
Ground Sampling Standards

**MINISTRY OF FORESTS
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Ground Sampling Standards

Introduction

This document contains the standards for the ground sampling phase (Phase II) of the Ministry of Forests Vegetation Resources Inventory (VRI) that are to be used in the 1997 field season. The standards were established in consultation with experts in the sampling phase and are considered achievable by sampling crews. The intent is that all projects will be in “**substantial compliance**” with these standards.

The “auditor’s standard” shown in column 3 of the tables containing the standards is the expected precision attainable by “expert” crews. The “crew standard” shown in column 4 is set at a wider interval, and is the precision by which the sampling crew will be evaluated.

It is expected that the standards will become stricter over time. Feedback about these standards is appreciated and should be directed to:

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Measurement of Attributes

Three types of attributes are measured:

- continuous attributes
- categorical attributes
- counted, missed, or added items.

This section explains how the standards for each of these data types are applied. The next section contains tables listing the individual attributes and the standards for each attribute. The order in which these are listed is similar to the order in which they are found on the field forms. *Measurements are compared only for attributes identified by both the crew and the auditor.*

Continuous Attributes

Continuous attributes are those for which continuous values can be collected. Acceptable error limits are established based on achievable audit results, for example, plus or minus (\pm) a number of units (m or cm) **or** a percentage of the absolute value. The crew standard is set with some tolerance around the achievable measurements; field crews should achieve the measurement within this broader limit.

The acceptable error limit is 85% for all continuous attributes. This means that a crew's measurements must be within the crew standards 85% of the time. If this level is not attained, the crew must receive training in the attribute(s) before doing further sampling.

Example: Diameter Measurements

The average sample cluster contains approximately 25 trees whose diameters are to be measured. If a crew exceeds the acceptable error limit in measuring 3 of the 25 trees, it will have achieved the standard on 88% of the trees, and the sample is accepted. If the crew exceeds the acceptable error limit in measuring 4 trees, it will have achieved the standard on 84% of the trees, and the crew will be required to receive training.

Categorical Attributes

Categorical attributes are those for which a numeric code or letter code is assigned. The acceptable error limit is set as follows:

- The expected rate of achievement of a fully qualified auditor is established. For example, it is expected that an auditor will correctly identify the correct tree species 98 out of 100 times.

- The field crew is allowed some tolerance: they are expected to correctly identify the tree species 96 out of 100 times.
- With all categorical attributes, an error of at least 1 incorrectly identified category is allowed.

Example: Tree Species Identification

The average sample cluster contains approximately 25 trees whose species are to be identified. If a crew correctly identifies 24 out of the 25 trees, they would have achieved a success rate of 96%, which is within the acceptable error limit. If the crew correctly identifies 23 out of the 25 trees, they would have achieved a success rate of 92%, which exceeds the acceptable error limit; this crew would be required to receive training.

Counted, Missed, and Added Items

Counted, missed, and added items are enumerated in lists. Two types of error can occur: an item might be missed or an item might be added. The acceptable error limit is set as follows:

- The expected rate of achievement of a fully qualified auditor is established. For example, it is expected that an auditor will correctly identify the trees within the sample clusters 99 out of 100 times.
- The field crew is allowed some tolerance: they are expected to correctly identify the trees within the sample clusters 98 out of 100 times.
- With all counted items, an error of 1 missed or added item is allowed.

Example: Large Tree Count

The average sample cluster contains approximately 25 trees that are to be tallied. If the crew correctly identifies 24 out of the 25 trees, they would have achieved a success rate of 96%. This does not meet the expectation of 98%, but the sample cluster is accepted because 1 missed or added item is allowed.

If the crew misses 1 tree and adds 1 tree, its success rate is 25/23, or 92%. This exceeds the acceptable error limit, and the crew would be required to receive training.

Plot Location and Establishment Standards

Attribute	Type ¹	Auditor's Standard	Crew Standard
Azimuth – tie point tree to tie point	CONT	± 2°	± 4°
Azimuth – reference tree to reference pin	CONT	± 2°	± 4°
Azimuth – tie point to IPC ²	CONT	± 2°	± 4°
Azimuth – IPC to auxiliary plots	CONT	± 2°	± 4°
Distance from tie point to tie point tree	CONT	± 2% of distance	± 4% of distance
Distance from reference tree to reference pin	CONT	± 0.1 m	± 0.2 m
Distance from tie point to IPC	CONT	± 5 m if distance < 200 m ± 2% if distance > 200 m	± 10 m if distance < 200 m ± 5% if distance > 200 m
Distance from IPC to auxiliary plots	CONT	± 1 m	± 2 m
Distance from reference pin to IPC (15.00 m)	CONT	± 0.1 m	± 0.2m
Number of auxiliary plots	CMA	98/100 correctly selected	94/100 correctly selected
Random and second transect azimuth	CONT	± 2°	± 4°
Transect length	CONT	± 0.1 m	± 0.2 m
Herb and bryoid plot (5.64 m)	CONT	± 0.1 m	± 0.2 m
Tree and shrub plot (10.0 m)	CONT	± 0.2 m	± 0.4 m
Azimuth for stem mapping	CONT	± 2°	± 4°
Distance for stem mapping	CONT	± 0.1m on distances < 10m ± 0.2m on distances > 10m	± 0.2m on distances < 10m ± 0.4m on distances > 10m

¹ CONT = continuous attribute; CMA = counted, missed, added attribute

² IPC = Integrated plot centre

Tree Attribute Standards

Tree Details Attributes

Attribute	Type	Auditor's Standard	Crew Standard
Integrated plot trees	CMA	99/100 correctly identified	97/100 correctly identified
Auxiliary volume trees	CMA	98/100 correctly selected	94/100 correctly selected
Genus	CAT	99/100 correct genus	97/100 correct genus
Species	CAT	98/100 correct species	96/100 correct species
Live/dead	CAT	99/100 in correct class	98/100 in correct class
Stand/fall	CAT	98/100 in correct class	96/100 in correct class
Diameter breast height	CONT	± 0.5 cm for stems < 25 cm ± 5% for stems ≥ 25 cm	± 1.0 cm for stems < 25 cm ± 10% for stems ≥ 25 cm
Bark remaining %	CONT	± 5%	± 10%
Tree length	CONT	± 0.25 m on trees < 10 m in length ± 3% on trees > 10m in length	± 0.5m on trees < 10 m in length ± 5% on trees > 10 m in length
Crown class	CAT	97/100 in correct class	91/100 in correct class
Height to live crown	CONT	± 1 m on crowns < 10 m ± 10% on crowns > 10 m	± 2 m on crowns < 10 m ± 20% on crowns > 10 m
First log grade	CAT	95/100 within 1 grade	85/100 within 1 grade and in correct category
First log length	CONT	± 10% of length	± 30% of length
First log net factor	CONT	± 2% when net factor > 80% ± 5% when net factor < 80%	± 6% when net factor > 80% ± 15% when net factor < 80%
Second log grade	CAT	95/100 within 1 grade	85/100 within 1 grade and in correct category
Second log length	CONT	± 10% of length	± 30% of length
Second log net factor	CONT	± 2% when net factor > 80% ± 5% when net factor < 80%	± 6% when net factor > 80% ± 15% when net factor < 80%
Third log grade	CAT	95/100 in correct "category"	85/100 in correct "category"
Third log length	CONT	± 10% of length	± 30% of length
Third log net factor	CONT	± 2% when net factor > 80% ± 5% when net factor < 80%	± 6% when net factor > 80% ± 15% when net factor < 80%
Fourth + log grade	CAT	95/100 in correct category ¹	85/100 in correct category
Fourth + log length	CONT	± 10% of length	± 30% of length
Fourth + log net factor	CONT	± 2% when net factor > 80% ± 5% when net factor < 80%	± 6% when net factor > 80% ± 15% when net factor < 80%
Visual appearance	CAT	95/100 in correct class	85/100 in correct class
Crown condition	CAT	95/100 in correct class	85/100 in correct class
Bark retention	CAT	95/100 in correct class	85/100 in correct class
Wood condition	CAT	95/100 in correct class	85/100 in correct class
Lichen loading	CAT	95/100 in correct class	85/100 in correct class
Wildlife use	CAT	95/100 in correct class	85/100 in correct class
Broken top diameter	CONT	± 5% when height to break < 10 m ± 10% when height to break > 10 m	± 10% when height to break < 10 m ± 30% when height to break > 10 m
Projected height	CONT	± 2% when height to break < 10 m ± 5% when height to break > 10 m	± 6% when height to break < 10 m ± 15% when height to break > 10 m

¹ On the upper logs the correct "category" is to be evaluated (for example sawlog vs. lumber vs. utility chipper).

Tree Loss Indicators Attributes

Attribute	Type	Auditor's Standard	Crew Standard
Damage agents	CMA	95/100 correctly identified	85/100 correctly identified
Damage agent A	CAT	95/100 correctly identified	85/100 correctly identified
Severity A	CAT	95/100 in correct category	85/100 in correct category
Loss indicators	CMA	95/100 correctly identified	85/100 correctly identified
Loss Indicator	CAT	98/100 correctly identified	94/100 correctly identified
Length of loss indicator OR	CONT	± 0.2 m for indicators in lower 10 m ± 0.5 m for indicators in upper stem	± 0.6 m for indicators in lower 10 m ± 1.5 m for indicators in upper stem
Position of loss indicator	CONT	± 0.1 m for indicator in lower 10 m ± 0.2 m for indicator in upper stem	± 0.3 m for indicator in lower 10 m ± 0.6 m for indicator in upper stem
Frequency	CONT	± 1 where number is < 10 ± 2 where number is > 10	± 3 where number is < 10 ± 6 where number is > 10

Site Tree Attributes

Attribute	Type	Auditor's Standard	Crew Standard
Top height tree	CMA	98/100 correctly selected	96/100 correctly selected
Second top height tree	CMA	96/100 correctly selected	92/100 correctly selected
Random tree	CMA	99/100 correctly selected	96/100 correctly selected
Auxiliary top height trees	CMA	98/100 correctly selected	94/100 correctly selected
Genus	CAT	99/100 correct genus	97/100 correct genus
Species	CAT	98/100 correct species	96/100 correct species
Crown class	CAT	98/100 correct class	96/100 correct class
Outside bark diameter	CONT	±0.25 cm for stems < 25 cm ± 5% for stems > 25 cm	±1.0 cm for stems < 25 cm ± 10% for stems > 25 cm
Length	CONT	± 0.25 m on trees < 10 m in length ± 3% on trees > 10 m in length	± 0.5 m on trees < 10 m in length ± 5% on trees > 10 m in length
Bark thickness	CONT	± 1 mm when bark < 10 mm ± 3 mm when bark > 10 mm	± 3 mm when bark < 10 mm ± 9 mm when bark > 10 mm
Bored age	CONT	± 1 ring if < 20 years ± 3 rings if < 100 years ± 5 rings if > 100 and < 200 years ± 20 rings if > 200 years	± 2 rings if < 20 years ± 5 rings if < 100 years ± 10 rings if > 100 and > 200 years ± 40 rings if > 200 years
Site index	CONT	± 5%	± 10%
5 year increment measured	CAT	99/100 collected as necessary	97/100 collected as necessary
5 year growth	CONT	± 2 mm	± 4 mm
10 year increment measured	CAT	99/100 collected as necessary	97/100 collected as necessary
10 year growth	CONT	± 2 mm	± 4 mm
20 year increment measured	CAT	99/100 collected as necessary	97/100 collected as necessary
20 year growth	CONT	± 2 mm	± 6 mm
Prorate data measured	CAT	99/100 collected when required	97/100 collected when required
Core length	CONT	± 1.0 cm	± 2.0 cm

Attribute	Type	Auditor's Standard	Crew Standard
Ring count	CONT	± 1 rings if < 20 years ± 3 rings if < 100 years ± 5 rings if > 100 years	± 2 rings if < 20 years ± 5 rings if < 100 years ± 10 rings if > 100 years
Direct age measurement	CAT	99/100 correct number of years	97/100 correct number of years
Age correction	CONT	98/100 correct value	96/100 correct value
Total age	CONT	± 1 rings if < 20 years ± 3 rings if < 100 years ± 5 rings if > 100 years and < 200 years ± 10 rings if > 200 years	± 3 rings if < 20 years ± 9 rings if < 100 years ± 15 rings if > 100 years and < 200 years ± 30 rings if > 200 years

Small Tree Attributes

Attribute	Type	Auditor's Standard	Crew Standard
Small tree species	CMA	98/100 correctly identified when count < 50 stems 96/100 correctly identified when count > 50 stems	94/100 correctly identified when count < 50 stems 88/100 correctly identified when count > 50 stems
Trees 10 to 30 cm in height	CONT	± 1 stems when tree count < 20 ± 3 stems when tree count > 20	± 3 stems when tree count < 20 ± 9 stems when tree count > 20
Trees 31 to 130 cm in height	CONT	± 1 stems when tree count < 20 ± 3 stems when tree count > 20	± 3 stems when tree count < 20 ± 6 stems when tree count > 20
Trees 130 cm in height to 3.9 cm in diameter at breast height	CONT	± 1 stems when tree count < 20 ± 2 stems when tree count > 20	± 3 stems when tree count < 20 ± 4 stems when tree count > 20

Stump Attributes

Attribute	Type	Auditor's Standard	Crew Standard
Stump species	CMA	99/100 correctly identified	97/100 correctly identified
Frequency	CONT	99/100 counted correctly	97/100 counted correctly
Diameter inside bark	CONT	± 2 cm for stems < 25 cm ± 3 cm for stems > 25 cm	± 6 cm for stems < 25 cm ± 9 cm for stems > 25 cm
Length	CONT	± 0.1 m	± 0.2 m
Percentage sound wood	CONT	± 2% when sound portion > 80% ± 5% when sound portion < 80%	± 6% when sound portion > 80% ± 15% when sound portion < 80%
Bark retention code	CAT	95/100 in correct class	85/100 in correct class
Wood condition code	CAT	95/100 in correct class	85/100 in correct class

Ecological Attribute Standards

Range Attributes

Attribute	Type	Auditor's Standard	Crew Standard
Shrub species	CMA	98/100	96/100
Layer designation B1 vs. B2	CAT	99/100 within correct layer	97/100 within correct layer
Shrub genus	CAT	98/100 correct genus	94/100 correct genus
Shrub species	CAT	94/100 correct species	88/100 correct species
Phenology	CAT	98/100 within correct class	94/100 within correct class
Transect – percent shrub coverage per species	CONT	± 5% of actual	± 10% of actual
Graminoid and forb production	CAT	99/100 of correct designation	97/100 of correct designation
Forage (dry wt.) abundance	CONT	± 1 gram if 0–50 ± 2% if ≥ 50g	± 2 grams if 0–50g ± 4% if ≥ 50g

Coarse Woody Debris Attributes

Attribute	Type	Auditor's Standard	Crew Standard
CWD pieces	CMA	95/100	90/100
Genus (if unknown, genus = X)	CAT	98/100 correct genus	94/100 correct genus
Species (if unknown, species = c, h, or blank)	CAT	96/100 correct species	88/100 correct species
Diameter	CONT	± 2 cm for stems < 25 cm ± 5% for stems ≥ 25 cm	± 4 cm for stems < 25 cm ± 10% for stems ≥ 25 cm
Length	CONT	± 0.2 m for pieces < 10 m ± 3% for pieces > 10 m	± 0.4 m for pieces < 10 m ± 6% for pieces > 10 m
Percent decay class 1	CONT	± 2% when sound portion > 80% ± 5% when sound portion < 80%	± 6% when sound portion > 80% ± 15% when sound portion < 80%
Other decay class	CAT	95/100 in correct class	85/100 in correct class
Tilt angle	CONT	± 3°	± 6°
Merchantability	CAT	95/100 correctly identified as “X” grade or better	85/100 correctly identified as “X” grade or better
Product to remove	CAT	99/100 in correct class	97/100 in correct class
Decay class for the piece	CAT	95/100 in correct class	85/100 in correct class

General Ecological Description

Attribute	Type	Auditor's Standard	Crew Standard
Uniformity code	CAT	95/100 correct	90/100 correct
Zone	CAT	99/100 correct	98/100 correct
Subzone	CAT	99/100 correct	98/100 correct
Variant	CAT	98/100 correct	92/100 correct
Phase	CAT	98/100 correct	90/100 correct
Site location	CMA	???	???
Slope	CONT	± 5%	± 10%
Aspect	CONT	± 10°	± 20°
Elevation	CONT	± 20 metres	± 40 metres
Surface shape	CAT	98/100 correct shape	94/100 correct shape
Meso-slope position	CAT	98/100 correct position	94/100 correct position
Microtopography	CAT	98/100	94/100
% coverage of cobbles and stones	CONT	± 2%	± 4%
% coverage of bedrock	CONT	± 2%	± 4%
Flood hazard	CAT	99/100 in correct category	97/100 in correct category
% coverage of flowing water	CONT	± 2%	± 4%
% coverage of standing water	CONT	± 2%	± 4%
Slope failure in plot	CAT	99/100 correctly identified	97/100 correctly identified
Slope failure between plots	CAT	98/100 correctly identified	94/100 correctly identified
Gullies within plot	CAT	99/100 correctly identified	97/100 correctly identified
Gullies between plots	CAT	98/100 correctly identified	94/100 correctly identified
Depth to water table	CONT	± 5 cm	± 10 cm
Depth to gleying	CONT	± 5 cm	± 10 cm
Depth to root restricting pan	CONT	± 5 cm	± 10 cm
Depth to bedrock	CONT	± 5 cm	± 10 cm
Depth to frozen layers	CONT	± 5 cm	± 10 cm
Depth to carbonates	CONT	± 5 cm	± 10 cm
Humus form	CAT	98/100 in correct class	96/100 in correct class
Surficial material	CAT	95/100 in correct class	85/100 in correct class
Soil colour	CAT	95/100 in correct class	85/100 in correct class
"L" layer depth identified	CONT	± 1 cm	± 2 cm
"F" layer depth identified	CONT	± 1 cm	± 2 cm
"H" layer depth identified	CONT	± 1 cm	± 2 cm

Site Description

Attribute	Type	Auditor's Standard	Crew Standard
Soil moisture regime	CAT	95/100 in correct class	90/100 in correct class 98/100 within one class
Soil nutrient regime	CAT	95/100 in correct class	90/100 in correct class 98/100 within one class
Site series number	CAT	95/100 in correct class	90/100 in correct class 98/100 within adjacent class
Land cover – level 1 (veg vs. non-veg)	CAT	99/100 correctly identified	97/100 correctly identified
Land cover – level 2 (treed vs. non-treed)	CAT	99/100 correctly identified	97/100 correctly identified
Land cover – level 3 (wet/upland/alpine)	CAT	99/100 in correct category	97/100 in correct category
Land cover – level 4 (cover type)	CAT	98/100 in correct category	94/100 in correct category
Land cover – level 5 (density/description)	CAT	95/100 in correct category	85/100 in correct category

Soil Description

Attribute	Type	Auditor's Standard	Crew Standard
Soil horizons	CMA	95/100	90/100
Distance from zero for each layer	CONT	± 5 cm	± 10 cm
Texture	CAT	90/100 in correct class	70/100 in correct class 90/100 within or adjacent class
Total % coarse fragments	CONT	± 5%	± 15%
% gravel	CONT	± 5%	± 10%
% cobbles and stones	CONT	± 5%	± 10%

Vegetation Layers

Attribute	Type	Auditor's Standard	Crew Standard
Tree Species	CMA	99/100	98/100
Overall cover estimate "A" layer	CONT	± 5%	± 10%
Overall cover estimate "B1" layer	CONT	± 5%	± 10%
Shrub species	CMA	98/100	96/100
Overall cover estimate "B2" layer	CONT	± 5%	± 10%
Species ID ¹ – layer "A"	CAT	98/100 correct species	96/100 correct species
Species coverage Layer "A"	CONT	± 1% if "A" layer < 10% ± 5% if "A" layer > 10%	± 2% if "A" layer < 10% ± 10% if "A" layer > 10% ± 5%
Species ID ¹ – layer "B1"	CAT	95/100 correct species	90/100 correct species

Attribute	Type	Auditor's Standard	Crew Standard
Species coverage – layer “B1”	CONT	± 1% if “B1” layer < 10% ± 5% if “B1” layer > 10%	± 2% if “B1” layer < 10% ± 10% if “B1” layer > 10%
Species ID ¹ – layer “B2”	CAT	95/100 correct species	90/100 correct species
Species coverage – layer “B2”	CONT	± 1% if “B2” layer < 10% ± 5% if “B2” layer > 10%	± 2% if “B2” layer < 10% ± 10% if “B2” layer > 10%
Herb species	CMA	95/100	90/100
Bryoid species	CMA	90/100	80/100
Species ID ¹ – layer “C, Dh, Dw, Dr”	CAT	90/100 correct species	80/100 correct species
Species coverage – layer “C”	CONT	± 2% if “C” layer < 10% ± 5% if “C” layer > 10%	± 4% if “C” layer < 10% ± 10% if “C” layer > 10%
Species coverage – layer “Dh”	CONT	± 2% if “Dh” layer < 10% ± 5% if “Dh” layer > 10%	± 4% if “Dh” layer < 10% ± 10% if “Dh” layer > 10%
Species coverage – layer “Dw”	CONT	± 2% if “Dw” layer < 10% ± 5% if “Dw” layer > 10%	± 4% if “Dw” layer < 10% ± 10% if “Dw” layer > 10%
Species coverage – layer “Dr”	CONT	± 2% if “Dr” layer < 10% ± 5% if “Dr” layer > 10%	± 4% if “Dr” layer < 10% ± 10% if “Dr” layer > 10%
Average height of “B1” layer	CONT	± 0.5 m	± 1.0 m
Average height of “B2” layer	CONT	± 0.2 m	± 0.4 m

¹ Species identification is for species listed as “known” by crew.

Succession Interpretation

Attribute	Type	Auditor's Standard	Crew Standard
Factors influencing vegetation establishment	CAT	95/100 correctly identified	85/100 correctly identified
Previous species	CAT	95/100 correctly identified	85/100 correctly identified
Current species	CAT	99/100 correctly identified	97/100 correctly identified
Tree harvesting	CAT	98/100 correctly identified	94/100 correctly identified
Presence of snags	CAT	98/100 correctly classified	94/100 correctly classified
Snags and CWD presence	CAT	98/100 correctly classified	94/100 correctly classified
Canopy gaps	CAT	98/100 correctly identified	94/100 correctly classified
Vertical structure	CAT	95/100 correctly classified	85/100 correctly classified
Successional stability	CAT	95/100 correctly classified	85/100 correctly classified
Tree size	CAT	99/100 correctly classified	97/100 correctly classified
Tree age	CAT	99/100 correctly classified	97/100 correctly classified
Structural stages	CAT	98/100 correctly classified	94/100 correctly classified
% old trees alive	CONT	± 5%	± 10%
Old growth	CAT	99/100 correctly classified	97/100 correctly classified

Pass/Fail Standards

Ecological Attributes

Attribute	Type	Auditor's Standard	Crew Standard
Range transect total forage shrub coverage (m ² /hectare)	CONT	± 5%	± 15%
CWD – Gross volume (m ³ /hectare)	CONT	± 5%	± 15%
Tree/shrub species identification ¹	CAT/CMA	95% of occurrences correctly identified	± 90% of occurrences correctly identified
Herb/bryoid species identification ¹	CAT/CMA	± 90% of occurrences correctly identified	± 80% of occurrences correctly identified

¹ Species identification: the species is correctly listed as “counted” and “species correctly recorded” (either as a “known” or else collected and called an “unknown”) by the crew.

Tree Attributes

Attribute	Type	Auditor's Standard	Crew Standard
Gross volume (m ³ /ha)	CONT	± 5 m ³ for volumes < 50 m ³ /ha ± 5% for volumes > 50 m ³ /ha	± 10 m ³ for volumes < 50 m ³ /ha ± 10% for volumes > 50 m ³ /ha
Net volume (m ³ /ha)	CONT	± 5 m ³ for volumes < 50 m ³ /ha ± 5% for volumes > 50 m ³ /ha	± 10 m ³ for volumes < 50 m ³ /ha ± 15% for volumes > 50 m ³ /ha
Net value (\$/m ³)	CONT	± 5%	± 15%