LIGNUM LTD.

INNOVATIVE FOREST PRACTICES AGREEMENT

GROWTH AND YIELD

PSP REMEASUREMENT

FIELD USER'S MANUAL

June 2003

VERSION F1.0.4

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SUMMARY OF CHANGES

1. Contractors are responsible for providing plot stakes and paint.
2. Plot corner trees will have the red painted rings painted over with blue paint.
3. All plot markings in paint (except for outer plot boundary double blue paint marks) will be touched up.
4. Dead trees, both standing and down, are measured for DBH and height. Trees that have died since the last measurement will have an age taken. DBH will be taken at either 1.3 m from ground or in the case where the tree has broken off below 1.3 m where 1.3 m would have been on the tree.
5. Cause of death will be recorded using MoF mortality codes.
6. All previously dead trees are also to be remeasured.
7. Three Dendrometer banded plots require remeasurement in 2003.
8. All replacement tags will be original hard blue circular tree tags.

INDEX OF KEY FACTORS

LIGNUM LTD. GY02 REMEASUREMENT FIELD MANUAL VERSION F1.0.3 - INDEX OF KEY FACTORS 8/15/2002

ITEM #	TASK	REFERENCE TO LIGNUM MANUAL	Manual Section	Page	DIFFERENT FROM MoF Y/N	REFERENCE TO MoF METHOD
1	Training	MoF Session with Branch Specialist.	1.1	7	N	MoF Session.
		Lignum Field Review	1.1	7	Y	
2	Plot Numbers	R; C; Sample: 300, 400 or 500 series number; Plot: 1; Type 'R'.	4.1	15	Y	Type 'G'.
3	Top Height plot	Full 0.01 Ha or half 0.005 ha (Diagram on Pg. 15/16.)	4.2	16/18	Y	
4	Compass Declination		3.5	12	N	
5	Access Notes	Report 1 from GYHost.	3.1	9	N	
6	Tie Point	As per MoF Specifications.	3.3	11	N	
7	Tie Line	As per MoF Specifications.	3.4	12	N	
8	Buffer	Generally 25 m. (Variance from 10 to 100 m where circumstances warrant.)	3.6.1	12	N	
9	Plot Size	Full - 0.1 Ha. (31.62 m side)	4.2.4	17	Y	Round; varying diameter.
		Half - 0.05 Ha. (22.36 m side)	4.2.5	18	Y	
	Tree Measurements					
10	BH	1.3 m, high side of tree.	5.3.2	24	N	
11	DBH	+ or - 0.1 cm or 1 %. (+ Dead Trees) (Reading from dendrometer band for four samples)	5.3.2	24	N	
12	Dendrometer Bands	Installing and Reading Dendrometer Bands	5.1.3-6	22	N	
13	Path	As per MoF Specifications.	5.5.3	32	N	
14	Pest	As per MoF Specifications.	5.5.4	33	N	
15	Crown Class	As per MoF Specifications.	5.5.5	33		

LIGNUM LTD. GY02 REMEASUREMENT FIELD MANUAL VERSION F1.0.3 - INDEX OF KEY FACTORS 8/15/2002

ITEM #	TASK	REFERENCE TO LIGNUM MANUAL	Manual Section	Page	DIFFERENT FROM MoF Y/N	REFERENCE TO MoF METHOD
16	Crown Length	a) Estimated crown length on all measured height trees. b) Actual Live crown on FPC & Lignum Top height trees and range trees to 1%.	5.5.6	34	Y	Nearest 10 %.
17	100 % Stem Map Stem Map	a) 100 % stem mapping in one plot per cluster. b) in all plots - center stake, two corner stakes, top ht stakes & tree.	5.4.1	30	Y	
18	Tree Height (Includes dead trees)	100 % of heights in the stem mapped plot (0ne plot per cluster). Regular plot: FPC. top ht; Lignum top ht; & range trees.	5.7	36-38	Y	
		Severe lean trees.	5.10	39	Y	
19	100 % Tree Height	100 % of heights in the stem mapped plot (0ne plot per cluster).	5.7.1	36	Y	
20	Height Trees Site Height Trees	Nine Lignum Top Heights (Site Sector).	5.7.4 & 5	36/37	Y	Ten largest diam. for each major spp.
21	Range Trees	As per MoF Specifications.	5.7.6	38	N	
22	Age	As per MoF Specifications.	5.11	40	N	
23	Dead Tree Ages	As per MoF Specifications.	5.11.3	43	Y	
24	5, 10, 20 Yr. Increments	As per MoF Specifications.	5.11	40	N	
25	Quality Assurance	10-100% of Plots-All Phases.	7.0	46	Y	10 % of plots.
26		± 10 % of Trees in Plots.			N	±12 trees/plot.

FIELD PROCEDURES for the REMEASUREMENT of NATURAL STAND PERMANENT SAMPLE PLOTS

1.0 INTRODUCTION

1.1 About This Manual

This manual describes the standards and procedures to be followed in the implementation of Lignum Ltd.'s Growth and Yield program. It is intended as a reference tool, and it is assumed that the user has a good understanding of growth and yield standards and procedures currently used in British Columbia. Personnel conducting field measurements in this Growth & Yield Program will have taken the Lignum Ltd. Growth & Yield training course. Lignum Ltd. expects that contractors working on this program will have taken part in a manual and field procedure review prior to starting operational activities.

When field crews encounter operational problems, they are expected to use sound judgment in suggesting solutions to those problems and to pass proposed solutions on to staff at Lignum Ltd. for approval. When some detail requires further clarification, the general approach will be to follow the usual Forest Productivity Council of B.C. or Ministry of Forests method of doing this work. Where exceptions arise, the contractor is to contact the Lignum Ltd. Project Manager for guidance. If this cannot be done in time to solve the problem in the field, then the contractor will use their best judgment on the spot and stop work if the result would be outside approved standards.

This manual will be amended as changes, clarifications or additions are required. In addition, a section will be maintained for outstanding issues, suggestions, etc.

1.2 Data Codes

Unless indicated otherwise codes to be used for recording data for G&Y plots will follow the following protocols:

1. Lignum G&Y Remeasurement Field Manual V1.0.3 dated September 9, 2002.
2. GYHand/GYHost 02.
3. Damage codes as per Appendix 4-14.

1.3 Measurement Standards and Tolerances

Measurement standards will follow Forest Productivity Council standards unless otherwise noted. Standards and associated tolerances are shown in the following Appendices and in the text where measurements and tallies are described.

-Appendix 1 – Measurement Standards
-Appendix 2 - Forest Productivity Council standards.
-Appendix 4 - Ministry of Forests manual attachment.
-Appendix 4-14 - Damage Agents & Severity Codes (June 2000).

2.0 SAMPLE DESIGN & LOCATION CRITERIA

2.01 Description of Plot and Buffer Layout

The individual sample plots are either 0.1 hectare (full size plot) or .05 hectare (half size plot) and square in shape. Distance between plots is generally 100 meters, plot center to plot center. The preferred minimum distance from a plot boundary to the edge of a stand is 25 meters. This distance may have been varied from 10 to 100 meters to match the height of the stand or other circumstances with approval from Lignum Ltd.

2.02 Description of Plot Measurements

All trees with a DBH greater than or equal to 4 cm were individually tagged and numbered at establishment. A number of tree height measurements were taken at the time of plot establishment:

Current Tree Height Requirements

- Top Height trees collected by Lignum: the largest diameter tree, (if suitable), regardless of species, within each of the nine Top Height plots (the 5.64 m radius plot includes area outside the main plot boundary). Half plots have 5 Top Height plots with a 5.64m radius. The Top Height tree is in Top Height plot #5. If there is not a suitable Top Height tree in a Top Height plot (no suitable Crown Class 1 or 2's are present), there will be no replacement (there will be no Top Height tree for that plot). These trees may or may not be representative of the major species within that stand; Note: Vets are not considered site/top ht. trees by MoF and GYHand will not accept them as a top or site ht tree. Where a Vet is selected as the largest tree for Lignum measurements, take the next larger in the site sector (if largest is a vet) as per MoF requirements.

- Site Height Trees: the largest diameter tree, (if suitable), for each of the two major species within each of the nine site sectors (Top Height plots) or 5 site sectors for a half plot. If this largest tree is not a suitable tree (no suitable Crown Class 1 or 2's), then there will be no replacement (there will not be a Site Height Tree for this Top Height plot for that species). Note the site sector of these trees even if not suitable.

- A sample of 15 suitable trees (if present) representing the diameter range, (down to 2 cm DBH), of all major, minor and scattered species trees on the plot and sub-plot.

- All heights previously taken must be remeasured even if now or previously dead.

Ages at DBH are to be determined on all of the Top Height, Site Height Trees and on the first two major species of the Range Trees down to 4.0 cm DBH using increment cores. Previous establishments may not fully meet the current requirements. Ages must be taken on these trees at Remeasurement. Damage and pathological indicators are recorded for each tagged tree at each measurement.

FIELD PROCEDURES

3.0 PLOT LOCATION

3.1 Access Notes/Mapping

Accurate access notes are critical. These notes are intended to describe access to the site over a period of up to ten years. The access package for the Remeasurement will include: the access notes; a photocopy of an air photo showing the plot locations; a 1:50,000 scale map; a 1:20,000 scale map which clearly shows the polygon boundary, labels and plot locations; and the plot dimension map/sketch map.

Access notes are to be checked and revised if either incomplete, access has changed or where tie point and tie line information is changed during the PSP Remeasurement phase.

1. Access starts from the junction of the Lignum Ltd. access road and Hwy. 20.
2. En route to the sample, check the distances to major road junctions, creek crossings, or other prominent features.
3. Ensure that actual names are used, not locally familiar ones. Where possible use Industrial and/or Forest Service Road numbers, names, and km board markers.
4. Check that the tie point is described accurately, keeping in mind the amount of growth likely to occur in ten years for vegetation that could screen the tie point or beginning of the tie line.
5. Check that the species, diameter, and location of the tie tree are correct.
6. Update access notes as required.

3.2 Plot Location

Plots were located in areas where minimum risk of vandalizing was likely to occur, and were generally some distance away from roads. Cutting of trees by unauthorized people causes serious damage to the value of the data from the plots damaged, and therefore damages the entire project. These plots and the data they provide are valuable and are essential to the success of the Lignum Ltd. program. Therefore damage by unauthorized cutting or travel through plots must be avoided.

3.2.1 Recording Plot Location by UTM & GPS

The "ground" UTM coordinates, or Latitude and Longitude have been recorded for each tie point and plot "center" stake, on a NAD 83 basis (to the nearest meter, even if this is more precision than warranted by the method used). This may differ from the "map" UTM coordinates used in the GIS. The plot center was determined using corrected GPS during the plot selection quality control check. The recorded UTM's are approximate.

The tie point UTM coordinates and Tie line bearing and distance must now be recorded in data.

The relative position in the stand was indicated as accurately as possible on an air photo of the stand. This was done so that the stand and/or plots could be placed on the GIS maps of the area in the correct relative position in the correct stand.

3.2.2 Plot Photographing - Digital Still/Video records.

Photos of the 1997 samples were taken during spring 2001 so retakes for the 1997 samples are not necessary.
The objective of taking photos of G&Y plots is to record stem structure from plot center. The reference height in all cases is DBH. The intent is to capture as much information as possible about stocking and crown closure.

Both still photos and video footage will be taken. Digital format cameras are required for still image capture. Video footage may be captured on tape. Standards for each type are discussed below.

A white board (no larger than 45 x 60 cm) will be used to record the poly number, sample number, and date. The board is to be placed in the image far enough away from the center to reduce instances of photo flash errors, obscuring stems/stand structure info. Personnel taking images will ensure that:

1. Acceptable light levels are available.
2. Depth of field is maximized.
3. Sun angle does not obscure stems.
4. Board placement allows for sample id without obscuring critical plot info.
5. No 'foreign objects' are present (e.g. - cruise vests, on or off of crewmembers) that will cause problems with the depth of field or flash.

Photo numbering protocol:
The following numbering system will be used to identify each photo/image.
Columns one to four are the poly number, columns six to nine are the sample #, column 11 is the cardinal direction for the Still photos (North, East, South, West);; columns thirteen to eighteen are the date as Yr, Mo, Day. An underscore will be used to separate each set of numbers. No spaces will be used in the identifier string.
- - - -_ - - - -_ 0420_0500_N_020201

Still Images:
Still images will be taken from plot center facing the cardinal directions. Images will be taken at DBH. Use the lowest power setting, i.e. no zoom. Images are to be checked in the viewfinder before personnel leave the plot to ensure useful images have been captured.
Camera settings should be set at high, preferably at a minimum dpi of 1.0 megapixels.

Video Images:
Video images will capture two 360 degree sweeps to be taken from plot center at DBH using a tripod. Both sweeps will start at north and proceed east. The first sweep will be parallel to the ground at plot center. The second sweep will have

the camera aimed up towards the crowns at a maximum angle of 45 degrees. A blue ribbon will be tied at DBH to the tree closest to the cardinal directions, approximately 5 m from plot center, prior to the sweeps being conducted. The camera will be paused for about 3 to 4 seconds at each cardinal direction and the photographer will call out the direction. Use the lowest power setting, i.e. no zoom. Note: 2002 remeasurements do not require a new video.

3.3 Choosing and Marking the Tie Point

The objective was to make the plot easy to find, and clearly recognizable when a person enters the general vicinity of either the tie point or the plot center.

The reference or tie point generally is a prominent topographic feature distinguishable on the photos and on the ground. **Examples:** a road junction, road bend, creek junction or bridge.

1. Ensure that paint, flagging and placards are in good shape and replace any flagging required to ensure lines and plots can be readily found..

   - The blazed and/or painted tie tree should be located nearby, as described in the access notes. Aluminum sample markers were nailed to the tie tree, and strands of plastic flagging tape should still be noticeable on or near the tree.

3.31 Numbering convention

1. The aluminum placard on the tie point tree contains the following information in the middle and bottom sections of the markers:
   - the sample type = R;
   - the sample number, (a 300, 400 or 500 series number);
   - the plot number (1);
   - the region number;
   - the compartment number;
   - the bearing and distance to the plot; and
   - two dates may be on the tie point placard. The first is entered when the sample is located. The second date entered on the placard is the establishment date.
   -

New Tie Point Needed

If a new tie point is needed:

1. Select a new tie point recognizable on the photos and the ground.
2. From the map, measure and record the new bearing and distance to the plot centre.
3. Paint both sides of the tie tree in the direction of the tie line.
4. Nail an aluminum sample marker above the paint.
5. Inscribe the pertinent information on the middle and bottom sections of the 2 markers. **Note:** "Date" on the marker always refers to the date the sample was originally established.

6. Flag the tie tree with two strands of flagging tape, one above and one below the markers. Paint both sides of the tree with blue paint approximately 2 m above the ground in the direction of the tie line. The paint mark should be in the form of a rectangle about 50 cm long and at least the width of the tree.
7. To aid future measurement crews, revise the sketch map showing the tie point, the sample location, and other significant topographic features. Attach the sketch to the access notes.
8. If you establish a new tie point, you must run a new tie line.

3.4 Checking the Tie Line

The tie line was run from the tie point with a hand compass, a clinometer and a measuring tape. If the original tie line is re-run, it is sufficient to paint the blazes, and to renew the tape markings.
Tie line bearing and distance to first sample is to be entered for appropriate sample.

3.5 Compass Declination

Williams Lake/100 Mile/Alexis Creek/Horsefly areas:
For 2002: 21.0 degrees east of true north.
For subsequent years the declination and annual change will be the same as the MoF as found on the Internet (http://www.geolab.nrcan.gc.ca/geomag/e_cgrf.html) or in the June 1999 MoF Inventory manual - Appendix 7.

3.6 Locating Plots within the Polygon

3.6.1 Plot Buffer

A plot buffer of 25 meters should have been established unless the height of the stand was greater than 25 m in which case the plot buffer should match the average height of trees in the plot. The horizontal distance from plot corner to the buffer corner (for a 25 m buffer), is 35.36 m.

3.6.1.1 Plot Buffer Overlap

Where plot buffers overlap, the buffers were usually squared-off to ensure that the buffer could be readily determined for each plot in the field.

3.6.2 Distance Between Plot Centers

Distance between plot centers is generally 100 meters.

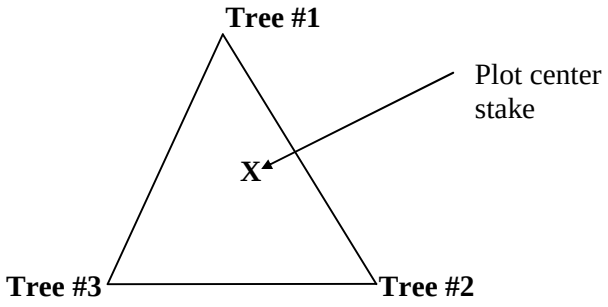
3.7 Checking the Centre Tree

Each established plot had a centre tree marked with aluminum markers and strands of flagging tape. The markers and tape were usually secured about two metres above ground to avoid interfering with dbh measurements. If the centre tree is missing, either because of natural causes or because somebody cut it down:
1. Select another centre tree near the plot centre.

2. Mark it with the two aluminum markers, flagging tape, and paint the tree with blue rectangles.

Checking the Center Plot Stake

1. The plot center was marked with a tubular aluminum stake, driven into the ground for at least half its length. To avoid the potential for cattle injury, the length of stake extending above ground was about 30 cm. This is the plot center stake. The top 15 cm of the center stake was painted red.
2. A large living tree close to the plot center stake is the plot center tree and is also described as the plot witness tree.
3. Bearing and distances from the center stake to three (3) nearby tagged trees (one of which was the witness tree and others the top height and/or Plot #5 site height tree), should have been noted to enable re-location of the center stake, should this be necessary. If not done, this should be done now. The trees used should have been tree class 1 or 2 and should have formed as close to an isosceles triangle as possible, as illustrated below. Insert a nail into the stem even with the centre point of the tree perpendicular to plot center. These nails were used to measure distance to the plot center stake.



The center plot was also described as the Lignum Top Height and Site Sector plot # 5 as well as the fixed sub-plot. Physically these plots are all located at the same place – i.e. plot center.

3.8 Corner Staking

1. Plot Corner stakes must be easy to find and as permanent as possible. Wooden stakes were generally used in 1996. For other years metal angle stakes were used for corner stakes. The top 15 cm of corner stakes were painted red. If stakes must be replaced, use metal stakes.
2. The inside angle of the corner stakes shall face plot center, making the sides of the stake parallel to the plot boundary.
3. Corner stakes on each end of one of the diagonals were stem mapped from three nearby tagged trees.

The closest tree to each corner stake that is outside the plot and greater than 10 cm DBH had a double ring of red paint painted at approximately 1.5 m from the ground.

The corner trees are to be re-painted by a double ring of blue painted over top of the existing red rings.

3.9 Top Height (Site Sector) Plot Staking

The Top Height plots were established and marked with round stakes. In 1997 the nine Top Height plots had a radius of 5.05m for the full plots and 3.43m for the half plots. The Top Height plot stakes will need to be relocated to reflect current standards. All samples will have 5.64m radius Top Height plots with full plots having 9 and half plots having 5 (see 4.2.4 and 4.2.7 for plot dimension figures). The top 15 cm of the Top Height (site sector*) plot stakes will be painted blue. (* Top Height plots in GYHand02 are called Site Sector plots- and designated as Ss).
Top Height plots have a 5.64 m radius for both full size (0.1 ha) plots and half size plots. See figures in Section 4.1, for Top Height plot location and dimension details.

The Top Height plot centers should be located as accurately as possible. The essential factor in the placement of Top Height plots is that they are re-locatable. Since vandals may remove these stakes, a distance and bearing from the Top Height plot center to 2 nearby trees, (the site height and/or top height trees if present) shall be recorded as a precaution.

4.0 PLOT ESTABLISHMENT

4.1 Plot Establishment Procedures

NOTE: NO trees in the plot or buffer may be blazed or cut by the measurement crew; all marking will be with paint.

1. The approximate location of plot center was marked in a manner that would not interfere with the positioning of a compass tripod. The plot location could not be moved to facilitate line of site measurements for plot corners.
2. The corners of the plot and of the buffer were located by staff compass or electronic device and a tape or electronic distance measuring device that was accurate to ± one centimeter.
3. The center of the plot was marked with a permanent stake that identified the plot. Where necessary to provide additional protection to the center stake, a cairn was built around the base of the stake to support it firmly. A large living tree close to the center stake is the plot center and witness tree. Two aluminum plot markers were nailed to the plot center tree about 2 m above the ground. The following information was recorded in the top section of each aluminum marker:
    - sample type (R)
    - sample number (a 300, 400 or 500 series number)
    - plot number (=1)

    The following information was recorded in the bottom section of each aluminum marker:
    - region number
    - compartment number
    - Two dates were required on the placard. The first was entered when the sample was located. The second date entered on the placard was the establishment date marked as ESTAB.

Where the plot center was also the tie point for the next sample, the 'TIE POINT FOR GROWTH' section of the aluminum marker was filled out as follows: At plot 2, the placard facing back towards plot 1 had the direction and bearing to plot 1; the placard facing towards plot 3 had the bearing and distance to plot 3, etc.
Flagging was placed on the plot center tree with two strands of red Lignum G&Y flagging tape, one above and one below the aluminum markers. Both sides of the witness tree were painted with blue paint approximately 2 m above the ground in the direction of the tie line. The paint mark was in the form of a rectangle about 50 cm long and at least the width of the tree.

Metal tags were placed on both sides of the plot center tree for both tie lines where the change in angle of the line was > 45 degrees.

4.2 Plot Dimensions and Layout

Where the ground slope exceeded 5% (or 2 degrees), distances were measured along the slope and corrected according to the angle of slope. It was **not** acceptable to try to hold the tape in a horizontal position on slopes exceeding 5%. It was most convenient to establish diagonally opposite corners first so that their locations could

be checked visually by standing at one corner and lining up the plot center and the opposite corner.

Top Height plot (in GYHand 02 these are called Site Sector plots- SS) numbering starts clockwise from northwest as shown in the plot dimension figure below.

4.2.1 Plot Dimension Map

A plot dimension map was completed that shows final measured horizontal distances, bearings, slope and direction of slope of sides, as applicable for each side. Distance and bearings between plot centers were also shown. Any vets, voids, trails or significant topographical features affecting the plot were sketched on. This map was attached to the access note package. The original sketch map/plot dimension diagrams should be updated as necessary.

4.2.2 Full Plot Dimensions (0.1 Ha)

The horizontal distance of each side is 31.62 m. The diagonal distance from plot corner to plot corner is 44.72 m. The distance from the plot center to the plot corner is 22.36 meters.

Standard measure for full plot side lengths: 31.62 m ± 10 cm.

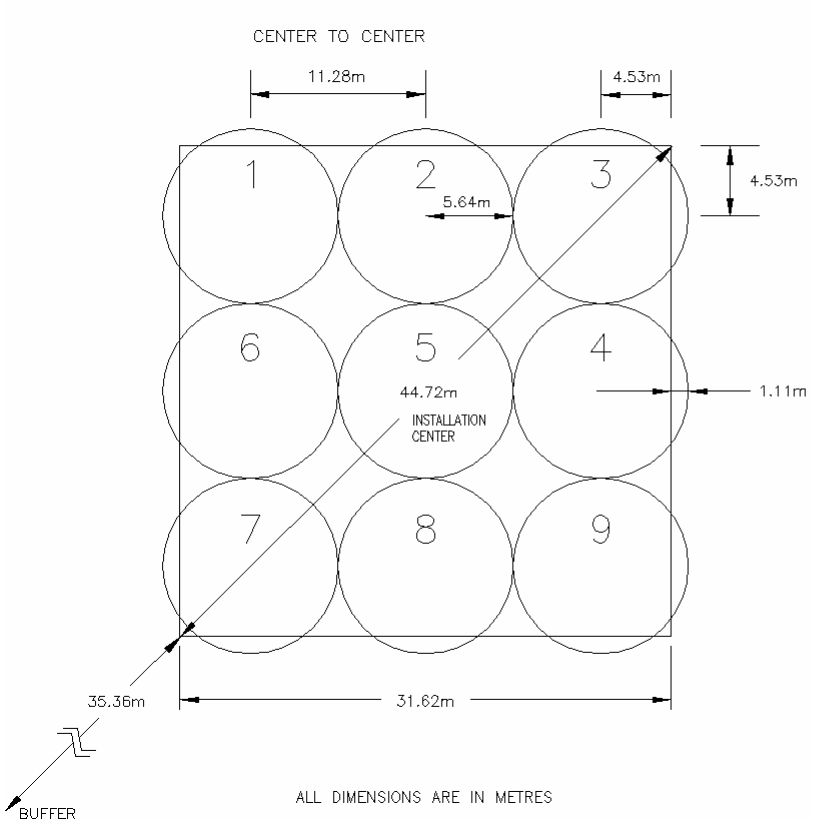
Standard measure for full plot diagonal lengths: 44.72 m ± 20 cm.

The distance from the plot corner to the center of Top Height plots 1, 3, 7 and 9 is 6.41 m.

4.2.3 Full Plot Buffer

The horizontal distance from plot corner to the buffer corner (for a 25 m buffer) is 35.36 m.

4.2.4 Full Plot Dimension Figure



4.2.5 Half Plot Dimensions (0.05 Ha)

The horizontal distance of each side is 22.36 m. The diagonal distance from plot corner to plot corner is 31.62 m. The distance from the plot center to the plot corner is 15.81 meters. The intent is to include a minimum of 50 crop trees at rotation in the plot.

Standard measure for half plot side lengths: 22.36 m ± 7.1 cm.

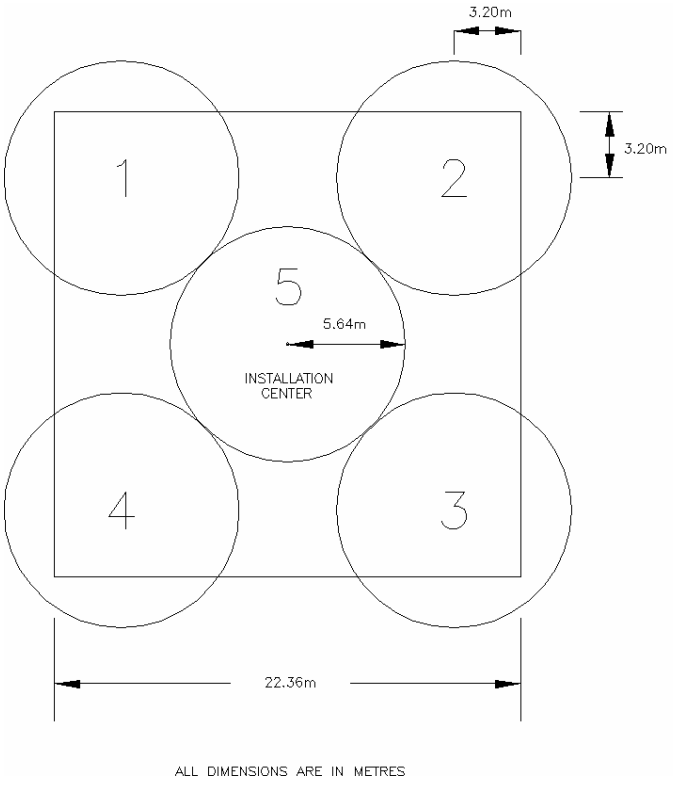
Standard measure for half plot diagonal lengths: 31.62 m ± 14.1 cm.

The distance from the plot corner to the center of Top Height plots 1, 2, 3 and 4 is 4.53 m.

4.2.6 Half Plot Buffer

The horizontal distance from plot corner to the buffer corner (for a 25 m buffer) is 35.36 m.

4.2.7 Half Plot Dimension Figure



4.3 Plot Layout

If any of the plot corner stakes are missing at Remeasurement try to determine the previous location (i.e. hole in ground or paint spot approximately where corner should be) and replace the missing stake with a new angle post. Remeasure horizontal distance and slopes for the sides and diagonals affected and record on the plot dimension map/sketch. Ensure that no tagged or out trees are affected.

If no indication of the previous location of the stake is found then the sides and diagonals affected will need to be measured to allow relocation of the corner stake in the spot which best represents the previous location. i.e. that the side/diagonal measurements are within tolerances and no there are no trees status changes (was in/now out).

1. The corners of the plot shall be marked with metal angle stakes as described in Section 3.8. Holes should be dug or rock cairns established for the stakes only where the ground is stony and driving them into the ground is impractical. Note that in the 1996 establishments that wooden corner stakes were used.
2. Once the four corners of the plot have been established, the final horizontal distance with slope % and direction of slope for each side of the plot should be recorded.
3. The boundaries of the buffer (see s. 4.3.1) and the plot (See S. 4.3.2) must be marked conspicuously with paint. Under **no** circumstances will trees be blazed or cut.

4.3.1 Buffer Boundary line marking

Trees immediately **inside** the outer boundary of the buffer will be conspicuously marked with red paint and with red Growth and Yield ribbon. The paint markings will be rectangular in shape and will face out from the buffer. These trees mark the beginning of the plot protected area.

4.3.2 Plot Boundary line marking

Trees immediately outside of the boundary of the actual plot will be marked with a double horizontal blue line at approximately 30 cm above DBH facing plot center.

4.3.2.1 Plot Boundary (Borderline Tree) tree marking
If trees are located exactly on the plot boundary, call the first such borderline tree in and the second borderline tree out, and so on. However, if more than half of any tree at the germination point falls inside the plot (or if more than half falls outside), it must be tagged (or excluded). The germination point is used for this decision, not the location of the roots or the crown. Note that in/out and B/L in/out is to be painted on close/borderline trees in blue paint facing plot center.

In almost every plot, circumstances arise which are not covered by the written instructions. For example:

If a plot corner cannot be located precisely because of a tree, put the corner in the nearest suitable spot, and make a note on the recording sheet. The actual corner will be stem mapped to this stake and recorded on the location diagram/plot dimension map.

Other situations will arise which are not described here. The crew chief must make a decision so that the crew can keep on working. The crew chief should then note that decision on the recording sheets so that the reasons and circumstances of the decision are not lost. These notes form part of the record of plot establishment and must be submitted to Lignum in a formal manner.

5.0 PLOT REMEASUREMENT

5.1 Overview

The intent of the Remeasurement program is to ensure that a sample can be located, that the sample has had all original trees remeasured, data collected and that any ingrowth is tagged and measured.

At remeasurement, the top height and site height trees selected may be different than those originally selected. However, once a tree has been selected as a top or site height tree it will continue to be remeasured. The Top Height trees, for instance, might change - but the old top height tree will continue to be measured.

All previous heights (including range and top/site height trees) must be retaken even if now dead. Select suitable range trees to satisfy current requirements down to 4 cm DBH in the main plot and 2 cm DBH in the sub-plot.

The general format for this work is to measure all tagged trees, then run the GYHand check routine. All ingrowth and sub-plot trees are then measured in a clockwise pattern.

Four samples established in 1997 have had dendrometer bands installed. These samples will have the DBH measured in a different manner.

5.1.1 List of Data to be gathered for each tagged ingrowth tree.

For each tagged ingrowth tree, gather and record the following information:

1. the tree number on the tag
2. the species
3. the DBH, (or reading and converting the dendrometer band reading),
4. the crown class
5. the estimated live-crown length percentage
6. the tree class
7. pathological indicators for trees 2 cm DBH and greater
8. the tagging sector number. The site sector will be noted only on trees that are or may be top or site height trees after all trees in the plot are measured. If a site sector for a tree is noted while plot is being measured then that site sector becomes the default for any subsequent trees (this is how GY 02 tagging and site sectors work).
9. the damage agent and severity codes for affected trees
10. the height suitability
11. for selected trees, the tree height and age.
12. tree sweep and/or lean.

5.1.2 100 % Height and Stem Mapping Plots

One plot in each cluster was selected by Lignum to have all heights measured on living and dead trees. This same plot will have all trees stem mapped (100% stem mapping).

5.1.3 Dendrometer Banding Plots

Lignum has assigned plots for dendrometer band installation. Stem mapped samples at 108 Spokin North, Staffords, Redeau Lake, Pigeon Road, Joes Lake, and Esler Log Dump locations have had dendrometer bands installed.

5.1.4 Procedures for Dendrometer Band Installation

All live trees that are equal to or greater than 5 cm diameter at breast height will be identified and are to be banded. Use Report 5 from the GYHOST program for the PSP sample to identify all trees that require banding. Select a dendroband of the correct size for the selected tree (the dendrobands are made in groups of different lengths to accommodate the different tree dbh's). Each dendroband has a unique serial number enabling each tree to be uniquely identified. An example of a serial number is: A546

When replacing a dendrometer band, the band must be replaced as close to the old location as possible. For new installations, the dendroband will be installed as close as possible to the top of the nail marking DBH. The bands are to be installed perpendicular to the lean of the tree, and should be relatively straight around the entire girth of the tree. There will be circumstances that occur that prevent the band from being installed perfectly straight, such as a branch or knot obstructing the band. Should this be the case, then the band is to be installed as straight and as close to 1.31m as possible. The band should be placed with the measurement window above the tree tag so that measurements can easily be recorded.

Once the band has been installed, tighten the band around the tree manually by pressing on the band and allowing the band to slip under the window end. Ensure that the spring has been stretched enough so that the band will move easily, but not too much as to be extended beyond the point of recoil.

The serial number of the dendroband will be recorded on either the Report 5 under the appropriate tree number or on a dendrometer band data form.

Record the date of the installation and the crewmembers in the top right hand corner of Report 5 or in the appropriate location on the data form.

5.1.5 Procedures for Dendrometer Band Remeasure

All trees with a dendrometer band will be remeasured. The reading from the dendrometer band will be recorded on the data form or Report 5 along with the type of reading (D - reading taken at the dot or R - reading taken at the right side of the window.) The appropriate conversion will be added to band readings taken from the old style bands. A correction to convert an R reading to a D reading will be added (subtract .5 cm). New style bands do not require a conversion.

Dendrometer bands that are on dead trees are not to be removed.

Where dendrometer bands appear to be impacting the growth of the tree, e.g. the band is not expanding due to pitch, the band will be removed. Before removing the band attempt to take a reading. After the band is removed a DBH will be taken using a diameter tape. Record that the band has been removed on the dendrometer band recording form.

Conversion numbers for old style bands:

A - 5.0 - 11.0 cms.	F - 30.0 - 36.0 cms.
B - 10.0 - 16.0 cms.	G - 35.0 - 41.0 cms.
C - 15.0 - 21.0 cms.	H - 40.0 - 46.0 cms.
D - 20.0 - 26.0 cms.	I - 45.0 - 51.0 cms.
E - 25.0 - 31.0 cms.	J - 50.0 - 56.0 cms.

5.1.6 Procedure for Dendrometer Band Replacement

When the dendrometer band has moved to the far right end of the reading tape or it is suspected that it will move beyond the tape end in the next five years, the band must be replaced. The actual reading on the current band will be taken and recorded. The band will be replaced with the next highest group band and the serial number and new reading recorded. When replacing a dendrometer band, the band must be replaced as close to the old location as possible. See the procedures in section 5.1.4 for installation details.

5.2 Measurements & comments

The basic required tree measurements are dictated by the Forest Productivity Council of B.C. and are set up for entry into a handheld field recorder.

Additional measurements will be recorded using remarks section in program or forms, and added to the database as follows:
When recording the height to break on live trees with broken tops (non-100%% ht. plots), the estimate is to be to the nearest 0.1m and this estimate recorded in the height to break field.

The field crew is encouraged to record their observations, advice and suggestions involving the individual tree, the PSP, the group of PSPs or the Growth and Yield program in general. The intention is that these comments will be entered as text files in GYHand02 at the tree and plot level.

When there are suspicious differences in measurements or errors noted in the field or office these should be noted for later clarification by a regular or special revisit.

5.3 Tree tagging Convention

The essential point is that trees are plainly marked, and can be located and remeasured with reasonable ease by the crews that visit the plots in the future. All trees associated with a particular plot are to have a unique number within that plot. Trees are considered "in or out" of the plot at the center of their germination point level with the ground. Once a tree is tagged, it will be measured at each visit. If there is any

doubt about the location of a tree, tag it and record the data. Do not duplicate tag numbers in a plot.

Standard: No Missed trees are allowed.
± 1 Borderline tree.

5.3.1 Remeasuring the Plot and Sub-plot

Accurate work is required when you compare new measurements with previous ones. Always position the dbh tape just above the nail and perpendicular to the bole of the tree. Check measurements that appear to be out of the expected range, that is, measurements showing a very large increase compared with those showing little or no increase.

Correct any errors and note them in the remarks. **Example**: "dbh checked."

5.3.2 Measuring D.B.H

For all **numbered living trees**, measure above the nail, to the nearest millimeter, the diameter at 1.3 m.

For trees with dendrometer bands, record the reading from the band onto the dendrometer band tally sheet, convert the number and enter the DBH into GYHand.

After remeasuring the diameter:

Pull out the nail holding the number enough to allow for tree growth until the next remeasurement.

For all previously numbered trees now dead:

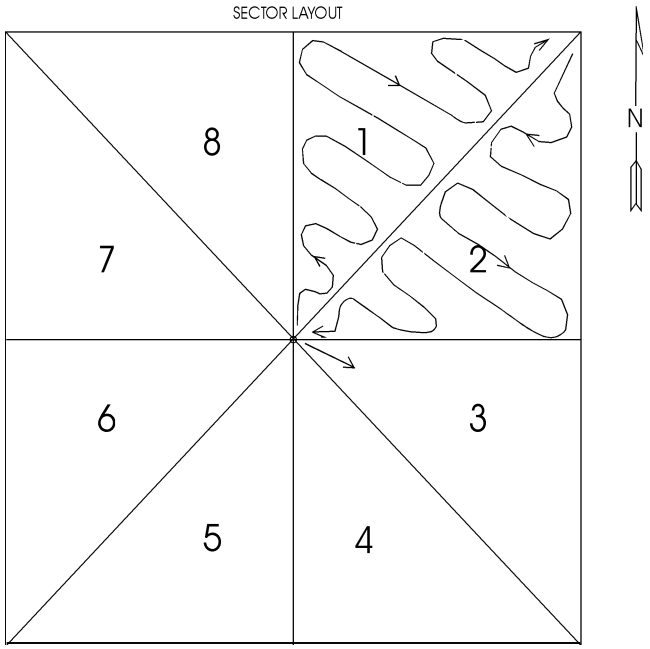
Measure the diameter above the nail at 1.3 m.

If the dead tree cannot be found, state that the tree is missing in the tree comments section: 'Tree Missing'. If the tree was cut down, record it as Tree Class 6. DBH will be taken at either 1.3 m from ground or in the case where the tree has been cut off below 1.3 m, where 1.3 m would have been on the tree.

5.3.3 Plot Sectors

The plots established in 1996 were divided into 4 quadrants. Plots established from 1997 forward were divided into 8 tagging sectors through the center stake. Tagging Sector 1 is always the first sector clockwise from north. Odd numbered sector tags face towards plot center. Even numbered sector tags face out from plot center.

Sector Numbering and Layout Figure - 1997 to present:



5.3.4 DBH Definition

BH was established at 1.3 meters above the high side of the tree base, measured along the sweep of the tree (along side of tree parallel to sweep). Use of a 1.3 m long DBH stick is recommended. A blue paint spot at DBH (where the nail was placed) is used to re-establish DBH in case a nail is removed.

Standard measure for BH: ± 5 cm of the true breast height.

DBH is always measured just above the nail, perpendicular to the bole of the tree, and is pulled tight.

Standard measure for DBH measurements –live trees: ± 0.1 cm or 1%, whichever is greater.

Standard measure for DBH measurements –dead trees: ± 0.2 cm or 2%, whichever is greater.

5.3.5 Trees with Missing Tags

For trees with tags missing there should be a blue dot at the previous DBH point to help to retag the tree.
Nail on a tag which has the same tag number as the missing one.

5.3.6 Tallying Dead Trees

In 100% height plots, tag, measure and record the height and DBH of all free standing dead trees ≥4 cm at DBH and at least 1.3 m high by species. In regular plots, tag, measure and record the DBH of all free standing dead trees ≥4 cm at DBH and at least 1.3 m high. For broken trees in regular plots with heights of 1.3 and greater, estimate the height to break to the nearest 0.1m. Measurement of dead trees will not contribute

to the weighted error for plot quality determination. All dead trees will continue to be measured throughout the life of the sample.

Using GY02 to enter the DBH of previously dead trees.
Enter 1 when curser is at TC and pressing <enter>. This action takes the curser to DBH where the new diameter can be entered. By proceeding as normal, when one comes to TC again, TC4 (or 3) can be entered and continue as normal.

5.3.7 Dead Tree Attributes

For each dead tree that is > = 4.0 cm in DBH and > = 1.3 meters in height, collect the following attributes if the tree is either standing or down both at establishment and remeasurement:

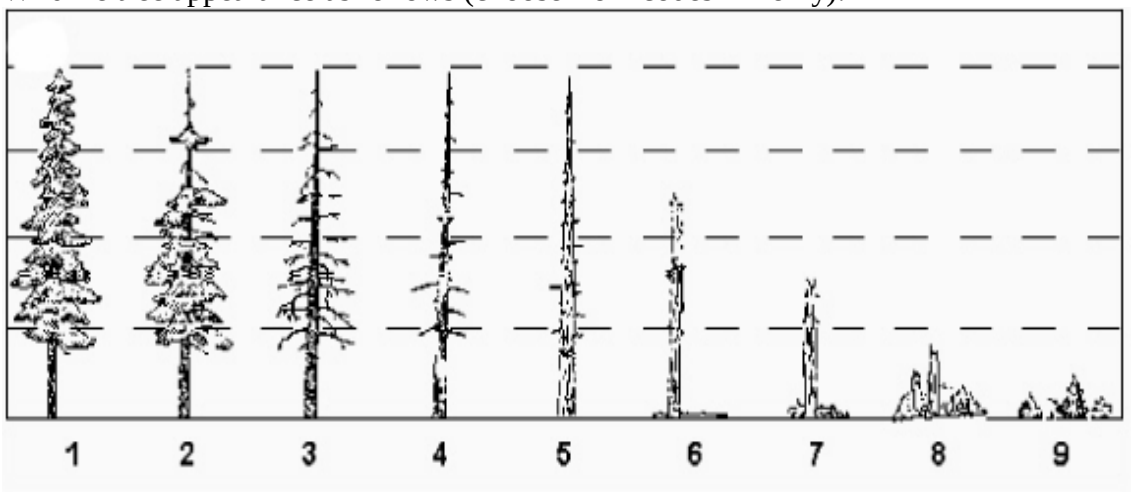
- Number certainty
  - positively identified (1)
  - likely correct (2)
  - uncertain (3)
- Species certainty
  - positively identified (1)
  - likely correct (2)
  - uncertain (3)
- Diameter at 1.3 meters
- Tagging sector
- Near tree number
- Tree class
- Vertical position
  - standing (S)
  - down (D)
    - supported (S)
    - on ground (G)
- Broken and standing
  - yes (Y)
  - no (N)

Height to break (ocular estimate to the nearest 0.1 meter).

Damage agent code and Severity (see Appendix 4: Ministry of Forests Manual-attachments).

For trees that have died since the last measurement take and record age at DBH.

Wildlife tree appearance as follows (choose from codes 1-7 only):



5.3.8 Tagging Ingrowth Trees in the main plot.

For remeasurements tag ingrowth trees (commercial species trees previously below the 4.0 cm tagging limit) which are now 4.0 cm or greater diameter with sequential numbers starting with one number larger than the previous last tree.
The nail, once attached, establishes the DBH of the tree for future remeasurements.
Note in general sample comments if the plot has gone over 900 trees.

Standard: No Missed trees are allowed.

5.3.9 Tagging Top Height trees outside the plot.

In some Top Height plots, the Top Height tree may be found to be outside the main plot boundary. When this occurs the tree will be tagged and recorded as an out of plot tree. Tag, measure & record as normal (enter NO under In Plot). Tree numbers will be assigned from the range of 950 to 999.

5.3.10 Tagging trees in the Sub-plot.

See Section 5.12.

5.3.11 Tagging by Sectors

1. Starting with sector 1 tags were affixed so that they faced the plot center.
2. The trees near the plot center were tagged first, then tagging continued outward by moving side-to-side across the sector.
3. When the outer circumference of sector 1 was reached, the last sideways pass was made in the direction of sector 2 so that the last tree tagged in sector 1 was as near as possible to the first tree tagged in sector 2. The crew chief should check in/out trees and completeness of tagging before the sector markers are moved.
4. In sector 2, the tags were affixed so that they faced the plot boundary, not the plot center as in sector l.
5. Trees near the plot boundary were tagged first, then tagging continued inward by moving side-to-side across the sector.

6. The last tree tagged in this sector was the one closest to the plot center.
7. The procedures were repeated for the remaining sectors.

5.3.12 Near tree information.

Near tree information was recorded for out of sequence trees to aid in the relocation of the tree for remeasurement or quality checks. Near tree information must be recorded for all tagged ingrowth trees.

5.3.13 Attaching Tags to Trees

1. Affix tags at breast height, which is 1.3 metres above the base of the tree on the uphill side. Use a 1.3-metre long DBH stick to measure the correct height.
2. If abnormal swelling or branch whorls occur at breast height, raise or lower the tag by up to 5 cm. The tag may be moved more than 5 cm in some circumstances-if this occurs record actual tag height in remarks.
3. Nail the tags to the tree:

- use 6 cm aluminum nails.
- drive the nail slightly upward so the tag hangs away from the tree.
- drive the nail into the trunk just enough to hold the tag securely and yet allow for radial growth.

5.3.14 Tagging Forked Trees

Here are special rules for tagging forked trees:
1. Tag the stem as a single tree if:

- the fork occurs above 1.3 m, and
- the stem has a DBH of at least 4 cm.

2. Tag each stem separately if:

- the fork occurs below 1.3 m, and
- two or more of the fork's stems have a DBH of 4 cm or greater.

Use consecutive numbers when you tag the stems. Record in the "Remarks" section that these trees are forked together.
3. Tag the stem as a single tree if:

- the fork occurs below 1.3 m, and
- only one of the fork's stems has a DBH of 4 cm or greater.

5.3.15 Measuring the Diameter of Trees Growing Together

To more accurately measure the diameter of trees that are or will soon be joined together at DBH, use the "1/2 wrap" method. To do this, measure or estimate, as accurately as possible, the diameter of each affected tree. Then, from the nail with the tag, measure half of the diameter around the bole of the tree and place a second nail. Note in the remarks, that these are "1/2 wrap" measurements. In the future, the distance between the two nails will be measured and multiplied by two to arrive at the diameter of the tree.

5.3.16 Tagging Unusual Live Trees

Now and then, you will find unusual live trees within a plot or sub-plot. Example: a tree of taggable size growing on a tall stump too high to climb. Exercise good judgment in these odd situations. Treat the above example like this:

l. Assign a tree number to the tree and attach the tag to the stump.
2. Estimate and record the diameter of the tree.
3. Note in the remarks, that you estimated the diameter.
4. Record any pathological indicators on the tree.

5.3.17 Recording Cut Stumps

Stumps were recorded on field sheets, by sector, starting in 1997.

l. Stumps were tagged with a tree number from the range of 900-949 and recorded in data.

5.4 Stem Maps

Stem mapping was done on the 100 % height plot by recording bearing, slope, and slope distance from the center stake. Tree distance was measured to point of germination as represented by the side of the bole perpendicular to plot center. Bearing to tree was to the tree center at point of germination.

Remeasurement Stem Mapping

Stem map all ingrowth trees, out of plot trees and any trees picked up where the sub-plot size was increased, that were tagged at remeasurement.

5.4.1 Stem Mapping

To stem map a tree, begin from the plot center stake and measure the bearing and distance to each tagged tree.

1. Set up the compass directly over the plot center stake (no offset can be used when stem mapping at the remeasurement stage):
   - level the instrument
   - record that the compass was not offset.
2. Adjust the compass for magnetic declination and raise the sighting vanes.
3. Sight on to the first tree on the plot.
4. Some tips for sighting are listed below:
   - to avoid sighting the wrong tree, wrap the DBH stick with flagging tape to make it more visible, then place the stick in front of the tree.
   - to avoid false compass readings as you sight the tree, keep sources of magnetic interference away from the compass, including steel tapes, axes, knives, steel datum holders, eye glasses with steel frames, and most metal objects.
   - to simplify recording and possibly minimize errors, use a staff compass with azimuth bearings when possible.
5. Measure the slope distance between the plot center and the center of the tree.
6. Measure the slope with the Suunto clinometer using the percent scale if $\geq$ 5 %.
7. Read the compass bearing on the scale at the north end of the compass needle.
8. Record all measurements for each tagged tree in the plot.
9. Sight onto the next tree and repeat the procedure until all tagged trees in the plot have been stem mapped.

Standard for Stem map bearing measurements: $\pm$ 2 degrees of the true bearing.

Standard for Stem map distance measurements: $\pm$ 2 % of the true distance.

5.5 Classifying Trees

5.5.1 Classifying trees for pathological indicators.

Classify each tagged tree according to its pathological indicators.

To classify a tree properly, view it from all sides. The person measuring DBH should move far enough away from the tree to be able to classify the lower third of the stem. The recorder should move around the tree to classify the upper two thirds.

In the pathological remarks section, record each pathological indicator as occurring on the lower, middle or upper third of the total height of the tree. Do this by entering the following Pathological (Decay) Indicator Position Codes:

CODE	Position on Tree (tree is divided into thirds)
1	Lower third
2	Middle third
3	Upper third
4	Lower and middle third
5	Middle and upper third
6	Lower and upper third
7	All thirds

5.5.2 Tree Classes

Each tagged tree is classed in one of the following categories:
Tree Class 1: Residual
Tree Class 2: Suspect
Tree Class 3: Dead Potential
Tree Class 4: Dead Useless
Tree Class 5: Veteran
Tree Class 6: Dead, Cut Down

Tree Class 1: Residual
Record tree class 1 if:
- the tree is alive and free of the pathological indicators.

Tree Class 2: Suspect
Record tree class 2 if:
- the tree is alive,
- the tree is not a veteran, and
- the tree has one or more pathological indicators.

Tree Class 3: Dead Potential
Record tree class 3 if:
- the tree is dead
- the tree contains at least an estimated 50 % of sound wood by volume, and
- the tree is greater than or equal to 10 cm DBH and greater than or equal to 3 m in height.

Tree Class 4: Dead Useless
Record tree class 4 if:
- the tree is dead
- the tree is not dead potential.

Tree Class 5: Veteran
In single-layered stands, record tree class 5 if:

- a tree is at least 40 years older than the mean age of the main stand
- the veteran component has an estimated crown closure of less than 6% for a sample.

In complex-layered stands, a tree is considered a veteran only when:
- it is a remnant of a much older stand
- it is at least 100 years older than the mean age of the main stand
- it has a much larger diameter than the other trees in the stand.

This criterion is necessary because of the subjectivity involved in determining what constitutes the main stand owing to the wide range of ages possible in it.
Veterans are not recognized in stands 121 years or older, except in lodgepole pine stands, which may have a veteran component of Douglas fir or larch.
Record pathological indicators for veteran trees the same way as for other trees.

Tree Class 6: Dead, Cut Down
Record Tree Class 6 if the tree is dead as a result of being cut down.

5.5.3 Pathological Indicators.

Pathological Indicators
The eight indicators of decay (pathological indicators) are:
1. Fork or Crook is the result of damage to the main leader.
2. Scar must be weathered and may be open or closed.
3. Frost Crack may resemble a scar but always follows the grain.
4. Dead or Broken Top is a broken or dead leader.
5. Conk is the fruiting body of decay fungi.
6. Mistletoe is a parasitic flowering plant.
7. Blind Conk is pronounced swelling or depression around knots.
8. Rotten branch is an obviously decayed large branch with a diameter inside bark (DIB) of over 10 cm.

Standard for Decay indicators: ± 1 or 10 % of the actual number of external indicators checked, whichever is greater.

The following abnormalities are not pathological indicators:
- butt rot
- flute
- candelabra branch
- sweep
- branch fan
- exposed root
- dry side
- spiral grain
- insect boring
- black knot
- sapsucker hole

- burl and gall

5.5.4 Assessing Damage Agents and Severity

Damage agent and severity codes are as described in the MoF Inventory Manual Coding included in Appendix 4 of this manual.
For each tree affected:
l. Identify, if possible, the damage agent(s).
2. Assess the damage severity.
3. Record the primary and secondary damage agent codes.

- The damage agent codes are hierarchical and enable coding from very general (type or category) to specific (species). The first letter indicates the type of the damage while the second and third indicate the specific agent.
- If you are unable to identify the damage agent species, a short, incomplete label is still useful. Example: You may identify a defoliating insect and assess the percent defoliation for the tree as 30 percent. Record this as ID 3.

For the sample:
1. Make a general assessment of the primary and secondary damage agents.
2. Make a percent assessment of the agent(s) for the sample.
3. Record the assessment for the total sample in the sample header section. If known, also record the year of the attack.

5.5.5 Assigning a Crown Class Code

Crown class refers to the position of the crown of a tree relative to all other trees within the general plot area, not the whole stand.
There are six crown classes: Crown class 1- Dominant
Crown class 2- Co-dominant
Crown class 3- Intermediate
Crown class 4- Suppressed
Crown class 5- Veteran
Crown class 6- Understory.

Assign a crown class code of 1 through 6 to each tagged tree classed as tree class 1, 2 or 5.

Standard for crown class estimate: ± one or 10%, whichever is greater of all crown classes checked.

Note: Crown class 6 should be used sparingly; do not confuse it with crown class 4. Use crown class 6 only in stands 60 years or older where the understory trees, usually shade tolerant, are clearly much younger than the main stand.

5.5.6 Live Crown Length Percent (LC%) Measurements and Estimates

Live-crown length is the distance between the treetop, if the top is alive, or from the top of the live portion, if the treetop is dead, and the base of the lowest contiguous live crown. The estimate is expressed as a percentage of the total height of the tree.

Estimate and record, to the nearest 10 percent, the live-crown length of every tagged tree. When determining the base of the lowest contiguous live crown, do not consider forks or epicormic branches.
The tops of defoliated trees may appear dead at the time of the assessment. Make sure it is or you may underestimate the live-crown length.

Standard for live crown length estimate: ± one 10% class for the live crown length.

In addition, for both regular plots and 100 % height plots, measure and record LC% (to the nearest per cent) on all height trees (including the Top Height trees) and 15 range trees per major species as well as up to 15 range trees for minor and scattered species. Measure and record the height to the bottom of the live crown. Note that GYHost will calculate the actual percentage of live crown.
If tree has a severe lean (>14º) then use same leaning tree length measurement procedures for the bottom of the live crown.
At remeasurement, previous and new range height trees need a measured live crown.

5.5.7 Describing the Stand Structure

Stand structure is the physical arrangement or pattern of organization of the stand. Stand structure is described and classified according to recognizable age and height differences.

The recognized stand structures are:

1. Simple layer (even age and height)
- with veterans
- without veterans
2. Complex layer (uneven age and height)
- with veterans
- without veterans
3. Multi-layer
- layer 1 is the top layer
- layer 2 is the bottom layer

For single layer stands, layer 1 is assumed for trees in the main stand and tree class 5 identifies the veteran layer.
For multi layer stands, record 1 for the top layer trees and 2 for the bottom layer. The sample primary layer, according to regional priorities, must be identified.

5.6 Other Plot Attributes

5.6.1 Estimating Crown Closure

Crown closure is the percentage of ground area covered by the vertically projected crowns of trees.

For each plot, estimate and record the crown closure by layer to the nearest 10 percent.

Standard for crown closure estimate: ± one 10% class for ground measurements.

For the veteran component of the plot, record crown closure to the nearest percent. If the crown closure of the veteran component for the sample is 6% or more, it must be classified as a separate layer.

5.6.2 Elevation

Elevation was recorded for each plot from GPS information.

Standard: ± 50 meters.

5.6.3 Aspect and Slope

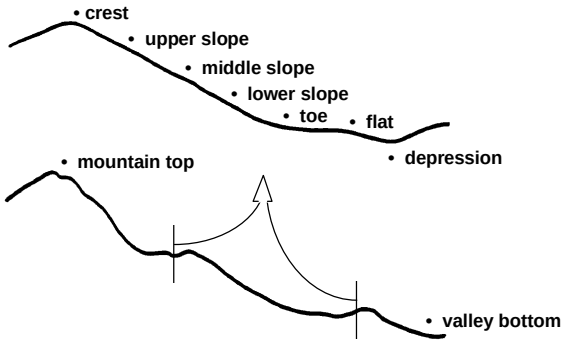
Aspect and slope was determined for each plot.

Standard for aspect measurement: ± 10 degrees of true aspect.

Standard for slope measurement: ± 5% of true slope.

5.6.4 Determining Slope Position

Slope position is the relative position of the plot within a water catchment area. Determine the slope position and record the appropriate code:

Code	Category	Slope Position
C	Crest	
U	Upper	
M	Mid	
L	Lower	
T	Toe	
F	Flat (level)	
D	Depression	

5.7 Tree Height Measurements

5.7.1 Top Height (Site Sector) Sample Trees

The Forest Productivity Council of B.C. defines Top Height (1998) as the height of the largest diameter tree, regardless of species, in a 0.01 ha plot, providing the tree is suitable. A suitable tree must be healthy, not have a broken or damaged top, not have its height growth affected by a competitor nor be a residual left from previous logging. There is no substitution for an unsuitable tree.

For a single-layered stand, or for each layer in a multi-layered stand, select height sample trees as described in the following sections.
In one plot of each cluster 100 % height measurements will be taken. This plot will be the same plot that has 100 % stem mapping.
In regular plots, Top Height trees and all range trees will have heights recorded.

5.7.2 Re-Calibrating Tree Measurement Instruments

If a Vertex or laser tree height measuring instrument is used, the instrument will be re-calibrated on every tenth tree by using a tight chain to confirm an accurate reading of horizontal distance.

5.7.3 Top Height Tree Used by the Forest Productivity Council of B.C.

The Forest Productivity Council of B.C. Top Height will be the Top Height tree recorded in Top Height plot #5 (Site Sector #5). This tree will be marked with a 'T', with the top of the 'T' located at DBH and the 'T' facing the main plot center. A blue dot will be painted on the tree accurately at DBH indicating the direction the height was taken from. Record a "C" (center sector) for this tree in GYHand in the sector field (under Cs).

5.7.4 Additional Top Height Trees Collected by Lignum

Lignum has designed their PSPs such that there are nine (9) spatially distributed Top Height plots within each full size PSP and five Top Height plots in a half size plot. In addition to the Top Height tree that is collected and used by the Forest Productivity Council (the Top Height in plot #5), Lignum will also be collecting one Top Height within each of the remaining eight Top Height plots (four for half plots), regardless of species, *if* there is a suitable tree for Top Height. If there is not a suitable tree, then there will be no substitution.
Suitable Top Height trees have the following characteristics:

1. largest diameter trees;
2. living;
3. a Crown class of 1 or 2. The exception is in the case of the second layer in a two-layer stand where crown class 3 and 4 are acceptable;
4. are free of major defects;
5. cannot be substituted.

The nine Top Height plots (five in half plots) are established and marked with round stakes. These Top Height plots have a 5.64 m radius for both full size (0.1 ha) plots

and half size plots. See figures in Section 4.2, for Top Height plot location and dimension details.

The Top Height plot centers were located as accurately as possible. The essential factor in the placement of Top Height plots was that they be re-locatable. Since vandals may remove these stakes, a distance and bearing from the Top Height plot center to 2 nearby trees with plot numbers was recorded as a precaution. The Top height and Site height trees were chosen for this if present in the Top Height plot.

Enter the stem map measurements for the Top Height and Site Height Tree into a spreadsheet designed for data entry.

The Top Height tree in each of the remaining eight Top Height plots will be marked with a 'T', with the top of the 'T' located just below DBH and facing the main plot center. A blue dot will be painted on the tree accurately at DBH indicating the direction the height was taken from.

5.7.5 Site Height Trees

A Site Height Tree is the largest diameter tree, if suitable, within each of the nine Top Height plots (five for half plots), for the first two major species. If the first largest diameter tree encountered is not a suitable tree[1], then there is no replacement (there will not be a Site Height Tree for that major species). *Note that it is possible that there are no Site Height Trees within any given Top Height plot.*

The Site Height Tree in each of the nine Top Height plots will be marked with an 'S', with the top of the 'S' located just below DBH and facing the main plot center. A blue dot will be painted on the tree accurately at DBH indicating the direction the height was taken from.

In some cases a tree will be selected as both a Top Height and a Site Height tree. These trees will be marked with both a T and an S with the top of the T being just below DBH and above the S, facing the main plot center. A blue dot will be painted on the tree accurately at DBH indicating the direction the height was taken from.

Standard for total tree height measurement: ± 20 cm or ± 2% of true height whichever is greater.

For remeasurements, the top height and site height trees selected may be different than those originally selected. All previous heights (including range and top/site height trees) must be retaken even if now dead. Select additional suitable range trees to satisfy current requirements down to 2 cm DBH.

Take the remeasurement height from the same direction as the previous height to maintain consistency. This direction should be indicated by a blue dot at DBH or an "H" and/or "A" facing the direction that the previous height was taken. A 'T' or 'S' shall be put on the tree facing the main plot center if the tree is retained as a Top height or Site Height Tree at the remeasure.

[1] Suitable Site Height Trees have: 1-a crown class of 1 or 2; 2- are free of major defects; 3- are within 5% of the original height.

5.7.6 Range Height Trees and Minor and Scattered Species Heights

Additional sample heights are to be chosen according to the following guidelines (for plots where all heights are not measured).

Standard for total tree height measurement: ± 20 cm or ± 2% of true height whichever is greater.

5.7.6.1 Selecting Sample Trees

When possible, select residual trees (tree class 1). Otherwise, select trees that do not have a major fork, which affects the true height, or a major scar at breast height, which affects the true diameter.

Do not select trees with:

1. diameters that were estimated
2. sweeps or leans greater than 10 degrees.

In some areas, it may be impossible to meet sample height requirements if only suitable trees as described above are taken. In this situation, take the best of the "poor" trees to meet the requirements. However, do not select a tree if its height is less than 95% of what it would be without its defect - lean, fork, broken top, etc. Make a note of the number of meters you have underestimated height due to the less than suitable trees in your sample.

5.7.6.2 Major Species: (>20 %)

For each of the first two major species (20 percent or more by composition), select trees for the sample as follows:

1. Select an additional 15 trees covering the range of diameters present down to 2 cm if available, for each of the first two major species present (commercial or non-commercial).

2. The range trees selected for the major species are to be marked with an 'R', with the top of the 'R' located just below DBH and facing the main plot center. A blue dot will be painted on the tree at DBH indicating the direction the height was taken from. Ages and live crown measurements are to be taken on these trees[2].

5.7.6.3 Minor and Scattered Species: (<20 %)

For each minor (10 to 19 percent by composition) and scattered species (less than 10 percent by composition), select 15 trees, if present and suitable. Distribute them across the DBH range, down to 2 cm DBH. Place the emphasis on larger diameter classes.

5.7.6.4 Veterans

For the veteran layer:

1. Select one tree for each species present.
2. Estimate the height of all others.
3. Record the estimated height in the Vet height section.

[2] Enter 'O' for 'Other' in GYHand 02 to differentiate these range trees from the Site Height Trees and Top Height Trees present in the Top Height plot.

5.8 Measuring Forked Trees with dead leader

For trees with a forked top that have a dead leader and a live replacement terminal, record height of dead top, if taller, as tree height and record the height of the live leader in comments. Otherwise, record height to top of live terminal.

5.9 Measuring Suppressed Trees with Flattened Tops

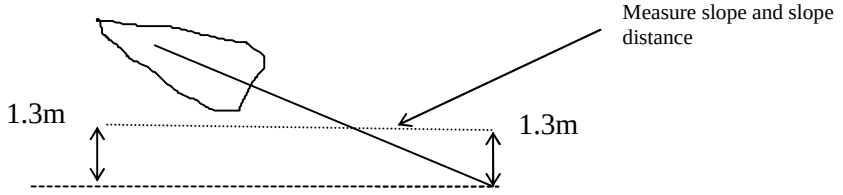
To ensure accurate measurements of suppressed trees:
1. Sight on the highest point of the top.
2. For hemlock trees, sight on the highest point of the droop.
3. For cedar trees, make sure you take the top reading on the tiny leader and not on a lateral branch, which may be higher.

5.10 Measuring Heights on Severely Leaning Trees

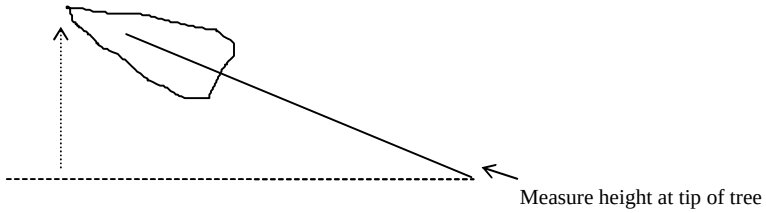
(Only in 100 % Height plots).
Heights of trees are usually measured with a height pole, a vertex or a clinometer. In certain situations, such as trees that are severely leaning, this method alone may underestimate the actual length of the tree, resulting in measurement errors in the Growth and Yield database. In order to record the length on these trees as accurately as possible, the following methodology should be followed on trees that have *severe leans only.*

'Severe leans' are described as trees that have more than a 14 ° lean from the vertical.

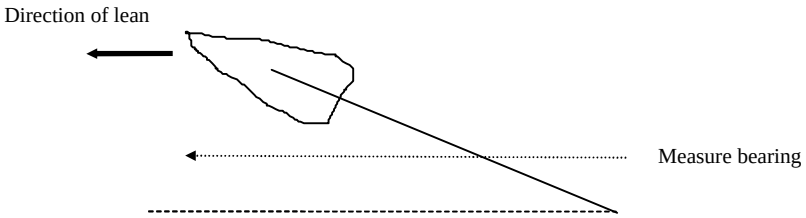
1. A slope distance and slope is taken from the base of the leaning tree to the point perpendicular to underneath the tip of the tree. This should be from 1.3m at the base of the tree to 1.3m above ground directly below the very tip.



2. A height is taken from the tip of the tree to the ground perpendicular to the tip of the tree.



3. A bearing is taken from the base of the tree following the general lean of the tree.



These measurements can then be used to calculate an approximate length, the height above ground that the top of the tree is now, as well as the position of the tree relative to the base.
*Note: Vertical height should also be directly measured if possible.

It should also be noted in the comments that this is a leaning tree.
Direct length and vertical height measurements only may be entered (i.e.: no slope distance and slope % need to be recorded unless ground is sloped).

5.11 Sample Ages

The ages of the Forest Productivity Council Top Height tree, the additional Top Height trees gathered by Lignum, all Site Height Trees, and the range trees (range height trees) of the first two major species down to 4.0 cm were recorded along with the 5, 10 and 20 year increments at plot establishment. For remeasurements, ages need to be taken on range trees (if not previously done) of the first two leading species as well as new Top or Site Height trees.

The age at remeasurement goes into 'new age' in GY02 even when it is taken for the first time. The new age also populates the BH age as well.

Attempt to get sound cores from trees with rot by re-boring them 90° to original direction. Note that in 100% height plots trees with a range of diameters are chosen to have the ages taken and height/live crowns measured.

Standard for breast height age measurement: ± 2 years or 2% whichever is greater.

Standard for radial increment: ± 1 mm of the true measurement.

5.11.1 Age Sample Trees

In **single layer simple stands**, pure and mixed, the age of the stand is determined by averaging the ages of the site height trees of the leading major species on the plot. However, ages of the site height trees of the second major species must also be taken.

The sample mean age is derived from the site height trees of the leading species only, even if some of their cores are rotted. The rotted portion must be estimated to derive a total age for the tree. See "Counting Rings on Rotted Cores" in this chapter.

Bore trees that appear to be **veterans** to confirm they are in fact veterans. Bore the smallest diameter veteran per species only; the others can then be assumed to be veterans too. Use these ages for the veteran layer.

In **single layer complex stands**, determine the average age of the stand from the ages of the site height trees of the leading major species. However, to show the variation of the stand's age, take additional ages of the leading major species from the younger portion of the stand. For additional major species, treat them as described above under mixed stands.

In **multi-layered stands**, select sample trees, as outlined above, for each layer. The site height tree method for determining site index is more suitable for even-aged stands. However, to simplify matters, select sample trees for both layers using the site height tree requirements as above.

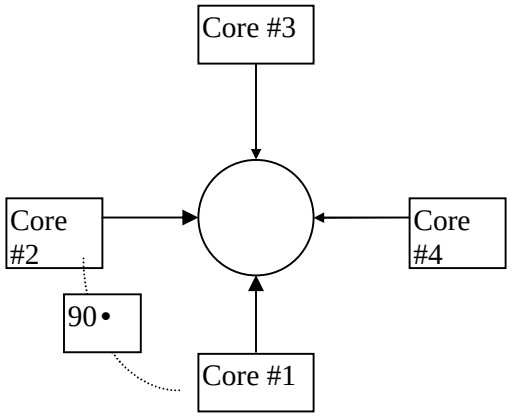
5.11.2 Taking the Age of a Live Tree

The procedures for drilling trees is as follows:

If the pith is not part of the first core taken at DBH (it is an acceptable core if, in the opinion of the crew chief, the core is within two years of pith), then other cores are to be taken, up to a total of four cores. Each subsequent core is to be taken 90° clockwise from the first core (see figure below). If, on the fourth core, the pith is not hit, no other cores will be taken.

The first attempt at drilling the tree and hitting the pith will be made from that point on the tree that is closest to plot center, unless the tree is leaning. If the first attempt fails one moves in a clockwise direction until one is successful.
For leaning trees the first attempt is made on the side of the tree perpendicular to the lean and if required a second attempt is made on the other side of the tree. Only two attempts will be made on a leaning tree.

Figure. Acceptable locations for taking increment cores on trees.



PLOT CENTER

1. Bore the selected trees just below 1.3m above the base of the tree on the uphill side. If there is a whorl located at DBH that will affect determining the sample age, move the bore hole slightly below DBH.
2. Remove the core. Make sure at least two cores per species include the pith.
3. If the core includes the pith, record Y in the pith field.
4. If rot is encountered drill the next position.
5. Keep and label all cores.

The total number of cores collected are recorded as the “# of Cores”.

All cores will be kept, labeled 1, 2, 3 and 4 according to the order in which they were pulled from the tree, with core #1 always being the core taken facing plot center. The "best" core (that being closest to the pith) according to the field crew, will be noted on the field card and selected for counting in the office. If necessary, an estimate of the

years to hit the pith will be recorded separately. Otherwise, the pith will be included in the core.

Collect all tree cores in "straws" and return to the office. Each straw is to be labeled, and should include polygon, sample number, core number, tree number, tree species, date, core position (1-4) and crew initials. The counting system that has been developed for keeping track of all plot cores is to be completed for each plot (to be provided). This is to ensure that the appropriate number of cores has been taken in the field and that all cores have been submitted for the office count.

All cores are to be deposited into a freezer for storage within 5 days after the tree is bored.

Standard for radial increment measurement: ± 1 mm of the true measurement.

5.11.3 Taking the Age of a Dead Tree

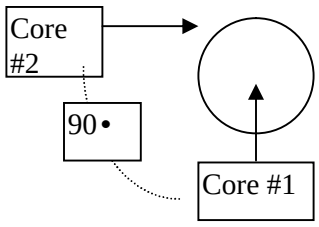
All recently dead trees (defined as trees that have died since the last measurement) will have an age taken. The procedures for drilling dead trees is as follows:

If the pith is not part of the first core taken at DBH (it is an acceptable core if, in the opinion of the crew chief, the core is within two years of pith), then one other core will be taken 90° clockwise from the first core (see figure below).

The first attempt at drilling the tree and hitting the pith will be made from that point on the tree that is closest to plot center, unless the tree is leaning. If the first attempt fails one moves in a clockwise direction to take the second core. A maximum of two attempts will be made on a dead tree.

For dead leaning trees the first attempt is made on the side of the tree perpendicular to the lean and if required a second attempt is made on the other side of the tree. A maximum of two attempts will be made on a dead leaning tree.

Figure. Acceptable locations for taking increment cores on trees.



PLOT CENTER

1. Bore the selected trees just below 1.3m above the base of the tree on the uphill side. If there is a whorl located at DBH that will affect determining the sample age, move the bore hole slightly below DBH.
2. Remove the core. Make sure at least two cores per species include the pith.

3. If the core includes the pith, record Y in the pith field.
4. If rot is encountered drill the next position.
5. Keep and label all cores.

The total number of cores collected are recorded as the "# of Cores".

All cores will be kept, labeled 1 and 2 according to the order in which they were pulled from the tree, with core #1 always being the core taken facing plot center. The "best" core (that being closest to the pith) according to the field crew, will be noted on the field card and selected for counting in the office. If necessary, an estimate of the years to hit the pith will be recorded separately. Otherwise, the pith will be included in the core.

Collect all tree cores in "straws" and return to the office. Each straw is to be labeled, and should include polygon, sample number, core number, tree number, tree species, date, core position (1 or 2) and crew initials. The counting system that has been developed for keeping track of all plot cores is to be completed for each plot (to be provided). This is to ensure that the appropriate number of cores has been taken in the field and that all cores have been submitted for the office count.

All cores are to be deposited into a freezer for storage within 5 days after the tree is bored.

Standard for radial increment measurement: ± 1 mm of the true measurement.

5.11.4 Counting Rings on Rotted Cores

If the sample tree has rotted:
1. Count the rings on the sound portion of the core.
2. Estimate the number of years in the rotten portion.
3. Add the number of years in the sound portion to the estimated number of years in the rotten portion.
4. Record the total breast-height age.
5. Record R for rot in the pith field in GYHand and record length of sound (counted) core in remarks.

5.11.5 Boring Small Trees

If it is not possible to bore a small (less than 4 cm DBH) tree without damaging it:
1. Select a similar tree outside the plot and bore it.
2. Assign a tree number 950 to 999 to the tree.
3. Paint a blue spot on the tree at breast height.
4. In the remarks, describe the location of the tree relative to the plot.

Note: selecting a similar tree outside of the plot for boring is not necessary for range trees. If the tree cannot be bored without damaging it, then an age will not be taken on that tree.

5.12 Fixed Sub-Plot

5.12.1 Fixed Sub-plot Data

The radius of the fixed sub-plot was 5.64 meters in 1997. Ingrowth trees >or = 2.0 cm in the subplot will be tagged at remeasure.

The sub-plot objective was to obtain a sample of commercial species that were less than 4 cm DBH and at least 0.3 m high.

Guidelines/Criteria:

1. Fixed Sub-Plot size will be 5.64 m radius for both 0.1 ha and 0.05 ha PSP plots.
2. All commercial trees within the subplot from 30 cm ht to 3.99 cm DBH will be measured and recorded according to MOF guidelines.
3. Stems 30 cm height to 1.9 cm DBH are to be dot tallied.
4. Stems from 2 cm DBH to 3.9 cm DBH are to be measured for all attributes normally done for main plot trees (i.e. tagged).

Dividing the Sub-plot into Sectors
For the sub-plot, use the same sector divisions as laid out for the main plot.

5.12.2 Tagging Trees in the Sub-plot

Tag with nails all living trees of commercial species between 2 cm DBH and 3.9 cm DBH. For trees of **commercial species less** than 2 cm DBH:
1. Count them in a dot tally.
2. Derive their metric DBH class (see table below).
3. Record them by species and DBH class.

Metric DBH Classes and Limits

DBH class	Limits
0	0.3 m to 1.3 m high
1	0.1 cm to 1.9 cm DBH

At remeasurement, tag ingrowth trees (commercial species trees previously below the 2.0 cm sub-plot tagging limit), which are now 2.0 cm or greater diameter with sequential numbers starting with one number larger than the previous last tree. Note and record near tree numbers! Use a near tree that is preferably larger than 10 cm and /or that shows signs of vigor. Avoid using trees that appear unhealthy.

5.12.3 Tagging Forked Trees in Sub-plots

The special rules for tagging forked trees with a DBH of between 2 cm and 3.9 cm are:
1. Tag the stem as a single tree if the fork occurs above 1.3 m.
2. Tag each stem separately if:

- the fork occurs below 1.3 m and has one root system.
- two or more of the fork's stems have a DBH of 2 cm or greater.

Give special attention to the method of tagging or counting forked trees with stems less than 2 cm DBH. Certain trees have numerous leaders, which are the topmost shoots of a main stem. To avoid counting them all, count only the tallest leader. This rule only applies if the main leader is less than 2 cm DBH.

5.12.4 Measuring Abnormal Center Sub-Plot Trees

For abnormal trees less than 2 cm DBH within the sub-plot, special measurement rules apply.

To obtain the small tree height, measure from the base of the tree on the uphill side to the tip of the terminal bud. See Ministry of Forests Appendix 10 in Appendix 4. For small trees with drooping leaders, such as cedar and hemlock, measure the length of the tree.

5.13 Ecosystem Data Collection

Ecosystem data and information will be collected by a separate ecological contractor.

6.0 DATA RECORDING

Lignum Ltd. will use the Ministry of Forests field data recorder program. Information that cannot be entered into the recorder will be entered and submitted on field forms.

7.0 QUALITY ASSURANCE

Forest Productivity Council of B.C. Standards of Measure for the establishment of Permanent Sample Plots will be used to determine acceptable levels of project quality.

Lignum Ltd. will use the Quality Control methods of the MoF Regional Inventory staff to check the work performed by G&Y contractors. Additional data or departures from MoF processes are covered in this manual, or may be added to the contract through a contract amendment, or added at the end of the field season. Many of these accuracy comparisons will be for the purpose of evaluating the contractor for future work, rather than for payment purposes.

7.1 PSP Plot Establishment Contractor Quality Assurance

Contractors are required to conduct Quality Control on their own work. Contractors are expected to complete a final data checklist to assist them in conducting QA processes. The Final Data Checklist has been prepared by Lignum to help reduce common mistakes that have been observed over past year's programs. A copy of this form is located in Appendix 7.

7.2 Quality Assurance, Mapping Samples, & Returning Field Sheets

Quality Assurance sampling crews should emphasize accuracy over production. For the standards of measurement, see Appendix 1.

Quality Assurance Sampling Crew Procedures

To ensure crews continue to work efficiently, and to ensure they follow and understand recommended procedures, carry out regular inspections.

l. Inspect at least 10 percent of all samples established. Where the number of plot trees exceeds 120, two or more field inspection sheets may be completed. If the sample has been poorly done, the original crew may be required to redo it.

2. Conduct spot checks as work progresses to be sure tie points are properly marked and that tie lines are run on the designated bearings.

3. Conduct spot checks as work progresses to observe sampling crew performance.

4. After inspecting the sample, decide if the level of errors warrants the contract crew returning to correct errors.

Checking the Samples in the Office

All samples must be checked in the office. Follow this procedure:

l. Ensure the sample identification is correct and valid.

2. Ensure the sample header is as complete as possible.

3. Ensure that the number and distribution of tree heights – both Top Height and others – were met.

4. Ensure the number of ages and piths (two per sample) were met.

5. Check that the access notes are complete and include the tie point sketch.

Inspecting the Samples

Once the samples have been checked in the office, randomly select one of the plots and conduct the following:

l. a pre-field inspection
2. a field inspection
3. a post-field inspection.

Pre-field Inspection

1. Randomly select one of the samples from the ones checked in the office.
2. Printout a Quality Assurance plot inspection report (report 8):
3. Seven trees will be randomly select for tree detail checking. Note if the number of trees in the sample exceeds 120 trees, additional number of QA trees will be selected to total approximately 10% of total trees in the sample.
4. Randomly select five trees from the sample tree section, for height checking
5. Select two trees for age checking.
6. Randomly select one tree count diameter class for a species. Later, you will use this diameter class in the field to check that the dot tally is correct for that class.

Field Inspection

l. Travel to the sample. Use the access information given by the original sampling crew. See "Describing Access and Location of the Sample" Section.
2. Check that the tie point is correctly marked. See "Choosing a Tie Point" Section.
3. Make sure the tie line bearing and distance run within the allowable standards.
4. Make sure the plot center markers are correctly inscribed.
5. From the plot center, check the bearings and distances to 3 trees.
6. Check the plot boundaries for distance, bearing, and length, and sub-plot radius at a minimum of three different locations. Check for trees that were missed or that should have been excluded from the plot or sub-plot.
7. Within the plot or sub-plot, make sure trees larger than the tagging limits were not missed. Also, check for trees that were tallied when they should not have been. Flag with a circled asterisk any missed or erroneously tallied tree.
8. Make sure all sub-plot trees of the selected tree count class were counted in the dot tally.
9. Dot tallies for dead trees are not required. All trees are tagged, therefore the dead trees are measured as part of the measurement process.
10. Carefully measure all the trees selected for field inspection:
    - Tree identification - Make sure the genus or species of each tree is correct. If not, place a circled asterisk beside the tree.
    - Tree tag height - Check the tag height of the seven selected trees to verify that breast height is 1.3 m above the base of the tree on the uphill side. At the same time, make sure the nails were securely driven into the trees and the nail with the tag was driven in at a slight angle so that the tag hangs away from the tree.
    - Diameter and pathological remarks (decay indicators) - Measure the DBH of the seven selected trees and classify them.
    - Sample tree heights - Measure the five selected trees for height and LC Length percent.

- Stem mapping - If the sample was stem mapped, check the selected trees for bearing, distance and percent slope.

11. Assess the crown closure for the plot.
12. Compare your tree measurements with the crew's measurements. Give the crew the benefit of the doubt on any slight discrepancy.
13. Make sure the results conform to the standards of measurements. See Appendix l.
14. If the difference between two measurements is greater than the allowable error, place an asterisk in the margin.
15. If the error is greater than two times the allowable error, place a circled asterisk in the margin.
16. Complete the inspection items section of the inspection report.
17. Rate the quality of the work on the plot using the Ministry of Forests weighted system (in Appendix 1).
18. Record your rating of the sample and any other comments in the remarks section of the plot inspection report.

Post-field Inspection

1. Discuss the results of your inspection with the field crew.
2. Make recommendations to the field crew, when necessary, on how to improve their work.
3. Ensure major errors are amended.

Submitting the Samples

Project Manager Review

The Project Manager will conduct a random review of the samples prepared by the Quality Assurance contractor. This review will be done to ensure standards and program objectives are met.

The program manager, in conjunction with the Quality Assurance crew will prepare a package for Lignum Ltd. staff to review.

Lignum Ltd. Staff Review

Lignum Ltd. staff will review the samples in the field and office to determine that the program standards have been met.

Contract Deliverables Submission to Ministry of Forests

Once the samples have been checked in the office and corrected, a package will be prepared for submission:

1. Make duplicate sets of the samples.
2. Write a covering letter listing the samples.
3. Make a duplicate of the covering letter and file in the Lignum Ltd. G&Y file.
4. Deliver two sets of the digital and hard copy of Reports 1, 2, 3, 5, 7 and Verify Complete along with one set of the Lignum Quality Assurance field sheets and the covering letter to the Regional Manager, Cariboo Region Ministry of Forests office.
5. File the second set in the Lignum Ltd. Growth and Yield file for security and reference.

Appendix 1: Measurement Standards

MoF: Standards of Measurement For Permanent Samples

Tie Line	
Bearing	±2°
Distance	±2%
Plot	
Missed and extra trees	No error within the plot. ±1 line tree within 5 cm.
Tree species	No error, but identification to genus level allowable for birch, interior spruce and willow.
Radius	±0.5% of plot/sub-plot radius tolerance for borderline trees.
Breast height	±5 cm
D.B.H.	±0.l cm or 1.0%, whichever is greater. ±0.2cm or 2.0% for dead trees.
Decay indicators	±1 or 10%, whichever is greater, of the total number of external indicators of all trees checked.
Crown closure	± one 10% class
Live crown	± one 10% class
Quality	± 1 or 10%, whichever is greater, of the total number of trees checked.
Crown class	± one crown class
Total tree height	± 20 cm or 2%, whichever is greater.
Estimated tree height	± 0.5 m or 10%, whichever is greater.
Tree age	±2 years or 2%, whichever is greater.
Radial increment	±0.1 cm
Slope	± 5%
Aspect	± 10 degrees
Elevation	± 50 Metres
Wildlife Visual Appearance	± 1 visual appearance class
Stem Mapping	
Bearing	±2°
Distance	±2%
Location	
Latitude	± 1 second
Longitude	± 1 second
UTM	± 20 metres

MoF: Weighted Error Rating Table and the Basis for the Acceptance or Rejection of a Plot

Symbol		Weighted error
	Missed and/or extra plot trees	2
	Missed and/or extra sub-plot trees (less than 2.0 cm d.b.h.)	½
	Missed and/or extra dead trees	½
	Missed an/or extra sub-plot trees (greater than or equal to 2.0 cm d.b.h.	1
	Tree genus/species live tree	2
	Breast height	1
	D.B.H. (Dead tree DBH is ½ point.)	2
	Path	1
	Live Crown	½
	Crown Class	½
	Quality	½
	Dead tree wildlife visual appearance	½
	Radial increment	½
	Crown closure	½
	Measured height	2
	Estimated height	½
	Total age	1
	Bearing	1
	Distance	1
	Slope	½
	Aspect	½
	Elevation	½
*	Asterisk	50% of above.

Color Codes

LIGNUM GY02

REMEASUREMENT FIELD MANUAL VERSION 1.0.3

PLOT PARAMETERS & COLOR CODES

PARAMETER	ITEM	COLOR
Tie Point	Paint, rectangle, both sides.	Blue
	Flagging	Red LIGNUM G&Y
Tie Line	Paint, square, both sides.	Blue
	Flagging	Red LIGNUM G&Y
Plot Center Stake	Round aluminum stake	Red
Plot Center Tree	Two bands of flagging above and below aluminum tree placard.	Red LIGNUM G&Y
Corner Stake	Angle aluminum	Red
Buffer Boundary	Paint, rectangle, facing away from plot.	Red
Plot boundary	Paint, double horizontal @ 1.8 m, facing to plot center.	Blue
Sub-plot stake	Round aluminum stake	Blue
Plot corner tree	Paint, two lines.	Blue over existing red
Recce line/plots	Double ribbon.	Red & lime green ribbon

Appendix 2: FOREST PRODUCTIVITY COUNCIL OF B.C. STANDARDS OF MEASURE FOR PERMANENT SAMPLE PLOTS

Dated: March 1999, see Forest Productivity Council Web site.

Appendix 3: Ministry of Forests Manual - Attachments

Dated: July 2002, see MSRM Web site, appendices 1, 2 & 14.

Appendix 4: Increment Core Data Collection and Entry Procedures.

Appendix 5: FINAL DATA CHECKLIST

Appendix 6: Age Core Data Card