
Vegetation Resources Inventory

Quality Assurance Procedures and Standards for VRI Ground Sampling

Prepared by
Ministry of Forests and Range
Forest Analysis and Inventory Branch
for the Terrestrial Ecosystem Task Force
Resources Information Standards Committee

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For further information about the Resources Information Standards Committee, please access the RISC website at: <http://ilmbwww.gov.bc.ca/risc/>.

Major Amendments

- **The MFR has made mandatory a minimum 10% of all samples be audited and a mandatory submission of the documentation for the sample selection for the audit.**
- **The Data Collection Standards and Quality Assurance Procedures have been combined into one document.**
- **Timber attribute point standards have been modified so that a sample does not have a higher probability of failing only because more trees have been checked (points percentage based versus maximum points obtained).**
- **Audited samples must proportionally represent the types of samples in the project.**

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Sampling Quality Assurance Procedures

Introduction

The Vegetation Resources Inventory (VRI) uses a two-phase sampling system to describe trees and other vegetation. The first phase (photo interpretation) involves the delineation of polygon boundaries and the estimation of a variety of vegetation polygon attributes from aerial photographs. The second phase (ground sampling) involves measurement of a variety of vegetation attributes at randomly selected ground sampling points within the Phase I polygons. A quality assurance audit is performed concurrently with the Phase II sampling.

Two monitoring/checking processes are used to ensure that quality field measurements are being collected in the ground sampling phase:

Quality Assurance is an external process, whereby the work is evaluated based on approved standards by an independent auditor and rated as having passed or failed. The auditor must be certified in VRI Ground Sampling Timber or Ecology depending on the data that is to be audited. The auditor must also be an experienced individual capable of conducting quality measurements and assessments to ensure the ground sampling procedures have been conducted within standards. There should be an arm's length relationship between the Quality Assurance auditor and the project being evaluated.

Quality Control is an internal process, whereby the project manager ensures that the fieldwork is being done to the required standards in accordance with the procedures. This is the opportunity for the project manager to provide additional training to field crews.

The procedures described here are the quality assurance procedures developed by the Ministry of Forests and Range (MFR) to be implemented on all VRI ground sampling projects. It is expected that field sampling crews will have their own quality control procedures.

The objectives of the audit are to:

- provide feedback to improve sample quality
- provide information for contract administration.

The auditor identifies substandard sampling work and provides feedback to improve the crews' performance. Another important aspect of the auditor's work is to provide positive feedback to sampling crews on a task well done.

An important issue for contract managers is whether the completed work is acceptable. Several levels of standards have been established for the data collection.

Pass/fail standards have been established for critical attributes.

Optional pass/fail standards have also been established for the compiled gross and net volumes.

Pass/fail point standards have also been established for specific attributes.

Standards have also been established for supporting information that contributes to the location, establishment, and measurement of samples.

If the audit shows a batch does not meet these standards, the batch fails and the samples must be revisited.

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The standards for ground sampling are included in this document and provide the standards of accuracy for VRI attributes measured from ground samples. A standard is a maximum allowable error for a given attribute. The standards are based on levels of precision achievable by auditors and were developed in consultation with a group of auditors in the various fields.

It is intended that quality assurance audits will be carried out as soon as possible after the samples are completed.

In order for the MFR to ensure the data meets current standards, copies of all 3rd party quality assurance reports must be sent to the Regional MFR VRI forester as soon as the report is completed

For more information on contacts , please see the following web site:

<http://www.for.gov.bc.ca/hts/vri/contactinfo.html>

Objectives

The audit process has two main objectives:

- to provide feedback to improve sample quality
- to provide information for contract administration.

Feedback

Feedback from the audits is important for the continual improvement in sample establishment. The auditor will note any problems found in the audits so that the field crews will be aware of areas where they may require improvement. Positive feedback is also valuable in improving sample measurements. To successfully accomplish this objective the crews should be audited early in the project and subsequent batches should be audited as soon as possible after they are submitted. The field crews will benefit from accompanying the auditor in the field and are encouraged to attend, especially on the initial audits

Contract Administration

The audit provides the contract administrator with information about the quality of the work being completed. Standards have been established for the location and measurement of samples. Contract administrators will use the pass/fail criteria as the basis for payment.

Audit Principles

Plot Selection

An audit system requires a statistically valid sample of ground samples. For the sample to be valid, four criteria must be met:

1. Batches of samples must be established. The criteria for defining a batch will be determined at the pre-work conference.
2. Audit samples must be chosen randomly within each batch except in specific "abnormal" circumstances as described in the detailed procedures.
3. The selection probability (i.e., number of audit samples divided by total number of samples) must be known and recorded.

4. The list of samples included in a batch must be recorded.

It is mandatory that a minimum of 10% of all samples should be audited and that auditing be more frequent (smaller batch sizes) at the beginning of the project.

Sample Batches

The exact batch size and composition of the batch will vary for each project and will be discussed at the pre-work conference.

To ensure that all types of data collected has been audited, auditors must also ensure that all sample types are audited in proportion to the numbers of samples by type in the project. For example if 15% of the samples in a project are NVAF enhanced samples (type N) then approximately 15% of the audits on the project must be on type "N" samples. Auditors should attempt to group sample types together in separate batches where possible.

To ensure early detection of potential errors the initial batch(s) should be small (3-5 samples) and should be separated by crew leader. Future batch sizes and the composition of each (for example, crew leader or company, low volume or high volume samples, immature versus mature) will be based on the outcome of the initial audits.

Pass/Fail Standards

Pass/fail standards have been established to ensure that the work meets minimum standards. These pass/fail standards are outlined in the *Ground Sampling Quality Assurance Standards*, beginning on page 9 of this document.

Batch Submission Requirements

It is expected that all submitted batches will be complete as set out in the pre-work conference. This includes requirements for air photos, maps, field cards and any other project specific information. The field cards for all samples in the batch must be complete before the auditor will field audit any sample in the batch. All samples in the batch will be returned if the batch is not complete when submitted.

General Procedures

1. Select the samples to audit.
2. Perform office checking.
3. Perform field audit.
4. Prepare audit summary.

Detailed Procedures

The following is a suggested process to follow:

Selecting Sample Plots to Be Audited

1. Determine the batch to be audited.
2. Randomly select the sample(s) to audit from the batch and document the selection. If "abnormal" weather, safety or access restrictions do not allow the sample to be audited, another audit sample

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may be randomly selected to satisfy contract administration requirements. Any time an audit sample is replaced the reasons must be documented.

3. A list of all the samples in each batch, the samples audited, dates audits were completed, and results of audits must be maintained. An example of an auditor's list is found in Appendix 1.
4. It is also mandatory that documentation around the random selection of audit samples be maintained as well. An example of such documentation is found in Appendix 2.

Office Checking

Complete an office evaluation of all samples in the batch. If any of the samples are incomplete or errors are noted, all samples will be returned and the audit will take place when the completed batch is returned. All corrections or additions to the field cards, after the field crew has left the field, must be done in **red** ink on the original cards.

Notify the field crew and project manager that an audit will take place. It is recommended that the original field crew accompany the auditor, especially in the early phase of the project.

Field Audit

Perform a field audit of the selected samples. After collecting the audit data, crosscheck the original plot data in the field to validate similar data and assess measurement differences.

No changes are to be made to the original field data cards at this time. If minor errors or data omissions have been identified that must be corrected, to enable the data to be processed, the entries will be entered in **red** ink on the original field cards. The project manager decides who will enter the data.

Document the major discrepancies in the comments section on one of the audit field cards before leaving the sample

The preliminary audit results should be presented to the field crew and project manager as soon as practical following the audit.

All plots in the cluster must still be visited, however not all of the attributes will be measured in the audit. Key attributes have been identified that must be measured in all samples, while others have been identified to be measured on only a selected number of trees. The following is a list of attributes that must be checked during a standard audit. A complete audit of all attributes on any selected audit sample can also be done if the project manager decides it is necessary and is advisable at the start of a new project or with a new crew.

Audit for Timber Attributes

1. Check IPC pin location in the polygon
2. Measure distance and bearing from Reference pin to IPC pin
3. Measure all trees within the cluster for in/out confirmation
4. Check all trees within the cluster for tree genus and species
5. Check all trees within the cluster for live/dead status
6. Select a minimum 5 measured trees within the plot cluster from the IPC and the enhanced auxiliary plot trees. Check the following attributes on these trees:
 - standing / fallen
 - DBH
 - length
 - crown class

- first log grade
 - first log length
 - second log grade
 - second log length
 - broken top diameters
 - projected heights
 - damage agents
 - loss indicators
7. Check site tree selection on all plot locations
 8. Check all site trees for the following attributes:
 - Tree length
 - DBH
 - Field bored age
 - pro-rate core lengths (if applicable)
 9. Check the small tree plot for tree species identification and total tree count.
 10. All other attributes should be evaluated to make sure they are within accepted standards. This is especially important at the beginning of a project or with a new crew.

Audit for Ecological Attributes

1. Coarse Woody Debris
 - Randomly select one transect
 - For round pieces collect species, diameter and decay class for the piece.
 - For accumulations and/or odd shaped pieces, collect species, horizontal length and vertical depth on transect, and decay class for the piece.
2. Range
 - Use the same transect as randomly selected for the CWD.
 - Measure all values for the one transect.
3. Ecological description [EP]
 - Collect the following attributes [1] Uniformity, [2] Biogeoclimatic unit, [3] Site series and coverage, [4] SMR, [5] SNR, [6] Land cover classification, [7] Slope, [8] Aspect, [9] Elevation, [10] Surface shape, and [11] Meso slope. Collect 7 to 11 on card ED if required.
4. Tree and shrub layers [ET]
 - Collect the data as usual, excluding average height values, for all species with $\geq 1\%$ coverage. Do overall cover estimate for the A, B1 and B2 layers.
5. Herb and moss layers [EH]
 - Collect data as usual for those species with $\geq 1\%$ coverage. Do the overall % cover estimate for the C, and applicable D layers.
6. Succession interpretations [EO]
 - Collect all attributes as usual excluding attribute 29 (tree succession species).

Preparing the Quality Assurance Report

1. Complete a report for each audit sample. The recommended sample summary report is included in Appendix 3. Summary reports can vary by project and any variance in format must be discussed at the pre-work conference.
2. If necessary, compile the audit sample to determine whether the data meets the established pass/fail criteria. If the pass/fail criteria are not met, the sample fails. In this case the “batch” of work will fail and the crew will be instructed to revisit, at their own cost, all samples in the batch

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to correct the items identified as contributing to the rejection. The batch of samples will then be subjected to an additional audit.

3. Provide feedback to the field crews and project manager about any items that may need work.
4. The project manager will be advised in "writing" of the samples that comprised the batch, which sample was selected for audit, and the results of the audit. The audit summary will be attached for reference.

Copies of all audit reports are to be sent to the Regional MFR VRI forester as they are completed. Ground Sampling Quality Assurance Standards

Introduction

This document contains the data collection standards for the Ground Sampling phase of the Vegetation Resources Inventory (VRI). The standards were established in consultation with quality assurance auditors, and after a review of audit field data, and are considered achievable by sampling crews.

The standards are based on the assumption that **all batches will be complete when submitted**. This means that all field cards must be completely filled out, photos and maps must meet the requirements as set out in the pre-work conference, and any other required information must be present as well. If the submitted batches are not complete they will not be accepted and will be returned to the field crew for completion. A batch is an identified number of samples to be completed by the field crew as determined at the pre-work conference.

The document has been separated into a timber section and an ecological section.

Timber Attribute Standards

There are three levels of timber attribute standards specified in this document:

- critical pass/fail standards;
- pass/fail point standards;
- Supporting information standards set for specific attributes and/or details. These attributes are not considered pass/fail criteria; however the established standards are expected to be met.

Critical pass/fail standards have been established for attributes that have an immediate impact on the ability to use the data for its main purpose of adjusting the Phase 1 inventory. If the standards are not met for any of these attributes the sample fails and the batch is rejected.

Pass/fail point standards have been established for many of the attributes that are important but individually do not have as large an impact on the overall result. Points are assigned when the measurement is outside the accepted standard. The sample is rejected when the percentage of penalty points versus penalty points possible *exceeds* 10%.

Optional critical pass/fail standards have also been established for volume and net value attributes. These attributes require the samples to be compiled before a determination can be made. The decision to use these optional standards will be made by the individual project managers.

Standards have been assigned to all other attributes which are considered as supporting information. It is still expected that the standards for these attributes are to be met. If it is found the attributes are repeatedly measured or conducted below standard the field crew may be required to revisit the batch to ensure project standards are attained.

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

Vegetation Resources Inventory Coordinator
Ministry of Forests and Range
Forest Analysis and Inventory Branch
P. O. Box 9512 Stn Prov Govt.
Victoria, B.C. V8W 9C2

Critical Pass/Fail Standards

Critical pass/fail standards have been established for attributes that have an immediate impact on the ability to use the data for its main purpose of adjusting the Phase 1 inventory. If the standards are not met for any of these attributes the sample fails and the batch is rejected.

Plot Cluster Location

| Attribute | Crew standard |
|---------------------------|---|
| Target polygon | no error permitted |
| Relative cluster location | ± 30 metres when appropriate field ties available |

Tree Attributes

| Attribute | Crew Standard |
|---------------------------|---|
| Tree Count* | no error on clusters with ≤ 15 trees 1 error maximum for clusters with > 15 trees (missed and added trees do not cancel each other) 2 errors allowed for ½ and ¼ fixed radius plots with more than 30 trees |
| Tree Genus | 1 error maximum per cluster |
| Tree Species | 1 error maximum per cluster |
| Live/Dead | 1 error maximum per cluster |
| DBH | Average absolute variation ≤ 2% |
| Tree Length | Average absolute variation ≤ 3% |
| Age/Height Tree Selection | No error allowed in determining the leading species and second species 1 error/cluster allowed in the selection of site trees (includes all leading species, second species, top height and random trees) |
| Net Factor | 90% of the net factors must be within ±10%** (samples with less than 10 logs, allowed one error) (the same log length must be used to determine the net factor) |

* Borderline tree measurements will be assessed as follows: if the borderline 'in' or 'out' tree has been measured and the original in or out status using these measurements has been correctly determined, it will be accepted provided that the original critical distance calculated for the tree does not exceed one percent variation from the check plot critical distance, and the original horizontal distance measured for the tree does not exceed one percent variation from the check plot horizontal distance. For borderline trees only, the critical distance standard written here overrides the dbh standards written in this manual.

All quality assurance of borderline trees will be done using the plot radius factor to the tree face [PRF f]. The plot radius factor to the "tree face" is the plot radius factor to the tree center [PRF c] less 0.005. Using this method, the horizontal distance is measured from the plot center pin to the tree face at DBH.

**Example: net factor between 40% - 60% is acceptable for auditor's result of 50%

Pass/Fail Point Standards

Pass/fail point standards have been established for many of the attributes that are important but individually do not have as large an impact on the overall result. Points are assigned when the measurement is outside the accepted standard. The sample is rejected when the total points obtained is greater than 10% of the total points possible. If it is found that a given attribute is repeatedly measured or conducted below standard the field crew may be required to revisit the batch to ensure project standards are attained. A report template is shown in Appendix 3.

Plot Cluster Location

| Attribute | Standard | Point Value |
|--|----------|-------------|
| Distance - reference pin to IPC (15.0 m) | ± 0.2m | 1 |
| Azimuth - reference pin to IPC | ± 2° | 1 |

Tree Attributes

These attributes must be checked on a minimum of five trees in the cluster. Point values are applied to each tree and are cumulative.

| Attribute | Standard | Point Value |
|---|--------------------------------------|-------------|
| Stand/fall | Correctly identified | ½ |
| Diameter | ± 3% | 1 |
| Tree length | ± 5% | 2 |
| Crown class | in correct class | ½ |
| First log grade | within 1 grade | ½ |
| First log length | ± 30% of length | ½ |
| Second log grade | within 1 grade | ½ |
| Second log length | ± 30% of length | ½ |
| Broken top diameter or Projected Height | ± 20% of diameter or ± 10% of length | ½ |
| Damage agents | ± 1 damage agent | ½ |
| Loss indicators | ± 1 indicators identified | 1 |

Site Tree Attributes

These attributes must be measured on all site trees (*top height, leading species, second species and random trees*).

| Attribute | Standard | Point Value |
|----------------------|----------|-------------|
| Tree Length | ± 3% | 2 |
| Diameter | ± 3% | 1 |
| Field Bored age | ± 10% | ½ |
| Pro-rate Core length | ± 1.0 cm | ½ |

Small Tree Attributes

| Attribute | Standard | Point Value |
|--------------------|--------------------------|-------------|
| Small tree species | 90% correctly identified | ½ |
| Total trees | ± 10% | ½ |

Optional Critical Pass/Fail Standards

Optional critical pass/fail standards have also been established for volume and net value attributes. These attributes require the samples to be compiled before a determination on pass/fail status can be made. The decision to use these optional standards will be made by the project manager.

| Attribute | Crew Standard |
|---|--|
| Gross volume (m ³ /ha) (4.0cm ⁺ live and dead) | ± 10 m ³ for volumes ≤ 100 m ³ /ha ± 10% for volumes > 100 m ³ /ha |
| Net volume (m ³ /ha) (live trees 4.0cm ⁺) | ± 10 m ³ for volumes ≤ 100 m ³ /ha ± 10% for volumes > 100 m ³ /ha |
| Net value (\$/m ³) (live trees 4.0cm ⁺) | ± 15% |

Supporting Information Attributes

Standards have been assigned to all other attributes which are considered as supporting information. It is still expected that the standards for these attributes are to be met. If it is found the attributes are repeatedly measured or conducted below standard the field crew may be required to revisit the batch to ensure project standards are attained.

Plot Cluster Location

| Attribute | Standard |
|---|------------------|
| Azimuth – tie point tree to tie point | ± 2° |
| Azimuth – reference tree to reference pin | ± 2° |
| Azimuth – tie point to Reference Pin | ± 4° |
| Azimuth – IPC to auxiliary plots | ± 4° |
| Distance from tie point to tie point tree | ± 4% of distance |
| Distance from reference tree to reference pin | ± 4% of distance |
| Distance from tie point to Reference Pin | ± 5% of distance |
| Distance from IPC to auxiliary plots | ± 2.0 m |
| Offset GPS distance to point | ± 4% of distance |
| Random and second transect azimuth | ± 4° |
| Transect length | ± 0.5 m |
| Location of forage plots | ± 0.2 m |
| Herb and bryoid plot (5.64 m) | ± 0.2 m |
| Tree and shrub plot (10.0 m) | ± 0.4 m |
| Azimuth for stem mapping | ± 2° |
| Distance for stem mapping | ± 2% of distance |

Tree Attributes

| Attribute | Standard |
|----------------------------|--|
| Bark remaining % | ± 10% |
| Height to live crown | ± 2 m |
| Visual appearance | 90% in correct or adjacent class |
| Crown condition | 90% in correct or adjacent class |
| Bark retention | 90% in correct or adjacent class |
| Wood condition | 90% in correct or adjacent class |
| Lichen loading | 90% in correct or adjacent class |
| Wildlife use | 90% in correct class |
| Position of loss indicator | ± 1.0 m for indicator in lower 10 m ± 2.0 m for indicator in upper stem |
| Frequency | 90% correctly identified |
| Bark thickness | ± 2 mm or 20% (whichever is greater) |
| 5 year growth | ± 2 mm |
| 10 year growth | ± 4 mm |
| 20 year growth | ± 6 mm |

Stump Attributes

| Attribute | Standard |
|-----------------------------|----------------------------------|
| Stump species | 90% correctly identified |
| Stump diameter inside bark | ± 5 cm |
| Stump length | ± 0.2 m |
| Stump percentage sound wood | ± 20% |
| Stump bark retention code | 90% in correct or adjacent class |
| Stump wood condition code | 90% in correct or adjacent class |

Ecological Attribute Standards

Critical pass/fail standards have been established for attributes that have an immediate impact on the final use of the data. If the standards are not met for any of these attributes the sample fails and the batch is rejected.

Standards have been assigned to all other attributes which are considered as supporting information. It is still expected that the standards for these attributes are to be met. If it is found the attributes are repeatedly measured or conducted below standard the field crew may be required to revisit the batch to ensure project standards are attained.

Critical Pass/Fail Standards

Critical pass/fail standards have been established for attributes that have an immediate impact on the final use of the data. If the standards are not met for any of these attributes the sample fails and the batch is rejected.

| Attribute | Crew Standard |
|---|---|
| Range transect total shrub coverage (m) | ± 15% |
| CWD – Gross volume (m ³ /hectare) | ± 15% |
| Tree/shrub species identification ¹ | > 90% of occurrences correctly identified |
| Herb/bryoid species identification ¹ | > 80% of occurrences correctly identified |

¹Species 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.

Supporting Information Attributes

Standards have been assigned to all other attributes which are considered as supporting information. It is still expected that the standards for these attributes are to be met. If it is found the attributes are repeatedly measured or conducted below standard the field crew may be required to revisit the batch to ensure project standards are attained.

| Attribute | Standard |
|---|--|
| Shrub species | 85% [Maximum ± 2 added or missed] |
| Layer designation - B1 vs. B2 | 95% within correct layer |
| Shrub genus | 90% within correct genus [Maximum 1 missed or added] |
| Phenology | 95% within correct class |
| Transect – percent shrub coverage per species | ± 10% of actual when coverage is < 10.0 m. ± 15% of actual when coverage is ≥ 10.0 m. |
| Graminoid and forb separation | 90% of weight within correct designation |
| Forage utilization | 95% in correct or adjacent class |
| Forage (dry wt.) abundance | ± 2 grams if 0–50g ± 4% if ≥ 50g |

Coarse Woody Debris Attributes

| Attribute | Standard |
|---------------------------|---|
| CWD pieces | ± 2 pieces per transect |
| Species | 90% correct species identified for decay class 1, 2 or 3 pieces 75% correct species identified for decay class 4 or 5 pieces |
| Diameter | ± 4 cm for stems < 40 cm ± 10% for stems ≥ 40 cm |
| Length (optional in VRI) | ± 0.4 m for pieces < 10 m ± 5% for pieces > 10 m |
| Percent decay class 1 | ± 10% when sound portion > 80% ± 20% when sound portion < 80% |
| Other decay class | 90/100 in correct class |
| Tilt angle | ± 5° |
| Merchantability | 80% correctly identified as "X" grade or better [Maximum 1 error] |
| Product to remove | 98% in correct class [Maximum 1 error] |
| Decay class for the piece | 90% in correct or adjacent class |

Ecological Site Description

| Attribute | Standard |
|--|--|
| Uniformity code | ± 1 class |
| Zone | No error unless on a transition boundary |
| Subzone | No error unless on a transition boundary |
| Variant | No error unless on a transition boundary |
| Slope | ± 5% |
| Aspect | ± 20° |
| Elevation | ± 50 metres |
| Surface shape | 100% within correct or adjacent class |
| Meso-slope position | 100% within correct or adjacent class |
| Microtopography | 100% within correct or adjacent class |
| % coverage of cobbles & stones | ± 5% if < 20% coverage; ± 10% if ≥ 20% coverage |
| % coverage of bedrock | ± 5% if < 20% coverage; ± 10% if ≥ 20% coverage |
| Flood hazard | 100% in correct or adjacent category |
| % coverage of flowing water | ± 5% if < 20% coverage; ± 10% if ≥ 20% coverage |
| % coverage of standing water | ± 5% if < 20% coverage; ± 10% if ≥ 20% coverage |
| Slope failure in plot | No error |
| Slope failure between plots | No error |
| Gullies within plot | No error |
| Gullies between plots | No error |
| Soil moisture regime | ± one category |
| Soil nutrient regime | ± one category |
| Site series number | no error unless on boundary transition (use SMR/SNR) |
| Land cover - level 1 (vegetated versus non vegetated) | no error unless on boundary of class |
| Land cover - level 2 (treed versus non-treed) | no error unless on boundary of class |
| Land cover - level 3 (wetland / upland / alpine) | no error unless on boundary of class |
| Land cover - level 4 | ± one category |

| Attribute | Standard |
|---|----------------|
| (cover type) | |
| Land cover - level 5 (density description) | ± one category |

Soil Description

| Attribute | Standard |
|------------------------------------|---|
| Soil horizons | main rhizosphere identified correctly, for other layers ± one layer |
| Distance from zero for each layer | ± 10 cm |
| Texture for each identified layer | 100 % in correct or adjacent class |
| Total % coarse fragments | ± 10% for fragments < 35 % ± 20 % for fragments ≥ 35 % |
| % gravel | ± 10% for fragments < 35 % ± 20 % for fragments ≥ 35 % |
| % cobbles and stones | ± 10% for fragments < 35 % ± 20 % for fragments ≥ 35 % |
| Depth to water table | ± 10 cm |
| Depth to gleying | ± 5 cm |
| Depth to root restricting pan | ± 5 cm |
| Depth to bedrock | ± 10 cm |
| Depth to frozen layers | ± 10 cm |
| Depth to carbonates | ± 10 cm |
| Humus form | no error within main category (mull, moder, mor) |
| Surficial material (primary layer) | no error |
| Soil colour | ± one category |
| L/F/H description and depth | layers correctly identified and within 2 cm. Cumulative depth |

Vegetation Layers

| Attribute | Standard |
|---|--|
| Tree Species identified | 90% correctly identified |
| Overall cover estimate "A" layer | ± 10 % for cover > 25 % ± 5 % for cover 11 to 25 % ± 3 % for cover 6 to 10 % ± 0.5 % for cover 0.5 % to 5 % |
| Overall cover estimate "B1" layer | ± 10 % for cover > 25 % ± 5 % for cover 11 to 25 % ± 3 % for cover 6 to 10 % ± 0.5 % for cover 0.5 % to 5 % |
| Shrub species identified | 90% correctly identified |
| Overall cover estimate "B2" layer | ± 10 % for cover > 25 % ± 5 % for cover 11 to 25 % ± 3 % for cover 6 to 10 % ± 0.5 % for cover 0.5 % to 5 % |
| Species coverage Layer "A" | ± 10 % for cover > 25 % ± 5 % for cover 11 to 25 % ± 3 % for cover 6 to 10 % ± 0.5 % for cover 0.5 % to 5 % |
| Attribute | Crew Standard |
| Species coverage – layer "B1" | ± 10 % for cover > 25 % ± 5 % for cover 11 to 25 % ± 3 % for cover 6 to 10 % ± 0.5 % for cover 0.5 % to 5 % ± 10% if "A" layer > 10% ± 5% |
| Species coverage – layer "B2" | ± 10 % for cover > 25 % ± 5 % for cover 11 to 25 % ± 3 % for cover 6 to 10 % ± 0.5 % for cover 0.5 % to 5 % |
| Average height of B 1 layer | ± 1 metre |
| Average height of B 2 layer | ± 0.4 metres |
| Percent coverage by species of seedlings (Dh, Dw, and Dr) | ± 10 % for cover > 25 % ± 5 % for cover 11 to 25 % ± 3 % for cover 6 to 10 % ± 0.5 % for cover 0.5 % to 5 % |
| Herb species identified | 90% correctly identified |
| Bryoid species identified | 80% correctly identified |
| Overall coverage of layer C | ± 10 % for coverage > 30 % ± 5 % for coverage 16 to 30 % ± 2 % for coverage 6 to 15 % ± 1 % for coverage 1 to 5 % |
| Overall coverage of layer D | ± 10 % for coverage > 30 % ± 5 % for coverage 16 to 30 % ± 2 % for coverage 6 to 15 % ± 1 % for coverage 1 to 5 % |
| Species ID ¹ -layer "C,Dh,Dw,Dr" | 80/100 correct species |
| Species coverage – layer "C" | ± 10 % for coverage > 30 % ± 5 % for coverage 16 to 30 % ± 2 % for coverage 6 to 15 % ± 1 % for coverage 1 to 5 % |

| Attribute | Standard |
|-------------------------------|--|
| Species coverage – layer “Dh” | ± 10 % for coverage > 30 % ± 5 % for coverage 16 to 30 % ± 2 % for coverage 6 to 15 % ± 1 % for coverage 1 to 5 % |
| Species coverage – layer “Dw” | ± 10 % for coverage > 30 % ± 5 % for coverage 16 to 30 % ± 2 % for coverage 6 to 15 % ± 1 % for coverage 1 to 5 % |
| Species coverage – layer “Dr” | ± 10 % for coverage > 30 % ± 5 % for coverage 16 to 30 % ± 2 % for coverage 6 to 15 % ± 1 % for coverage 1 to 5 % |

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

Succession Interpretation

| Attribute | Standard |
|--|---|
| Factors influencing vegetation establishment | ± one factor missed or added |
| Previous species | must have at least one species of two correctly identified |
| Current species | must have at least one species of two correctly identified |
| Tree harvesting | In correct or adjacent category |
| Presence of snags | In correct or adjacent category |
| Snags and CWD presence | In correct or adjacent category |
| Canopy gaps | In correct or adjacent category |
| Vertical structure | In correct or adjacent category |
| Successional stability | In correct or adjacent category |
| Tree size | In correct or adjacent category |
| Tree age | In correct or adjacent category |
| Structural stages | In correct or adjacent category |
| % old trees alive | ± 10% |
| Old growth | “No” correctly identified “No (some) or Yes in correct or adjacent class |

Vegetation Resources Inventory

Appendix 1: Auditor's List

Vegetation Resources Inventory

Project Jones Creek

Sampling Crew Leader Bob Johnson Ecological Attributes

| Random Order | Plot Cluster No. | Date Sample Completed | Audit Batch | Date Audited | Pass / Fail | Comments |
|--------------|------------------|-----------------------|-------------|--------------|-------------|----------|
| 1 | 27 | May12 | 1 | | | |
| 2 | 23 | May 13 | 1 | May21 | Pass | |
| 3 | 7 | May15 | 1 | | | |
| 4 | 13 | May16 | 2 | | | |
| 5 | 17 | May17 | 2 | May 26 | Fail | |
| 6 | 11 | May18 | 2 | | | |
| 7 | 3 | May19 | 2 | | | |
| 8 | 15 | May20 | 2 | | | |
| 9 | 19 | May23 | 3 | | | |
| 10 | 8 | May24 | 3 | | | |
| 11 | 20 | May25 | 3 | | | |
| 12 | 4 | May26 | 3 | June1 | Pass | |
| 13 | 13 | May28 | 2 | | | Re-audit |
| 14 | 17 | May28 | 2 | | | Re-audit |
| 15 | 11 | May29 | 2 | June1 | Pass | Re-audit |
| 16 | 3 | May29 | 2 | | | Re-audit |
| 17 | 15 | May30 | 2 | | | Re-audit |
| 18 | 47 | June1 | 4 | | | |
| 19 | 54 | June2 | 4 | | | |
| 20 | 12 | June3 | 4 | | | |
| 21 | 46 | June4 | 4 | | | |
| 22 | 5 | June7 | 4 | | | |
| 23 | 1 | June8 | 4 | | | |
| 24 | 16 | June9 | 4 | | | |
| 25 | 25 | June10 | 4 | June12 | Pass | |
| 26 | | | | | | |
| 27 | | | | | | |
| 28 | | | | | | |
| 29 | | | | | | |
| 30 | | | | | | |
| 31 | | | | | | |
| 32 | | | | | | |
| 33 | | | | | | |
| 34 | | | | | | |
| 35 | | | | | | |

Appendix 2: Audit Plot Selection List

Project: Jones Creek

| Random Order | Sample Number | |
|--------------|---------------|---|
| 1 | 27 | Crew Leader <u>Bob Johnson</u> |
| 2 | 23 | |
| 3 | 7 | Batch # <u>1</u> |
| 4 | | |
| 5 | | Random # selected <u>2</u> |
| 6 | | |
| 7 | | Date <u>May 17, 2001</u> |
| 8 | | |
| 9 | | Auditor <u>J. Smith</u> |
| 10 | | |
| 11 | | |
| 12 | | Ecology <input type="checkbox"/> |
| 13 | | Trees <input checked="" type="checkbox"/> |
| 14 | | |
| 15 | | |

| Random Order | Sample Number | |
|--------------|---------------|---|
| 1 | 13 | Crew Leader <u>Bob Johnson</u> |
| 2 | 17 | |
| 3 | 3 | Batch # <u>2</u> |
| 4 | 15 | |
| 5 | | Random # selected <u>2</u> |
| 6 | | |
| 7 | | Date <u>May 23, 2001</u> |
| 8 | | |
| 9 | | Auditor <u>J. Smith</u> |
| 10 | | |
| 11 | | |
| 12 | | Ecology <input checked="" type="checkbox"/> |
| 13 | | Trees <input checked="" type="checkbox"/> |
| 14 | | |
| 15 | | |

Appendix 3: Audit Report Template

Project # _____ VRI Sample Audit Report
Sample # _____

Establishment Crew: _____ **Date:** _____

Audit Crew: _____ **Date:** _____

Batch #: _____

Samples in Batch: _____

Overall Audit Summary:

Timber Attribute Standards

Plot Cluster Location:

Critical Pass- Fail standards:

| Attribute | Crew standard | Pass(P)/Fail(F) |
|---------------------------|---|-----------------|
| Target polygon | no error permitted | |
| Relative cluster location | ± 30 metres when appropriate field ties available | |

Points standards:

| Attribute | Standard | Possible Points | Points Obtained |
|--|----------|-----------------|-----------------|
| Distance - reference pin to IPC (15.0 m) | ± 0.2m | 1 | |
| Azimuth - reference pin to IPC | ± 2° | 1 | |
| Total Plot Cluster | | | |

Plot Cluster Attribute comments (including supporting attributes):

Vegetation Resources Inventory

Tree Attributes:

Critical Pass-Fail Standards:

| Attribute | Crew Standard | Pass(P)/Fail(F) |
|------------------------------|--|-----------------|
| Tree Count* | no error on clusters with ≤ 15 trees 1 error maximum for clusters with > 15 trees (missed and added trees do not cancel each other) 2 errors allowed for $\frac{1}{2}$ and $\frac{1}{4}$ fixed radius plots with more than 30 trees | |
| Tree Genus | 1 error maximum per cluster | |
| Tree Species | 1 error maximum per cluster | |
| Live/Dead | 1 error maximum per cluster | |
| DBH | Average absolute variation $\leq 2\%$ | |
| Tree Length | Average absolute variation $\leq 3\%$ | |
| Age/Height Tree Selection | No error allowed in determining the leading species and second species 1 error/cluster allowed in the selection of site trees (includes all leading species, second species, top height and random trees) | |
| Net Factor | 90% of the net factors must be within $\pm 10\%^{**}$ (the same log length must be used to determine the net factor) | |

Points standards:

| Attribute | Standard | Point Value per tree | Number of trees audited | Max Points (Point Value times number of trees where audited) | Points Obtained |
|---------------------|--------------------------|----------------------|-------------------------|--|-----------------|
| Stand/fall | Correctly identified | 1 | | | |
| Tree Genus | Correct genus | 1 | | | |
| Tree Species | Correct species | 1 | | | |
| Live/Dead | Correctly identified | 1 | | | |
| Diameter | $\pm 3\%$ | 1 | | | |
| Tree length | $\pm 5\%$ | 2 | | | |
| Crown class | in correct class | $\frac{1}{2}$ | | | |
| First log grade | within 1 grade | $\frac{1}{2}$ | | | |
| First log length | $\pm 30\%$ of length | $\frac{1}{2}$ | | | |
| Second log grade | within 1 grade | $\frac{1}{2}$ | | | |
| Second log length | $\pm 30\%$ of length | $\frac{1}{2}$ | | | |
| Broken top diameter | $\pm 20\%$ of diameter | 1 | | | |
| Projected height | $\pm 10\%$ of length | 1 | | | |
| Damage agents | 90% correctly identified | $\frac{1}{2}$ | | | |
| Loss indicators | 90% correctly identified | 1 | | | |
| Total Points | | | | | |

Vegetation Resources Inventory

Tree attribute comments (including supporting attributes and optional pass fail criteria):

Site Tree Attributes:

| Attribute | Standard | Point Value per tree | Number of trees audited | Possible Points (Point Value times number of trees audited) | Points Obtained |
|----------------------|----------|----------------------|-------------------------|---|-----------------|
| Tree Length | ± 3% | 2 | | | |
| Diameter | ± 3% | 1 | | | |
| Field Bored age | ± 10% | ½ | | | |
| Pro-rate Core length | ± 1.0 cm | ½ | | | |
| Total | | | | | |

Site Tree attribute comments (including supporting attributes): _____

Small Tree Attributes:

| Attribute | Standard | Point Value | Points Obtained |
|--------------------|--------------------------|-------------|-----------------|
| Small tree species | 90% correctly identified | ½ | |
| Total trees | ± 10% | ½ | |
| Total | | | |

Small Tree attribute comments (including supporting attributes):

Total Timber Attribute Points Summary:

| Section | Points possible | Points obtained | | |
|---|-----------------|-----------------|---------------------|------------------|
| Plot Cluster Location | | | | |
| Tree Attributes | | | | |
| Site Tree Attributes | | | | |
| Small Tree Attributes | | | Percentage * | Pass/Fail |
| Total (Must be < = 10% to pass) | | | % | |

* Percentage = Total points obtained / total points possible *100

Overall Timber attribute comments:

Ecological Attributes

Critical Pass/Fail Standards:

| Attribute | Crew Standard | Pass(P)/Fail(F) |
|--|---|-----------------|
| Range transect total shrub coverage (m) | ± 15% | |
| CWD – Gross volume (m ³ /hectare) | ± 15% | |
| Tree/shrub species identification | > 90% of occurrences correctly identified | |
| Herb/bryoid species identification | > 80% of occurrences correctly identified | |

Ecological Attribute comments (including supporting attributes):

Attach a table showing DBH and Length calculations, as well as other supporting information as required.

Add additional pages as necessary for further comment.