34	35	36	100
18	18	19	20	21	22	22	23	24	25	26	26	27	28	29	30	30	31	32	33	34	34	35	105
17	18	19	20	20	21	22	23	24	24	25	26	27	28	28	29	30	31	32	32	33	34	35	110
17	17	18	19	20	21	21	22	23	24	25	25	26	27	28	29	29	30	31	32	33	33	34	115
16	17	18	19	19	20	21	22	23	23	24	25	26	27	27	28	29	30	31	31	32	33	34	120
16	17	17	18	19	20	21	21	22	23	24	25	25	26	27	28	29	29	30	31	32	32	33	125
16	16	17	18	19	19	20	21	22	23	23	24	25	26	27	27	28	29	30	31	31	32	33	130
15	16	17	18	18	19	20	21	22	22	23	24	25	25	26	27	28	29	29	30	31	32	33	135
15	16	16	17	18	19	20	20	21	22	23	24	24	25	26	27	27	28	29	30	31	31	32	140
15	15	16	17	18	19	19	20	21	22	22	23	24	25	26	26	27	28	29	30	30	31	32	145
14	15	16	17	18	18	19	20	21	21	22	23	24	25	25	26	27	28	28	29	30	31	32	150
14	15	16	17	17	18	19	20	20	21	22	23	24	24	25	26	27	27	28	29	30	31	31	155
14	15	16	16	17	18	19	19	20	21	22	23	23	24	25	26	26	27	28	29	30	30	31	160
14	15	15	16	17	18	18	19	20	21	22	22	23	24	25	25	26	27	28	29	29	30	31	165
14	14	15	16	17	17	18	19	20	21	21	22	23	24	25	25	26	27	28	28	29	30	31	170
13	14	15	16	17	17	18	19	20	20	21	22	23	24	24	25	26	27	27	28	29	30	31	175
13	14	15	16	16	17	18	19	19	20	21	22	23	23	24	25	26	26	27	28	29	30	30	180
13	14	15	15	16	17	18	19	19	20	21	22	22	23	24	25	26	26	27	28	29	29	30	185
13	14	15	15	16	17	18	18	19	20	21	22	22	23	24	25	25	26	27	28	29	29	30	190
13	14	14	15	16	17	18	18	19	20	21	21	22	23	24	25	25	26	27	28	28	29	30	195
13	14	14	15	16	17	17	18	19	20	21	21	22	23	24	24	25	26	27	28	28	29	30	200

Years to Boring Height

Site Index	5	6	7	8	9	10	11-12	13-14	15-16	17-21	22-27	28-40	41+
Correct yrs	21	18	16	14	13	12	11	10	9	8	7	6	5

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Figure A.54 Lw – Western Larch – Provincial.

Table of Site Index by Breast Height Age and Height
Species: Pli – Lodgepole Pine - Provincial

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Site Index (m)																						
10	19	22	25	28	31	33	36	38	41	43	45	47	49										
15	13	16	18	20	22	24	26	28	30	32	34	35	37	39	40	42	44	45	47	48	50		
20	11	12	14	16	18	20	21	23	24	26	27	29	30	32	33	35	36	38	39	40	42	43	44
25	9	10	12	14	15	17	18	19	21	22	24	25	26	28	29	30	31	33	34	35	36	38	39
30	8	9	10	12	13	14	16	17	18	20	21	22	23	25	26	27	28	29	30	32	33	34	35
35	7	8	9	11	12	13	14	15	17	18	19	20	21	22	23	25	26	27	28	29	30	31	32
40	6	7	8	9	11	12	13	14	15	16	17	18	19	21	22	23	24	25	26	27	28	29	30
45	5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	6	7	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
60		5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20	21	22	23	24	25
65		5	6	7	7	8	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23	24
70		5	5	6	7	8	9	10	10	11	12	13	14	15	16	17	18	19	20	20	21	22	23
75			5	6	7	8	8	9	10	11	12	13	13	14	15	16	17	18	19	20	21	22	23
80			5	6	6	7	8	9	10	10	11	12	13	14	15	16	17	17	18	19	20	21	22
85			5	5	6	7	8	8	9	10	11	12	13	13	14	15	16	17	18	19	20	21	22
90			5	5	6	7	7	8	9	10	11	11	12	13	14	15	16	17	17	18	19	20	21
95				5	6	6	7	8	9	9	10	11	12	13	14	14	15	16	17	18	19	20	21
100				5	6	6	7	8	8	9	10	11	12	12	13	14	15	16	17	18	18	19	20
105				5	5	6	7	7	8	9	10	11	11	12	13	14	15	16	16	17	18	19	20
110				5	5	6	6	7	8	9	9	10	11	12	13	14	14	15	16	17	18	19	20
115					5	6	6	7	8	8	9	10	11	12	12	13	14	15	16	17	18	18	19
120					5	5	6	7	8	8	9	10	11	11	12	13	14	15	16	16	17	18	19
125					5	5	6	7	7	8	9	10	10	11	12	13	14	15	15	16	17	18	19
130					5	5	6	7	7	8	9	9	10	11	12	13	13	14	15	16	17	18	19
135					5	5	6	6	7	8	8	9	10	11	12	12	13	14	15	16	17	18	18
140						5	6	6	7	8	8	9	10	11	11	12	13	14	15	16	16	17	18
145						5	5	6	7	7	8	9	10	10	11	12	13	14	15	15	16	17	18
150						5	5	6	7	7	8	9	10	10	11	12	13	14	14	15	16	17	18
155						5	5	6	7	7	8	9	9	10	11	12	13	13	14	15	16	17	18
160						5	5	6	6	7	8	9	9	10	11	12	12	13	14	15	16	17	18
165						5	5	6	6	7	8	8	9	10	11	12	12	13	14	15	16	17	17
170							5	6	6	7	8	8	9	10	11	11	12	13	14	15	16	16	17
175							5	6	6	7	7	8	9	10	10	11	12	13	14	15	15	16	17
180							5	5	6	7	7	8	9	10	10	11	12	13	14	14	15	16	17
185							5	5	6	7	7	8	9	9	10	11	12	13	14	14	15	16	17
190							5	5	6	7	7	8	9	9	10	11	12	13	13	14	15	16	17
195							5	5	6	6	7	8	9	9	10	11	12	12	13	14	15	16	17
200							5	5	6	6	7	8	8	9	10	11	12	12	13	14	15	16	17

Years to Boring Height

Site Index	5	6	7	8	9	10-11	12-14	15-17	18-21	22-26	27-36	37+
Correct yrs	16	14	12	11	10	9	8	7	6	5	4	3

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Nigh (1999)

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Table of Site Index by Breast Height Age and Height
Species: Pli – Lodgepole Pine - Provincial

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
Site Index (m)																							
																							10
																							15
46	47	48	49																				20
40	41	42	44	45	46	47	48	50															25
36	37	38	40	41	42	43	44	45	46	47	49	50											30
33	34	36	37	38	39	40	41	42	43	44	45	46	47	48	49								35
31	32	33	34	35	36	37	39	40	41	42	43	44	45	46	47	48	49	50					40
29	30	31	32	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	55
26	27	28	29	30	31	32	33	34	35	36	37	37	38	39	40	41	42	43	44	45	46	47	60
25	26	27	28	29	30	31	32	33	34	35	36	37	37	38	39	40	41	42	43	44	45	46	65
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	40	41	42	43	44	45	70
24	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	75
23	24	25	26	27	28	29	30	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	80
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	38	39	40	41	42	43	85
22	23	24	25	26	27	28	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	90
22	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	37	38	39	40	41	42	95
21	22	23	24	25	26	27	28	29	29	30	31	32	33	34	35	36	37	38	39	40	41	42	100
21	22	23	24	25	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	40	41	105
21	21	22	23	24	25	26	27	28	29	30	31	32	33	33	34	35	36	37	38	39	40	41	110
20	21	22	23	24	25	26	27	28	28	29	30	31	32	33	34	35	36	37	38	39	40	41	115
20	21	22	23	24	25	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	40	120
20	21	22	22	23	24	25	26	27	28	29	30	31	32	33	34	35	35	36	37	38	39	40	125
20	20	21	22	23	24	25	26	27	28	29	30	31	31	32	33	34	35	36	37	38	39	40	130
19	20	21	22	23	24	25	26	27	27	28	29	30	31	32	33	34	35	36	37	38	39	40	135
19	20	21	22	23	24	25	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	140
19	20	21	22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	36	37	38	39	145
19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	33	33	34	35	36	37	38	39	150
19	19	20	21	22	23	24	25	26	27	28	29	30	30	31	32	33	34	35	36	37	38	39	155
18	19	20	21	22	23	24	25	26	27	28	28	29	30	31	32	33	34	35	36	37	38	39	160
18	19	20	21	22	23	24	25	26	26	27	28	29	30	31	32	33	34	35	36	37	38	39	165
18	19	20	21	22	23	24	25	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	170
18	19	20	21	22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	37	38	175
18	19	20	21	22	22	23	24	25	26	27	28	29	30	31	32	33	34	35	35	36	37	38	180
18	19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	33	33	34	35	36	37	38	185
18	19	20	20	21	22	23	24	25	26	27	28	29	30	31	31	32	33	34	35	36	37	38	190
18	19	19	20	21	22	23	24	25	26	27	28	29	29	30	31	32	33	34	35	36	37	38	195
18	18	19	20	21	22	23	24	25	26	27	28	28	29	30	31	32	33	34	35	36	37	38	200

Years to Boring Height

Site Index	5	6	7	8	9	10-11	12-14	15-17	18-21	22-26	27-36	37+
Correct yrs	16	14	12	11	10	9	8	7	6	5	4	3

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Figure A.55 Pli – Lodgepole Pine - Provincial.

Table of Site Index by Breast Height Age and Height
Species: Pw – Western White Pine - Provincial

Age	Top Height (m)																						
@ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Site Index (m)																						
10	25	29	32	35	37	40	42	44	46	48	50												
15	18	21	24	26	28	30	32	34	36	38	39	41	42	44	45	47	48	49					
20	14	17	19	21	23	25	26	28	30	31	33	34	35	37	38	39	41	42	43	44	45	46	48
25	11	13	15	17	19	20	22	24	25	26	28	29	30	32	33	34	35	36	38	39	40	41	42
30	9	11	13	14	16	17	19	20	22	23	24	25	27	28	29	30	31	32	34	35	36	37	38
35	8	9	11	12	14	15	16	17	19	20	21	22	24	25	26	27	28	29	30	31	32	33	34
40	6	8	9	10	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28	30	31	32
45	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55		5	6	7	8	9	10	11	12	13	14	14	15	16	17	18	19	20	21	22	23	24	25
60		5	6	6	7	8	9	10	11	11	12	13	14	15	16	17	18	19	20	20	21	22	23
65			5	6	7	7	8	9	10	10	11	12	13	14	14	15	16	17	18	19	20	21	22
70			5	5	6	7	7	8	9	9	10	11	12	13	13	14	15	16	17	18	19	20	20
75				5	6	6	7	7	8	9	9	10	11	12	12	13	14	15	16	16	17	18	19
80				5	5	6	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	17	18
85					5	5	6	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	17
90						5	5	6	6	7	7	8	9	9	10	11	11	12	13	13	14	15	16
95						5	5	6	6	6	7	8	8	9	9	10	10	11	12	13	13	14	15
100							5	5	6	6	7	7	8	8	9	9	10	10	11	12	13	13	14
105							5	5	5	6	6	7	7	8	8	9	9	10	10	11	12	13	13
110								5	5	5	6	6	7	7	8	8	9	9	10	10	11	12	13
115									5	5	6	6	6	7	7	8	8	9	9	10	11	11	12
120									5	5	5	6	6	6	7	7	8	8	9	9	10	11	11
125										5	5	5	6	6	7	7	7	8	8	9	9	10	11
130											5	5	5	6	6	7	7	7	8	8	9	10	10
135											5	5	5	6	6	6	7	7	8	8	9	9	10
140												5	5	5	6	6	6	7	7	8	8	9	9
145												5	5	5	5	6	6	6	7	7	8	8	9
150													5	5	5	6	6	6	7	7	7	8	8
155														5	5	5	6	6	6	7	7	8	8
160														5	5	5	5	6	6	6	7	7	8
165															5	5	5	6	6	6	7	7	7
170															5	5	5	5	6	6	6	7	7
175																5	5	5	5	6	6	6	7
180																	5	5	5	6	6	6	7
185																	5	5	5	5	6	6	6
190																		5	5	5	5	6	6
195																		5	5	5	5	6	6
200																			5	5	5	5	6

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12-13	14-15	16-17	18-20	21-25	26-33	34-47	48+
Correct yrs	26	23	20	18	16	15	14	13	12	11	10	9	8	7	6

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Curtis, Diaz, and Clendenen (1990)

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Table of Site Index by Breast Height Age and Height
Species: Pw – Western White Pine - Provincial

Top Height (m)																							Age
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	@ bh
Site Index (m)																							
																							10
																							15
49	50																						20
43	44	45	46	47	48	49	50																25
39	40	41	42	43	44	45	46	47	48	48	49	50											30
35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50								35
33	34	35	36	37	37	38	39	40	41	42	43	44	45	46	47	48	49	50					40
30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	44	45	46	47	48	49	55
24	25	26	27	28	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	47	48	60
23	24	25	26	27	28	29	30	31	32	33	34	36	37	38	39	40	41	42	43	44	46	47	65
21	22	23	24	26	27	28	29	30	31	32	33	34	35	37	38	39	40	41	42	44	45	46	70
20	21	22	23	24	25	26	28	29	30	31	32	33	34	36	37	38	39	40	42	43	44	45	75
19	20	21	22	23	24	25	26	27	29	30	31	32	33	35	36	37	38	40	41	42	43	44	80
18	19	20	21	22	23	24	25	26	28	29	30	31	33	34	35	36	38	39	40	41	43	44	85
17	18	19	20	21	22	23	24	25	27	28	29	30	32	33	34	36	37	38	39	41	42	43	90
16	17	18	19	20	21	22	23	24	26	27	28	30	31	32	34	35	36	38	39	40	42	43	95
15	16	17	18	19	20	21	22	24	25	26	27	29	30	31	33	34	36	37	38	40	41	42	100
14	15	16	17	18	19	20	21	23	24	25	27	28	29	31	32	34	35	36	38	39	40	42	105
13	14	15	16	17	18	19	21	22	23	24	26	27	29	30	32	33	34	36	37	39	40	41	110
13	13	14	15	16	17	18	20	21	22	24	25	26	28	29	31	32	34	35	37	38	40	41	115
12	13	14	15	16	17	18	19	20	21	23	24	26	27	29	30	32	33	35	36	38	39	40	120
11	12	13	14	15	16	17	18	19	21	22	24	25	27	28	30	31	33	34	36	37	39	40	125
11	12	12	13	14	15	16	17	19	20	21	23	24	26	28	29	31	32	34	35	37	38	40	130
10	11	12	13	13	14	16	17	18	19	21	22	24	25	27	28	30	32	33	35	36	38	39	135
10	10	11	12	13	14	15	16	17	19	20	22	23	25	26	28	29	31	33	34	36	37	39	140
9	10	11	11	12	13	14	15	17	18	19	21	22	24	26	27	29	31	32	34	35	37	38	145
9	10	10	11	12	13	14	15	16	17	19	20	22	23	25	27	28	30	32	33	35	36	38	150
9	9	10	10	11	12	13	14	15	17	18	20	21	23	25	26	28	29	31	33	34	36	37	155
8	9	9	10	11	12	12	14	15	16	17	19	21	22	24	26	27	29	31	32	34	35	37	160
8	8	9	10	10	11	12	13	14	15	17	18	20	22	23	25	27	28	30	32	33	35	36	165
8	8	9	9	10	11	11	12	14	15	16	18	19	21	23	25	26	28	30	31	33	35	36	170
7	8	8	9	9	10	11	12	13	14	16	17	19	21	22	24	26	27	29	31	32	34	36	175
7	7	8	8	9	10	11	11	12	14	15	17	18	20	22	23	25	27	29	30	32	34	35	180
7	7	8	8	9	9	10	11	12	13	14	16	18	19	21	23	25	26	28	30	32	33	35	185
7	7	7	8	8	9	10	11	12	13	14	15	17	19	21	22	24	26	28	29	31	33	34	190
6	7	7	8	8	9	9	10	11	12	13	15	16	18	20	22	24	25	27	29	31	32	34	195
6	6	7	7	8	8	9	10	11	12	13	14	16	18	19	21	23	25	27	28	30	32	33	200

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12-13	14-15	16-17	18-20	21-25	26-33	34-47	48+
Correct yrs	26	23	20	18	16	15	14	13	12	11	10	9	8	7	6

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Figure A.56 Pw – Western White Pine – Provincial.

Table of Site Index by Breast Height Age and Height
Species: Py – Ponderosa Pine - Provincial

Top Height (m) / Site Index (m)

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
10	22	27	32	37	42	47																	
15	14	18	21	25	28	31	34	38	41	44	47	50											
20	11	13	16	18	21	23	26	28	31	33	35	38	40	42	45	47	49						
25	9	11	13	15	17	19	21	23	25	26	28	30	32	34	36	38	40	41	43	45	47	49	
30	8	9	11	13	14	16	17	19	21	22	24	25	27	29	30	32	33	35	36	38	40	41	43
35	7	8	9	11	12	14	15	16	18	19	21	22	23	25	26	27	29	30	32	33	34	36	37
40	6	7	8	10	11	12	13	15	16	17	18	19	21	22	23	24	26	27	28	29	30	32	33
45	5	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28	30
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	18	19	20	21	22	23	24	25
60		5	6	7	8	9	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22	22	23
65		5	6	7	7	8	9	10	10	11	12	13	14	15	15	16	17	18	19	19	20	21	22
70		5	5	6	7	8	8	9	10	11	11	12	13	14	14	15	16	17	18	18	19	20	21
75			5	6	7	7	8	9	9	10	11	12	12	13	14	14	15	16	17	17	18	19	20
80			5	6	6	7	8	8	9	10	10	11	12	12	13	14	14	15	16	17	17	18	19
85			5	5	6	7	7	8	9	9	10	11	11	12	13	13	14	15	15	16	17	17	18
90			5	5	6	6	7	8	8	9	10	10	11	11	12	13	13	14	15	15	16	17	17
95				5	6	6	7	7	8	9	9	10	10	11	12	12	13	13	14	15	15	16	17
100				5	5	6	7	7	8	8	9	9	10	11	11	12	12	13	14	14	15	15	16
105				5	5	6	6	7	7	8	9	9	10	10	11	11	12	13	13	14	14	15	16
110				5	5	6	6	7	7	8	8	9	9	10	11	11	12	12	13	13	14	15	15
115					5	5	6	7	7	8	8	9	9	10	10	11	11	12	13	13	14	14	15
120					5	5	6	6	7	7	8	8	9	10	10	11	11	12	12	13	13	14	14
125					5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	14	14
130					5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14
135					5	5	6	6	6	7	7	8	8	9	9	10	10	11	11	12	13	13	14
140						5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13
145						5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13
150						5	5	6	6	7	7	8	8	8	9	9	10	10	11	11	12	12	13
155						5	5	6	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13
160						5	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13
165						5	5	5	6	6	7	7	8	8	9	9	9	10	10	11	11	12	12
170						5	5	5	6	6	7	7	8	8	8	9	9	10	10	11	11	12	12
175							5	5	6	6	7	7	7	8	8	9	9	10	10	11	11	12	12
180							5	5	6	6	6	7	7	8	8	9	9	10	10	11	11	12	12
185							5	5	6	6	6	7	7	8	8	9	9	10	10	10	11	11	12
190							5	5	6	6	6	7	7	8	8	9	9	9	10	10	11	11	12
195							5	5	5	6	6	7	7	8	8	8	9	9	10	10	11	11	12
200							5	5	5	6	6	7	7	8	8	8	9	9	10	10	11	11	12

Years to Boring Height

Site Index	5	6	7	8	9-10	11-14	15-22	23-47	48+
Correct yrs	14	13	12	11	10	9	8	7	6

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Hann and Scrivani (1986)

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Table of Site Index by Breast Height Age and Height
Species: Py – Ponderosa Pine - Provincial

Top Height (m) / Site Index (m)

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
																							10
																							15
																							20
																							25
44	46	47	49	50																			30
38	40	41	42	44	45	46	48	49	50														35
34	35	36	38	39	40	41	42	44	45	46	47	48	50										40
31	32	33	34	35	36	37	38	39	40	42	43	44	45	46	47	48	49	50					45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
26	27	28	29	30	31	31	32	33	34	35	36	37	38	39	40	41	42	43	44	44	45	46	55
24	25	26	27	28	28	29	30	31	32	33	34	35	35	36	37	38	39	40	41	42	42	43	60
23	23	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	37	37	38	39	40	41	65
21	22	23	24	25	25	26	27	28	28	29	30	31	32	32	33	34	35	36	36	37	38	39	70
20	21	22	23	23	24	25	26	26	27	28	29	29	30	31	32	32	33	34	35	35	36	37	75
19	20	21	22	22	23	24	24	25	26	27	27	28	29	29	30	31	32	32	33	34	35	35	80
19	19	20	21	21	22	23	23	24	25	25	26	27	28	28	29	30	30	31	32	33	33	34	85
18	19	19	20	21	21	22	23	23	24	25	25	26	27	27	28	29	29	30	31	31	32	33	90
17	18	19	19	20	20	21	22	22	23	24	24	25	26	26	27	28	28	29	30	30	31	32	95
17	17	18	19	19	20	20	21	22	22	23	24	24	25	26	26	27	28	28	29	29	30	31	100
16	17	17	18	19	19	20	20	21	22	22	23	24	24	25	25	26	27	27	28	29	29	30	105
16	16	17	18	18	19	19	20	21	21	22	22	23	24	24	25	25	26	27	27	28	29	29	110
15	16	17	17	18	18	19	19	20	21	21	22	22	23	24	24	25	25	26	27	27	28	29	115
15	16	16	17	17	18	18	19	20	20	21	21	22	23	23	24	24	25	26	26	27	27	28	120
15	15	16	16	17	17	18	19	19	20	20	21	22	22	23	23	24	24	25	26	26	27	27	125
14	15	15	16	17	17	18	18	19	19	20	21	21	22	22	23	23	24	25	25	26	26	27	130
14	15	15	16	16	17	17	18	19	19	20	20	21	21	22	22	23	24	24	25	25	26	27	135
14	14	15	15	16	17	17	18	18	19	19	20	20	21	22	22	23	23	24	24	25	26	26	140
14	14	15	15	16	16	17	17	18	18	19	20	20	21	21	22	22	23	24	24	25	25	26	145
13	14	14	15	16	16	17	17	18	18	19	19	20	20	21	22	22	23	23	24	24	25	25	150
13	14	14	15	15	16	16	17	17	18	19	19	20	20	21	21	22	22	23	23	24	25	25	155
13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	22	22	23	23	24	24	25	160
13	13	14	14	15	15	16	17	17	18	18	19	19	20	20	21	21	22	22	23	24	24	25	165
13	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	21	22	22	23	23	24	24	170
13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	23	23	24	24	175
13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	24	24	180
12	13	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	21	22	22	23	23	24	185
12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	22	22	23	23	24	190
12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	23	23	24	195
12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	200

Years to Boring Height

Site Index	5	6	7	8	9-10	11-14	15-22	23-47	48+
Correct yrs	14	13	12	11	10	9	8	7	6

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Figure A.57 Py – Ponderosa Pine – Provincial.

Table of Site Index by Breast Height Age and Height
Species: Sb – Black Spruce – Provincial

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Site Index (m)																						
10	17	20	23	25	27	29	32	34	35	37	39	41	43	44	46	47	49						
15	13	15	17	19	21	23	25	27	28	30	31	33	34	36	37	39	40	41	43	44	45	47	48
20	10	12	14	16	18	19	21	22	24	25	27	28	29	31	32	33	35	36	37	38	39	41	42
25	9	10	12	14	15	17	18	19	21	22	23	25	26	27	28	30	31	32	33	34	35	37	38
30	8	9	10	12	13	15	16	17	18	20	21	22	23	24	26	27	28	29	30	31	32	33	35
35	7	8	9	11	12	13	14	15	17	18	19	20	21	22	23	25	26	27	28	29	30	31	32
40	6	7	8	10	11	12	13	14	15	16	17	19	20	21	22	23	24	25	26	27	28	29	30
45	5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
60		5	6	7	8	9	10	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
65		5	6	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20	21	22	23	24
70		5	5	6	7	8	8	9	10	11	12	13	14	14	15	16	17	18	19	20	21	22	23
75			5	6	7	7	8	9	10	10	11	12	13	14	15	16	16	17	18	19	20	21	22
80			5	5	6	7	8	8	9	10	11	12	12	13	14	15	16	17	18	19	19	20	21
85			5	5	6	7	7	8	9	9	10	11	12	13	13	14	15	16	17	18	19	20	21
90				5	6	6	7	8	8	9	10	11	11	12	13	14	15	15	16	17	18	19	20
95				5	5	6	7	7	8	9	9	10	11	12	12	13	14	15	16	17	18	19	19
100				5	5	6	6	7	8	8	9	10	10	11	12	13	14	14	15	16	17	18	19
105					5	6	6	7	7	8	9	9	10	11	12	12	13	14	15	16	17	18	18
110					5	5	6	6	7	8	8	9	10	10	11	12	13	14	14	15	16	17	18
115					5	5	6	6	7	7	8	9	9	10	11	12	12	13	14	15	16	17	18
120						5	5	6	7	7	8	8	9	10	10	11	12	13	14	14	15	16	17
125						5	5	6	6	7	8	8	9	9	10	11	12	12	13	14	15	16	17
130						5	5	6	6	7	7	8	8	9	10	11	11	12	13	14	15	15	16
135						5	5	5	6	6	7	8	8	9	10	10	11	12	13	13	14	15	16
140							5	5	6	6	7	7	8	9	9	10	11	11	12	13	14	15	16
145							5	5	6	6	7	7	8	8	9	10	10	11	12	13	14	14	15
150							5	5	5	6	6	7	8	8	9	9	10	11	12	12	13	14	15
155								5	5	6	6	7	7	8	9	9	10	11	11	12	13	14	15
160								5	5	6	6	7	7	8	8	9	10	10	11	12	13	14	14
165								5	5	5	6	6	7	8	8	9	9	10	11	12	12	13	14
170								5	5	5	6	6	7	7	8	9	9	10	11	11	12	13	14
175									5	5	6	6	7	7	8	8	9	10	10	11	12	13	14
180									5	5	6	6	6	7	8	8	9	9	10	11	12	13	13
185									5	5	5	6	6	7	7	8	9	9	10	11	11	12	13
190										5	5	6	6	7	7	8	8	9	10	10	11	12	13
195										5	5	6	6	7	7	8	8	9	10	10	11	12	13
200										5	5	5	6	6	7	7	8	9	9	10	11	12	12

Years to Boring Height

Site Index	5	6	7	8	9	10-11	12-13	14-17	18-24	25-41	42
Correct yrs	23	21	20	19	18	17	16	15	14	13	12

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Alberta Forest Service (1985)

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Table of Site Index by Breast Height Age and Height
Species: Sb – Black Spruce - Provincial

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
Site Index (m)																							
																							10
49	50																						15
43	44	45	46	48	49	50																	20
39	40	41	42	43	44	45	46	48	49	50													25
36	37	38	39	40	41	42	43	44	45	46	47	48	49	50									30
33	34	35	36	37	38	39	40	41	43	44	45	46	47	48	49	50							35
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50				40
29	30	31	32	34	34	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	55
26	27	28	29	30	31	32	33	34	35	36	37	38	38	39	40	41	42	43	44	45	46	47	60
25	26	27	28	29	30	31	32	33	33	34	35	36	37	38	39	40	41	42	43	44	45	46	65
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	70
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	75
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	80
22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	85
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	90
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	95
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	100
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	105
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	110
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	115
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	120
18	19	19	20	21	22	23	24	25	26	27	28	29	30	31	32	34	35	36	37	38	39	40	125
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	130
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	135
17	17	18	19	20	21	22	23	24	25	26	27	28	29	30	32	33	34	35	36	37	38	39	140
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	39	145
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	150
16	17	17	18	19	20	21	22	23	24	25	27	28	29	30	31	32	33	34	35	36	37	38	155
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	33	34	35	36	37	38	160
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	37	38	165
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	170
15	15	16	17	18	19	20	21	22	23	24	26	27	28	29	30	31	32	33	34	35	36	37	175
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	30	31	32	33	34	35	36	37	180
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	33	34	35	36	37	185
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	35	36	37	190
14	15	15	16	17	18	19	20	22	23	24	25	26	27	28	29	30	31	32	33	34	35	37	195
13	14	15	16	17	18	19	20	21	22	23	25	26	27	28	29	30	31	32	33	34	35	36	200

Years to Boring Height

Site Index	5	6	7	8	9	10-11	12-13	14-17	18-24	25-41	42
Correct yrs	23	21	20	19	18	17	16	15	14	13	12

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Figure A.58 Sb – Black Spruce – Provincial.

Table of Site Index by Breast Height Age and Height
Species: Ss- Sitka Spruce - Provincial

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	Top Height (m) / **Site Index (m)**																
10	24	29	33	37	40	44	47	50	53	56	59	62	65	68			
15	16	20	23	25	28	31	33	36	38	40	43	45	47	49	51	53	55
20	12	15	17	19	22	24	26	28	30	32	34	35	37	39	41	42	44
25	10	12	14	16	18	19	21	23	24	26	28	29	31	32	34	35	37
30	8	10	12	13	15	16	18	19	21	22	24	25	27	28	29	31	32
35	7	8	10	11	13	14	15	17	18	19	21	22	23	24	26	27	28
40	6	7	9	10	11	12	14	15	16	17	18	20	21	22	23	24	25
45	6	7	8	9	10	11	12	13	14	15	17	18	19	20	21	22	23
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
55	5	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18	19
60		5	6	7	8	8	9	10	11	12	13	14	14	15	16	17	18
65		5	5	6	7	8	9	9	10	11	12	13	13	14	15	16	17
70			5	6	7	7	8	9	9	10	11	12	13	13	14	15	16
75			5	5	6	7	7	8	9	10	10	11	12	13	13	14	15
80			5	5	6	6	7	8	8	9	10	10	11	12	13	13	14
85				5	5	6	7	7	8	9	9	10	10	11	12	13	13
90				5	5	6	6	7	7	8	9	9	10	11	11	12	13
95					5	5	6	7	7	8	8	9	9	10	11	11	12
100					5	5	6	6	7	7	8	8	9	10	10	11	12
105						5	5	6	6	7	8	8	9	9	10	10	11
110						5	5	6	6	7	7	8	8	9	9	10	11
115						5	5	5	6	6	7	7	8	8	9	10	10
120							5	5	6	6	7	7	8	8	9	9	10
125							5	5	5	6	6	7	7	8	8	9	9
130								5	5	6	6	7	7	8	8	9	9
135								5	5	6	6	6	7	7	8	8	9
140								5	5	5	6	6	7	7	8	8	9
145									5	5	6	6	6	7	7	8	8
150									5	5	5	6	6	7	7	8	8
155									5	5	5	6	6	6	7	7	8
160										5	5	5	6	6	7	7	8
165										5	5	5	6	6	6	7	7
170											5	5	6	6	6	7	7
175											5	5	5	6	6	7	7
180											5	5	5	6	6	6	7
185												5	5	5	6	6	7
190												5	5	5	6	6	6
195												5	5	5	6	6	6
200													5	5	5	6	6

Years to Boring Height

Site Index	10–11	12-17	18-22	23-28	29-33	34-38	39-44	45-49	50+
Correct yrs	10	9	8	7	6	5	4	3	2

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Nigh (1997)

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Table of Site Index by Breast Height Age and Height
Species: Ss- Sitka Spruce - Provincial

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	Age @ bh
Top Height (m) / **Site Index (m)**																
																10
57	59	61														15
46	47	49	51	52	54	55	57									20
38	40	41	43	44	46	47	48	50	51	52	54	55				25
33	35	36	37	39	40	41	42	44	45	46	47	49	50	51	52	30
29	31	32	33	34	35	37	38	39	40	41	42	44	45	46	47	35
26	28	29	30	31	32	33	34	35	36	38	39	40	41	42	43	40
24	25	26	27	28	29	30	31	32	33	35	36	37	38	39	40	45
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	50
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	55
19	20	21	22	23	23	24	25	26	27	28	29	30	31	32	33	60
18	19	19	20	21	22	23	24	25	26	26	27	28	29	30	31	65
17	17	18	19	20	21	22	23	23	24	25	26	27	28	29	30	70
16	16	17	18	19	20	21	21	22	23	24	25	26	26	27	28	75
15	16	16	17	18	19	20	20	21	22	23	24	24	25	26	27	80
14	15	16	16	17	18	19	19	20	21	22	23	23	24	25	26	85
13	14	15	16	16	17	18	19	19	20	21	22	23	23	24	25	90
13	13	14	15	16	16	17	18	19	19	20	21	22	22	23	24	95
12	13	14	14	15	16	16	17	18	19	19	20	21	22	22	23	100
12	12	13	14	14	15	16	16	17	18	19	19	20	21	22	23	105
11	12	12	13	14	14	15	16	17	17	18	19	20	20	21	22	110
11	11	12	13	13	14	15	15	16	17	17	18	19	20	20	21	115
10	11	12	12	13	13	14	15	16	16	17	18	18	19	20	21	120
10	11	11	12	12	13	14	14	15	16	16	17	18	19	19	20	125
10	10	11	11	12	13	13	14	15	15	16	17	17	18	19	20	130
9	10	10	11	12	12	13	14	14	15	16	16	17	18	18	19	135
9	10	10	11	11	12	13	13	14	14	15	16	16	17	18	19	140
9	9	10	10	11	12	12	13	13	14	15	15	16	17	17	18	145
9	9	10	10	11	11	12	12	13	14	14	15	16	16	17	18	150
8	9	9	10	10	11	12	12	13	13	14	15	15	16	17	17	155
8	9	9	10	10	11	11	12	12	13	14	14	15	16	16	17	160
8	8	9	9	10	10	11	12	12	13	13	14	15	15	16	17	165
8	8	9	9	10	10	11	11	12	12	13	14	14	15	16	16	170
7	8	8	9	9	10	10	11	12	12	13	13	14	15	15	16	175
7	8	8	9	9	10	10	11	11	12	12	13	14	14	15	16	180
7	7	8	8	9	9	10	10	11	12	12	13	13	14	15	15	185
7	7	8	8	9	9	10	10	11	11	12	13	13	14	15	15	190
7	7	8	8	9	9	10	10	11	11	12	12	13	14	14	15	195
7	7	7	8	8	9	9	10	10	11	12	12	13	13	14	15	200

Years to Boring Height

Site Index	10-11	12-17	18-22	23-28	29-33	34-38	39-44	45-49	50+
Correct yrs	10	9	8	7	6	5	4	3	2

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Table of Site Index by Breast Height Age and Height
Species: Ss- Sitka Spruce - Provincial

Age	Top Height (m)																
@ bh	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
	Site Index (m)																
10																	
15																	
20																	
25																	
30	53	55															
35	48	49	50	52	53	54											
40	44	45	46	47	48	49	51	52	53								
45	41	42	43	44	45	46	47	48	49	50	51	52					
50	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52		
55	36	37	38	39	40	41	42	42	43	44	45	46	47	48	49	50	51
60	34	35	36	37	37	38	39	40	41	42	43	44	45	46	47	48	49
65	32	33	34	35	36	37	38	38	39	40	41	42	43	44	45	46	47
70	30	31	32	33	34	35	36	37	38	39	40	40	41	42	43	44	45
75	29	30	31	32	33	34	34	35	36	37	38	39	40	41	42	43	44
80	28	29	30	30	31	32	33	34	35	36	37	38	39	39	40	41	42
85	27	28	29	29	30	31	32	33	34	35	36	36	37	38	39	40	41
90	26	27	27	28	29	30	31	32	33	34	34	35	36	37	38	39	40
95	25	26	27	27	28	29	30	31	32	33	33	34	35	36	37	38	39
100	24	25	26	27	27	28	29	30	31	32	33	33	34	35	36	37	38
105	23	24	25	26	27	27	28	29	30	31	32	33	33	34	35	36	37
110	23	23	24	25	26	27	28	28	29	30	31	32	33	34	34	35	36
115	22	23	24	24	25	26	27	28	29	29	30	31	32	33	34	35	35
120	21	22	23	24	25	25	26	27	28	29	30	30	31	32	33	34	35
125	21	22	22	23	24	25	26	26	27	28	29	30	31	31	32	33	34
130	20	21	22	23	23	24	25	26	27	28	28	29	30	31	32	33	34
135	20	21	21	22	23	24	25	25	26	27	28	29	30	30	31	32	33
140	19	20	21	22	22	23	24	25	26	26	27	28	29	30	31	32	32
145	19	20	20	21	22	23	24	24	25	26	27	28	29	29	30	31	32
150	19	19	20	21	22	22	23	24	25	26	26	27	28	29	30	31	31
155	18	19	20	20	21	22	23	24	24	25	26	27	28	28	29	30	31
160	18	18	19	20	21	22	22	23	24	25	26	26	27	28	29	30	31
165	17	18	19	20	20	21	22	23	24	24	25	26	27	28	29	29	30
170	17	18	19	19	20	21	22	22	23	24	25	26	26	27	28	29	30
175	17	17	18	19	20	20	21	22	23	24	24	25	26	27	28	29	30
180	16	17	18	19	19	20	21	22	23	23	24	25	26	27	28	28	29
185	16	17	18	18	19	20	21	21	22	23	24	25	26	26	27	28	29
190	16	17	17	18	19	20	20	21	22	23	24	24	25	26	27	28	29
195	16	16	17	18	19	19	20	21	22	22	23	24	25	26	27	27	28
200	15	16	17	18	18	19	20	21	21	22	23	24	25	25	26	27	28

Years to Boring Height

Site Index	10–11	12-17	18-22	23-28	29-33	34-38	39-44	45-49	50+
Correct yrs	10	9	8	7	6	5	4	3	2

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Table of Site Index by Breast Height Age and Height
Species: Ss- Sitka Spruce - Provincial

Top Height (m)																Age
55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	@ bh
Site Index (m)																
																10
																15
																20
																25
																30
																35
																40
																45
																50
																55
50	51															60
48	49	50	51													65
46	47	48	49	50	51											70
45	45	46	47	48	49	50										75
43	44	45	46	47	48	49	50	51								80
42	43	44	45	45	46	47	48	49	50							85
41	42	43	43	44	45	46	47	48	49	50						90
40	41	41	42	43	44	45	46	47	48	49	50					95
39	40	41	41	42	43	44	45	46	47	48	49	50				100
38	39	40	41	41	42	43	44	45	46	47	48	49	50			105
37	38	39	40	41	42	42	43	44	45	46	47	48	49	50		110
36	37	38	39	40	41	42	43	44	44	45	46	47	48	49	50	115
36	36	37	38	39	40	41	42	43	44	45	46	46	47	48	49	120
35	36	37	38	39	39	40	41	42	43	44	45	46	47	48	49	125
34	35	36	37	38	39	40	41	42	42	43	44	45	46	47	48	130
34	35	36	36	37	38	39	40	41	42	43	44	45	46	46	47	135
33	34	35	36	37	38	39	40	40	41	42	43	44	45	46	47	140
33	34	35	35	36	37	38	39	40	41	42	43	44	45	45	46	145
32	33	34	35	36	37	38	39	39	40	41	42	43	44	45	46	150
32	33	34	35	35	36	37	38	39	40	41	42	43	44	45	45	155
32	32	33	34	35	36	37	38	39	40	40	41	42	43	44	45	160
31	32	33	34	35	36	36	37	38	39	40	41	42	43	44	45	165
31	32	33	33	34	35	36	37	38	39	40	41	42	42	43	44	170
30	31	32	33	34	35	36	37	38	38	39	40	41	42	43	44	175
30	31	32	33	34	35	35	36	37	38	39	40	41	42	43	44	180
30	31	32	32	33	34	35	36	37	38	39	40	41	41	42	43	185
29	30	31	32	33	34	35	36	37	38	38	39	40	41	42	43	190
29	30	31	32	33	34	35	35	36	37	38	39	40	41	42	43	195
29	30	31	32	32	33	34	35	36	37	38	39	40	41	42	43	200

Years to Boring Height

Site Index	10-11	12-17	18-22	23-28	29-33	34-38	39-44	45-49	50+
Correct yrs	10	9	8	7	6	5	4	3	2

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Figure A.59 Ss – Sitka Spruce - Provincial.

Table of Site Index by Breast Height Age and Height
Species: Sw – White Spruce and Englemann Spruce – Provincial

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Site Index (m)																						
10	23	27	31	34	36	39	42	44	47	49													
15	16	19	22	24	27	29	31	33	35	37	39	40	42	44	45	47	49	50					
20	13	15	17	19	21	23	25	26	28	30	31	33	34	36	37	39	40	42	43	44	46	47	48
25	10	12	14	16	17	19	21	22	24	25	27	28	29	31	32	33	35	36	37	38	40	41	42
30	8	10	12	13	15	16	18	19	20	22	23	24	26	27	28	29	30	32	33	34	35	36	37
35	7	9	10	11	13	14	15	17	18	19	20	22	23	24	25	26	27	28	30	31	32	33	34
40	6	8	9	10	11	12	14	15	16	17	18	19	20	22	23	24	25	26	27	28	29	30	31
45	6	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28	29
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	20	21	22	23	24	25
60		5	6	7	7	8	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22	23	24
65		5	5	6	7	8	8	9	10	11	12	13	13	14	15	16	17	18	19	20	21	22	23
70			5	6	6	7	8	9	9	10	11	12	13	13	14	15	16	17	18	19	20	21	22
75			5	5	6	7	7	8	9	9	10	11	12	13	13	14	15	16	17	18	19	20	21
80				5	6	6	7	7	8	9	10	10	11	12	13	13	14	15	16	17	18	19	20
85				5	5	6	6	7	8	8	9	10	10	11	12	13	14	14	15	16	17	18	19
90					5	5	6	7	7	8	9	9	10	11	11	12	13	14	15	15	16	17	18
95					5	5	6	6	7	7	8	9	9	10	11	12	12	13	14	15	16	16	17
100						5	5	6	6	7	8	8	9	10	10	11	12	12	13	14	15	16	17
105						5	5	6	6	7	7	8	8	9	10	10	11	12	13	13	14	15	16
110							5	5	6	6	7	7	8	9	9	10	11	11	12	13	14	15	15
115							5	5	6	6	7	7	8	8	9	10	10	11	12	12	13	14	15
120								5	5	6	6	7	7	8	9	9	10	10	11	12	13	14	14
125								5	5	6	6	7	7	8	8	9	9	10	11	12	12	13	14
130								5	5	5	6	6	7	7	8	8	9	10	10	11	12	13	13
135									5	5	6	6	6	7	8	8	9	9	10	11	11	12	13
140									5	5	5	6	6	7	7	8	8	9	10	10	11	12	13
145										5	5	6	6	6	7	7	8	9	9	10	11	11	12
150										5	5	5	6	6	7	7	8	8	9	10	10	11	12
155											5	5	6	6	6	7	7	8	9	9	10	11	12
160											5	5	5	6	6	7	7	8	8	9	10	10	11
165												5	5	6	6	6	7	8	8	9	9	10	11
170												5	5	5	6	6	7	7	8	8	9	10	11
175												5	5	5	6	6	7	7	8	8	9	10	10
180													5	5	5	6	6	7	7	8	9	9	10
185													5	5	5	6	6	7	7	8	8	9	10
190														5	5	6	6	6	7	7	8	9	9
195														5	5	5	6	6	7	7	8	8	9
200														5	5	5	6	6	7	7	8	8	9

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12-13	14-15	16-17	18-20	21-25	26-33	34-47	48+
Correct yrs	30	27	24	22	20	19	18	17	16	15	14	13	12	11	10

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Goudie (1984) (natural)

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Table of Site Index by Breast Height Age and Height
Species: Sw – White Spruce and Englemann Spruce – Provincial

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
Site Index (m)																							
																							10
																							15
49																							20
43	44	45	47	48	49	50																	25
39	40	41	42	43	44	45	46	47	48	50													30
35	36	37	38	39	40	41	43	44	45	46	47	48	49	50									35
32	33	34	35	36	37	38	40	41	42	43	44	45	46	47	48	49	50						40
30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	55
25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	60
24	25	26	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	65
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	70
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	75
21	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	80
20	21	22	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	85
19	20	21	22	23	24	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	90
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	95
18	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	100
17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	39	105
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	110
16	17	18	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	38	115
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	120
15	16	17	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	34	35	36	37	125
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	130
14	15	16	17	17	18	19	20	21	22	23	24	25	26	28	29	30	31	32	33	34	35	36	135
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	35	36	140
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	145
13	14	14	15	16	17	18	19	20	21	22	23	24	25	26	28	29	30	31	32	33	34	35	150
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	33	34	35	155
12	13	14	15	16	17	17	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	160
12	12	13	14	15	16	17	18	19	20	21	22	23	24	26	27	28	29	30	31	32	33	34	165
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	29	30	31	32	33	34	170
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	32	33	34	175
11	12	12	13	14	15	16	17	18	19	20	22	23	24	25	26	27	28	29	30	31	32	34	180
10	11	12	13	14	15	16	17	18	19	20	21	22	23	25	26	27	28	29	30	31	32	33	185
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	27	28	29	30	31	32	33	190
10	11	12	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	29	30	31	32	33	195
10	10	11	12	13	14	15	16	17	18	19	21	22	23	24	25	26	27	28	29	31	32	33	200

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12-13	14-15	16-17	18-20	21-25	26-33	34-47	48+
Correct yrs	30	27	24	22	20	19	18	17	16	15	14	13	12	11	10

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Figure A.60 Sw – White and Englemann Spruce - Provincial.

Appendix 10 CGNF Standards and Procedures for the Coast Forest Region

For the Coast Forest Region, the effective date is November 1, 2006 (optional) or January 1, 2007 (mandatory).

The *CGNF Standards and Procedures for the Coast Forest Region* is available at:

http://www.for.gov.bc.ca/hva/manuals/cgnf.htm

Glossary

Accuracy	The nearness of a measurement to the actual value of the variable being measured.
AAC (Allowable Annual Cut)	The rate of harvest determined by the Chief Forester for Timber Supply Areas (TSA's) and Tree Farm Licences (TFL's), and by the District Manager for Woodlot Licences (WL's), and the rate of harvest specified for a licence or in a management plan.
Absolute Variation	The difference between two measurements or a standard and a measurement, disregarding the plus or minus sign (e.g., standard of 7 and measurement of 5 gives absolute variation of 2).
BAF (Basal Area Factor)	Basal Area Factor or "BAF". Prisms come in a wide variety of sizes. They are classified by "diopter" size. The size denotes the basal area per hectare that each "in" tree represents (i.e., an 8 prism which tallies 7 trees in a plot would give a basal area (in timber) of 56 m^2/hectare).
Bias	Measurement bias occurs when the mean of the measured values differs from the mean of the actual values. Sampling bias occurs when certain sampling units are more likely to be included than others (lack of randomness). Statistical bias occurs when the expected value of the statistic differs from the population parameter.
Boring-Height	The boring-height is the distance from the ground (high-side) up the tree to where an age is taken with an increment-borer. It is always taken at dbh (1.3 m) above high-side.
Breakage	Breakage is defined as any piece broken at both ends and shorter than 3 m which results from normal falling or yarding/forwarding operations.

Breast-Height	The location on a tree where its diameter (dbh) is taken. It is located exactly 1.3 m above "high-side".
Catastrophic Losses	Damage to timber from fire, windfall, insects or disease that inflicts losses well above the norm reflected in the forest inventory for the locality or region.
Cardinal	North, South, East and West.
Closure Error	In a closed traverse, the closure error is the distance between the start and end of the traverse, divided by the length of the traverse, and is usually expressed in percent. It can also be calculated by taking the square root of the sum of the squared sum of latitudes plus the squared sum of departures. A closure error of 1 percent will result in an area error of approximately 2 percent.
Coast	Refer to the Coast Appraisal Manual for the definition of the Coast.
Coefficient of Variation (CV)	A relative measure of variation, equal to the sample standard deviation expressed as a percentage of the sample mean.
Confidence	An expression of accuracy of sample estimates, usually assessed by confidence intervals, a specified proportion of which, such as 95 percent confidence intervals, contain the true population parameters.
Count-Plot	A prism plot where only the number of "in" trees by species is noted. No individual tree measurements are taken. Enhanced count-plots have some measurements taken as required (i.e., diameters or heights).
Crown-Class	Trees are classified into four crown classes. They are dominant, co-dominant, intermediate and overtopped (see Figure 3.10).

Cutblock	A discrete area covered by a form of licence and logged according to an approved harvesting plan.
Cutting Authority Area	The authority to harvest Crown timber, as provided by the *Forest Act*. (Cutting authority area means a Timber Sale Licence, a Licence to Cut, a Road Permit, or a cutting permit issued under a Tree Farm Licence, Forest Licence, Timber Licence or a Woodlot Licence.)
Cutting Specifications	The timber merchantability specifications in the Cutting Permit document.
DBH (Diameter Breast Height)	The outside-bark diameter of a tree taken at breast-height (1.3 m above the high side of the ground).
Decay, Waste and Breakage (DWB)	Factors to reduce the gross merchantable volume to a net utilizable volume and to approximate the provincial volume depletion due to decay, firmwood waste and breakage due to harvesting. The statutory authority to allow for DWB is in the *Forest Act*, Part 2, Section 8(8)iv.
DIB (Diameter Inside Bark)	The inside-bark diameter of a tree. It can be anywhere along the stem of the tree from the base to the top.
Diopter	One way of denoting prism "size". A value of one diopter represents a right-angled deflection of one unit per one hundred units in distance. The formula for converting diopter size to baf size (metric) is: baf = 10,000 / $\left[1+\left(\frac{200}{\text{diopters}}\right)^2\right]$.
Double-Sampling	This sampling method incorporates a second sampling procedure where only some of the characteristics of the main sampling method are noted. An example is measure and count-plots established on a cut-block. The major reason for using this method is the savings in time and therefore money because the count-plots take much less time to put in.
Endemic Losses	Damage to timber from normal populations of insects or disease that inflicts average losses over the long term for the locality or region. The forest inventory provides net merchantable volumes which reflect "endemic" (average or normal) losses.

Enhanced Count Plot	A count plot where some individual tree species measurements or specific tree attributes are measured to improve the estimate for the species or specific attributes.
Faller Selection	This timber falling technique applies to selection logging in cutting authorities where the cut and leave trees are not marked and the faller decides which trees to cut or leave. The decision is based on the partial cut prescription and safety considerations.
Fixed-Area Plot Sampling	A sampling method where a fixed amount of area is sampled in each plot within a stratum. All trees above the timber merchantability specifications are tallied regardless of their distance from plot centre. All plots within a stratum must be the same size and shape.
Forest Inventory Zone	British Columbia is segregated into 12 forest inventory zones. All commercial tree species were sampled for volume and decay by the Inventory Branch of the Ministry of Forests (now the Ministry of Sustainable Resources Management). All regions of the province were sampled and areas of similar timber types and climatic conditions were grouped into a common Forest Inventory Zone to produce DWB factors.
GPS (Global Positioning System)	A method of accurately determining or relocating a ground position using the signal from several satellites simultaneously. A small portable computer evaluates the time for each signal to reach it and then computes a three dimensional location.
High-Side	The position where the ground meets the tree on the (uphill side – side of the stump adjacent to highest ground), ignoring any root flare, obstacles, vegetation, and loose matter that has accumulated at the base of the tree.
Interior	Refer to the Interior Appraisal Manual for the definition of the Interior.
Licensee	The holder of the cutting authority area.

Log Grade	Those log grades that are defined in the *Scaling Regul*ation.
Major Species	Comprises 20 percent or more of total gross volume in a timber type, cut-block or cutting permit.
Minor Species	Comprises less than 20 percent of the total gross volume in a timber type, cut-block or cutting permit.
Mean (Mode & Median)	The "mean" of a set of measurements is the sum of all measurement values divided by the number of measurements. The "mode" of a set of measurements is the value which occurs most often or with the greatest frequency. The "median" of a set of measurements arranged in an increasing order of magnitude is the middle value (or arithmetic mean of the two middle values).
Merchantable	A segment of a tree at least 3 metres long with a top diameter inside bark that meets or exceeds the timber merchantability specifications.
Mean Absolute Variation	The arithmetic mean of a set of absolute variations.
Variation:	The difference, plus or minus, between two measurements or a standard and a measurement (e.g., standard of 7 and measurement of 5 gives variation of -2).
Mean Absolute Variation:	The arithmetic mean of a set of absolute variations.
100% Cruise	A cruise in which every tree is measured. There are no samples or estimates.
Partial Cutting	A variety of silviculture systems in which a stand may be cut to ensure regeneration. In a Partial Cutting system, only some of the trees are felled during the harvesting phase. The selection method may specify "removal" or "leave" trees. Some examples of selection criteria are diameter, species, volume, age, height, disease or other damage.
Pathological Indicators	They include conk, blind conk, scar, fork or crook, frost crack, mistletoe, rotten branch, and dead or broken top.
Percent Reduction	In reference to partial cutting, this refers to a specified percent reduction of the total cruise volume which is targeted to be left or to be cut and removed.

PRF (Plot Radius Factor)	In prism cruising, each tree has its own plot radius. This is a function of tree diameter (dbh) and prism baf size. The plot radius factor (prf) times the dbh gives the appropriate plot radius for any tree. The prf formula is: $prf = 0.5 / \sqrt{baf}$
Plot Sampling	The estimation of volumes and grades by species within a cut-block from sample plot measurements, and the determination of the sampling error associated with the plot estimates.
Precision	The closeness, to each other, of repeated measures of the same quantity, expressed as Sampling Error or Standard Error of the sample estimate.
Recompilation	A second or subsequent cruise compilation with some plots added or deleted, or both.
Residual	Living trees with none of the eight pathological indicators.
Risk-Group	As the name implies, this is simply a grouping by expected "risk" or probability of average decay, waste and breakage, for volume deduction by individual tree. These take the form of from one to three "risk-groups" which are individually specified for each tree species by age and location (Forest Inventory Zone) in the Province. Each risk-group (by species and location) keys to a loss factor table with volume deductions for decay, waste, and breakage. The pathological indicators place each tree into a tree-class. Various tree-classes are grouped together into one of three risk groups which in turn determine the severity of the deductions for volume.
Sampling Error (S.E.)	The expressing of the accuracy of the sampling of the cruise. It is calculated as a percent of an estimated mean to a desired probability.
Site-Class	A set of 4 site quality classes (good, medium, poor, low) which characterize the potential growth capacity of the minerals and moisture in the soil, as measured in tree height (metres) attained at the breast-height age of 50 years.

SD (Standard Deviation)	The Standard Deviation is the square root of variance. It characterizes dispersion of individuals about the mean and gives some idea whether most of the individuals in a population are close to the mean or spread out. On the average, about two-thirds of the unit values of a normal population will be within one standard deviation of the mean. About 95 percent will be within two standard deviations and about 99 percent within 2.6 standard deviations.
Stratum	A specified portion of a subpopulation area for which separate volumes and sampling statistics are calculated. A subpopulation may be made up of one or many strata.
Stratification	The process of delineating strata boundaries within a subpopulation, where each stratum has unique characteristics such as species composition, height, stand volume or age.
Strip-Line	A ribboned line running through the forest and tied to a base-line and/or boundary at one or both ends. Cruise plots are located at regular intervals along each strip.
Stumpage	Stumpage is the price that is paid to the provincial government for the right to harvest timber from Crown land. The amount of stumpage that is charged for the timber depends upon the appraised value of the stand and, in some cases, a price bid above this value.
Suspect	A living tree with one or more pathological indicators.
Tie-Point	An important point from which a boundary, base-line or cruise strip is "tied" into (e.g., legal lot corner (I.P.); creek and road junction (mapped)).
Timber Supply Area	Large contiguous areas of Crown land on which an annual allowable cut is calculated.
Top-Height	The mean height of the 100 trees per hectare of largest diameter.
Tree-Class	A series of classes (nine) primarily used for age/maturity and live/dead classification. This classification puts each tree into the appropriate risk-group for volume deduction.

True	Refers to height, diameter, number, sum, plot volume, LRF, or other variable. The "true" value is determined by the Forest Service.
Variance	The mean of squared deviations of observations about a sample mean. (These deviations or differences from the mean are called residuals).
Waste	In the timber cruising compilation programme, decay, waste and breakage are deducted from the gross tree volume. The waste component is the firmwood volume associated with 5 m logs in a tree which contain less than 50 percent of their gross scale in firmwood volume. These logs are assumed to be left on the cut-block and so their remaining firmwood volume is then classified as waste.

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