FIELD MANUAL FOR RE-MEASUREMENTS

STRIP CUT UNDERSTORY PROTECTION STUDY

Version 1

March 2018

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Background

This document is intended for use by contractors engaged re-measuring the Forest Growth Organization of Western Canada's Strip Cut Understory Protection (SCUP) plots. This manual is only intended for use in plots that have been re-measured under the new protocol that was effective in 2013.

The original protocol was designed to assess stand level performance following strip cut understory protection harvesting, to provide information for growth model development and/or calibration and to provide data acceptable to Alberta Agriculture and Forestry for use in monitoring and yield curve validation. The protocol was revised in 2013 to:

- collect data suitable for both MGM model development and initiation
- maximize efficiency of sampling, particularly reducing effort on tagging and measuring saplings.

1.1   Plot Layout

The protocol is intended for *Single-Pass* Strip Cut Understory Protection systems only and samples three different areas within the treatment. The *Extraction Trail* is the area within which all trees have been harvested to provide access for harvesting equipment. The *Removal Strip* is the area subjected to overstory removal (generally aspen), for the purpose of releasing understory conifers (generally white spruce). The *Buffer Strip* is a "leave" area, within which the overstory is retained to reduce windthrow effects on release trees in the Removal Strip.

The SCUP protocol uses a *Plot Cluster* design. A Plot Cluster consists of a series of adjacent plots, each sampling one of the three treatment areas (Removal, Extraction and Buffer). There are usually 6 randomly distributed plots in the same block to capture within block variability.

Plot cluster dimensions vary depending on the width of extraction, removal and buffer areas and time of establishment. The two basic plot cluster layouts for blocks with and without buffer areas are shown in Figures 1 and 2, respectively. In each case there are 7 sapling plots established along the plot centre line.

	Buffer (B)			S5		
Removal Plot 1 (R1)		S4	
		S3	
Extraction Trail (E)		S2	Plot Centre Post
		S1	
Removal Plot 2 (R2)		S7	
		S6	Plot Centre Line

2 m

Variable in old plots, 20 m in new establishments
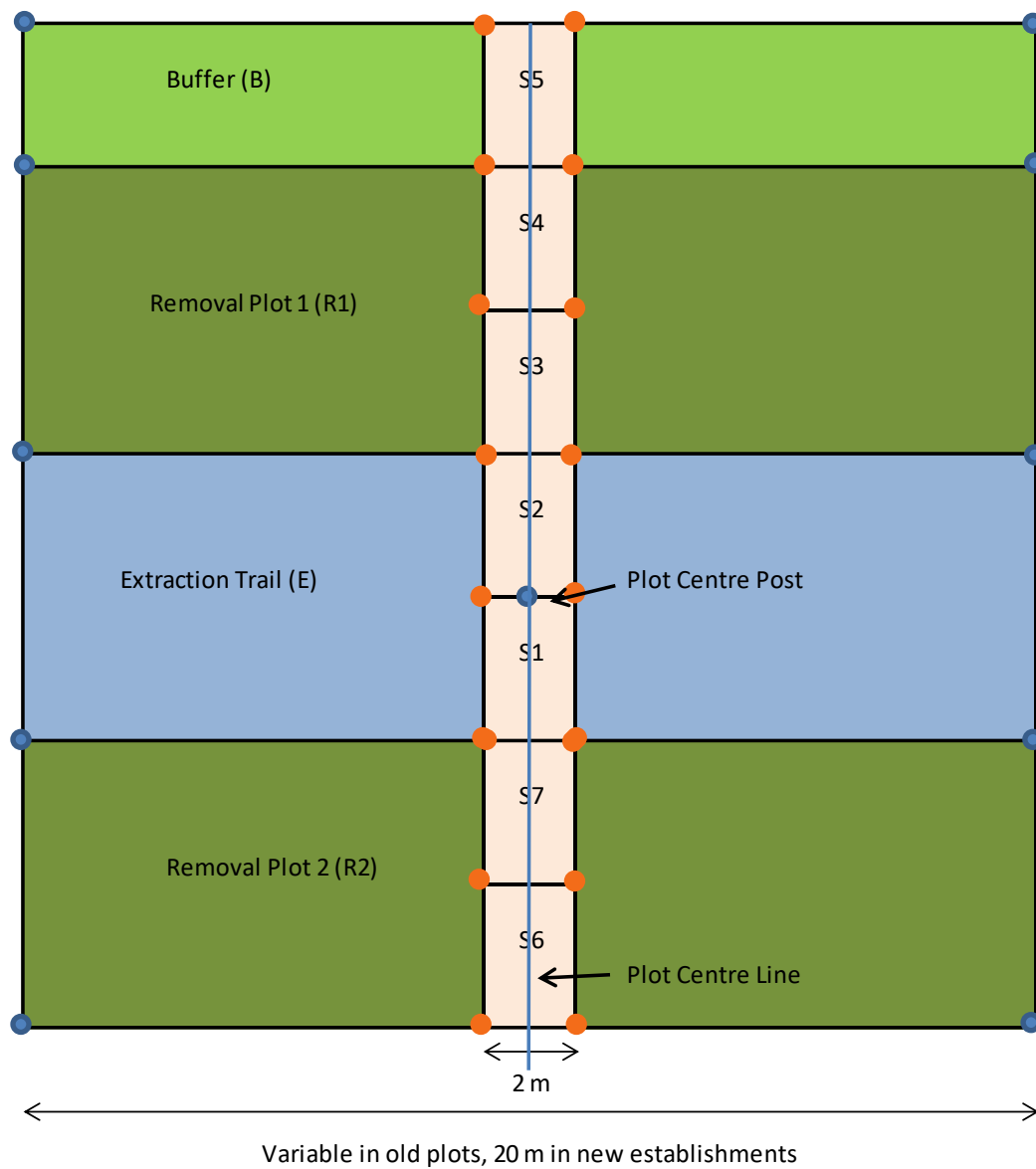
Figure 1. SAPLING SUBPLOT LAYOUT FOR PLOT CLUSTERS WITH BUFFER PLOTS.

Removal Plot (R)

S7

S6

S5

S4

S3

S2

Extraction Trail (E)

Plot Centre Post

S1

Plot Centre Line

2 m

Variable 10 - 18 m

Variable 6 - 10 m

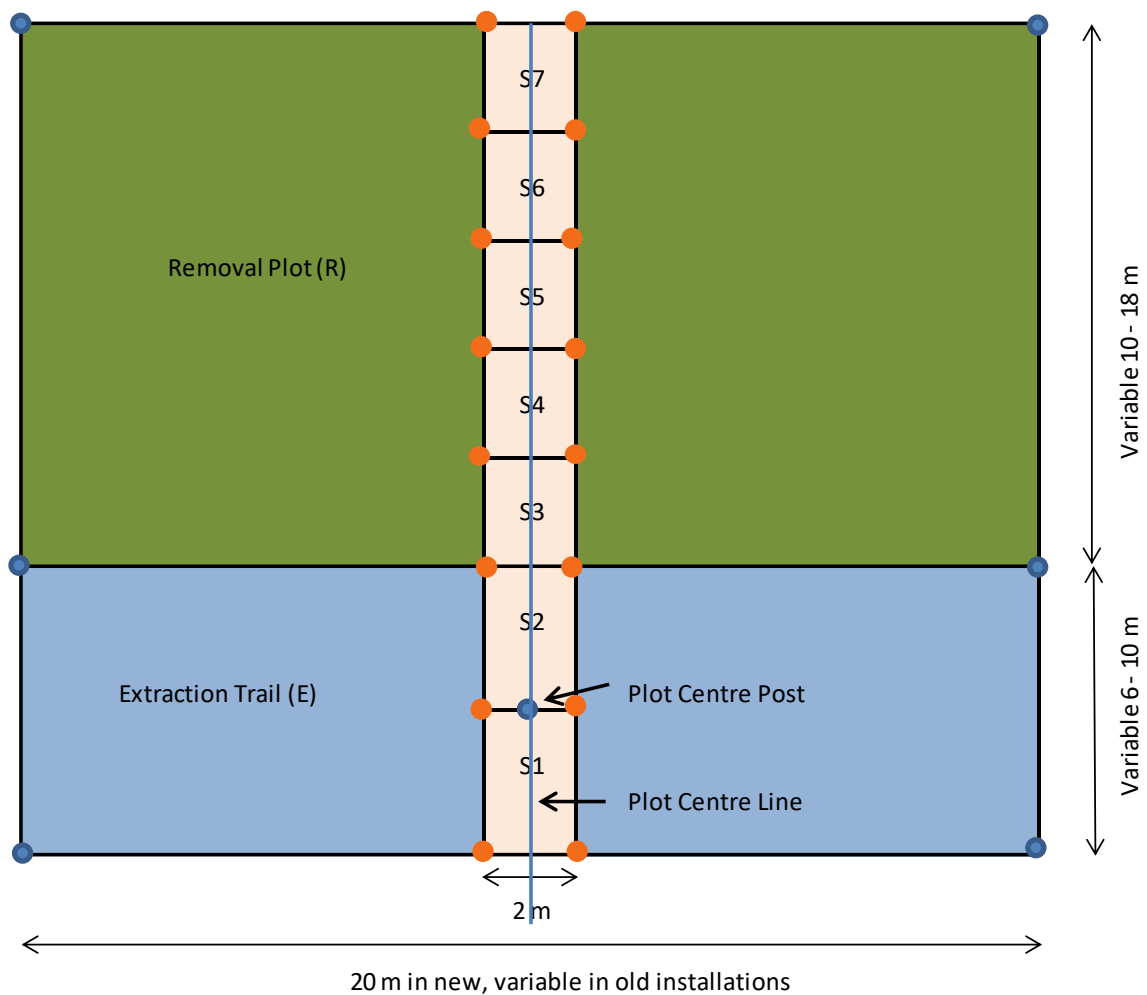20 m in new, variable in old installations

Figure 2. SAPLING SUBPLOT LAYOUT FOR PLOT CLUSTERS WITHOUT BUFFER

2 Plot Cluster Re-measurement Protocols

2.1 Maintenance

When navigating to and between plots, ensure that the starting point and tie points are visible and in good condition. This includes touch-up painting of nearby trees and replacement of faded flagging tape. If access has changed since the last measurement, document the changes on the *Maintenance/Measurement Form.*

Replace or repair any posts or pigtails which show signs of damage or fading. This includes touch-up painting of metal posts and replacement of faded flagging tape. Walk the Plot Cluster boundary and touch up paint on blue-marked trees. Ensure that all tree tags remain securely fastened and legible, and that DBH markings are intact. If cables were used to attach tags, ensure that there is adequate space to allow trees to grow without being girdled by the cable. If tags were fastened with nails, remove nails and replace them with cables only if nails are causing problems for tree growth or the tag is illegible. Pull nail out of tree to allow for 10 year growth.

2.2 Photos

Four photographs must be taken from each plot cluster center:

1. Facing Removal plot A and the Buffer Plot (B)
2. Facing Removal Plot B (RB)
3. Down the extraction trail to the left (N)
4. Down the extraction trail to the right (S)

Photo cards labels must include the SCUP identification code, plot number, date, and photo direction (B, RB, N or S) as in the examples below.

SCUP 15571-P4 Aug 20, 2013 B	SCUP 15571-P4 Aug 20, 2013 RB	SCUP 15571-P4 Aug 20, 2013 N	SCUP 15571-P4 Aug 20, 2013 S

2.3 Plot Measurements

All previously measured trees as well as saplings that have reached the tree tagging limit (≥7.1 cm DBH must be relocated and measured in the tree plot. New trees will be numbered using 6000 series numbers. **DO NOT reuse tree numbers from dead or missing trees and do not re-use tags remove from sapling trees outside the sapling plots.**

For trees that have died since the last measurement, record species, DBH, height and condition codes. Condition code 15 should be 25, 61 or 29. If possible, condition codes 2 and 3 should describe the cause of mortality.

Note: DBH should not decrease on subsequent measurements. Height should not decrease unless a damage condition code is recorded. Trees that have died between measurement periods should be noted using the condition codes in Appendix IV and measured a final time.

2.3.1   Sapling Plot Measurements

Depending on the density of the saplings, some of the subplots may not have been previously measured. Only the sapling plots previously selected for measurement must be re-measured. Within those sapling plots, all previously measured saplings must be relocated and measured, in addition to measuring new saplings that have reached the 1.3 m tagging limit. Tag new saplings using 8000-series numbers.

For saplings that have died since the last measurement, record species, DBH, height and condition codes. Condition code 15 should be 25, 61 or 29. If possible, condition codes 2 and 3 should describe the cause of mortality.

For each tagged tree in the sapling plots, record:

- plot (one of: S1 to S7)
- tree number
- species code
- total height (0.1 m)
- Diameter at breast height (0.1 cm)
- lean%,
- crown class
- Up to 3 condition codes, in order of priority

2.3.2   Retention and Buffer Tree Plot measurements

All previously measured trees must be relocated and measured, in addition to measuring new trees that have reached the tagging limit of 7.1 cm dbh. For each tagged tree in the retention and buffer plots, record the following:

- Section, i.e. E (Extraction), B (Buffer), Removal Area (R1 or R2)
- Tree Number
- Species code
- Diameter at breast height (0.1 cm)
- Total height (0.1 m)
- Height to live crown (0.1 m)
- Crown class code (Up to 3 condition codes, in order of priority)

Appendix I provides the species codes, crown class codes and condition codes. Instructions for diameter and height measurements are in Appendices II and III, respectively.

2.3.3   Stem Mapping

All tagged trees should have been stem mapped in previous measurement. For trees that have newly reached the tagging limit of 7.1cm DBH, distance and azimuth will be recorded from plot center. Sapling plots will not be stem mapped.

2.3.3   Age Plot Re-measurement

The height of the white spruce age trees should be recorded at every measurement. This will enable the analyst to calculate a post-release site index instead of a site index reflecting the total growth of the understory tree.

Since release may not occur instantly after overstory removal, height growth between 2nd and 3rd measurement may be used.
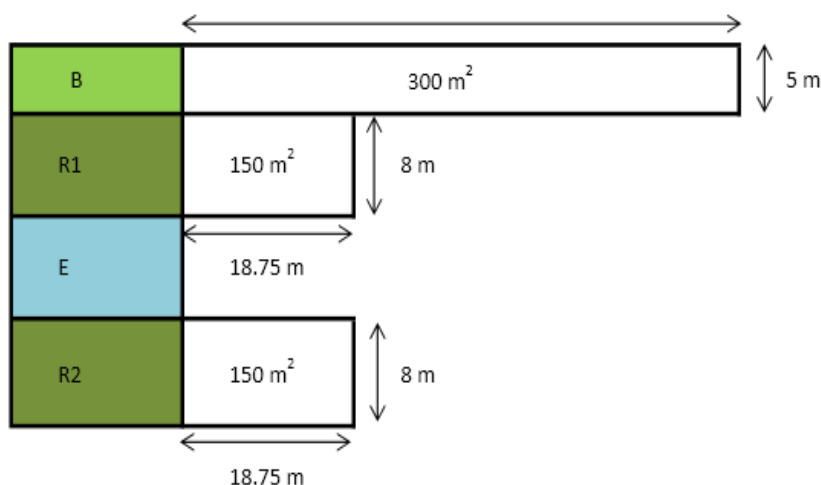

Figure 3. EXAMPLE OF AGE PLOT LAYOUT AND DIMENSIONS WHERE BUFFER WIDTH IS 5M AND REMOVAL AREA WIDTHS ARE 8M EACH.

3   Field Measurement Quality Control Standards

Blocks will be field checked to ensure that all measurement requirements have been met. A minimum of one out of every five sampled Blocks will be subjected to QC. Within each selected Block, all navigation information will be QC'd. In addition, two Plot Clusters will be randomly selected for QC'ing plot measurements.

Standards for quality control for Plot Clusters are provided in Table 1. Standard quality control checks involve checking approximately 50% of the measurements within the selected Plot Cluster (except for total number of trees and species, which will have a 100% check). At the discretion of the check cruiser, more than 50% of the measurements may be checked. A total Plot Cluster error of ≥ 2.0 points is considered unacceptable and the Plot Cluster may have to be re sampled, at the discretion of the check cruiser. If the error ≥ 2.0 points, then all other Plot Clusters within the Block will be checked.

 All costs associated with correcting errors are the responsibility of the field crew. Plot Clusters will be returned to the pool for quality control selection.

Table 1. Quality control standards for Plot Cluster establishment and measurement.

Attribute	Allowable Error	Points
Plot Cluster Length	- length of each side of the Plot Cluster must be within 0.3 m of center line length	0.5
Plot Cluster Center	- must be correctly flagged and identified - plot header information must be complete	0.5
Slope %	- must be within +10% of the slope gradient value	0.1 per > 10%
Slope Position	- must be within + 1 position class	0.25 per class

Aspect	- must be within + 10 degrees	0.1 per > 10%
Ecosite	- no error	0.25
Number of Live Trees Tagged	- no error allowed; all acceptable stems within the Buffer and Removal Plots must be included	0.5 per tree
Corner Posts	must be properly placed by color code standard - must reasonably mark boundary of plots within Plot Cluster	0.5
Species	- no error allowed; all species must be identified correctly	0.25 per tree
Breast Height Tags	- must be within + 3 cm from 1.3 m	0.25 per tree
Diameter - Breast Height	- must be within + 0.2 cm of the DBH	0.25 per tree
Height	- must be within + 0.5 meters of the height,	0.25 per tree
Crown Class Codes	- a maximum of 10 % of the stems can be misclassified by one crown class	0.25 > 10%
Condition Codes	- a maximum of 10% of the affected stems may be misclassified	0.25 > 10%
Number of Dead Trees	- no error allowed; all acceptable trees within the plot boundaries must be included	0.5 per tree
Tally by Height Class	- no species missed - check tally must be within 10% of cruise tally	0.1 per piece > 10%

APPENDIX I: Codes

Table 2. Member company codes.

Company Code	Company Name
AINS	Ainsworth Lumber Co. Ltd.
ALPL	Alberta Plywood Ltd.
ALPA	Alberta Pacific Forest Industries Ltd.
DMI	Daishowa Marubeni International Ltd.
FOOT	Footner Forest Products Ltd.
MWFP	Millar Western Forest Products Ltd.
SLP	Slave Lake Pulp Corp.
TOLK	Tolko Industries Ltd.
WEYC	Weyerhaeuser of Canada
VAND	Vanderwell Contractors Ltd.

Table 3. Acceptable species codes.

Species Code	Species
SW	white spruce
SB	black spruce
PL	lodgepole pine
PJ	jack pine
FB	balsam fir
LT	larch (tamarack)
AW	trembling aspen
PB	balsam poplar
BW	white birch
DD	dead deciduous
DC	dead coniferous
DU	dead unknown

Table 4. Crown class codes.

Crown Class Code	Description
D	Dominant - crown extends above the general level of the canopy.
C	Codominant - crown forms the general level of the canopy.
I	Intermediate - crown is below but extending into the bottom of the general level of the canopy.
S	Suppressed - crown is entirely below the general level of the canopy.

Table 5. Condition codes (based on LFS PSP standards).

Condition Code	Description	Condition Code	Description
0	Healthy	45	Other mammalian/avian evidence
1	Insects	51	Conks/Blind Conks
2	Disease	52	Open Scars
3	Rabbit Browsing	53	Burls and Galls (DBH ≥ 7.0 cm)
4	Shepherds Crook	54	Fork (DIB>7.0cm-2.5m past fork)
5	Browsing (other)	55	Pronounced Crook (DIB>7.0cm -2.5m past crook)
6	Fire	56	Broken Top (<=10cm DIB at break, DBH ≥ 7.0 cm; no CC)
7	Mechanical	57	Limby (DBH ≥ 7.0 cm)
8	Windthrow	58	Leaning (DBH ≥ 7.0 cm, & if severe, No CC)
9	Climate	59	Broken Stem (>=10cm DIB at break; No CC)
10	Flooding	60	Generic woodpecker feeding
11	Poor Planting	61	Dead and Down (No CC; DBH ≥ 7.0 cm)
12	Suppression	62	Stem Insects (Bark & Sawyer Beetle; DBH ≥ 7.0 cm)
13	Frost Heaving	63	Stem Disease (Cankers; DBH ≥ 7.0 cm)
14	Erosion	64	Foliar Insects (DBH ≥ 7.0 cm)
15	Missing	65	Foliar Disease (Needle blights & rust; DBH ≥ 7.0 cm)
16	Dead Top/Dieback	66	Stem Form Defect (=>7.0cm DIB where defect begins)
17	Poor Seedbed	67	Closed Scars
18	Herbicide	68	Atropellis Canker
19	Western Gall Rust	69	Comandra Blister Rust
20	Armillaria Root Rot	70	Elytroderma needle cast of pine
21	Moldy Planting Stock	71	Hypoxylon Canker
22	Multiple Leader	72	Spruce Cone Rust
23	Poor Form	73	Stalactiform Blister Rust
24	Broken Top (new or old)	74	Tomentosus Root Rot
25	Dead & Standing (No CC)	75	Spruce Spanworm
26	Snow Press	76	Cone Maggot
27	Dead Top with new leader	77	Coneworm
28	Sucker from old stump	78	Eastern Spruce Budworm
29	Cut down	79	Mountain Pine Beetle
30	Terminal Weevil	80	Spruce Beetle

31	SW Gall Aphid	81	Spruce Needle Rust
32	Tent Caterpiller	82	Yellow-headed Spruce Sawfly
33	Root Collar Weevil	83	Large Aspen Tortrix
34	J-Root	84	Excavations by woodpeckers
35	Leaning	85	Yellow-bellied Sapsucker feeding
36	Same Stump	86	Small Mammal feeding on tree bole
37	Unknown	87	Small Cavity
38	Pitch Moth	88	Large Cavity
39	DBH taken on new leader	89	Hollow tree/bole section
40	Nutrient Deficiency	90	Beaver (feeding/harvest)
41	Mouse Feeding	91 - 96	Hawksworth Mistletoe Rating System
42	Ungulate feeding/rubbing	98	Data changed by office
43	Domestic livestock (rubbing)		
44	Nest		

APPENDIX II: DIAMETER MEASUREMENTS

Measure diameter at 1.3 m above the root collar, paying attention to the following anomalies
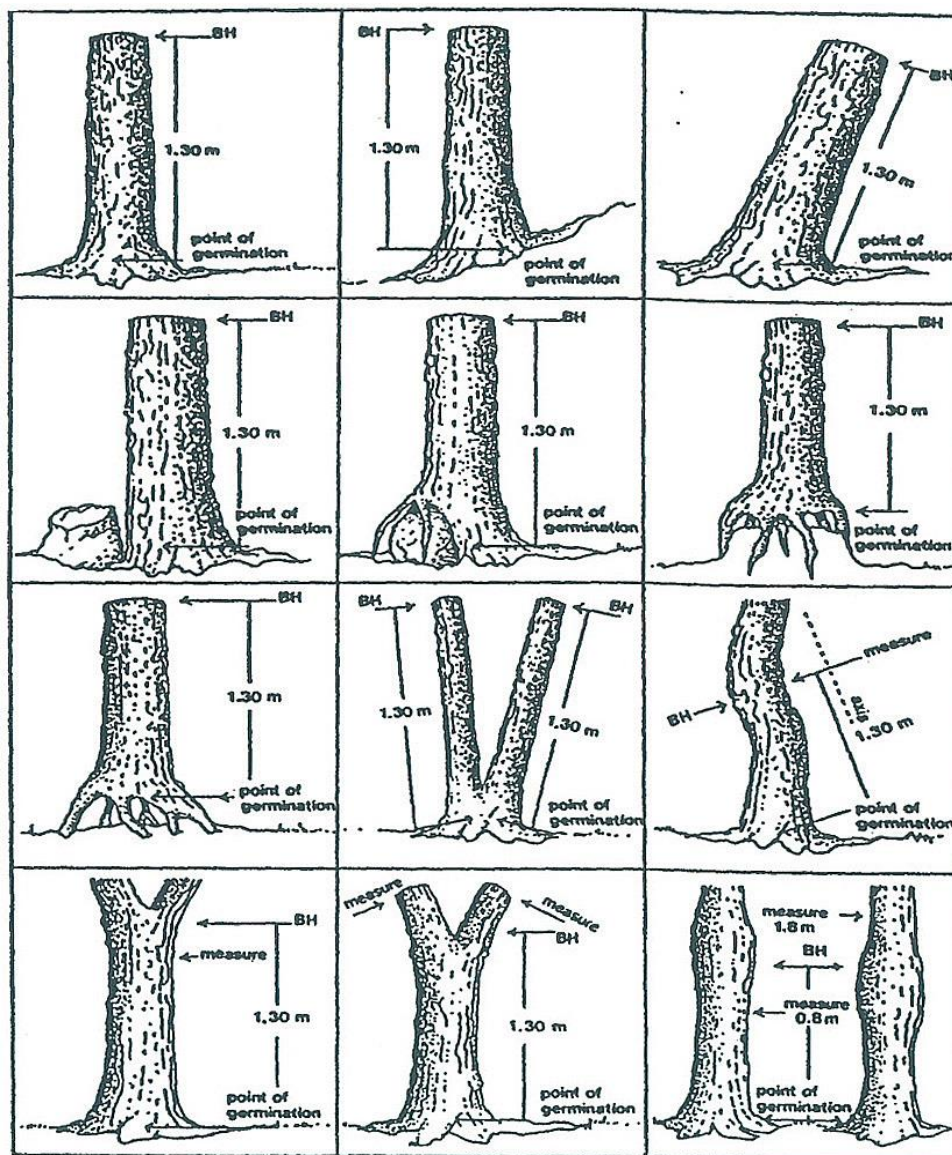

Figure 4. DIAMETER MEASUREMENT TECHNIQUES.

1. If tree is on a slope, measure at 1.3 m at midpoint.
2. If tree is leaning, measure at 1.3 m perpendicular to the lean.
3. If tree is forked below 1.3 m, measure as two separate trees at 1.3 m.
4. If tree is forked above 1.3 m, measure as one tree at 1.3 m.
5. If tree is deformed at 1.3 m or is a bottleneck tree, measure diameter above deformation or bottleneck. Record in comments field the height at which diameter was taken.

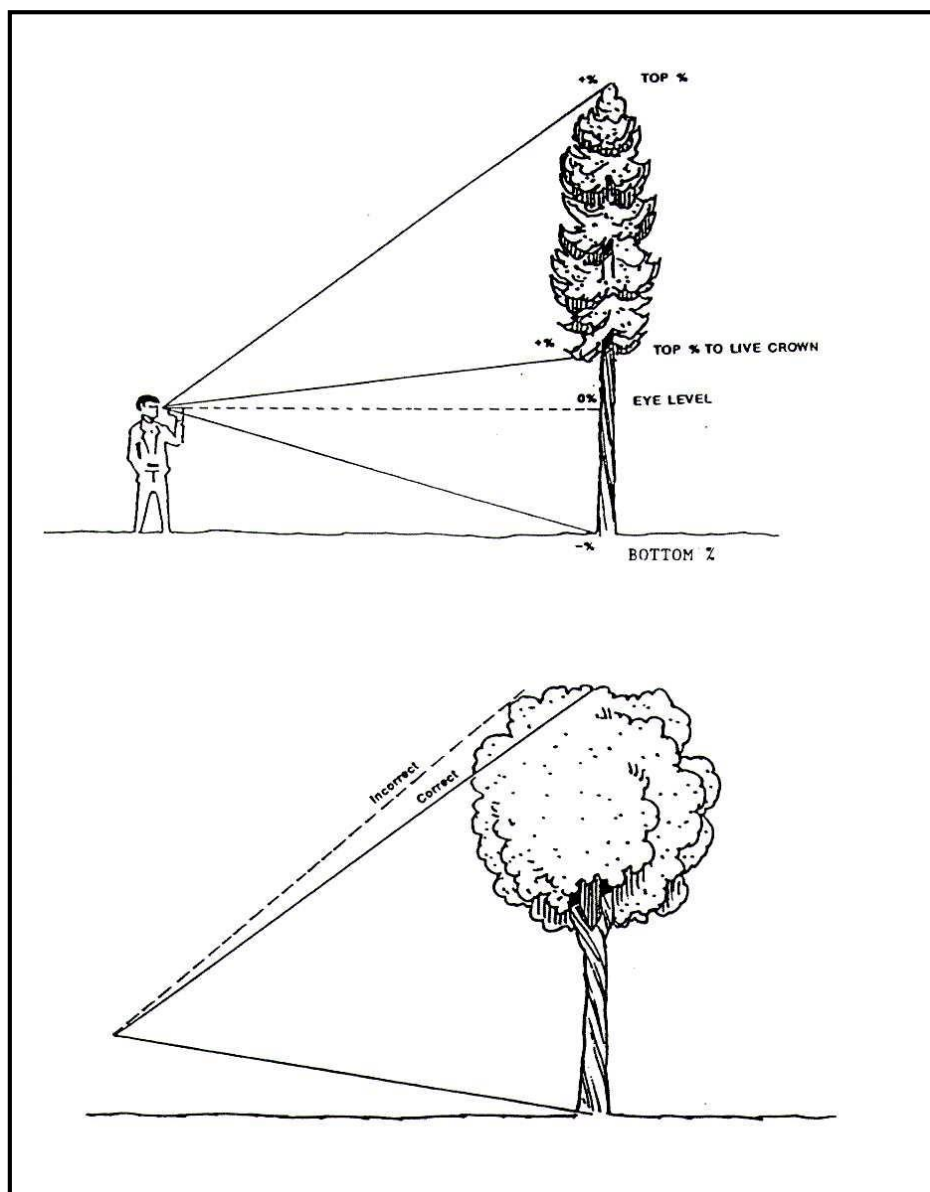# APPENDIX III: HEIGHT MEASUREMENT

Figure 5. CONIFEROUS AND DECIDUOUS HEIGHT MEASUREMENT.

For leaning trees, height readings are taken while standing perpendicular to the direction of the lean (Figure 6).
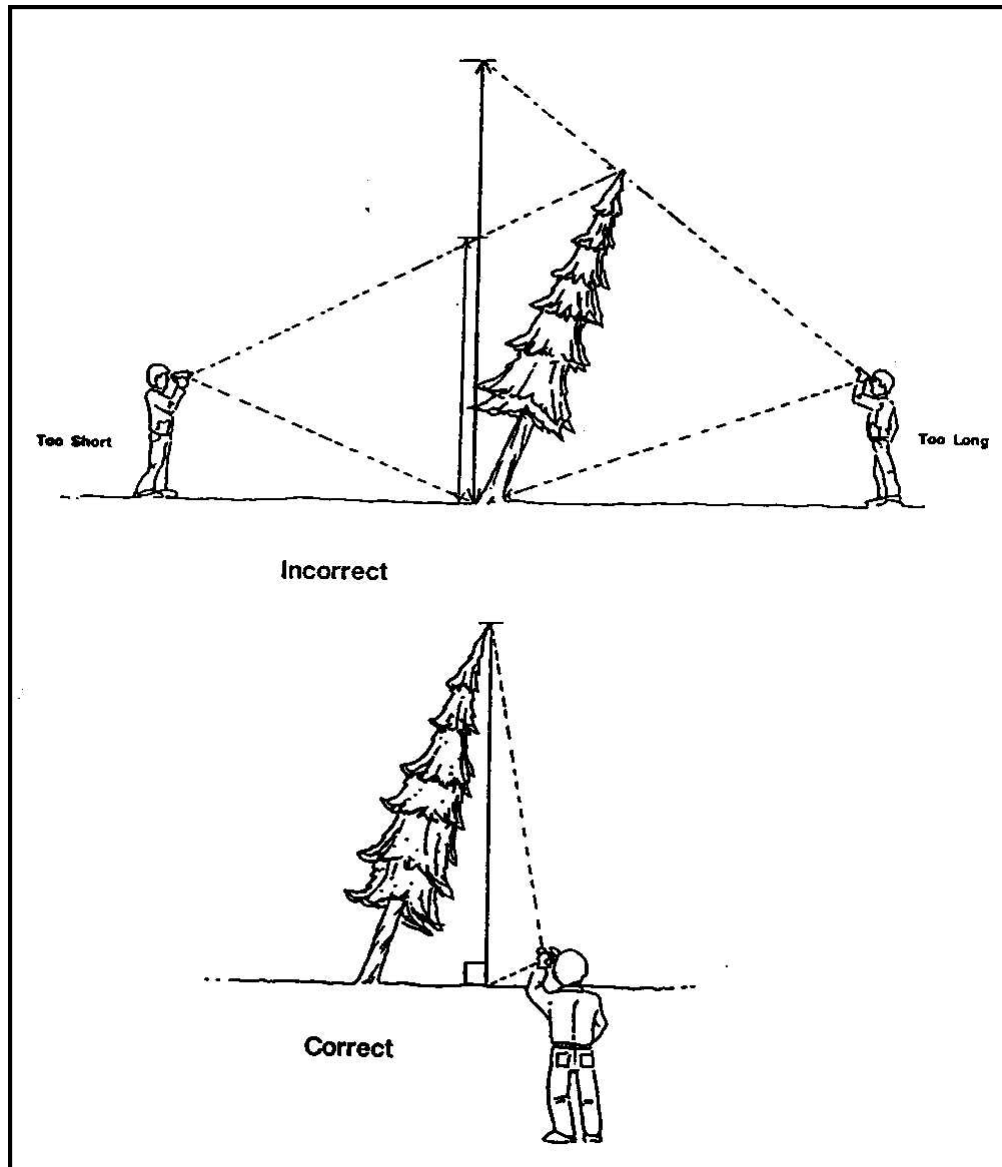
Too Short

Too Long

Incorrect

Correct

Figure 6. MEASURING HEIGHT ON A LEANING TREE.

Diagrams taken from Alberta Lands and Forest Permanent Sample Plot Field Procedures Manual, 1994.