TIMBER PRICING BRANCH

Provincial Logging Residue and Waste Measurement Procedures Manual – Interior Version

Effective: April 1, 2019

Includes Amendments	Effective Date
Amendment No. 1	July 22, 2019
Amendment No. 2	September 1, 2020

BRITISH COLUMBIA

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Amendment No. 2 – Provincial Logging Residue and Waste Procedures Manual – Interior Version Highlights

Section, Table or Appendix Number	Description
Throughout	Reorganized
Throughout	Revisions to add clarity
Throughout	Replaced cutblock terminology with “waste assessment area”
Throughout	Restored wording from previous manual versions (i.e. examples and/or descriptions)
Throughout	Removed grade 5 as a distinct waste grade and replaced it with grade 4
1.1	Removed reference to Pre Harvest Waste Assessments
1.3.1	Added a reference to the application dates for this manual
4.1	Updated the description for structuring reporting units in the Waste System
4.2	Updated submission timelines for small and large populations
4.3	Updated Reporting Requirements
4.3.2	Clarified process for determining volumes on blocks < 2 ha not requiring sampling
5.2	Added description on defining sample populations and added clarification on submitting 100% measure and estimated strata in aggregate populations
5.4, 5.5	Updated descriptions on how the sampling principles apply to the population types
6.2.1	Added waste assessment area description
6.2.2	Updated requirements for cutblocks < 2 ha
6.3	Updated requirements for structuring populations
6.5	Simplified procedures for determining number of plots
6.7.3	Updated large population sample plan section
6.8.1	Updated mapping requirements
8.3	Restored wording on Sampling Method
8.5.2	Updated mapping procedures and clarified plot numbering procedure
8.5.3	Added procedure for aggregate plot distribution in dispersed strata
8.6	Clarified sampling process for spot accumulations
8.7.1.2	Simplified survey requirements for external road rights of way
8.7.2.3	Restored wording on variable / fixed roadside strata
8.8	Restored wording on strip accumulations
8.9, 8.9.1	Restored wording on landings and added clarity on sampling procedures

8.11	Clarified procedures on stratifying and sampling cold decks
8.12	Restored wording on partial cutting (variable retention) areas
9.2.6.2	Added procedure for moving plots in roadside strata, and added steps to locate dispersed plots
9.3.5	Clarified measure factor calculations and procedures in prediction plots
9.4.1	Clarified requirements for measuring grade 6 / Z
9.5.2	Updated tree measurement procedures and updated submission requirements
9.5.2.4	Clarified process for obtaining grade profile information
9.5.5	Restored wording on bucking waste classification
9.5.5.4	Clarified measurement of sequential pieces of bucking waste
9.5.7	Restored wording on breakage
9.5.9	Restored wording on coarse woody debris
9.5.10	Restored wording on special cases
10.1.2	Updated the check survey objectives
10.2.1	Updated the field check requirements
10.2.2.3	Updated individual parameters and restored examples
10.2.3	Restored section on acceptability of check survey results
10.2.6	Restored section on BCTS dispute resolution process
10.3.1	Updated the office review standards

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1. Administration

1.1 Introduction

In British Columbia, the right to harvest Crown timber is conferred through the form of Agreements under the Forest Act. The Forest Act and subsequent Agreements require licensees to carry out waste and residue assessments.

Waste assessments are carried out to quantify the volumes of waste and residue remaining on harvested areas following the completion of harvesting operations. Waste assessments obtain an unbiased estimate of the volume and quality of timber on a cutblock whether standing or felled, that meets or exceeds the timber merchantability specifications which was not removed from the cutting authority area and was not reserved from cutting. The waste volume data compiled from the assessments are used to invoice licensees for monetary and cut control charges.

This manual outlines the administration and field measurement procedures to be used in the assessments and is intended to serve as the reference for industry and government staff who conduct or check waste assessments in British Columbia.

1.2 Authority and Obligations

1.2.1 Authority

The right to harvest Crown timber is granted in the form of Agreements under the *Forest Act.*

Waste assessments are carried out under the authority of:

1. The *Forest Act* section 103.1 and other related sections,
2. Agreements and cutting authority documents, and
3. The *Provincial Logging Residue and Waste Measurement Procedures Manual*.

The licensee has the discretion of whether or not to harvest the timber from the agreement area subject to the forest management standards required.

Under the *Forest Act* and the Agreements, the licensee must pay a waste assessment for timber not harvested.

1.2.2 Continuing Liability

In accordance with section 79 of the *Forest Act***,** and notwithstanding the timeframes specified in section 4.2 for conducting and submitting a waste assessment, and despite the expiry, surrender, suspension or cancellation of a holder's agreement, the holder of an agreement is required to conduct a waste assessment, and pay the fees, costs and invoice billings owing to the government in respect of the waste assessment.

1.3 Applicability

The manual is applicable to waste assessments located in the North Area, South Area, and Manning Park other than those:

1. Required under a Community Forest Agreement, or
2. Required under a Woodlot Licence.

1.3.1 Application Dates

This manual applies to timber sales advertised, or cutting authorities issued on or after the dates specified in the most recent amendment of the *Provincial Logging Residue and Waste Measurement Procedures Manual.*

1.3.2 Scale Based Cutting Authorities

Where the amount of stumpage payable on the timber harvested from a cutting authority is calculated using the information reported in a scale of the timber, the holder of the agreement must conduct a waste assessment on that cutting authority.

1.3.3 Cruise Based Cutting Authorities

Where the amount of stumpage payable on the timber harvested from a cutting authority is calculated using the information reported in a cruise of the timber, the holder of the agreement is not required to conduct a waste assessment on that cutting authority.

1.4 Responsibility

The responsibilities are as follows:

1.4.1 Timber Pricing Branch

1.4.1.1 Director, Timber Pricing Branch

The Director, Timber Pricing Branch is responsible for:

1. Approving *Provincial Logging Residue and Waste Measurement Procedures Manual* and amendments.
2. Processing and maintaining waste data.
3. Billing licensees by issuing waste invoices.

1.4.1.2 Residue and Log Salvage Policy Forester, Timber Pricing Branch

The Residue and Log Salvage Policy Forester is responsible for:

1. Developing and maintaining standards and procedures for determining and reporting waste.
2. Providing training and technical support.
3. Providing policy interpretation to industry and ministry staff.
4. Maintaining software compilation programs and standards.
5. Conducting technical reviews of Forest Regions and Forest Districts for policy and procedure compliance.

1.4.2 Regional Manager

The Regional Manager is responsible for:

1. Ensuring that district staff adhere to policy and procedures, and where necessary, provide training to district staff.
2. Recommending survey procedure changes where necessary, to the Director, Timber Pricing Branch.
3. Advising industry and forest district staff on matters relating to waste assessments.
4. Processing waste reports and FS 702 for waste monetary billing and cut control where required.

5. Providing Waste System guidance and training to district staff and industry users.

1.4.3 District Manager

The District Manager is responsible for:

1. Conducting check surveys in accordance with manual standards.
2. Implementing and administering the policy and procedures and recommending survey procedure changes where necessary to the Regional Manager.
3. Approving waste assessments and issuing reporting unit numbers in the Waste System.
4. Checking for completeness of licensees submitted reports.
5. Processing waste reports and FS 702 for waste monetary billing and cut control where required.

1.4.4 Timber Sales Manager

Unless otherwise specified in the agreement, the Timber Sales Manager is responsible for:

1. Ensuring BCTS Licensees submit waste assessments in accordance with licence agreements, Waste Policy and the *Provincial Logging Waste Measurement Procedures Manual*.
2. Where a BCTS Licensee does not submit a waste assessment as required under section 1.4.4(1) the Timber Sales Manager may carry out the assessment, and in a notice given to the holder, may require the holder to pay the costs incurred by the Timber Sales Manager in carrying out the assessment.

1.4.5 Licensees

Licence holders are responsible for conducting waste assessments on their scale based cutting authorities in accordance with the licence agreement.

The licensees are responsible for:

1. Submitting waste assessment plans.
2. Conducting waste assessments in accordance with this manual.
3. Submitting waste data into the online Waste System.

Where the above-mentioned work is performed by a contractor or a subcontractor, it is the licensee's responsibility for ensuring that the work is carried out in compliance with Ministry standards and requirements.

1.4.5.1 Complete and Accurate Information

In accordance with section 105.1 (3) of the Forest Act, the licensee must ensure that any information that is submitted to the government for the purposes of a waste assessment or check survey is complete and accurate at the time the information is submitted.

1.5 Waste Assessor Qualifications

The minimum requirements for completion and submission of waste surveys are as follows.

1.5.1 Waste Sample Planning

Preparation of sample plans including development of sample populations, sampling designs and waste assessment area survey plans must be completed or endorsed by a Registered Forest Professional (RPF or RFT).

1.5.2 Field Survey

Field survey work, including the establishment of survey plot samples, estimation of plot volumes, measurement of plot pieces, collection of waste data, and upload of waste data into the Harvest Residue Compiler software must be completed by a person that is competent in field measurements, plot survey techniques, cruising and/or scaling.

1.5.3 Survey Compilation and Reporting

Compilation and reporting of waste assessment information must be completed or endorsed by a Registered Forest Professional (RPF or RFT).

1.6 Data Collection and Compilation Programs

To support the collection and compilation of waste data, the Ministry of Forests, Lands, Natural Resource Operations and Rural Development maintains three software programs: the Waste System, the Harvest Residue Compiler (HRC), and EForwasteBC.

1.6.1 The Waste System

The Waste System is used to submit waste information, generate reports and upload data into the Harvest Billing System for billing.

1. Access is provided through the Waste System application located on the Timber Pricing Branch website.

2. The system can be accessed at:
   https://apps.nrs.gov.bc.ca/ext/waste-for/

3. Users may follow the procedures in the *Waste System User Procedures Manual* at:
   http://www.for.gov.bc.ca/hva/rh/rwtraining/

1.6.2 The Harvest Residue Compiler

The Harvest Residue Compiler (HRC) is used by waste planners to create waste sampling plans, collect and compile waste assessment area and population information and export data to the Waste System.

1. HRC is available at:
   https://apps.nrs.gov.bc.ca/pub/hrc/

2. Users may follow the procedures in the *Harvest Residue Compiler User Guide* on the Timber Pricing Branch website.

1.6.3 EForwasteBC

EForwasteBC (EFW) is an iPad-based software application used by waste surveyors to collect waste assessment area survey information.

1. EForwasteBC is available from the Apple App store.

2. A user manual is available on the Timber Pricing Branch website.

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2. Waste Relief

2.1 Waste Relief Policy

A licensee may submit a request for waste relief to the District Manager or a Timber Sale Manager.

The Executive Director responsible for waste assessments may direct that no waste assessment will be issued to a licensee where:

1.
    a. No waste assessment has been issued to the licensee for the timber on the cutting authority area and,
    b. In the opinion of the Executive Director the licensee left the timber on the cutting authority area because of circumstances that were:
        i. Beyond the control of the licensee, and
        ii. Unrelated to the licensee's:
            a. Financial situation, and
            b. Economic circumstances.
        ii. Some examples of circumstances in (1)(b)(i) where it would be reasonable for the Executive Director to exercise his or her discretion in favor of the licensee are as follows:
            a. Where the licensee is prevented from removing the timber from the cutting authority area by an act of God.
            b. Where the licensee is prevented from removing the timber from the cutting authority area by a physical barrier or a manmade blockade over which the licensee has no control.
            c. Where the licensee is prevented from concluding harvesting operations prior to expiration of the cutting authority because of misfortune that an employee of the government has provided to the licensee with respect to the cutting authority provisions or the harvesting operations.
            d. Where the licensee is prevented from concluding harvesting operations prior to expiration of the cutting authority because land from the cutting authority has been set aside by agreement between the licensee and the government.

2. The licensee held a cutting authority that was issued prior to June 1, 2004 and where:
    a. Merchantable crown timber that was authorized for harvest under the cutting authority, at the agreement holder's discretion was not cut and removed,
    b. The timber is standing,
    c. In the opinion of the Executive Director the timber is of sufficient quantity, quality and concentrations that can be marketed at a reasonable price, and
    d. In the opinion of the Executive Director the licensee has exhausted all the licensee's rights under the *Forest Act* to extend the term of the licence, and
    e. The Ministry has not issued a waste assessment for the timber to the licensee.

2.2 Applications

A licensee may apply, in writing, for waste relief with respect to the timber left on a cutting authority provided the government has not issued a waste assessment (invoice) for the timber to the licensee.

2.2.1 Initiating Applications

1. The application for waste relief must include the reasons for seeking relief and data on the timber volume and grades for which relief is being sought (the supporting data).
2. An application must be submitted by:
    a. BCTS licensees to the Timber Sales Manager with a copy to the District Manager, and,
    b. All other licensees to the District Manager.
3. The application must be submitted prior to issuance of the waste assessment (invoice).

2.2.2 Content and Processing of Applications

1. The licensee shall submit the supporting data to the Timber Sales Manager or District Manager, as the case may be.
2. The supporting data must provide an accurate estimate of timber volume remaining on each of the cutblock(s) in the cutting authority. That timber volume estimate may be determined by, but not necessarily limited to, the following methods:
    a. A full waste survey conducted in accordance with this manual, and/or,
    b. A timber cruise with a map showing the locations of the timber included in the waste relief application.
3. The supporting data will be submitted by the licensee into the Waste System and identified by way of a notation or comment in the Waste System that the information pertains to an application for waste relief.
    a. The supporting data for the timber for which waste relief is requested **must** be submitted by the licensee into the Waste System as a separate waste survey, prior to the waste relief application being processed. This waste survey will be kept in the Waste System in ‘Submitted’ status and will not be processed until a determination has been rendered on the application.

4. Timber Sales Manager or District Manager, as applicable, upon receipt of the data submitted, will prepare an information package that should include:
    a. Relevant information on the cutting authority,
    b. An estimated waste monetary assessment based on the timber grade profile, on a block by block basis, and the applicable waste rates.
    c. An assessment of the opportunity for resale of the timber included in the waste relief application, including the current market value, and,
    d. A Briefing Note to the Executive Director, responsible for waste assessments confirming receipt of the waste relief application.
5. The information package will be forwarded in electronic form to the Director, Timber Pricing Branch, Ministry of Forests, Lands, Natural Resource Operations and Rural Development, with a copy to the Regional Executive Director and the Regional Revenue Manager.

2.2.3 Determination

The Executive Director, upon reviewing the information provided and considering the pertinent documentation, will make a determination and notify the licensee, with a copy to the District Manager, the Timber Sales Manager (in the case of BCTS Agreements), and the appropriate Regional Executive Director and the Regional Revenue Manager.

If the waste relief application is not approved, the District Manager will process the waste survey and issue an invoice for that timber included in the waste relief application.

If the waste relief application is approved, the District Manager will deactivate the waste survey submitted to the Waste System for that timber included in the waste relief application.

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3. Timber Merchantability Specifications and Waste Monetary Billing

3.1 Timber Merchantability Specifications

Timber merchantability specifications are based on the determination of maturity in a timber cruise of the cutblock and are further refined by species.

Table 3-1 Interior Timber Merchantability Specifications

Description		**All Stands**
Stumps **Measured on the side of the stump adjacent to the highest ground.		
•	No higher than	30 cm
Diameter (outside bark) at stump height		
•	Lodgepole pine: all timber that meets or exceeds	7.5 rads (15 cm)
•	All other species: all timber that meets or exceeds	10 rads (20 cm)
Top diameter (inside bark) or slab thickness		
•	For all species and ages, except cedar older than 141 years, all timber that meets or exceeds	5 rads (10 cm)
•	For all cedar older than 141 years	7.5 rads (15 cm)
Minimum length		
•	Log	3 m
•	Bucking waste	0.1 m

3.2 Waste Monetary Billing

Waste volumes are measured and billed monetarily in accordance with the following table.

Table 3-2 The Disposition of Residue and Waste Volumes in Monetary Billing

Table Effective April 1, 2019 (Valid for All Species)							
Waste Type	**Grade**	**Avoidable**			**Unavoidable**		
		Measure / Record	**Rate**	**AAC**	**Measure / Record**	**Rate**	**AAC**
Sawlog	1 and 2	Yes	Full $*	Yes	Yes	$0.00	Yes
Lumber Reject (Green or Dead and Dry)	4	Yes	$0.25	Yes	Yes	$0.00	Yes
Undersize	6	Optional	$0.00	No	Optional	$0.00	No
Firmwood Reject	Z	Optional	$0.00	No	Optional	$0.00	No

* Full $ Waste Rate ($/m^3) from section 3.2.2

3.2.1 Waste Amount Payable

For merchantable Crown timber that is not cut and removed, the amount payable is calculated by multiplying the volumes of avoidable waste reported in a waste assessment by the applicable waste rate.

Unavoidable waste volumes will not result in amounts payable but will be included in the harvested volume for cut control purposes when applicable in accordance with the *Forest Act*.

3.2.2 Waste Rate

The application of a waste rate is dependent on whether there has been timber harvesting on a cutting authority. A waste rate is determined for each waste assessment area in the cutting authority when timber has been harvested.

The waste rate applies to dispersed waste, accumulations, and standing timber within the waste assessment area and will be determined as outlined in this section.

The applicable rates charged will include any bonus bids and levies as applicable.

1. Avoidable coniferous species graded:
    a. Grade 1 and 2 are billed using the weighted average sawlog stumpage rate for the 12 month period multiplied by the waste monetary reduction factor (WMRF), and
    b. Grade 4 is billed using the rates established in the *Interior Appraisal Manual*.
2. Avoidable deciduous species graded:
    a. Sawlog is billed using either:
        i. The appraised rate, or, if there is no appraised rate,
        ii. The fixed rate for the species as specified in the *Interior Appraisal Manual*, and
    b. Other than sawlog is billed using the fixed rate in the *Interior Appraisal Manual*.

3.2.2.1 Waste Assessment Areas with Harvesting

For waste assessment areas with harvesting, the waste rate for coniferous sawlogs is calculated using the weighted average stumpage rate charged for the sawlogs (grade code 1 and 2) in invoices issued during the 12 month period after the ready for survey date for the waste assessment area is achieved.

The formula to be used is:

$$\mathbf{WR=TS/TV}$$

Where:

1. **WR**= The waste rate for the cutting authority
2. **TS***= Total billed sawlog stumpage (sum of Upset Stumpage*, and Bonus Bid) for timber harvested under the applicable timber mark for the twelve-month period ending one month after the month the waste assessment area was ready for survey
3. **TV***= Total billed volume (accumulated volume in cubic metres that derived the total billed stumpage for the sawlogs) for the twelve-month period ending one month after the month the waste assessment area was ready for survey
    a. ***TV** includes silviculture and development levies

Remaining areas of standing timber within a waste assessment area that are left unharvested at the expiry, surrender, termination, or cancellation of the cutting authority are waste billed using the ready for survey date for the cutblock.

3.2.2.2 Cutblocks with No Harvesting but Harvesting has Occurred on the Cutting Authority

If there has been no harvesting on the cutblock but there has been harvesting for the cutting authority, then the conifer stumpage rate for the cutblock is derived using the average of the cutting authority's four quarterly timber appraisal stumpage rate (plus any bonus and levies where applicable) in effect during the twelve-months preceding the date of cutting authority's expiry, surrender, termination or cancellation, as the case may be.

The formula to be used is:

$$\mathbf{WR = ACASR}$$

Where:

1. **WR** = The waste rate for the cutblock
2. **ACASR** = Average Cutting Authority Stumpage Rate over the four quarters preceding the expiry, surrender, termination or cancellation date.

Example 1

If Cutting Authority A (CP A) became effective on September 5, 2017, and expires on September 4, 2018, then the ACASR is the simple average of the four quarterly stumpage rates for CP A from October 1, 2017, January 1, 2018, April 1, 2018 to July 1, 2018.

Example 2

If Cutting Authority B (CP B) became effective on April 20, 2016, and is surrendered on September 5, 2016, then the ACASR is the simple average of the April 20, 2016 and July 1, 2016 stumpage rates for CP B.

3.2.2.3 Cutblocks with No Harvesting and No Harvesting has Occurred on the Cutting Authority

If there has been no harvesting on the cutblock and there has been no harvesting on the cutting authority, then waste billings do not apply to cutblocks upon expiry, surrender, termination or cancellation of the cutting authority.

3.3 Waste Benchmarks

3.3.1 Benchmark Levels

The following waste benchmarks will be used for monetary billing of avoidable conifer sawlog grade waste volumes and are applied on an individual waste assessment area basis until further notice.

Table 3-3 Interior Benchmark Levels

	Dry Belt	**Transition**	**Wet Belt**
Benchmark Level	4 m^3/ha	10 m^3/ha	20 m^3/ha

Where a cutblock or a partial cutblock contains one or more biogeoclimatic zones, the benchmark applying to the waste assessment area will be determined by the zone covering the largest proportion of the cutblock area.

The waste benchmarks by biogeoclimatic zone are available on the Timber Pricing Branch website.

3.3.2 Benchmark Eligibility

The benchmarks are administered on an individual waste assessment area basis. Therefore, each waste assessment area must be individually assessed to determine whether the avoidable waste within the waste assessment area is above or below the benchmark.

Waste benchmarks do not apply to unharvested cutblocks.

Merchantable volume that may be required to meet coarse woody debris requirements is not exempt from billing and will be included in the waste benchmarks. No special provisions are made for coarse woody debris in waste assessments.

3.3.3 Benchmark Calculations and Billings

The waste benchmark volume for a waste assessment area is derived by multiplying the benchmark level value with the total of the dispersed, accumulation, and standing trees subpopulation area reported in a waste assessment.

Avoidable waste volumes in conifer sawlog grades 1 and 2 from the dispersed, accumulated and the standing tree subpopulations of the waste assessment area will be applied to the benchmarks.

Where the avoidable waste volumes in conifer sawlog grades are below the established benchmark for the waste assessment area, no monetary billing of avoidable waste in conifer sawlog grades will be made.

Where the avoidable waste volumes in conifer sawlog grades are above the established benchmark for the waste assessment area, monetary billings will be made on the conifer sawlog grade volumes exceeding the benchmark. Avoidable waste volumes in grade 4 will not be applied to the benchmark but will be billed monetarily in all cases.

3.3.4 WMRF and Billing

A waste monetary reduction factor (WMRF) is calculated for billing purposes. The WMRF is applied to the waste rate as determined in section 3.2.2 to calculate the conifer grade 1 and 2 waste amount payable.

The WMRF is calculated to 4 decimal points and the minimum is 0.0000.

The formula for calculating the WMRF is:

$$\frac{\mathbf{AV - BM}}{\mathbf{AV}} = \mathbf{WMRF}$$

Where:

1. **AV*=** Avoidable Sawlog Waste Volume (m3/ha)
    a. ***AV** is the avoidable coniferous sawlog (grade 1 and 2) waste volumes.
2. **BM =** Benchmark Value (m3/ha)
3. **WMRF =** Waste Monetary Reduction Factor

See Appendix 2 for an example.

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4. Reporting Structure, Timeframes, and Requirements

4.1 Reporting Structure

Waste assessments are reported in the Waste System using a reporting unit that is unique to a Forest District and the client number associated with a licence (or licences).

In the Waste System, reporting units are created for the following reporting options:

1. Cutblock option – used to report single waste assessment area populations.
2. Aggregate option – used to report waste assessment areas in a small population (aggregate) sample plan or in a large population sample plan.

4.1.1 Single Waste Assessment Area Population Reporting Units

Where the holder of an agreement uses the single waste assessment area option, each waste assessment area may be submitted:

1. In separate reporting units, or
2. In one reporting unit. Under this option, a new reporting unit must be created every calendar year.

4.1.2 Small Population (Aggregate) Reporting Units

Where the holder of an agreement uses the small population (aggregate) option, waste assessment areas form an aggregate reporting unit. Individual reporting units must be created for each sample plan.

4.1.3 Large Population Reporting Units

Where the holder of an agreement uses the large population option, individual reporting units must be created for each sample plan.

4.2 Timeframes

The completion and submission of waste surveys are linked to the completion of harvesting activities and the seasonal ability to complete field measurements. Waste surveys cannot be completed when snow is present in sufficient quantities to prevent the accurate measurement and grading of waste pieces.

4.2.1 Submission Timelines

Survey data for waste assessment areas and the compilation of the waste survey results will be submitted as per the timelines below.

Table 4-1 Submission Timelines

<table>
<tr><th>Population Format</th><th>Submit Sample Plan to District Manager?</th><th>Initial Sample Plan Due Date</th><th>Waste Assessment Area Survey Map Due Date</th><th>Waste Assessment Area Survey Data (EFW file)</th><th>Compilation and Submission into the Waste System</th><th>Finalized Sample Plan Due Date</th></tr>
<tr><td>Single Waste Assessment Area</td><td>No</td><td>N/A</td><td rowspan="3">A minimum of 1 day before the survey</td><td>Upon request</td><td rowspan="2">Earliest of:

1. Section 4.2.1.1 (hazard abatement etc.), or

2. September 15 or June 30 depending on the ready for survey date</td><td>N/A</td></tr>
<tr><td>Small Population (Aggregate)</td><td rowspan="2">Yes</td><td>A minimum of 7 days before starting the first field survey</td><td>1. As per section 4.2.1.1 (hazard abatement etc.), or

2. Upon request</td><td rowspan="2">Upon submission into the Waste System</td></tr>
<tr><td>Large Population</td><td>A minimum of 7 days before starting the first field survey from batch 1</td><td>Earliest of:

1. 30 days after field survey completion, or

2. Section 4.2.1.1 (hazard abatement etc.), or

3. Upon request</td><td>One year, plus 30 days from the earliest ready for survey date in the population</td></tr>
</table>

Waste surveys must be submitted to the District Manager using the earliest timeframe as laid out in section 4.2.1.1 or 4.2.1.2, depending on which occurs first.

In all cases, submissions must be completed prior to site treatments and hazard abatement requirements occurring.

When the access to a waste assessment area is restricted by snow, licensees may apply to the District Manager to extend the completion timeline by 30 days.

Survey reports submitted to the District Manager after November 15th may result in having invoices issued in the following year.

4.2.1.1 Submission Requirements for Waste Assessment Areas Requiring Site Treatments or Hazard Abatement

Waste assessment areas must be surveyed and submitted to the District Manager the earliest of:

1. A minimum of thirty (30) days prior to:
    a. The commencement of any post-harvest site treatments that will alter the waste volumes or grades (i.e. stumping, burning, mounding), or
    b. The reduction of the fuel hazard as required by the Wildfire Regulation section 12.1, or
2. No later than September 15.
    a. Where a waste assessment area has a ready for survey date between August 15 and September 15, and site treatments or hazard abatement are to occur later in the fall, Licensees may apply to the District Manager to extend the completion timeline by 30 days.

Where a waste assessment area in an aggregate sample plan is planned for site treatments or hazard abatement, and the population is not ready to be submitted into the Waste System, the survey data in the form of the EFW file must be submitted to the District 30 days prior to any activities occurring.

In a large population, post-harvest treatments may commence at any time on completed waste assessment areas that have been included in a batch in HRC and are not selected to be surveyed.

Partial cutblock waste assessment areas may be submitted in order to complete waste assessment obligations prior to hazard abatement.

4.2.1.2 Submission Requirements for Waste Assessment Areas Not Requiring Site Treatments or Hazard Abatement

Except as specified in section 4.2.1.1, waste assessment areas must be surveyed and submitted as outlined below.

Single Waste Assessment Area or Small Populations (Aggregate)

Where a waste assessment area within the population has a ready for survey date between:

1. January 1st and July 31st, the waste assessment must be submitted no later than September 15th of the same year, or
2. August 1st and December 31st, the waste assessment must be submitted no later than June 30st of the year following the ready for survey date.

In a small population (aggregate), the waste assessment area with the earliest ready for survey date is used to determine the submission timeframe as stated above.

Large Populations

Large populations must be submitted no later than one year, plus 30 days from the earliest ready for survey date in the population.

4.2.2 Submission of Waste Assessments Not Requiring a Field Survey

Waste assessment areas that will have the waste assessment volumes determined through alternate methods (i.e. cutblocks <2.0 ha in a large population) must be submitted no later than thirty (30) days after:

1. The ready for survey date when District Average rates are used, or
2. The data required for completion and compilation of the sample population to be used to generate the required information is available (i.e. compilation of the sample waste assessment area or population).

4.2.3 Overdue Waste Assessments and Reports

Where the holder of an agreement, other than an agreement entered into with the timber sales manager, does not complete the waste assessment and submit it to the District Manager as required under section 4.2, the District Manager may, in a notice given to the licensees, take actions to complete and submit a waste assessment for a block or blocks. The District Manager may require the holder to pay the costs incurred in carrying out the assessment.

Where the holder of an agreement entered into with the Timber Sales Manager that is required by that agreement to conduct a waste assessment, fails to conduct that waste assessment, the Timber Sales Manager may carry out the assessment, and in a notice given to the holder, may require the holder to pay the costs incurred by the Timber Sales Manager in carrying out the assessment.

4.3 Reporting Requirements

Waste assessments must be surveyed and submitted to the Waste System and include the items outlined below:

1. Licensees must enter and submit the data into the Waste System for a waste assessment area as required in section 4.2.
2. A final survey map for each waste assessment area as required in Table 6-3 and area calculations must be included in the submission.
3. The post harvest reserve tree specifications document (where applicable).
4. If used, the following files must be uploaded into the Waste System or emailed to the District:
    a. The final version of the sample plan,
    b. The Aggregate Sample Plan,
    c. The EFW file (for aggregate populations only), and
    d. The HRC file used for compilation.
5. If the person submitting the survey information into the Waste System is not a Registered Forest Professional, a signed and sealed cover letter from a Registered Forest Professional accepting responsibility for the submission information must be submitted. This letter must include the Registered Forest Professional's designation and registration number.
6. The agreement between parties when a population contains waste assessment areas from different client codes.

HRC, EFW files, GPS shapefiles, PRP tables, traverse notes, and plot cards will be stored by the Licensee and made available to the Ministry upon request.

4.3.1 Material Disposed of Prior to Waste Assessments

If waste materials within any strata of a waste assessment area are disposed of prior to the completion and submission of a waste assessment as specified in section 4.2, the licensee must notify the Natural Resource District and submit waste volumes for the affected strata using the higher of:

1. The district or the licensee waste volume average experienced for the stratum type in the past year, or
2. The best information available to complete the assessment.

If the licensee does not account for this volume, the District Manager will bill the licensee and determine the volume for cut control purposes. The District Manager may bill the licensee for the administration and field costs incurred in preparing the estimates.

4.3.2 Cutblocks Less Than 2.0 ha Not Requiring Field Sampling

The waste volumes for cutblocks less than 2.0 hectares that do not require field sampling as per section 6.2.2 are reported:

1. In a large population, using the population average.
    a. These waste assessment areas are not included in the sample plan as they are not eligible to be sampled, and
    b. Are reported in the Waste System, not HRC.
2. In a cutting authority that does not require a silviculture prescription, or in an external road right of way, alternate waste data sources may be selected in the following order:
    a. Closest waste assessment area owned by the licensee of the same benchmark, harvest system and stand type, or
    b. Closest population average, or
    c. District average volume/ha from the waste system and species and grade from HBS.

Note: all submissions using alternate waste data sources must be based on surveys completed on cutting authorities issued, or timber sales advertised, on or after April 1, 2019.

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5. Sample Populations and Sampling Designs

5.1 Overview

The sampling designs provide the basis for obtaining the waste and residue volume estimate for the sample population.

The main steps in selecting a sample design and creating a sample plan are:

1. Defining the population of interest.
2. Selecting a sampling design.
    a. Some of the sampling options are designed to increase the efficiency of sampling (i.e. lower costs) and improve the precision of the estimates.
    b. The sampling design chosen will determine how waste assessment areas are selected for sampling, how data is collected within the waste assessment areas, and how the results from the sample are applied to the population.
3. Developing the sample plan for the population.
    a. The sample plan describes the details of how the sample will be completed, including what waste assessment area(s) are included in the sample, and where the plots are located.

Once these steps are completed, the plan can be implemented. This involves collecting field data from the sample plots, compiling the data, reviewing the results, and submitting the information into the Waste System.

5.2 Sample Populations

The sample population is the total net area of all waste assessment areas where estimates of waste and residue volumes are required.

The population is determined by the number of waste assessment areas in the population.

The sample populations are:

1. Single Waste Assessment Area
    a. The sample population is one waste assessment area.
    b. In this population, a single waste assessment area is sampled to obtain the waste and residue estimate.
2. Small Population (Aggregate):
    a. The sample population contains 2 to 19 waste assessment areas.
    b. Waste assessment areas in a small population are aggregated into one population for sampling and reporting.
    c. In an aggregate, the results for the population are applied to each waste assessment area within the population, with each waste assessment area receiving the same estimate of volume per hectare by species and grade, except for estimated or 100% measure strata which are reported in the individual waste assessment area(s) they are sampled in.
3. Large Population
    a. The sample population is 20 or more waste assessment areas.
    b. In a large population, not all waste assessment areas require sampling. A sample of the waste assessment areas in the population are measured in the field and are used to determine the waste volumes for the waste assessment areas that are not sampled.

5.3 Sampling Designs

The sampling principles used to collect and compile waste information are simple random sampling (SRS) and ratio adjustment (Ratio) sampling. The sampling design names specify which principle is used.

5.3.1 Single Waste Assessment Area or Small Population Sampling Designs

The following designs are used on single waste assessment areas or small populations and employ a single sampling principle to develop the result:

- SRS, or
- Ratio.

5.3.2 Large Population Sampling Designs

In a large population, the sampling design employs two sampling principles to develop the result. The first term defines how the volume is estimated within the plots in sampled waste assessment areas, and the second term defines how the volume is estimated among the waste assessment areas in the population.

The following designs are used for large populations:

- SRS/SRS
- SRS/Ratio
- Ratio/SRS
- Ratio/Ratio

5.4 Sampling Designs Within Single Waste Assessment Area and Small Populations

5.4.1 Simple Random Sampling

Simple random sampling uses only measure plots. Within the waste assessment area, a predetermined number of sample plots are established, measured, and averaged to determine an estimate of volume for the population.

5.4.2 Ratio Adjustment Sampling

In ratio adjustment sampling, a predetermined number of prediction plots are established, and a random selection of these plots are measured.

In a prediction plot, the surveyor will predict (estimate) the total volume (m^3) of merchantable timber within all 200 m^2 dispersed or 50 m^2 accumulation strata plots.

In this method:

1. Ratio adjustment sampling is implemented at the plot level,
2. A ratio between the measured plot volumes and predicted plot volumes is developed. This ratio adjustment is applied to the average volume per hectare from all prediction plots in the stratum, and
3. The ratio adjusted volumes per hectare are used to determine an estimated volume for the population, and
4. Other strata volumes are added to derive the total waste assessment area volume.

5.5 Sampling Designs Within Large Populations

Simple random sampling or ratio adjustment sampling can be used at the plot level or waste assessment area level depending on the survey method selected. At the plot level, SRS and Ratio sampling principles are applied the same as in a single waste assessment area or small population.

5.5.1 Simple Random Sampling

Using SRS at the waste assessment area level involves:

1. HRC randomly selecting waste assessment areas from the population for sampling,
2. Measuring the selected waste assessment areas using SRS or ratio adjustment sampling at the plot level,
3. Proportionally weighting the sample waste assessment area volumes by net area, and the resulting volume per hectare is applied to the sampled waste assessment area,
4. The sampled waste assessment areas receiving their specific estimates from the survey, and
5. The averages of all sampled waste assessment areas are applied to all non-sampled waste assessment areas in the population.

5.5.2 Ratio Adjustment Sampling

Using ratio adjustment sampling at the waste assessment area level involves:

1. Predicting the total estimated waste volume (m^3/ha of grades 1, 2, and 4) for each waste assessment area in the sample plan prior to sampling for Ratio/Ratio or SRS/Ratio sample designs,
2. HRC randomly selecting waste assessment areas from the population for sampling,
3. Measuring the selected waste assessment areas using SRS or ratio adjustment sampling at the plot level,
4. Developing a ratio between the measured waste assessment areas and the predicted waste assessment area volumes,
5. Applying the ratio to adjust the predicted volume on the non-sample waste assessment areas,
6. The sampled waste assessment areas receiving their specific estimates from the survey, and
7. The non-sampled waste assessment areas receiving unique estimates.

5.5.3 Sampling Design Options

5.5.3.1 Simple Random Sampling / Simple Random Sampling

The SRS/SRS method requires:

1. The measurement of all sample plots established within the selected waste assessment areas, and
2. The measurement of selected waste assessment areas within the population.

5.5.3.2 Simple Random Sampling / Ratio

The SRS/Ratio method:

1. Requires the measurement of all sample plots established within the selected waste assessment areas,
2. Uses a prediction of waste assessment area volumes for the population combined with measurements within selected waste assessment areas to develop a ratio, and
3. The ratio is used to adjust all waste assessment area predictions within the population.

5.5.3.3 Ratio Sampling / Simple Random Sampling

The Ratio/SRS method:

1. Uses a combination of measured and predicted plots, and
2. The measurement of plot volumes and a prediction of waste assessment area volumes for the population are used to develop the ratio adjustments.

5.5.3.4 Ratio / Ratio

Ratio/Ratio sampling uses:

1. A combination of measured and predicted plots, and
2. A prediction of plot volumes and a prediction of waste assessment area volumes for the population to develop two ratio adjustments.

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6. Sample Plans

6.1 Waste Sample Plan Development and Implementation

A waste sample plan involves the creation of a population using one of the sample designs described in Chapter 5 and calculation of the required number of plots for each waste assessment area in the plan.

The waste sample plan is the key document that provides the information needed by the waste surveyor to complete a waste survey and provides assurances to the Ministry that the waste assessment data was collected in an unbiased manner.

Waste sample plans are professional documents and must be:

1. Prepared by a qualified registered member (RPF, RFT) of the Association of BC Forest Professionals, or
2. Supervised and endorsed by a registered member (RPF, RFT) of the Association of BC Forest Professionals.

A licensee or party responsible must submit initial and completed waste sample plans, and a waste assessment area survey map in accordance with section 4.2. A completed waste sample plan is prepared after all field surveying is complete and is submitted with the sample population.

In addition to the requirements above, for large populations, the updated sample plan and HRC file must be submitted to the Natural Resource District after each batch is created.

The waste sample plan is not required to be approved by the District Manager. A review of the sample plan may be completed at the discretion of the District Manager.

The waste sample plans are submitted to the Ministry staff to allow for the development of field quality assurance schedules and to provide a basis for comparison against the final waste submission.

6.2 Sample Plan Composition

6.2.1 Waste Assessment Area

A waste sample plan is composed of waste assessment areas.

A waste assessment area can be either a complete cutblock, or a portion of a cutblock submitted in a waste assessment.

Cutblocks may be submitted and sampled as separate waste assessment areas for each year of harvest when the harvest of a cutblock has occurred over multiple years.

Cutblocks containing both helicopter and conventional harvest methods must be separated into two waste assessment areas and sampled separately.

6.2.2 Cutblocks Less Than 2.0 Hectares

Cutblocks less than 2.0 ha do not need to be sampled when:

1. Added to a large population sample plan, or
2. Included in a cutting authority that does not require a silviculture prescription (i.e. Forestry Licence to Cut for salvage).

Otherwise, cutblocks less than 2.0 hectares must be:

1. Sampled as a single waste assessment area, or
2. Included in an aggregate sample plan.

All partial cutblocks less than 2.0 hectares must form separate waste assessment areas. These waste assessment areas must be submitted in a sample plan and sampled individually based on their respective areas.

Until large populations are available for use, a maximum of 10 additional cutblocks less than 2.0 hectares may be added into an aggregate sample plan for a maximum of 29 waste assessment areas in the population.

6.3 Population Structure

6.3.1 Small Populations (Aggregate)

An aggregate sample plan and population must:

1. Be comprised of at least two waste assessment areas which can originate from different cutting authorities,
2. Have primary harvest complete for all the waste assessment areas in the population to be included in the sampling plan, and
3. Only consist of:
    a. Waste assessment areas that were harvested using conventional methods, or
    b. Waste assessment areas that were harvested using a helicopter.

6.3.2 Large Populations

The sample plan and population must consist of waste assessment areas where the ready for survey dates are, or will be, within 12 months of each other.

For example:

1. January 1 and December 31, or
2. September 1 of the preceding year and August 30 of the following year.

6.3.3 Population Format

In addition to the population structure requirements listed above, the following criteria are used to create small and large sample populations:

1. A single or partial cutblock within any licence,
    a. The decision to include a partial cutblock within a population should be based on factors such as post-harvest treatments (hazard abatement) and reforestation requirements, location, and cutblock size,
2. One or more cutblock(s), or partial cutblock(s) within an area-based tenure (TFL, FNWL, etc.),
3. One or more cutblock(s), or partial cutblock(s) within a Timber Sale Licence, or

4. One or more cutblock(s), or partial cutblock(s) held by one or more licensees that are all within the same Timber Supply Area where the population does not contain any cutblocks from a Timber Sale Licence, and:
    a. All licences within the population are held by the same company (client code), or
    b. A population is comprised of two or more licensees (client codes) and an agreement has been made between the licensees accepting the waste sampling results within the population for each licence. This agreement must be included as an attachment in each waste submission entry in the Waste System. Each licensee will need a separate RU for reporting purposes in the Waste System.

Examples of Populations:

1. A Tree Farm Licence containing one or more waste assessment areas.
2. One or more Forest Licences held by the same licensee containing more than one waste assessment area in the same TSA.
3. One or more Forest Licences held by multiple licensees containing more than one waste assessment area in the same TSA (agreement required).
4. A Timber Sale Licence.
5. A First Nation Woodland Licence containing one or more waste assessment areas.

6.4 Stratification

Stratification can increase the precision of population volume estimates and reduce the amount of sampling required to achieve a desired level of precision. Therefore, it is useful to stratify subpopulations where possible and practical.

In waste assessments, stratification should be limited to significant differences in the relative quantity of waste. Unique strata must be easily and consistently identifiable and must be estimated in the same manner throughout the population. All stratification decisions must occur prior to field sampling and be identified on the waste assessment area survey map.

All strata within a waste assessment area must be reported in the survey submission. The correct and consistent coding of these strata is a key driver in the compilation of the survey information.

Each stratum must be assigned one of the three subpopulation types listed below and requires the minimum number of samples required for that strata type. Each subpopulation must be sampled independently of other subpopulation areas.

Any stratification of waste types must be supported with field notes and a map and must be consistently applied within each waste assessment area of the population.

6.4.1 Subpopulations

Three subpopulations exist: accumulated, dispersed, and standing trees. Each subpopulation may be subdivided into one or more strata.

Subpopulations and strata are and are always sampled independently of each other.

6.4.1.1 Dispersed

Dispersed waste occurs on the areas from which trees or logs have been cut or removed and is scattered throughout the waste assessment area. The majority of area in a waste survey will be in this stratum.

6.4.1.2 Accumulations

Accumulated waste occurs at landings, along roadsides, and at other areas in a waste assessment area where waste material has been piled (accumulated) by a machine. Accumulated strata can include spot accumulations, roadside accumulations from yarding, windrows, and cold decks.

The key identifying feature of accumulated strata is the waste material is gathered onto a small area creating a condensed pile of waste material.

Accumulation strata must not be confused with areas of high waste volume in the dispersed stratum.

6.4.1.3 Standing Trees

Standing trees are trees authorized for harvest under the cutting authority (excepting reserved trees) but at the discretion of the licence holder, are not cut and removed.

Individual standing trees that are found at different locations of the waste assessment area must be stratified, measured, and scaled individually. Standing tree patches must be delineated separately from the dispersed to form their own subpopulation and the volumes determined with methods outlined under section 9.5.2.

6.5 Sample Size and Number of Plots

The sample size (number of sample waste assessment areas or sample plots within a waste assessment area) is based on the sampling system to be used for the population or size of the sample waste assessment area.

The number of sample plots required within each waste assessment area is dependent on the sampling design (single waste assessment area, aggregate or large population plans).

To determine the number of plots within a sample plan:

1. For small population sampling plans, either:
    a. For single waste assessment area populations, use Appendix 4, or
    b. For aggregate populations, use the Aggregate Sample Plan to calculate the required number of dispersed, roadside, or spot accumulation plots for the sample population.
        i. The Aggregate Sample Plan is available on the Timber Pricing Branch website.
2. For large population sampling plans:
    a. Use Table 6-1 and Table 6-2 to determine the required number of waste assessment areas to be sampled and the number of plots for all strata.

Table 6-1 Minimum Sampling Requirements for Large Populations

Sampling Design	Minimum Waste Assessment Areas to be Sampled	Minimum Number of Plots per Waste Assessment Area					
		Dispersed		Spot Accumulation		Other Accumulation Strata	
		Predict	Measure	Predict	Measure	Predict	Measure
Ratio/Ratio or Ratio / SRS	**20, 25, 30***	18	6	12	4	12	4
SRS/Ratio or SRS/ SRS		0	12	0	10	0	10

* The minimum number of samples are determined using Table 6-2.

Table 6-2 Minimum Sample Waste Assessment Area Requirements for Large Populations

Population Size (Waste Assessment Areas)	Minimum Number of Waste Assessment Areas to be Sampled
20 - 100	20
101 - 150	25
151 +	30

6.6 Amendments

The objective of a sample design is to identify a population to be sampled. Changes to a plan can significantly impact the sample size and the number of plots required. Changes to a small population sample plan or to the waste assessment areas selected to be sampled in a large population sample plan should only be undertaken to affect unforeseen issues that affect good forest management or other operational issues (i.e. a wildfire burns a cutblock).

The submitting forest professional recognizes that changes to a plan, such as the addition or removal of a waste assessment area or a significant change in area will significantly alter the sample plan requirements. The forest professional will assess the impact of the changes against the principles of sampling identified in these standards.

Upon request the submitting forest professional will submit a rationale for any changes to a sample plan. This model is consistent with the direction of professional reliance.

For guidance on how to prepare a professional rationale, please refer to the document *Guidance for Professional Quality Rationales and Commitments* published by and available on the Association of BC Forest Professionals website.

The District Manager will make a determination on each change on a case by case basis and decide if the change meets the intent of the sampling principles within this manual.

6.7 Implementation

6.7.1 Single Waste Assessment Area Sample Plans

1. Identify the sample population,
2. Select a sampling design,
3. Determine the sample size, including:
    a. The number of plots in dispersed strata
    b. The number of accumulation samples,
4. Prepare the waste assessment area survey map,
5. The waste assessment area survey map is signed by a Forest Professional, and
6. Submit the waste assessment area survey map.

6.7.2 Aggregate Sample Plans

1. Identify the sample population,
2. Select a sampling design,
3. Using the Aggregate Sample Plan, determine the sample size:
    a. Number of plots in dispersed strata
    b. Number of other samples as required
    c. The plots are located within the waste assessment areas proportional to their weighted size within the population and are allocated using a random starting point
    d. The assigned plot numbers on the Aggregate Sample Plan in each waste assessment area must be used to label the plots on the survey map and to record the plots in EForwasteBC exactly,
4. The sample plan is signed by a Forest Professional,
5. Prepare waste assessment area survey maps,
6. Submit the sample plan and waste assessment area survey maps, and
7. Once the Aggregate Sample Plan is submitted, no variation is allowed.

6.7.3 Large Population Sample Plans

Sample plans for large populations must be developed using the HRC system.

Until further notice, large population sampling designs are not available for inclusion in any sample plan development.

To create a large population sample plan:

1. Identify the population to be sampled. The population is comprised of waste assessment areas that are expected to be harvested and sampled within the applicable sampling year (as per section 6.3.2).
    a. The sample plan can contain waste assessment areas where the harvest status is:
        i. **Complete**: primary harvesting operations are completed and ready for survey status has been achieved,
        ii. **Active**: harvesting operations have commenced, and the waste assessment area has not achieved ready for survey status, or
        iii. **Not started**: cutblocks that are planned for harvest completion within the sampling year; however, harvesting operations have not started.
2. Decide on a sampling design (Ratio/Ratio, SRS/Ratio, Ratio/SRS, SRS/SRS) for the population.
3. In HRC, create a sample plan and enter the sample population attributes.
4. Update the sample plan as per section 6.7.3.2.
5. Use HRC to determine the sample waste assessment areas from the population by creating a batch.
6. Confirm the sampling design (Ratio/Ratio, SRS/Ratio, Ratio/SRS, SRS/SRS) in HRC.
7. Confirm or update the sample size (the number of waste assessment areas in the population to be sampled). HRC will default to the minimum sample size. Users can increase it if desired.
8. The sample plan is signed by a Forest Professional in HRC.
9. Users can view the sample plan or create the sample plan report. On the sample plan report, adjust the number of plots in the strata if required.
10. Update the sample plan as needed.
11. Create subsequent batches until all waste assessment areas within the sample plan have been included in a batch.

6.7.3.1 Batch Selection Principles

A sample of waste assessment areas are selected from the population for measurement when a batch is created. Sorting the waste assessment areas in the population by common criteria prior to selecting samples helps to ensure that the sample represents the population.

Sample batches are created from the waste assessment areas where harvesting is complete and ready for survey status has been reached. A sample batch can be created when there are enough waste assessment areas to result in a minimum sample size of five.

The remaining (active or not complete) waste assessment areas are retained in the system for subsequent batches.

Once the first batch has been created, HRC will display the minimum batch size required for subsequent batches to result in a sample size of five. If the minimum sample size is not achieved, and there are enough waste assessment areas in the population to meet the minimum batch size requirement, a batch will not be created until there are enough waste assessment areas in completed status.

Once the number of completed waste assessment areas in a batch cannot meet the minimum batch size requirement, HRC will randomly select waste assessment areas using the Bernoulli selection process.

Example:
A sample plan contains 204 waste assessment areas and 30 will be sampled.

Batch 1 is created with 160 waste assessment areas in completed status.

The sample size for batch 1 will equal 30 (160/204) = 23.5 (rounds to 24 samples).

The sampling frequency is calculated by dividing the number of waste assessment areas in completed status (160) by the number of samples in batch one. Sampling frequency is always rounded down.

Sampling frequency = 160 / 23.5 = 6.8, rounds down to 6.

The minimum batch size required to result in 5 waste assessment areas to sample in subsequent batches is calculated using the sampling frequency (6) * minimum sample size (5) = 30
Therefore, new batches cannot be created until a minimum of 30 waste assessment areas are in a status of complete.

At such time as a batch cannot result in the minimum sample size of 5, the Bernoulli selection process is used.

6.7.3.2 Sample Plan Updates and Amendments

Throughout the sampling year, cutblock scheduling and harvest completion will change. Sample plans must be updated throughout the sampling year to record changes within the population and enable batch creation.

New waste assessment areas may be added to the sample population by adding them to the sample plan as they become available. The number of blocks added cannot increase the population so that more samples (i.e. the number of waste assessment areas to be sampled) would be required.

Cutblocks that will not be harvested or do not achieve ready for survey status during the current sampling year can be deleted from the sample population at any time; however, the number of waste assessment areas to be sampled must still be achieved.

Deleting waste assessment areas selected for sampling, or the submission and compilation of sample plans that do not meet the minimum sample size requirements may only be done in circumstances beyond the control of the licensee (i.e. wildfire, landslide, etc.). In these cases, a rationale prepared by a forest professional must be submitted to the Natural Resource District as per section 6.6. Approval by the District Manager is required prior to removal of a sample waste assessment area.

6.8 Waste Assessment Area Survey Map

Once an initial sample plan is complete, a waste assessment area survey map must be created.

The initial waste assessment area survey map is not required to be approved by the District Manager.

6.8.1 Waste Assessment Area Survey Map Requirements

The maps used in a waste survey must accurately reflect the post-harvest condition of a cutblock including the location and shape of areas of unharvested standing timber, and reserved timber, whether grouped or dispersed.

A waste assessment area survey plan map must show the cutblock boundaries, roads, the point of commencement, strip and plot locations, stratum types and locations, and any other areas that are excluded from waste estimations.

The waste assessment area survey plan map is required as part of a complete waste submission. The cartographic standards used by the Ministry of Forests, Lands and Natural Resource Operations are mandatory. Maps drawn digitally must be produced using geographic information system (GIS) software (i.e. ArcGIS).

The waste assessment area survey plan map must:

1. Be legible and of good quality 1:5,000 scale,
    a. Note: a 1:10:000 scale map may be accepted at the discretion of the District; however, it will be rejected if the required items cannot be mapped legibly due to the scale,
2. Provide neat and clean lines, lettering and numbers,
3. Reflect the post-harvest conditions of the cutblock, and
4. Include the items indicated in Table 6-3.

Only one waste assessment area survey map may be submitted for each waste assessment area and it must align with the submitted sample plan.

After the field survey is completed, the final waste assessment area survey plan map must be submitted with the waste submission.

Accumulations, standing trees not harvested, and areas subject to 100 percent measurement or estimation must be clearly indicated on the final waste assessment area maps. In situations where there are a significant number of piles and they cannot be mapped neatly, individual pile locations do not need to be shown; however, the pile plot locations must be identified on the final map.

Table 6-3 Waste Assessment Area Survey Plan Map and Final Waste Submission Map Requirements

Requirements	**Waste Assessment Area Survey Plan Map**	**Final Waste Submission**
Tenure, CP, timber mark areas	Yes	Yes
Forest Region and District	Yes	Yes
Cutblock identifier	Yes	Yes
Map scale	Yes	Yes
Harvest boundary (with verifiable reference points such as falling corners)	Yes	Yes
Non-harvest areas (non-productive etc.)	Yes	Yes
Biogeoclimatic zone(s) (Interior)	Yes	Yes
North arrow, declination, map base	Yes	Yes
Cutblock maturity (where applicable)	Yes	Yes
Roads and other NP areas	Yes	Yes
Areas of reserved timber and zones of partial cutting (when identified in a cutting authority and appraisal)	Yes	Yes
Areas of high stump exemptions	Yes	Yes
Strata type lines and identifier	If known	Yes
Waste assessment area and strata net areas	If known	Yes
POC, local grid, baseline, and plot locations	Yes	Yes
Strip line direction of travel	No	Yes
Contour lines - clearly legible	Yes	Yes
Physiographic features	Only if they affect sampling	Only if they affect sampling
Reporting unit number	If known	Yes
Surveyor name(s)	If known	Yes
Sampling design	Yes	Yes

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7. Waste Area Determination

7.1 Principles

The determination of the area to be surveyed is an important component in obtaining the correct waste volume per hectare, the waste assessment area volume, and waste billing.

The waste survey planner must develop waste assessment area survey maps and conduct area calculations to determine accurate areas for waste reporting.

A cutblock can contain areas of reserved timber, non-productive areas (roads), merchantable timber areas (standing timber), and areas outside of the appraised cutblock boundaries (i.e. external landings) that contain waste from the waste assessment area to be sampled.

The area used to calculate waste volumes is the total area of a waste assessment area that was authorized to remove timber and/or will contain waste material from the waste assessment area.

1. The net waste area is calculated as follows:
    a. Determine the gross harvested area
    b. Subtract any mapped retention from the waste assessment area's gross area
    c. Add the sum of the area associated with external roads and/or any external landings to the figure determined in step ii
    d. Subtract the area of all non-productive areas (i.e. built road surface) from the figure determined in step iii.
2. The net waste area reported into the Waste System does not need to and usually will not reconcile with the cutblock net area in other reporting systems i.e. RESULTS, FTA etc.
3. Waste assessment area net areas are increased by adding external areas containing waste volumes attributable to the cutblock (i.e. external landings or road permit areas outside of the cutblock).
4. Road permit areas outside of the cutblock are only added into the net waste area if they contained merchantable timber. Road sections that did not contain merchantable timber are not added to the net waste area.
5. The net waste area will form the area that the surveyed average waste volume per hectare is applied to.
6. Non-timbered and reserve areas where timber is not cut or removed are excluded from the net waste area (i.e. WTRA).
7. Partial cut, machine free, riparian management zones etc. within the external boundaries of the waste assessment area are assessed for waste material.
8. The combined sum of all sub-strata areas within a waste assessment area must equal the net waste area.

7.2 Net Waste Assessment Area Calculation Method

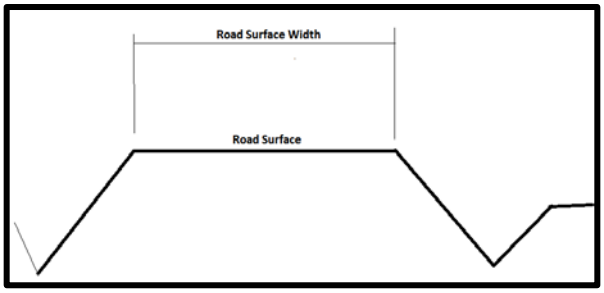
1. Identify the gross area of the waste assessment area. Use the cruise information from the ECommerce Appraisal System (ECAS) submission if it is available.
    a. Subtract any mapped reserves or retention, and
    b. Calculate the net harvestable area including any areas deducted from the waste assessment area for road permitted road construction.
2. Add in external areas to the area determined in step 1 above, including:
    a. Off-site landings
    b. External road right of way
3. Determine the area of non-productive (NP) areas (i.e. roads, landings, or other features). NP areas that do not contain any waste material are removed from the waste assessment area and are not sampled.

    To calculate the NP area of roads for waste area calculations, the road surface area is the same as the road running surface area (as shown in the Figure below); it does not include ditches and fill slopes.

    To determine the road NP area:

    a. Measure the road width (running track of the road) at various locations within the waste assessment area and calculate the average
    b. Determine the length in metres of the constructed roads
    c. Multiply the road length by the width to determine the net road surface area.
    d. Enter the NP area into the Waste System on the Waste102 page under Roads (NP/NF).

Figure 1 Road Prism Diagram



4. Calculate the area of other features:
    a. Identify other areas within the gross area that do not contain any waste material (i.e. WTRA),
    b. Determine the external dimensions of the NP area in a manner similar to roads and calculate the area in hectares,
    c. All areas of a similar type must be identified within a waste assessment area, and
    d. Areas must be greater than 0.01ha to be recorded.
5. Subtract non-productive (NP) waste areas from the area determined in step 2.

Refer to Appendix 6 for an example of a net waste area calculation.

7.3 Strata and Road Right of Way Areas

7.3.1 Strata Areas

Strata are defined as unique areas within the net waste assessment area that contain similar waste characteristics (volume per hectare, species, grade, etc.). The net waste area is segregated into unique stratum areas and the total of the stratum areas must equal the net waste assessment area.

An accurate area calculation is required for each stratum and all the plots attributed to a stratum must fall within its boundaries (i.e. stratification cannot be done on a plot by plot basis).

Minimum plot requirements must be met within each unique stratum.

7.3.2 Road Right of Way Areas

Where a cutting authority is accessed by a scale based road permit, road permit segments external to, or contained within the cutting authority must be reported into the Waste System:

1. In a scale based cutting authority, report the road permit area as per section 7.4.1, or
2. In a cruise based cutting authority, report the road permit area using the applicable licence number and road permit timber mark.

The area of road right of way leading into the waste assessment area must be included in the net area of the waste assessment area unless the waste volume has been included in a previous waste survey.

External road right of way to be included in a waste assessment includes all access roads leading into the cutblock from the closest previously logged cutblock or the preceding road junction.

The area of the right of way is calculated by multiplying the road length by the right of way width. The right of way width is measured between the harvested right of way boundaries (from each clearing edge containing standing timber). The net area is the right of way width minus the road surface (NP) area.

Where the road has been debuilt and waste material is located on the road surface area, the road surface is not removed from the area calculation.

7.4 Multiple Timber Mark Waste Assessment Areas

Most waste assessment areas contain cutting permit and road permit marks. Where this situation occurs, each timber mark within the waste assessment area must be reported together into the Waste System.

Licensees must ensure the waste reported on the road rights of way is attributed to the correct timber mark or road permit mark as applicable.

The sum of all the mark areas must equal the net area of the waste assessment area entered on the Waste 102 – Block Details screen.

The waste volume for each timber mark is calculated by applying the waste assessment area average waste volume (m^3/ha) and grade breakdown to each mark.

7.4.1 Waste Assessment Areas Containing Road Permit Area

In the Waste System, the cutblock and road permit timber marks are submitted within a waste assessment area submission using the Waste 104 – Multiple Timber Marks screen.

In the Waste 104 – Multiple Timber Marks screen, enter the road permit timber mark that corresponds with the waste assessment area, along with the timber mark for the waste assessment area.

7.4.2 Cutblock Authorized Under Two or More Tenures

Where a cutblock is authorized under two or more tenures (i.e. Timber Licence, Tree Farm Licence), the waste assessment area is surveyed and reported in one waste submission.

In the Waste 104 – Multiple Timber Marks screen, enter the timber mark that corresponds with each tenure, along with each individual mark area.

8. Waste Assessment Area Planning and Plot Layout

8.1 The Plot Sampling Process

The planning and implementation of plot sampling surveys involves either a single waste assessment area, a group of waste assessment areas within an aggregate, or a group of sample waste assessment areas within a large population sample plan. The following steps are required to complete a waste assessment.

Prepare the waste assessment area sample plan

↓

Determine the number of plots required for each stratum within the population

↓

Obtain the appropriate SPIF for each waste assessment area

↓

Determine the plot grid spacing within the waste assessment areas

↓

Prepare and submit the waste assessment area survey map

↓

Collect data from the sample in the field

↓

Compile the survey results

↓

Review and submit the data into the Waste System

8.2 Sampling Method

There are three assessment methods: Plot (P), 100% Measure (S), and Estimate Percent (E).

In all waste populations where plots are established, the waste volume in the dispersed and accumulation subpopulations is calculated based on fixed-area sample plots laid out systematically.

The fixed-area plots are established in a systematic, staggered grid pattern in dispersed types. In roadside accumulations, the plot spacing depends on the average width of the accumulation. The grid spacing will also depend on the net area and number of plots determined for the subpopulation.

For the estimated or 100 percent piece scale subpopulations, waste volumes are either estimated or 100 percent measured for each specified stratum.

8.3 The Right-Hand Rule

The right-hand rule is an unbiased selection procedure where an action or a direction of travel is chosen by selecting the first option available from the right-hand side or direction.

The right-hand rule is used when determining accumulation (roadside stratum) plot location for a waste assessment area survey map or when counting spot accumulations in the field.

8.4 Dispersed Strata Plot Layout

8.4.1 Plot Spacing (Grid Size)

Once the number of plots within each waste assessment area or population (aggregate or large populations) has been determined, the inter-plot spacing (grid spacing) must be determined. The grid spacing is calculated by taking the square root of (10 000 * area (ha) / # of plots).

The grid spacing calculation will generate a result to within one metre or less. This value should be used if the survey plan is generated using GIS software. If the survey plan will be produced by hand, the calculated grid spacing value must be rounded to the nearest 5 metre value (the smallest measurable measurement at 1: 5,000 scale).

If necessary when drawing the waste survey plan, after the grid spacing value is calculated, the grid spacing can be reduced or increased to generate the required number of plots within the waste assessment area.

Example: 30 plots required in a 122.0 ha waste assessment area will generate a GSD of 201.7m (202m)

- For survey plans drawn using GIS, use a 202m GSD
- For survey plans drawn by hand, use a 200m GSD
    - If the 200m GSD generates less than 29 plots, reduce the GSD to 190m
    - If the 200m GSD generates more than 31 plots, increase the GSD to 210m

Appendix 5 contains an example of a Grid Spacing Worksheet.

8.4.2 Plot Location

The steps required to locate dispersed plots on the waste assessment area survey map are as follows:

1. Compute the grid spacing distance (GSD) using the grid spacing worksheet or the procedure described in section 8.4.1.
2. Establish a local grid on the waste assessment area using the following procedure:
    a. Project a line due south from the most western point of the net merchantable area, and
    b. Project a second line due west from the most southern point of the net merchantable area for the cutblock. This line is the baseline.
3. Obtain the Starting Point Interval Factor (SPIF) from the Timber Pricing Branch website for the ready for survey month. The SPIF multiplied by the GSD will determine the horizontal distance from the point of intersection of the local grid to the initial strip (IS) location.

4. Starting at the point of intersection of the local grid, locate the IS at the SPIF distance. The IS must be oriented North/South.
5. Locate all remaining strips at the full GSD along the baseline from the IS and orient them North/South.
6. Number the strips:
    a. Sequentially from West to East.
    b. All strips that fall within the harvested area must be numbered.
7. Locating the plots:
    a. All plot locations that fall within the harvested area must be mapped.
    b. On odd numbered strips, locate the first two plots at one half the GSD along the strip in both directions from the baseline. Locate the remaining plots at full GSD along the strip.
    c. On even numbered strips, locate one plot at the intersection of the strip and the baseline, and all remaining plots at full GSD along the strip.

    Occasionally the number of located plots on the map will not match the intended number of plots. This can be caused by two situations:

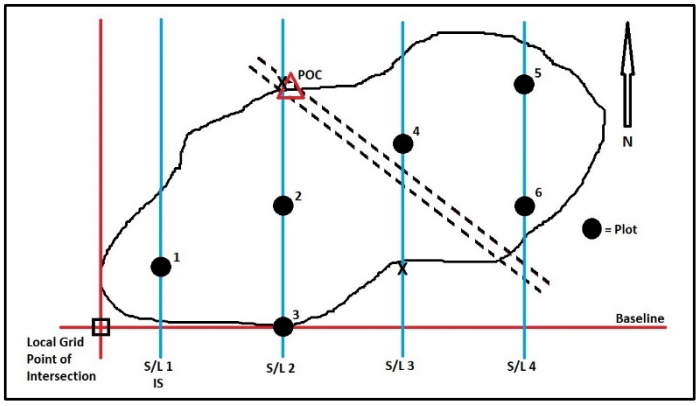
        i. The sample grid was not completed correctly (incorrect GSD, missed plot location, etc.), or
        ii. The configuration of the cutblock results in a reduced or increased number of sample points.
8. Adjust the GSD when:
    a. In a single waste assessment area or large population sample cutblock, the number of plots is greater than plus or minus 1 plot from the intended number, or
    b. In aggregate populations, the located number of plots does not match the intended number from the sample plan.

    For survey plans drawn by hand, the grid is reduced or increased in 10 metre increments.

    For survey plans drawn using GIS, use the first grid spacing that will result in the required number of plots.
9. Number the plots. Each plot in the dispersed stratum must have a unique number identified on the survey plan map.
    a. Starting from strip 1, number the plots sequentially from north to south along each strip.

Figure 2 provides an example of the dispersed plot design.

Figure 2 Example Strip and Plot Placement Using a 50% SPIF

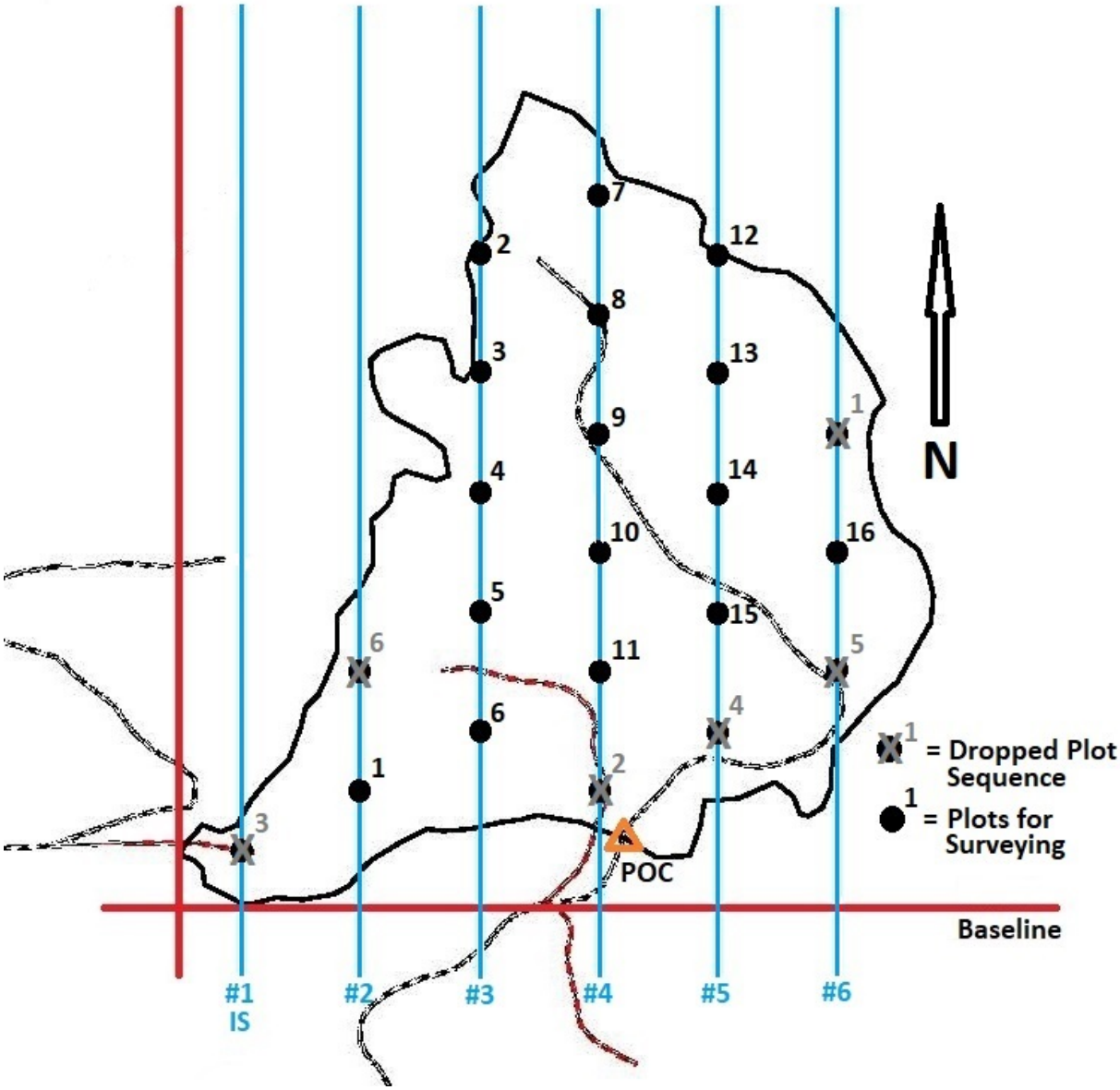


8.4.3 Aggregate Plot Allocation

When, after adjusting the GSD, the exact number of plots listed on the Aggregate Sample Plan cannot be located on the survey map:

1. Adjust the GSD interval in ten (10) metre increments until the number of plots is greater than the number of plots required, and
2. Apply the following rules in order to reduce the number of plots until the desired number of plots is achieved. If a plot is not available to drop using a step below, proceed to the next step.
    a. The first dropped plot will be the most northern plot on the most easterly strip line.
    b. The second dropped plot will be the most southern plot closest to the point of intersection of the local grid (on any strip line).
    c. The third dropped plot will be the most southern plot on the most westerly strip line.
    d. The fourth dropped plot will be the most northern plot closest to the point of intersection (on any strip line).
    e. The fifth dropped plot will be the most southern plot on the most easterly strip line.
    f. The sixth dropped plot will be the most northern plot on the most westerly strip line.
    g. If, after following the above procedures, there are still too many plots in the dispersed stratum then complete steps 1 through 6 again to determine further dropped plots until the desired number of plots is achieved.

Figure 3 Example of Aggregate Plot Allocation Process



8.5 Spot Accumulation Stratification and Plot Layout

8.5.1 Stratification

Spot accumulations (piles) may exist throughout a waste assessment area. The options to stratify spot accumulations are:

1. Stratify all spot accumulations within a waste assessment area as one stratum (section 8.5.1.1), or
2. Stratify the roadside spot accumulations as one stratum (8.5.1.2), or
3. Stratify roadside spot accumulations and dispersed spot accumulations as two separate strata (8.5.1.2 and 8.5.1.3).

8.5.1.1 Spot Accumulations Within a Waste Assessment Area

If all the spot accumulations within a waste assessment area are to be sampled as one stratum, the spot accumulations must be identified as a unique stratum and are defined using the following criteria:

1. The piles are located anywhere within the waste assessment area,
2. All piles within the waste assessment area are counted,
3. The piles are sampled separately from the dispersed and roadside strata, and
4. The area of the spot accumulations must be removed from the dispersed and roadside strata areas.

8.5.1.2 Roadside Spot Accumulations

If the roadside spot accumulations within a waste assessment area are to be sampled as one stratum, the roadside spot accumulations must be identified as a unique stratum and are defined using the following criteria:

1. The piles are located either:
    a. In the roadside stratum of the waste assessment area, or
    b. Less than or equal to 20 metres from the road edges.
2. The roadside piles must be sampled separately from the dispersed or roadside strata.
3. If a roadside stratum is established, roadside pile accumulations must be excluded from all roadside plots. The space intervals between spot accumulations must be treated as part of the roadside stratum.
4. If a roadside stratum is included in the waste assessment area, the area of the spot accumulations must be removed from the roadside stratum area.

8.5.1.3 Dispersed Spot Accumulations

Dispersed spot accumulations may be identified as a unique stratum and are defined using the following criteria:

1. The piles are located in the dispersed stratum of the waste assessment area.
2. All piles within the dispersed portion of the waste assessment area sample plan are counted.
3. The piles are sampled separately from the dispersed and roadside spot accumulation strata.
4. The area of the spot accumulations must be removed from the dispersed stratum area.

If the dispersed spot accumulations are not stratified as a unique stratum, any spot accumulations landing within a dispersed plot must be sampled and included in the dispersed population volume.

8.5.2 Sampling Dispersed Spot Accumulations

Dispersed spot accumulations found within a waste assessment area may be surveyed in one of two different ways – as part of the dispersed stratum or as a unique spot accumulation stratum.

1. Spot accumulations in the dispersed stratum, when not stratified are surveyed as part of the dispersed subpopulation. Dispersed stratum plots:
    a. Must include any piles or portions of piles contained within the plot boundary,
    b. Cannot be moved or altered to exclude piles or portions of piles,
    c. All accessible pieces that fall within the plot will be measured and recorded,
    d. A measure factor will be applied to account for inaccessible pieces.
2. If spot accumulations in the dispersed stratum are stratified, they are surveyed separately from the dispersed stratum:
    a. Dispersed plot centers must be offset away from all pile accumulations,
    b. The procedures in section 9.2.6 are used as required to avoid overlapping a spot accumulation stratum, and
    c. Dispersed plots must retain a 200 m^2 size.

8.5.3 Numbering Procedures

The selection of sample piles must be completed in a systematic and random manner. Pile numbers must be either marked on a minimum of 1 out of every 10 piles or in a method that provides for replication of sampling procedures for auditing purposes.

The numbering and selection of roadside sample piles utilizes the right-hand rule and must be completed using the one-sided method:

1. Starting at the POC (where the road enters the waste assessment area), number piles sequentially on the right-hand side of all roads.
2. Always stay to the right-hand side of the road in the direction of travel when numbering the piles. When coming to a branch or spur, go up the spur on the right-hand side. At the end of the spur, turn around and come down on the right-hand side.

For piles that are stratified out under section 8.5.2(2) within the dispersed stratum, all piles must be identified and numbered sequentially throughout the waste assessment area.

In aggregate populations:

1. Pile numbering must restart at one (1) in each waste assessment area in the population, and
2. The pile plot numbers assigned must be established within the corresponding cutblocks exactly as they appear on the Aggregate Sample Plan.

8.5.4 Sampling Method and Procedures

For waste assessment areas that use simple random sampling (single waste assessment area SRS, aggregate SRS, SRS/Ratio or SRS/SRS sampling designs):

1. Count all piles and label them using the procedure outlined above,
2. Determine the number of samples required,
3. Identify the sample piles to be measured, and
4. Measure the required pile attributes for the selected samples.

For waste assessment areas that use ratio adjustment sampling (single waste assessment area ratio, aggregate ratio, Ratio/Ratio or Ratio/SRS sampling designs):

1. Count all piles and label them using the procedure outlined above,
2. Determine the number of prediction and measure samples required,
    a. Identify the sample piles to be predicted and measured
3. Complete predictions, and
4. Measure the required pile attributes for the randomly selected samples.

In large populations, the procedures listed above only apply to the waste assessment areas that are selected to be sampled.

For aggregate populations, piles may be estimated or counted when completing the sample plan for the population. To estimate the number of piles, the Aggregate Sample Plan will multiply the waste assessment area's net area by a factor of 1 pile per 0.9 hectare to obtain the estimate.

8.5.4.1 Sample Selection Process

To select the piles to be sampled:

1. Calculate the sample pile interval. To do this:
    a. Divide the number of piles by the planned number of samples.
    b. Round the result to the nearest whole number.

    Note: This will occasionally result in more samples than intended.

        i. In a single waste assessment area or large population, establish the extra plot.
        ii. In an aggregate, only establish the required number of plots as specified on the Aggregate Sample Plan.
2. Use the date of the month when the surveyor first arrives on site to do the survey to select the first pile to be sampled. Where the date is greater than the number of piles, use the last digit of the date. If the last digit of the date is zero, use the first number of the date.

Example 1:

- 36 piles requiring 15 samples, surveyed on the 23rd of the month
- 36 piles / 15 samples = 2.40; survey every 2nd pile
- Select the following piles: 23, 25, 27, 29, 31, 33, 35, 1, 3, 5, 7, 9, 11, 13, 15

Example 2:

- 25 piles requiring 13 samples, surveyed on the 30th
- 25 piles / 13 samples = 1.92; survey every 2nd pile
- Select the following piles: 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 2

8.5.4.2 Plot Location Procedure

In spot accumulation strata, the plot is placed on the front for even numbered piles, and on the back for odd. If it is not safe to work around the correct plot location, establish the plot on the side of the pile closest to the POC for odd numbered plots and farthest away from the POC for even numbered plots.

The plot size and shape to be used for pile plots is 50 m^2. When a rectangular (or other shape as necessitated by the shape of the pile) is used, the plot edges must be painted and clearly marked in the field using stakes or ribbon.

8.6 External Road Right of Way and Roadside Strata Plot Layout

8.6.1 Road Right of Way External to a Cutblock

Road rights of way containing merchantable timber must be reported in the Waste System.

8.6.1.1 Procedures

There are three options to account for external road right of way:

1. No plot sampling is required
    a. Include the area of the road right of way area with the dispersed subpopulation area of the waste assessment area, or
2. Sample with plots (50 m^2) in a separate roadside stratum
    a. Use the stratum code of OT0X, or
3. When a scale based road permit accesses a cruise based cutting authority:
    a. Sample with plots (50 m2), or
    b. Use the right of way survey information from another surveyed road permit area containing similar species composition and waste levels, or
    c. Use the procedures in section 4.3.2 for determining waste.
    Note: the external road right of way may be greater than 2.0 ha.

8.6.1.2 Plot Location Procedure

Right of way sampling is completed using rectangular 50 m^2 plots. Starting from the POC (where the road enters the waste assessment area), locate the plots covering the width of the area between the edge of the road and the edge of the timber using the right-hand rule.

1. Determine the GSD between the plots. This is calculated by dividing the right of way length by the number of plots that are required.
2. Apply the SPIF to the GSD for the first plot.

To establish plots, follow the procedures below for roadside plot establishment.

8.6.2 Roadside Stratum Within a Waste Assessment Area

The roadside stratum is the area adjacent to a road and typically contains roadside piles and cold decks. If decision is made to stratify out a roadside stratum, then the roadside stratum must be isolated from other strata found within it by removing the area of piles and cold decks. Roadside strata can contain heavier or lighter waste volume than the dispersed area.

A roadside stratum should only be identified where there is clear evidence of a difference in volume per hectare and the strata edges can be consistently identified across the population. If this cannot be determined, then the area should remain within the dispersed stratum.

This area is calculated by measuring the length, along the road of one-sided strata (occurs when a roadside stratum only exists on one side of the road) and/or two-sided strata (occurs when a roadside stratum that exists on both sides of the road). The length is multiplied by an average width for the strata (usually, but not restricted to 15 m). The number of plots required is based on the sample design and accumulation strata requirements in Chapter 5.

The plot location procedure is identified in the table below.

Table 8-1 Roadside Stratum Plot Location Procedure

<table>
<tr><th>One-sided or a mixture of one and two-sided strata</th><th>Two-sided strata</th></tr>
<tr><td>1. Start from the POC.
2. Measure the length of the one-sided strata and the length of the two-sided strata
3. Multiply the two-sided strata length by two.
4. Add the one-sided and two-sided strata together.</td><td>1. Start from the POC.
2. Measure the length of the strata and multiply it by two.
3. Determine width of roadside stratum.
4. Go to step 5</td></tr>
<tr><td colspan="2">5. Calculate the area of the stratum as follows:
Area (ha) = (length x width) / 10,000.
6. Look up the number of plots required.
7. Calculate the grid spacing distance (GSD) as follows:
Grid Spacing = length / number of plots required.</td></tr>
<tr><td>Example:
• Total length of one-sided strata= 1500 m
• Total length of two-sided strata= 750 m x 2 = 1500 m
• 1500 m + 1500 m = 3000 m
• Area= 3000 m x 15 m= 4.5 ha (10 plots in SRSB sample population)
• Grid Spacing Distance= 3000 /10=300 m</td><td>Example:
• Total length of roadside strata= 3000 m x 2 = 6000 m
• Width of roadside accumulation= 30 m (average 15 m on each side of the road)
• Area = 6000 m x 15 m=9 ha (10 plots in SRSB sample population)
• Grid Spacing Distance= 6000 / 10 = 600 m</td></tr>
</table>

8.6.2.1 Plot Layout

1. Start from the POC and follow the right-hand rule.
2. Using the SPIF, establish the first plot at the GSD times the SPIF.
3. For one-sided or a mixture of one and two-sided strata, locate a 50 m^2 plot on the right side of the road. For two-sided strata, locate a 50 m^2 plot on each side of the road.
4. If the stratum is sectioned along the road, stop measuring distance at the end of each strata section and resume measuring at the beginning of the next strata section until each GSD is located.
5. Always stay to the right-hand side of the road in the direction of travel when laying out the plots. When coming to a spur, go up the spur on the right-hand side. At the end of the spur, turn around and come down on the right-hand side.
6. For two sided strata when an odd number of plots are required, establish the last plot on one side of the road. If the last digit of the cutting permit is odd, establish it on the right-hand side. If the last digit of the cutting permit is even, establish it on the left-hand side.
7. Number the plots starting from the POC using the right-hand rule.
8. Roadside strata must be marked on the waste survey map so the layout can be audited.

8.6.2.2 Establishing Plots

Plots located within a roadside stratum must be located in an unbiased and random manner. Plots must be located in such a way that all areas of the stratum are available for and have an equal probability of sampling.

In the field, plot centers are located alternately at 4 m for even numbered plots and 11 m for odd numbered plots from the road surface edge when a 15 metre wide roadside stratum is used. Either circular or rectangular plots are acceptable in these circumstances. If a different stratum width is used, the surveyor must ensure the plots cover the entire stratum width and may use a rectangular 50 m^2 plot where needed.

8.6.2.3 Variable or Fixed Roadside Strata Greater than 15 Metres Wide

For fixed width roadside stratums that are over 15 m wide, 50 m^2 rectangular plots must be used. Each plot must cover half the width of the stratum by the distance required to make the plot size. The plots will be staggered with the odd number plots covering the outside half of the stratum and the even number of plots covering the inside half (i.e. for a 20 m wide stratum each plot would be 10 m wide by 5 m long).

For varying width stratums, map the width of the stratum every 25 m along the road. Rectangular plots (which cover the entire width of the stratum where the plot is located) must be used.

8.7 Strip Accumulations

If the roadside accumulations consist of strips (i.e. windrows), use:

1. A rectangular plot which covers the entire width of the strip, or
2. A 50 m^2 circular plot system with plot centers located alternatively at 4 m and 11 m from the strip accumulation edges, for a 15 m wide strip.

Strip accumulations are normally treated as one stratum but may need to be stratified according to different levels of waste or harvesting methods.

Plots are located using the procedure in section 8.6.1.2.

8.8 Landings

Landings contain accumulated material resulting from yarding or processing to a central location or spot accumulations.

Landing accumulations resulting from highlead, helicopter logging, etc., may be stratified separately from the roadside spot accumulations to form their own stratum.

Off-site landings must be stratified and sampled. Include their area in the waste assessment area net area.

Determine the number of plots for a landing stratum using the Other Accumulation Strata table in Appendix 4. If the landing contains spot accumulations, use the procedures in section 8.5.4 to sample the accumulations, otherwise, use the procedure in section 8.8.1.

8.8.1 Establishing Plots

When a landing contains accumulated material that has not been piled, landing plots are located on a line starting from the geographic center of the landing. A plot must be established at the first successful attempt using the sequence of steps listed below.

1. Mark the center of the landing (with ribbon or paint) so that the check surveyor will be able to find the P.O.C.
2. The first line is always run north from the P.O.C.
3. A plot is located at mid distance between the points where the line enters and exits the accumulation. This distance must be at least twice the plot radius because the plot must fall completely within the accumulation.
4. If a circular plot cannot be established on the North bearing, try East, then South, then West.
    a. If a circular plot cannot be established on these bearings try N45E, S45E, S45W and N45W consecutively.
    b. If a circular plot still cannot be established try N22.5E, N67.5E, S67.5E, S22.5E, S22.5W, S67.5W, N67.5W and N22.5W consecutively around the compass.
5. If a circular plot still cannot be established using the smallest plot size available (50 m^2 or 3.99 m radius):
    a. A rectangular plot can be established, or
    b. Measure 100 percent of the accumulation.

In waste assessment areas where there is only one landing or one landing that is safe to work on, the minimum number of plots must still be established. Therefore, a landing may have to have more than one plot established on it. In this case, distribute the plots as evenly as possible.

8.9 Debuilt Road

If a road has been debuilt, logs and stumps have been pulled back from the side-slopes and scattered over the top of the deactivated road. A debuilt road may be surveyed with the dispersed stratum or as a unique stratum.

8.9.1 Sample with the Dispersed Stratum

A debuilt road can be surveyed as part of the dispersed subpopulation. Any plots located on the debuilt portion are sampled where they are located using a circular plot. All pieces that fall within the plot will be measured and recorded.

Note: The road surface area for debuilt roads is added back into the net waste area of the waste assessment area.

8.9.2 Sample as a Unique Stratum

A debuilt road can be stratified from the dispersed subpopulation and surveyed as a unique stratum. The stratum code for debuilt roads is WB0X.

1. The minimum number of plots for an other accumulation stratum type must be established.
2. The stratum area is determined by the road surface width and length.
3. Locate 50 m^2 rectangular plots on the debuilt portion.
4. Plot dimensions will be 50 m^2 divided by the road width
    a. Determine the GSD between the plots (stratum length/number of plots).
    b. Apply the SPIF to the GSD for the first plot.
    c. Starting at the POC, proceed down the road the calculated distance to the first plot. This point (C1) establishes the center point of the first plot.
    d. From C1 locate a 50 m^2 plot on the debuilt road area.
    e. Establish the next plot by measuring the full GSD from C1 down the debuilt road to C1 of the next plot.

Example:

- Stratum area:
    - Road surface: 400 m, road width: 5 m
    - 400 m length * 5 m width = 2000 m^2 or 0.20 ha
- Plot dimensions:
    - 50 m^2 plot size / 5 m width = 10 m,
    - Establish a 5 metre by 10 metre plot.

8.10 Cold Decks

Log decks that remain on a waste assessment area and are to be removed and scaled at a scale site, or are field scaled, are not to be included in a waste assessment as the scale data will be reported in HBS. These decks must be clearly marked by the licensee.

Otherwise, all cold decks in a roadside or landing strata must be stratified into an accumulation stratum and measured using the procedures in section 9.5.8.

Cold decks found within the dispersed stratum may be surveyed in one of two different ways – as part of the dispersed stratum or as a unique deck accumulation stratum.

1. Surveyed as part of the dispersed stratum. Under this method:
    a. Dispersed plots established in the field will include all dispersed cold decks or portions thereof within the plot,
    b. All pieces that fall within the 200 m^2 dispersed plot will be measured and recorded, and
    c. Plots cannot be moved or altered to exclude decks or portions of decks contained within the plot boundary.
2. Surveyed as a deck accumulation stratum. Under this method:
    a. All decks within the dispersed stratum must be stratified separately from the dispersed, roadside, or landing strata,
    b. All decks <u>must</u> be identified and sampled throughout the waste assessment area,
    c. The areas of the decks in both the accumulation and dispersed strata must be noted on the final map and the deck areas removed from their respective strata areas,
    d. Dispersed sample plot centers must be offset away from all decks, and
    e. Dispersed plots may be moved as per section 9.2.6 as required to avoid overlapping a deck stratum; however, must retain a 200 m^2 size.

8.11 Partial Cut (Variable Retention) Waste Assessment Areas

Partial cutting (variable retention) waste assessment areas contain leave trees in groups (over 0.25 ha in size is termed group retention) and/or as dispersed individual trees or small groups of a few trees (dispersed retention). Stratum codes for variable retention waste assessment areas are “G” for group retention, and “D” for dispersed retention.

An accurate map showing the leave areas and corridors must be used as the waste assessment area survey map.

Leave areas and corridors must be stratified out and sampled accordingly.

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9. Field Procedures

9.1 Overview

This chapter assumes the waste surveyor is knowledgeable in the principles of sampling, forest surveying techniques, is competent with conventional field traverse procedures and equipment and is familiar with log scaling and grading procedures.

If there are uncertainties over any aspect of the field procedures, waste surveyors are encouraged to direct questions to the forest professional responsible for submitting the work.

9.2 Plot Establishment

Sample plots must be established at the location identified on the waste survey plan. Moving plot centers from the measured or traversed location presents significant bias and is only permitted in accordance with section 9.2.6 of this manual. If the plot cannot be completed safely, the procedures outlined in section 9.2.7 of the manual are to be used.

9.2.1 Plot Sizes

Plots in dispersed must be 200 m^2.

Plots in accumulations and roadside strata may be rectangular or circular, or other shapes as required and must be 50 m^2. External right of way areas must use 50 m^2 rectangular plots when sampled as a separate stratum (OT0X).

The formula for calculating the horizontal plot radius is: SQR (plot size in m^2 / PI), where SQR means "the square root of", and PI means 3.1415927.

The plot sizes and recommended shapes are as follows:

Open slash	200 m^2 round (radius = 7.98 m)
Felled and bucked	200 m^2 round (radius = 7.98 m) or 100 percent scale if area is small
Accumulations	50 m^2 round (radius = 3.99 m) or rectangular (i.e. 5 m x 10 m)
Roadside accumulations	50 m^2 rectangular (for strips 10 m wide or less). 50 m^2 circular (for a 15 m wide strip, locate plot centers alternatively at 4 m and 11 m from the roadside). 50 m^2 rectangular (for strips greater than 15 m wide).

9.2.2 Locating Waste Plots Using Conventional Methods

To locate waste plots using conventional (hand survey) methods, determine the distance and bearing from a tie point on the survey plan map to a sample point. Using field traverse procedures, travel the required distance and bearing from the tie point to the plot location as indicated on the waste plan. When the required distance has been measured, a stake, pin or equally effective center point marker must be established at the plot center.

Tie points must be linked to the survey grid with a hand traverse that meets the standards in Chapter 9. All distances are to be corrected for slope and must be measured to the standards listed in this manual.

9.2.3 Establishing Waste Plots Using GPS Technology

Waste plots may be located with the use of GPS technology provided the following procedures are followed:

1. The survey plan map has been created using GIS software,
2. The plot location coordinates are generated through GIS software,
3. The plot locations are identified from 'system derived' X, Y coordinates with the coordinate in an attribute table,
4. The coordinate system used must be specified as either UTM or BC Albers,
5. Coordinates must be labeled to the plot number,
6. Plot coordinates must be transferred to the GPS unit via digital file, and
7. Plot coordinate and shape files must be provided to the Ministry upon request.

Best practices for establishing waste plots using GPS are described in detail in Appendix 11.

Georeferenced maps cannot be used for traversing to or establishing a waste plot location. An iPad, tablet, or cellular device cannot be used to create the final waste assessment area survey map.

9.2.4 Plot Establishment Marking

All POCs and tie points must be clearly marked with aluminum tags or flagging ribbon and high-visibility paint and be easily observed from access roads.

All tie points and plot centers, including prediction plot locations, are to be established with a sturdy stake driven well into the ground and made clearly visible with paint or surveyors flagging ribbon and labeled using a waterproof felt pen or other method (i.e. aluminum tags) that clearly identifies the plot number.

The plot center is the point at which the center stake enters the ground, not the top of the stake. If the plot center location is within a stump or other impenetrable object, mark the plot center with an "X" at the point on the object with paint and locate a plot center stake close to the indicated center point. Record the distance and bearing from the plot stake to the actual plot center on the field tally card.

Plot boundaries of measure plots are to be clearly marked on all borderline pieces with paint. Stakes may be used to define the plot boundaries on spot accumulations. Marking the entire plot radius is not required.

Recorded pieces are to be clearly numbered with tree marking paint. Paint must be log or tree-marking grade.

The formula for calculating the horizontal radius of a circular plot is:

$$\sqrt{[\text{plot size in } m^2 \ / \ \pi]}$$

Any odd shaped accumulations may be sampled with a long rectangular plot or strip so long as the plot size is consistent within the stratum.

All distances between plots and plot radii are to be corrected for slope and must be measured to the standards listed in Chapter 9.

The formula used to correct for slope is:

COS [Tan-1 (slope %/100)]

The inverse (1/*x*) of this number is multiplied by the plot radius to obtain the corrected slope distance.

Example: Slope of 74% and plot radius of 7.98 m

COS [Tan -1 (74/100)] = 0.8038

0.8038 -1 = 1.2441
1.2441 * 7.98 m = 9.93 m slope distance

Appendix 9 contains the corrected slope distances for a 7.98 m (200 m^2 plot) plot radius.

9.2.5 Piece Numbers

Waste pieces are to be clearly marked in such a manner as to allow identification of the piece for audit purposes. Mark all pieces measured in the plot clearly with the piece number, using tree marking paint.

Piece marking must be completed in a manner that retains the marking for up to six (6) months.

Waste pieces are usually assigned one piece number. However, some pieces contain both avoidable and unavoidable segments. In these situations, the segments are marked and recorded separately, each with its own piece number.

9.2.6 Establishing Border Plots or Moving Plots

The completion of all the sample points identified on the survey plan and the location of the sample point at, or very near its intended location, is a key principle of sampling. Sample points will occasionally fall outside or too close to the edge of the dispersed stratum due to map inaccuracies, acceptable location errors, obstructions (i.e. pile) or safety reasons (i.e. a wasp nest). When this occurs, two options are available - the completion of a border plot or moving the plot.

Prior to applying one of the two options the surveyor must:

1. Confirm the plot location procedures and sample plan map are correct,
2. Never move a plot center that falls completely within the stratum it was intended to sample, and
3. Follow the procedures in the order they are presented:
    a. Locate a border plot (only in the dispersed stratum), or, if that is not successful,
    b. Move the plot location using the method described in the manual.

9.2.6.1 Using Border Plots in a Dispersed Stratum

If the dispersed plot center falls within the stratum to be sampled but a 200 m^2 circular plot cannot be established because a portion of the plot falls outside the stratum, establish a 200 m^2 half circular plot (11.28 m radius).

To establish a plot, proceed the shortest possible distance to the edge of the stratum from the plot center point, measure 3.0 m in each direction along the edge of the stratum and take a compass bearing between the two points. This compass bearing will be used, to determine the edge (straight line boundary) of the half-circle plot.

From plot center, travel the determined bearing 11.28 m and establish a ‘corner’ of the border plot. Establish the second corner of the border plot using opposite bearing of first plot. Proceed within the stratum locating the plot boundary using the 11.28 m radius. Plot corners must be clearly marked in the field.

If a 200 m^2 half-circle plot (11.28 m radius) cannot be established without sampling outside of the stratum, move the plot using the procedure described below.

Border plots cannot be used in an accumulation stratum.

9.2.6.2 Moving Dispersed or Accumulation Plots

Dispersed and accumulation plots that fall outside the type stratum they were intended to sample are to be moved in a consistent and therefore auditable manner.

Never move a plot that falls completely within the stratum it was intended to sample.

The procedures for moving plots are as follows:

1. From the traversed plot location, move the plot center:
    a. In a dispersed stratum, North one plot radius (i.e. 8.0 m in a dispersed strata) to establish either a full circle plot or a half circle (border) plot. If this point does not result in a plot that remains entirely within the stratum it is meant to sample, attempt the same process East with the same distance and procedure, then South, then West.

    b. In a roadside stratum, for odd numbered plots, one plot radius in the direction towards the point of termination of the road being sampled. For even numbered plots, move the plot one plot radius towards the point of commencement of the road (0+000). If a full circular plot cannot be established, use a rectangular shape instead.
2. If the above fails, repeat the same procedure but increase the distance by increments of one plot radius.
3. If the plot cannot be located within one half (½) of the intended GSD using steps 1 and 2 above, in the dispersed strata, attempt to locate the plot moving North East, then North West, then South East, and then South West.
4. The plot may be dropped in a single waste assessment area or large population sample design if a plot cannot be located within one half of the intended GSD after using the steps outlined above.
    Note: a plot can only be excluded from sampling for this reason or as outlined in section 9.2.7.
5. In an aggregate sample plan, the plot cannot be dropped and must be established.
    a. In the dispersed strata, repeat steps 1-3 above; however, an irregular plot shape may be used. If a plot cannot be established, continue using increments of one plot radius until the plot can be located.
    b. In the roadside strata, continue using increments of one plot radius until the plot can be located.

A full or half circle (border) plot (only in dispersed strata) must be established at the first possible location.

9.2.7 Waste Survey Safety Procedures

In accordance with WorkSafeBC section 3.12(1) of the Occupational Health and Safety Regulation: "A person **must not** carry out or cause to be carried out any work process or operate or cause to be operated any tool, appliance or equipment if that person has reasonable cause to believe that to do so would create an undue hazard to the health and safety of any person."

The safety of the surveyor must always take precedence when estimating or measuring plots, including the wearing of proper safety equipment and footwear.

The objective of this section is to provide an alternative method of determining waste volumes where a portion or the entire plot or waste assessment area cannot be measured safely.

The procedures are intended to provide the surveyor with a set of procedures to follow in the order listed below that will provide the best available information and support the key principles of sampling while maintaining worker safety.

1. Where a piece or portion of a plot or an entire plot cannot be measured safely, attempt to complete the piece or plot through estimation from a nearby location.
2. Where the plot cannot be measured or estimated safely, move the plot to a safe location as specified in section 9.2.6.
3. When a plot must be dropped for safety, use replacement data of an existing plot from the same cutblock or licence that has similar waste levels, species, grade profile, age and method of harvesting. The surveyor may have to use a measure factor to adjust the volume to make it representative of the actual waste levels.
    a. If replacement data from another plot is used, ensure the volume is the same or less of the dropped plot
    b. If the volume is less, then apply the measure factor to increase the waste volume to the appropriate level. The Waste System cannot reduce a plot volume; therefore, assigning a measure factor greater than 100% will not work.
4. Where more than half of the plots cannot be established safely, the waste volumes on the waste assessment area can be determined using the following alternate methods:
    a. Within a single or aggregate sample plan, use the procedures in section 4.3.2 (2), or
    b. Within large population sample plans, delete the waste assessment area from the sample population and select a replacement waste assessment area of similar sort criteria. Use the procedures in section 6.6 to amend the sample plan.

9.3 General Requirements

9.3.1 Material to be Measured

All waste volumes within the sample waste assessment area boundaries, external areas attributed to a cutblock and/or plots must be included in a waste assessment according to the timber merchantability specifications specified in this manual.

All coniferous and deciduous timber, except reserved timber which is within the specifications of timber merchantability described in this manual, must be included in a waste assessment.

9.3.2 Classifying Pieces

For pieces that lie across plot boundaries, record the in-plot portion only and classify the piece (kind, waste class, grade) based on the entire piece as if it were completely within the plot.

9.3.3 Avoidable and Unavoidable Waste Classification

Waste classification must not be biased for any reason such as accommodating inadequate planning and supervision, poor harvesting methods, inadequate/careless logging practices, or a licensee's own manufacturing or market specifications.

All waste pieces must be classified as either avoidable or unavoidable.

Unavoidable volumes are those which cannot be removed because of physical impediments, safety considerations, or environmental constraints. All other volumes are ***avoidable***.

9.3.3.1 Examples of Unavoidable Waste

1. Due to physical impediments:
    a. Logs wedged between boulders, or
    b. A log stranded on an inaccessible ledge.
2. Due to safety:
    a. The portion of a high stump (with a rock against it) between the maximum allowable stump height and the height where the stump could have been safely cut (see Figure 9),
    b. Logs with shards of embedded rock, usually resulting from blasting. If the pieces are trimmed within 20 cm of the rock, such pieces may be classified as unavoidable. If the pieces have been trimmed longer, the segment beyond the rock should be classified as avoidable, without making any trim allowance,

c. Log pieces in hand falling cutblocks that were cut to create escape paths for the fallers. The pieces must be less than 35 cm in diameter and angle cut,

d. Bucking waste with severe deformities as outlined in bucking waste section, or

e. Logs or downed trees that are unsafe to remove due to site specific circumstances.

3. Due to environmental or stewardship requirements:

   a. A log if removed will cause excessive site disturbance or soil degradations,

   b. A log left bridging a class 4 stream,

   c. Stub trees or high stumps left to protect reserve trees within a WTRA (where identified in a cutting authority and appraisal), or

   d. Approved high stumps due to snowpack (section 9.5.4.8).

   e. For stream cleanout conducted in accordance with the Riparian Management Area Guidebook, the waste classification procedures are as follows:

      i. Where a log is left across a creek, classify the log as unavoidable for environmental reasons.

      ii. If a creek was machine cleaned and it was reasonable to recover the log pieces, classify the pieces as avoidable.

      iii. If a creek was hand cleaned and the log was bucked into small segments and thrown out of the creek channel, classify the pieces as unavoidable.

Figure 4 Example of Unavoidable Waste

9.3.3.2 Examples of Avoidable Waste

1. Stub trees that have not been identified in the cutting authority and appraisal or the retained volume was not accounted for in the appraisal of the cutting authority.
2. Chunks on a skidding trail used to support the machinery that resulted in the breakage of pieces greater than the minimum log length. Such pieces are classified as avoidable and are graded according to the characteristics of the whole original piece.
3. Helicopter bucking waste. Incorrect estimation of log weights may result in having to buck the logs shorter after attempting to lift them. Such waste is always regarded as avoidable.
4. Pieces bucked from a log to 'zero' the processor.
5. Bucking waste cut from a log to remove a defect that extends beyond the effect of the defect.

9.3.4 Piece Estimates

Waste pieces are often partially obstructed by branches, soil and other loose debris. The correct measurement of waste pieces is dependent on the ability of the surveyor to view a piece and confidently measure dimensions and observe defects affecting volume and grade. Surveyors are expected to attempt to clear loose debris to facilitate measurement and classification of pieces.

A reasonable effort must be made to measure as much as possible even if one end of the piece cannot be seen and must be estimated.

In order to correctly establish the grade of a log, at least one end must be visible or the piece should not be recorded.

9.3.5 Measure Factor

In strata where piling or deep accumulations exist, pieces in a plot may be unsafe to measure, obstructed, or inaccessible, therefore it may not be possible to measure or estimate each piece within a plot. Only in these cases, a measure factor can be applied to the plot. The measure factor adjusts the plot volume to account for pieces that were not measured or estimated by the surveyor within the plot.

In these cases:

1. Measure and/or estimate the waste material that is accessible. Measure as many pieces as possible, even when some dimensions of an individual piece must be estimated.
2. Project the plot boundaries down to the ground and estimate what percentage of the volumes within the plot boundaries were measured. This is the measure factor for the plot.

3. In spot accumulation strata:
    a. For piles equal to or greater than 50 m^2, record the measure factor on the plot tally card under "Measure %", or
    b. For piles less than 50 m^2, adjust the measure factor to account for the area that is available for sampling using the following calculation:
    (Area of the pile / Area of the plot) * measure factor of the pile.
    Record this value on the plot tally card under "Measure %."

The measure factor is applied to measure and prediction plots.

When estimating the prediction plot volume in an accumulation stratum, the total plot volume must include all volume that is not visible or available to be measured. The value entered into EForwasteBC take into consideration the measure factor for the plot. The percent measure field in the prediction plot header must be set to 100%.

Example:

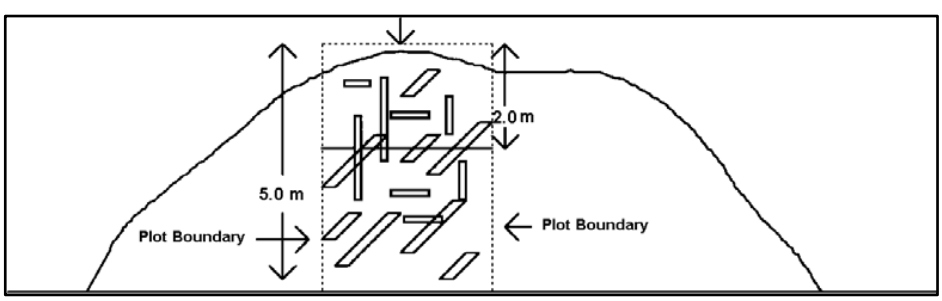
In the example below, if you were able to measure down approximately 2 m, you would record a measure factor of 40 percent providing that the volumes of waste were spread evenly through the cylinder within the plot boundaries. The measure factor is derived from
2 m / 5 m * 100% = 40%.

In a prediction plot, if the volume within the plot is estimated at 2 m^3:

- To adjust by a measure factor, divide the measure factor percent by 100:
  40 / 100 = 0.4
- Calculate the prediction plot value:
  2 m^3 / 0.4 = 5 m^3
- Enter 5 m^3 into EForwasteBC

Figure 5 Measure Factor

Plot center



9.4 Measurement Protocol and Standards

9.4.1 Measurement and Recording Standards

Waste material, logs, and trees are measured for volume and graded using the principles and procedures identified in the Ministry of Forests, Lands, Natural Resource Operations and Rural Development *Scaling Manual* except where otherwise described in this manual. Waste stumps and bucking waste are graded using the principles and procedures identified in this manual.

Record gross length measurements to the nearest one-tenth (0.1) of a metre and gross diameter measurements in radius class units (rads, 1 rad = 2 cm). Record deductions in length to the nearest one-tenth (0.1) of a metre and deductions in radius to the nearest rad.

Record the gross dimensions of each piece including rot or other defects. In addition, the waste surveyor calculates the volume deductions for any defects or missing wood and records the deduction equivalent under "Deduction for Rot/Holes" in rads and/or in metres as a length deduction, along with the most appropriate "decay type."

When netting down the dimensions of a log because of defect or missing wood, the gross length will be used to determine if the piece meets the 3.0 m minimum log length. Therefore, the net length of a log used for volume calculations can be less than 3 m. Both the gross length and deductions are always recorded.

Top measurements on logs which have very little taper must be made carefully due to the length of merchantable wood involved between radius classes.

1. For oversized tops, the top measurement is made at the last occurrence (i.e. at the uppermost point on the tree) of the applicable timber merchantability top dimension specification.
2. When using a scale stick, for a 10 cm top, it will be the midpoint of the 5 radius class. For a 15 cm top, it will be the line separating the 7 and the 8 radius class.

Recording the measurements of the portion of borderline pieces that are outside the plot is optional. The minimum requirement will be the measurements of the portions of the pieces within the plot, together with a code (when needed) that will override computer checks on minimum log length.

Measurement of Grade 6 is required when specified in the cutting authority document. Measurement of Grade code Z logs is not required.

9.4.2 Minimum Measurement Requirements

The minimum length requirement for measurement is 0.1 of a metre (10 cm). Pieces less than 0.10 of a metre (10 cm) at the midpoint of the diameter are not recorded.

All dead pieces greater than fifty percent (50%) sound that meet or exceed the TMS must be measured.

The minimum specifications for logs, trees, slabs, stumps, and bucking waste are outlined in section 9.5.

9.4.3 Lengths

1. Lengths will be recorded to the nearest tenth (0.1) of a metre
    a. Digits 0-4 are rounded down and 5-9 are rounded up
    b. Example:
        i. A log 4.24 m in length - record as 4.2 m
        ii. A log 4.26 m in length - record as 4.3 m
2. Logs broken at both ends are tallied only if they meet or exceed 3.0 m, TMS point to TMS point. Logs less than 3.0 m are breakage and are not tallied.
    a. Example A:
        i. A log 2.99 m in length - is breakage, do not tally
        ii. A log 3.0 m in length - is a log, tally as 3.0 m
        iii. A log 3.06 m in length - tally as 3.1 m
    b. Example B:
        i. A log 3.2 m from TMS to TMS with a 0.2 m length deduction at the top and a 0.1 length deduction at the butt is a log,
        ii. Tally as 3.2 m with 0.3 m length deduction
        iii. Do not tally as a log 2.90 m in length
3. Pieces less than 0.05 m in length (cookies) are not measured.
4. Pieces 0.05 m and greater are measured. Pieces 0.05 m to 0.1 m are recorded as 0.1 m.

The determination of KIND (logs, bucking waste, breakage) is based on gross length.

9.4.3.1 Broken Tops

The length measurement procedure for broken tops is:

1. Locate the TMS diameter (must have minimum slab thickness of 5 rads) measured from the small end,
2. Locate the X Y line upon which the volume above the TMS diameter to the X Y line equals to the void of the missing wood, and
3. Record the length from the X Y line to the cut end.

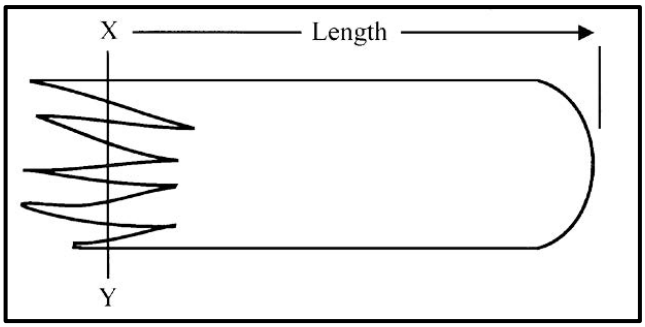
9.4.3.2 Shattered Ends

Length is measured to the XY line where the protrusions are folded in to compensate the missing wood in the voids.

Pencil buck each finger to the TMS before folding as shown for broken tops.

Do not measure fractured pieces where little effort would be required to break the piece into numerous pieces all below the TMS.

Figure 6 Measuring Shattered Ends



9.4.4 Piece Diameters

Diameters will be recorded to the nearest radius class unit (rad), inside bark.

If the end is out of round, the average of measurements taken across two or more representative diameters shall be recorded as the end measurement.

All half measurements shall be taken to the nearest even number. Thus 24.5 will be recorded as 24 while 25.5 will be recorded as 26.

Top log diameter standards reflect log diameters in centimeters, which must be converted to radius class units for field measurement.

Example:

15 cm =	7.5 rads - represented on the scale stick by the black line between 7 and 8 rads.
10 cm =	5 rads - represented on the scale stick by the red line in the middle of the 5 rad class.

9.4.5 Deductions

It is a standard convention in the *Scaling Manual* to account for the volume of decay by reducing the gross dimensions of a piece by a length and/or diameter (rad) deduction (computed using the volume data on the scale stick). This gives net dimensions that will produce a volume equal to the net volume of the piece.

Deductions for defect must be calculated in the field using the British Columbia metric scale stick.

For waste assessments, the length and/or diameter (rad) deductions must be recorded along with the gross dimensions of the piece. The compilation program will subtract the deduction values (if any) in the deduction columns for length, top and/or butt dimensions respectively. The resulting dimensions will then be used to calculate volume.

The values recorded in the deduction columns are not the actual dimensions of the decay or missing wood. The decay values represent the deduction equivalent in rads and/or metres, along with the most appropriate "decay type" to be applied to the gross piece dimensions as a result of the decay or missing wood.

Example: a log with gross dimensions of 4.2 m and 18 rad top / 20 rad butt with 0.6 m length deduction and a 2 rad top deduction would be calculated as a 3.6 m, 16 rad top / 20 rad butt.

9.4.6 Grading Pieces

All waste pieces must be measured and graded according to their condition (i.e. grade and decay) at the time the timber was felled. The effect of time and weather since the date the timber was felled (i.e. sun checking) is not taken into account when grading waste pieces, except when a wildfire affects the timber. If a licensee was responsible, or failed to comply with the Wildfire Act or Wildfire Regulations, this exception does not apply.

Bucking waste and stumps must be graded according to the rules in this manual.

Logs and trees must be graded according to the rules in the *Scaling Manual* except where the waste rules are different and then waste rules are used. For example, the minimum log length for waste is 3.0 m (instead of 2.5 m in the *Scaling Manual*).

9.4.6.1 Summary of Grade Code 4 Grade Rule

All waste pieces graded as dead lumber reject (i.e. cut from trees which were dead when harvested) were previously identified as grade code 5. These pieces are to be recorded as grade 4.

9.4.6.2 Characteristics of Green and Dead Pieces

Dead pieces *must* have one or more of the following characteristics (indicators):

1. Deteriorated cambium,
2. Loose or shedding bark,
3. Sap rot,
4. Wood borers,
5. Deep checks (not weather checks).

Green pieces can display any of the following characteristics (contraindicators):

1. Curling bark (green bark that is curling or cupping due to the drying process),
2. Green needles,
3. Fresh cambium (sticky),
4. Mildew or mold on wood surface (except on windthrow),
5. Charred wood (recent fire kill),
6. Dark weathered ends (indicative of decked timber), or
7. Pitching log ends.

Logs which display at least one indicator plus one or more contraindicators are deemed to have come from a live, green tree.

9.5 Kind and Measurement of Material

9.5.1 Logs

A log is defined as:

1. Any near-round piece with more than half of its original diameter remaining,
2. A piece with a gross length of 3.0 metres or greater as measured between the utilization top and butt diameter, and
3. A piece that is broken or cut at each end.

9.5.1.1 Recording Logs

Log length is the length that a scaler records to accurately determine the gross volume of the piece (i.e. without making any deductions for rot).

Logs are measured and recorded as a single piece, they are never pencil bucked into multiple pieces to separate defects or waste class.

Record as "L" under "Kind of Material" on the plot tally card.

Figure 7 Example of a Log Measured as a Single Piece

9.5.2 Trees

Trees left standing after timber harvesting that are not reserved for silviculture, biodiversity or a forest management reason are measured in a waste assessment and classified as avoidable or, less commonly, as unavoidable waste.

The surveyor must reference appropriate documents such as the cutting authority, the appraisal, and maps as submitted into ECAS to determine the conifer and/or deciduous leave trees identified by species to be retained as reserved timber for the area being waste assessed.

When a waste assessment area contains standing timber, the post harvest reserve tree specifications must be documented by a forest professional, and:

1. If standing timber is to be reappraised under section 2.2.2 (2) (c) of the *Interior Appraisal Manual*, an assurance statement prepared by a forest professional confirming that standing timber is not to be tallied must accompany the waste submission, or
2. If standing timber is to be tallied as waste, the updated documents (maps, etc.) must be provided to the waste surveyor.

In all cases, the post harvest reserve tree specifications document must be submitted into the Waste System.

A tree must contain a log meeting the minimum timber merchantability length (3.0m) from high side of the stump to the utilization top diameter.

9.5.2.1 Recording Trees

For standing trees, record as "T" under "Kind of Material" and classify the trees as avoidable. For downed trees, record “D” and classify the trees as either avoidable or unavoidable. Enter the dimensions for length, top and butt diameters, end codes, and assign a log grade.

9.5.2.2 Individual Tree Measurements

Individual standing tree volumes that are measured must be stratified out and kept separate from the plot waste volumes. Trees that were left scattered sparingly throughout the cutblock are measured and graded individually.

Tree length is determined using a tape/chain and a clinometer or an electronic measuring device such as a laser instrument. The waste surveyor estimates the location of the timber merchantability specification top diameter, and then measures the length from this point down to the timber merchantability stump height. To record as a piece, the tree must contain a 3 m log that meets the timber merchantability specifications.

Record the timber merchantability specification top diameter in rads as the top diameter. If the top is broken, estimate the diameter in rads at the break.

The butt diameter is the tree diameter at the timber merchantability specification stump height, accounting for flare (see *Scaling Manual* section 6.2.2).

Trees are measured, recorded, and graded as a single piece, they are never pencil bucked into multiple pieces.

9.5.2.3 Trees in Patches

For trees that were left in a patch where individual tree measurement is impractical, the waste surveyor will measure the precise area represented by the tree patch (i.e. perform a closed traverse or traverse using GPS). A patch is defined to be a grouping of trees occupying an area of equal to or greater than 0.1 hectare.

The volume may be determined by:

1. Using the cruise compilation information from the appraisal, or
2. Completing a cruise of the timber. The cruise must be completed to the standards contained within the *Cruising Manual*.

Use the procedures in 9.5.2.4 to determine the volume, species, and grade allocations for the waste submission.

9.5.2.4 Volume, Species, and Grade Allocations for Standing Timber

The cruise net volume per hectare (for the applicable timber type(s)) will be used to determine the volume of timber in unharvested tree patches or waste assessment areas.

To obtain the volumes, use the timber type summary report from the net cruise compilation report for the timber type corresponding to each of the patch location(s) or the block summary report when a patch covers multiple timber types.

The grade allocations for tree patches, are based on the historic billing grade profile of the timber mark for the cutting authority from the Harvest Billing System (HBS). The grade profile can be obtained in HBS by running the mark monthly billing history selection report (billing history) for a twelve-month period ending one month after the month primary logging was completed for the waste assessment area.

Only in the absence of the billing history records, the net cruise volume and species for the waste assessment area being surveyed are used. The grades default to sawlog except for dead potential volumes which are recorded as grade 4.

9.5.2.5 Partial Cut (Variable Retention)

Timber volume that is left in excess of the leave volume and is not included in a reappraisal of the cutting authority will be billed as waste subject to the application of the waste benchmarks.

Surveyors should reference appropriate documents that provide the volume percent reduction by either one or more of species, timber type, risk group/tree class or treatment unit for each individual cutblock within the cutting permit or agreement.

There are two methods for determining the unharvested standing tree volume in a partial cut – by re-cruising the waste assessment area or by tallying the standing timber in fixed area waste plots. Choose a method that is appropriate for the waste assessment area:

1. For a re-cruise, a licensee must put in a sufficient number of cruise plots that will either achieve the sampling error objective as stated in the *Cruising Manual*, or meet the conditions required to waive it.
    a. Once the unharvested standing tree volume has been derived, the timber scale grades will be assigned using the procedure described in section 9.5.2.4 to obtain the volume, species, and grade profile for the waste submission.
2. If waste plots are used, the plot size should be 200 m^2. Licensees are encouraged to use a higher sampling intensity than the minimum sampling requirements for the waste stratum.

The survey results for cutblocks that have been harvested using partial cut systems must be sponsored by an RPF or RFT. When there is no standing timber to report, an assurance statement must be submitted into the Waste System by a forest professional confirming that the partial cut timber harvesting requirements stated in the Schedule B or the Percent Reduction Report in the Appraisal Cruise Compilation Submission have been met.

If a field or office review by ministry staff identifies an apparent discrepancy with the species or volume harvested, the licensee or the TSM may be directed by the District Manager to re-cruise or resurvey the residual standing trees.

9.5.2.6 Unharvested Cutblocks

The District Manager may bill an unharvested cutblock in an expired, surrendered or cancelled cutting permit or authority. The billings will be made based on the net cruise volume attributed to the unharvested cutblock.

The procedure described in section 9.5.2.4 will be used to obtain the volume, species, and grade profile for the waste submission.

9.5.3 Slabs

A slab is defined as any non-round piece with less than half (1/2) of its original diameter remaining, a minimum thickness of 5 rads (10 cm) and an average diameter equal to or larger than the timber merchantability specification diameter.

9.5.3.1 Recording Slabs

Slabs are measured, graded and recorded as a log (L) if greater than 3.0 m in length and have a minimum thickness of a least 5 rads (10 cm) for at least 3.0 m.

Slabs <3.0m in length are measured as bucking waste (W) if they are bucked at the butt end or both ends and have a minimum thickness of at least 10 cm.

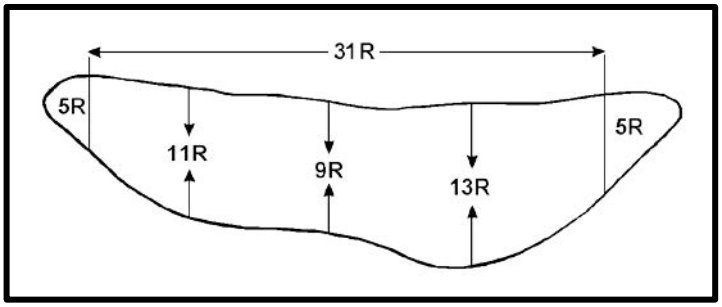
Bucking waste slabs with an average thickness less than 7.5 rads (15 cm) will be downgraded to Grade 4.

Refer to Chapter 5 of the *Scaling Manual* for measurement procedures for slab ends in various shapes (i.e. semi-circle, quadrant, sector, segment, etc.). Alternatively, the following method is accepted for computing slab diameters, for waste purposes.

Using Figure 8, slab diameters are computed using the following steps:

1. Measure and average 3 thicknesses.
   i.e. 11 + 9 + 13 = 33/3 = 11 rads
2. Measure 1 width between 5 rad edges.
   i.e. Width = 31 rads
3. Average the thickness and the width.
   i.e. 11 + 31 = 42/2 = 21 rads

Figure 8 Measuring Slabs



9.5.4 Stumps

A stump is defined as any piece with more than half (1/2) of its original diameter remaining, less than 3.3 m in length, and is still attached to the roots.

The length is to be measured from the high side of the stump. A stump that is equal to or greater than 3 m in length after the maximum allowable stump height (usually 30 cm) has been deducted is classified as a log because of its length.

9.5.4.1 Recording Stumps

Careful measurement of stumps is critical because they contain high volume per unit of length.

Stumps are not tallied if there is evidence a log equal to or exceeding the timber merchantability specifications did not exist. For example, a log cut from the stump is present and does not contain a 3 metre log.

If the stump has less than 50 percent firmwood volume due to decay, the stump is not recorded.

Sometimes stumps can be broken up in logging. Any stump fragments are ignored. Conversely, any stumps with missing fragments are measured as if the fragment was still in place.

9.5.4.2 Avoidable and Unavoidable Waste Class in Stumps

The surveyor should always view high stumps with consideration to safety. Physical obstructions are often moved away from stumps during harvesting operations. Look for unusual bark patterns that indicate the presence of a log or rock before falling.

Unless there are physical obstructions or safety precautions because of decayed wood, waste in stumps is classified as avoidable waste. All waste created by the limitations of a machine (i.e. waste that could have been avoided by using a hand faller) is classified as avoidable. Waste surveyors must assess each situation independently and determine the amount of avoidable waste based on where a hand faller could have safely made the falling cuts.

Unavoidable waste occurs where an obstruction prevents cutting the tree to the timber merchantability specifications. Where there are physical obstructions, the lowest height that the tree could have been cut must be established.

Guy line stumps are considered unavoidable if there is no unnecessary waste of wood. Any portion that is excessive waste must be classified as avoidable.

9.5.4.3 Stump Heights

Stump heights are always measured from the high side.

Stump height *is not* measured from the top of any root flare or any obstacles such as accumulated bark, moss, or other loose duff and vegetation that could be avoided during the falling process. No consideration should be given to brush and undergrowth that should cut away before falling.

For raised stumps (nurse stumps) where the tree has grown out of a rotten log, the stump height should be measured from the point of germination, or the high side, whichever is higher.

A minimum diameter at stump height (outside bark) is specified in the timber merchantability specification measured at a point 0.3 m above the high side of the stump. The minimum stump diameter must be obtained (without rounding up) or the stump is not tallied.

For a stump whose total height exceeds 1.3 m, record the diameter (inside bark) at 1.3 m above the ground on the high side of the stump. The taper of the stump should be finished at approximately that point and recording the top diameter above 1.3 m would end up under estimating the volume of the stump.

Examples of Stump Heights:

1. Stump height 0.34 m - do not tally
2. Stump height 0.35 m - tally and record as 0.1 m
3. Stump height 0.36 m - tally and record as 0.1 m
4. Stump height 0.45 m - tally and record as 0.2 m

If the stump total height, including the TMS of 30 cm, is 1.3 m or less, measure the top diameter on the top of the stump. If the stump total height exceeds 1.3 m, measure the top diameter at 1.3 m above the ground on the high side.

Minimum stump height must be 35 cm above high side to be tallied: rounding to nearest 10th of a metre gives 0.4, less 0.3 m stump allowance, nets 0.1 m to be tallied.

Stumps over 3.3 m in length should be measured from the contractual stump height (0.3 m) and classified as logs.

9.5.4.4 Stump Diameters

Measure the top diameter (inside bark) of the stump (unless the total height of the stump exceeds 1.3 m) and record it in the "top" column. Butt dimensions are not required for stumps.

Measure from where the ground high side meets the base of the stem to the top of the felling cut (as shown in Figure below) to the nearest tenth (0.1) of a metre. The volume of an undercut is included in the measured stump volume. Deduct the stump height of 0.3 m and record the result under length on the plot tally card.

If the total stump height is less than or equal to the stump height of 0.3 m measured from the high side, then the stump is not recorded.

All tallied stumps are measured and recorded using inside bark, therefore, it is possible to have a stump diameter which is less than the minimum stump cutting specification.

9.5.4.5 Grading Stumps

Stumps will default to sawlog grade unless decay is present. If the stump has greater than 50% and less than 75% firmwood volume it is Grade 4.

If the log from the stump is present, the stump is graded the same as the log.

9.5.4.6 Recording Stumps in Segments

Frequently, trees and snags with butt rot or obstructions are felled above the TMS stump height for safety reasons. Under these circumstances, a stump may have both avoidable and unavoidable components.

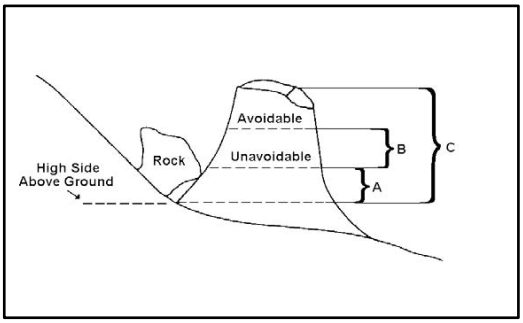
If there are both avoidable and unavoidable components of waste, the stump is recorded as two pieces each with its own piece number and record appropriate comment code such as MP on the Plot Tally Card to indicate multiple pieces.

Record the top portion as avoidable piece. Enter the difference between the total stump height and the allowed stump height in the length field, and the top radius in the top field. Classify this piece as avoidable (A).

Record the lower portion as unavoidable piece. Enter the difference between the allowed stump height and the TMS stump height in the length field, and the top radius of this lower segment in the top field. Classify this piece as unavoidable (U).

This situation is illustrated below.

Figure 9 Avoidable and Unavoidable Waste



Where:

A – *Timber merchantability specifications (TMS) stump height* of 30 cm is measured from the ground on the *high side*. This part is not recorded. If the stump is higher, length measurements start from the 30 cm mark.

B – *Unavoidable stump height* is the height specified is the minimum distance from the ground on the *high side* of a stump up to a point above a physical obstruction which allows for safe falling. B minus A = unavoidable piece.

C – *Total stump height* is the distance from the ground on the *high side* to the top of the felling cut. C minus B = avoidable piece.

9.5.4.7 Borderline Stumps

For borderline stumps, measure the horizontal distance from the plot center to the geometric center of the stump at a point 30 cm above the high side. If this point is located inside the plot, the entire stump is recorded. If it is not, the entire stump is not recorded.

For knocked-over and uprooted stumps, measure the horizontal distance from the plot center to a point 30 cm above the high side or the point of germination (POG), whichever is higher. If this point is located inside the plot, measure the entire stump.

9.5.4.8 High Stump Exemptions

The District Manager may approve a higher allowed stump height on all or a portion of a cutblock where:

1. Higher stumps are required for safety reasons, or
2. Higher stumps are required for identified stewardship or environmental reasons (i.e. ecosystem-based management or Forest Stewardship Plan requirements, prescription from a registered professional) or,
3. Snow depth prevents access to the cutting authority TMS stump height or,
4. Higher stumps are required for retaining logs within the cutblock on very steep slopes.

Where an exemption for a portion of a cutblock is submitted the application must include a map and/or written description indicating the requested portions of the cutblock.

1. The exemption will specify a new maximum stump height.
2. Measurement of approved high stumps
    a. High stumps are always measured and recorded as waste.
    b. The portions of the stump between the TMS stump height and the approved exemption stump height is considered unavoidable waste and is recorded

appropriately.

c. The portion of the stump above the approved exemption stump height is considered avoidable waste and recorded appropriately.

In all cases, trees must be cut as close to the TMS stump height as possible.

Survey crews must confirm if an exemption letter has been issued prior to the survey.

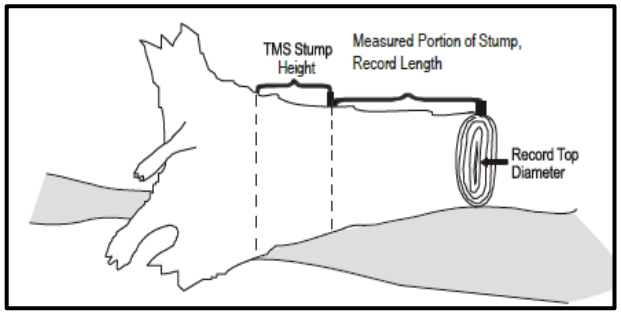
9.5.4.9 Windfall Stumps

High stumps often occur in areas damaged by wind or as single trees within a stand. Safety for the person cutting the log off a tree that has been blown over is the primary consideration when classifying these pieces.

Windfall stumps can typically be identified by the presence of the roots where the soil has fallen away. The stump and roots will appear weathered and or contain other plants growing perpendicular to the tree stem.

1. It is very difficult to determine if a stump is avoidable or unavoidable after the logging has been completed since the cause for the high stump (i.e. an obstruction) will likely be moved.
2. In some blowdown situations, there may be wind sheared trees resulting in high stumps that could not yield a minimum-length (3.0m) log. These stumps are classified as unavoidable.
3. In hand falling areas, for borderline calls, if there is any question as to whether the stump should be called avoidable or unavoidable the waste surveyor should give the licensee the benefit of the doubt and call the stump unavoidable.
4. In machine falling areas, the safety considerations are reduced therefore, stumps should not contain significant waste volumes.
5. In machine falling areas where there is evidence a machine was used to push over the tree or has damaged or broken the stem of the tree, the stumps will be measured from the TMS stump height.
6. If bucking could safely produce a minimum length log from such stumps, the volume above the TMS stump height should be recorded as avoidable waste.
7. Examples of unavoidable stumps:
    a. Other windfall trees obstruct the trunks of standing trees preventing lower cuts.
    b. Blowdown stumps which stand back up when the logs are bucked off.
    c. Blowdown stumps on a roadside or landing should be classified as unavoidable.
8. If a minimum length log (3.0m) is left attached to a windfall stumps, the volume above the TMS stump height is recorded.

Figure 10 Examples of Windfall Stumps



9.5.5 Bucking Waste

Bucking waste is defined as any piece:

1. That is 50% or more of the original log diameter and meets the TMS, except for slabs that are recorded as bucking waste (see section 9.5.3.1), and
2. With a gross length less than 3 m (originating from a log at least 3 m in length) that has been cut at the large end or at both ends.

A piece cut at the small end (top) and broken at the large end (butt) is:

- Not recorded in the dispersed subpopulation as it is breakage
- Measured and recorded as bucking waste in accumulation subpopulations.

If the logging system was inappropriate or there was excessive breakage in the dispersed subpopulation then all pieces cut at the small end (top) and broken at the large end (butt) should be recorded as avoidable breakage.

Examples of bucking waste:

1. Tops bucked off at a diameter larger than the TMS diameter,
2. Long butts,
3. Pieces where the 0.1 m trim allowance has been exceeded, or
4. Pieces where decay has been bucked off a log and the remaining piece is more than 50 percent sound.

Examples of bucking waste that are not measured are:

1. Trim ends less than 50 percent sound which are less than the dimensions of a slab,
2. Trim ends which are heavily fractured,
3. Pieces less than 50% of its original log diameter (at the butt) with a broken end and a gross length of less than 0.4 metres.

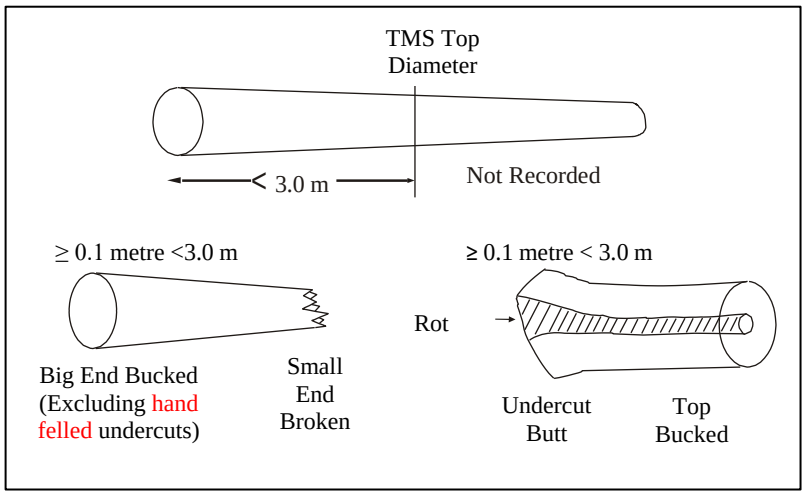
All three criteria must be met or the piece must be recorded. The piece cannot be folded (accounting for volume) to become less than 0.4 metres.

4. Pieces that physically meet the minimum requirements; however, contain severe shatter that extends through the entire piece and/or the piece would easily break apart into pieces less than the TMS.

Bucking waste is recorded as "W" under "Kind of Material" on the plot tally card.

The figure below shows several bucking waste pieces.

Figure 11 Examples of Bucking Waste



9.5.5.1 Bucking Waste Lengths

When cut at both ends, tally to the nearest tenth (0.1) of a metre regardless of length.

When cut at the large end, tally as waste if length meets or exceeds a tenth (0.1) of a metre.

Examples:

- 0.09 m in length - tally as 0.10m,
- 0.15m in length – tally as 0.20m.

9.5.5.2 Avoidable and Unavoidable Waste Class

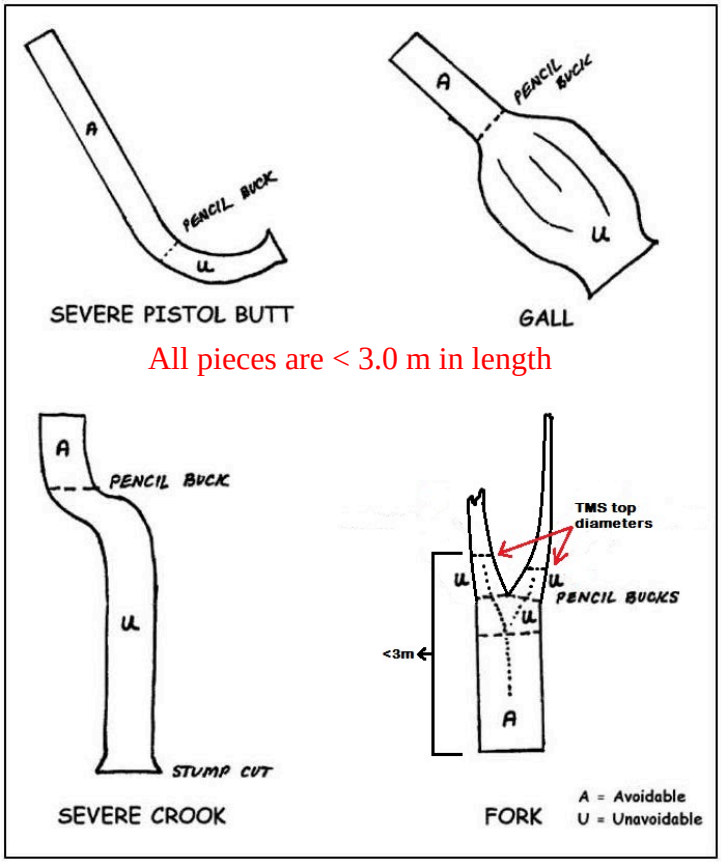
All bucking waste pieces are classified as avoidable or unavoidable.

Bucking waste is considered avoidable unless there is clear evidence that pieces were cut out for physical, environmental, or safety reasons during falling and bucking. Unavoidable bucking waste can usually be identified through on-site evidence and/or oblique cut angles required during hand bucking to create escape paths for fallers.

Some bucking waste pieces may contain sections of avoidable and unavoidable waste which must be tallied separately. Pieces may be pencil bucked and recorded as unique pieces to separate avoidable and unavoidable portions as shown in Figure 12 below. Segregations must be identified and tallied separately for any section greater than 0.10 m in length.

Severely deformed sections of logs must be removed because they cause difficulty (and in some instances a safety hazard) when the logs are processed, loaded and transported. Pieces with severe physical deformities such as forks, crooks, pistol butt, extreme sweep, galls or goitres can be pencil bucked and classified appropriately.

Figure 12 Examples of Severely Deformed Bucking Waste



9.5.5.3 Grading Bucking Waste

All bucking waste pieces must be assigned a grade code. Grading assigns the waste billing rate and the cut control attribution category for the piece.

The short lengths as well as field conditions that affect the measurement and classification of the pieces limit the amount of information available to correctly assign a grade code. Harvest methods, utilization standards, log quality, decay and many other factors influence how and why pieces of bucking waste are cut from logs.

In the Interior, bucking waste is graded using the grading matrix and field card contained in Appendix 10.

Waste grades are determined by the balance of probability based on the grade the piece would have been. Not all results will generate the correct grade on all pieces.

9.5.5.4 Sequential Pieces of Bucking Waste

Where a plot contains multiple pieces of bucking waste that are cut sequentially from the same log, the pieces may be tallied as a single piece. Sequential pieces exhibit consistent taper, matching cuts, and matching features amongst the pieces (i.e. species, shape, rot, and knot pattern).

To tally bucking waste as a single piece, determine the grade of each piece using the bucking card. Group sequential pieces with the same waste class and grade together and assign a piece number.

When a change of grade or class occurs, a new piece must be recorded.

Sequential pieces with a combined total length greater than or equal to 3 metres must be entered as kind “L” (log).

9.5.6 Forks

A fork is defined as a division of a log or bucking waste into two or more stems. If forks are found in logs (pieces greater than or equal to 3.0 m in length) no pencil bucking is permitted. If forks are found in bucking waste (pieces less than 3.0 m in length), forks can be pencil bucked and treated as separate pieces as per Figure 12.

The point at which the pith separates is the starting point of a fork.

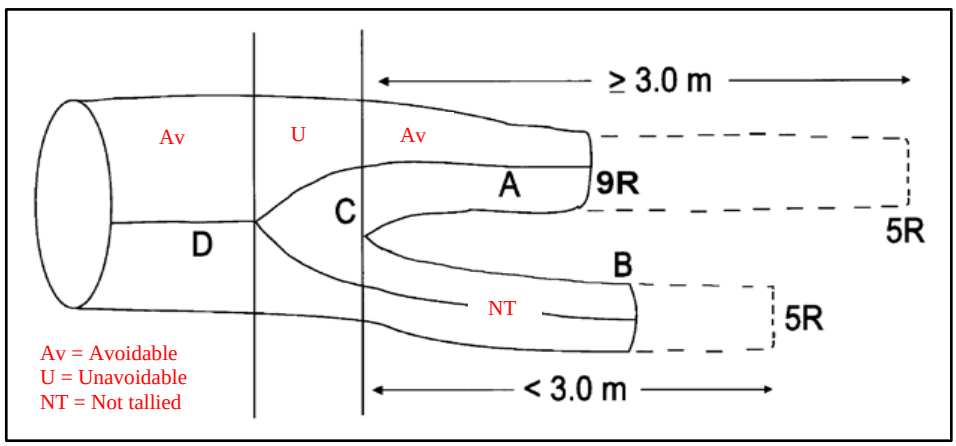
If the diameter of a fork is greater than or equal to the minimum diameter of the timber merchantability specifications, the portion(s) of the tree above the fork or crook must meet the criteria for minimum log length to be considered avoidable.

If the portion(s) of the tree, above the fork or crook, doesn't meet the minimum log length criteria (3.0 m) to the TMS top diameter, it is not measured.

As demonstrated in Figure 13 (note: in this example, the total piece length is less than 3.0 m and is classified as bucking waste):

1. Segment A, if visually extended to the minimum top diameter (5 rads), would meet the minimum log length (3.0 m); therefore, is classified as avoidable waste.
2. Segment B, if visually extended to the minimum top diameter (5 rads), would not meet the minimum log length (3.0 m) and therefore is not measured.
3. Segment C is recorded as unavoidable waste for safety reasons. The length of segment C is determined by the separation point of the pith between segment C and D.
4. Segment D (with one pith showing) is recorded as avoidable waste.
5. Segments A, B, C and D are recorded as separate pieces on the plot tally card, each with its own piece number.
6. Use 'FK' as comment code to indicate the pieces belong to a fork and the reason for classification of piece C as unavoidable.

Figure 13 Example of Forked Bucking Waste



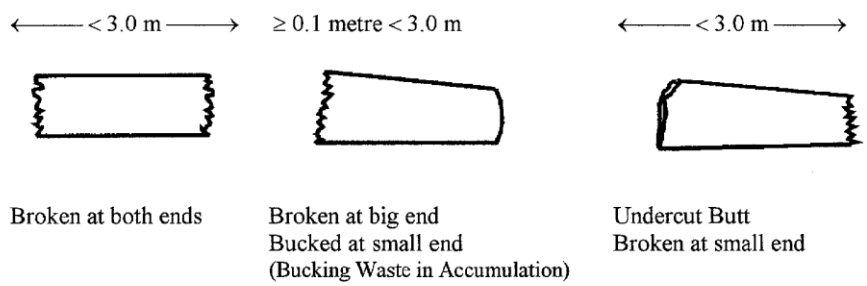
9.5.7 Breakage

Breakage is defined as any piece, meeting the minimum diameter of the TMS, which is shorter than 3 m in length and broken at the large end or broken at both ends.

9.5.7.1 Examples of Breakage

Hand felled undercut butts less than 3 m in length with a broken top are classified as breakage and should not be tallied.

Figure 14 Examples of Breakage



9.5.7.2 Recording Breakage

Breakage, if recorded, is tallied as "B" under "Kind of Material" on the Plot Tally Card.

If breakage resulted from normal falling or yarding, it is unavoidable and not tallied.

Where breakage is considered excessive because of an inadequate harvesting method or was intentionally caused by the logging crew, it is considered avoidable waste (i.e. waste pieces crushed under the weight of a machine). These volumes will be included in the cut control volume.

A log lying in a dispersed area that is heavily fractured from being felled and would break into pieces less than 3.0 metres in length during yarding, should be classified as breakage and not recorded.

9.5.7.3 Grading Breakage

Where there is evidence of intentional or excessive breakage, classify as avoidable, and grade the piece as if it were a 3 metre long log.

9.5.8 Cold Decks

Cold decks are five or more grade 1, 2, 4 or 6 (when required to be measured) logs that are mechanically placed together in a deck.

Cold decks that are to be included in a waste assessment must be measured using a one hundred percent or percent estimate method. Another acceptable estimation method is a top scale which is the determination of the average piece size multiplied by the number of pieces.

9.5.8.1 Road Deactivation Material

Road deactivation material is timber previously used in the construction of a culvert, bridge, other required structure.

At the time of a waste assessment, all road deactivation material that has not been previously scaled must be included in the waste assessment. All road material must be measured within a cold deck stratum using the one hundred percent or percent estimate measurement methods, unless it is unsafe, then the volume may be estimated using an accepted method.

9.5.9 Coarse Woody Debris

Log pieces that may be required to meet coarse woody debris requirements are included in the waste benchmarks.

9.5.10 Special Cases

Waste surveyors often encounter pieces that are hard to classify as waste or breakage, or as avoidable or unavoidable. A few of these circumstances are listed here:

1. Embedded rock, usually resulting from blasting. If the pieces are trimmed within 20 cm of the rock, such pieces may be classified as unavoidable. If the pieces have been trimmed longer, the segment beyond the rock should be classified as avoidable, without making any trim allowance,
2. Chunks on the tail-spar or skidding trails used to support the roadbeds, that resulted in the breakage of pieces greater than the minimum log length. Such pieces are classified as avoidable, and may be graded according to the characteristics of the whole piece,
3. Windfalls will be tallied in the usual manner for in-plot portions. The exceptions are windfalls that are blown down after harvesting with their roots sitting outside the block. These pieces will not be tallied,
4. Helicopter bucking waste. Incorrect estimation of log weights may result in having to buck the logs shorter after attempting to lift them. Such waste is always regarded as avoidable, or
5. Chunks in the landing, bucked at both ends and used to support a steel tower. Classify as avoidable waste and grade as per the parent log.

9.6 Data Entry Requirements

The Waste System, EForwasteBC, and paper field tally cards can be used to collect survey information. The EForwasteBC application must be used for all ratio adjustment sampling projects and all small population (aggregate) sampling plans.

The following requirements outline the data recording format and requirements for the collection of this information. Failure to apply these requirements may result in data collection and compilation warnings or errors. The EForwasteBC user manual also provides a brief description of the data entry requirements.

9.6.1 Cutblock Header Information

The cutblock information data fields contain the general identification information for the waste assessment area.

Note: the fields shown below may vary depending on what method is used for data collection (i.e. FS 444 card versus EForwasteBC).

Table 9-1 Cutblock Header Data Format

Field	Data Requirement		Data Format	Comments
	Field	Compilation		
Forest District	Optional	Required	Alpha	Identifies the District office responsible for the administration of the block being sampled.
Reporting Unit	Optional	Required	Numeric	Created by the online Waste System.
Licence	Optional	Required	Alpha Numeric	The Licence number under which harvesting of the cutblock was authorized
Cutting Permit	Optional	Required	Alpha Numeric	The cutting permit number under which harvesting of the cutblock was authorized
Timber Mark	Optional	Required	Alpha Numeric	The timber mark used for the cutblock
Cutblock Name	Required	Required	Alpha Numeric	The cutblock being sampled

Field	Data Requirement		Data Format	Comments
	Field	Compilation		
Location	Optional	Optional	Alpha	
Logged From	Optional	Required	Numeric	The year primary logging started
Logged To	Optional	Required	Numeric	The year primary logging was completed
Logging Completion Date	Optional	Required	Date	Ready for survey date
Survey Date	Required	Required	Date	The date the survey started
Net Area (ha)	Required	Required	Alpha, 2 decimals	Area, in hectares, of the total area of all stratum areas available for sampling and/or estimating.
NP/NF area	Optional	Optional	Alpha, 2 decimals	Area, in hectares, The total area of road surface or non-productive area.
Waste Benchmark Zone (Interior Site Code)	Required	Required	Numeric	Quantifies, in cubic metres per hectare of the avoidable waste threshold
Cruise Volume	Not required	Optional	Numeric	Quantifies, in cubic metres per hectare, the average cruise volume for the block. Data is available from cruise summaries.
Reason for Survey	Not required	Required	Alpha	

Field	Data Requirement		Data Format	Comments
	Field	Compilation		
Return Number	Required	Required	Numeric	Identifies the annual survey number of the waste surveyor responsible for the establishment of the plot. Return numbers will increment by one for each new waste assessment area sampled by the surveyor in a given year. It is the responsibility of each waste surveyor to keep track of their own return number.
Surveyor Licence	Required	Required	Alpha numeric	Identifies the certificate number of the waste surveyor responsible for the establishment of the plot. Those without a certificate number may use the following: Southern Forest Region =WASI Northern Forest Region =WANI
Waste Surveyor Name	Required	Required	Alpha	The name of the waste surveyor responsible for the establishment of the plot.
Professional Designation	Required If registered	Required If registered	Alpha	
Registration Number	Required If registered	Required If registered	Alpha	
Position	Optional	Optional	Alpha	
Notes	Optional	Optional	Alpha	General notes regarding the waste survey

9.6.2 Waste Stratum Codes

Identification of strata within a waste assessment area must be completed using the codes in tables below. Each stratum name is comprised of four characters: waste type, harvest method, plot size, and sub stratification variable. All strata must have unique stratum codes.

9.6.2.1 Dispersed and Accumulated Types and Codes

The FIRST character, (alpha) starting from the left identifies the waste type and defines a new stratum type. The recognized waste types and their codes are as follows:

Table 9-2 Waste Type Codes

	Waste Types	**Code**
1.	**Dispersed Types**	
	Dispersed Retention	D
	Felled and bucked	F
	Group Retention	G
	Historic Waste	H
	Open Slash/Clearcut	S
	Standing Stem	T
2.	**Accumulated Types**	
	Landings	L
	Roadside	R
	Windrow, Debuilt road	W
	Cold decked	C
	Spot accumulation	P
	Off-site landing (i.e. not in the block)	O

The SECOND character (alpha) identifies the method used to harvest the waste type being sampled. This is a descriptive label only and will not cause a separate stratum to be created. Harvesting method codes are shown as follows:

Table 9-3 Waste Stratum Harvest Method Codes

Harvesting Method	Code
Spar (high lead)	S
Grapple yarder	G
Rubber-tired skidder	R
Tractor (cat)	T
Horse	P
Hand logging	M
Hoe chucking	B
Helicopter	H
Any combination	C
Wyssen	W
Other	O

Open slash that has been logged using more than one harvesting method can be given the code for the predominant method or the code for a combination of methods.

The THIRD character identifies the assessment method used. There are three assessment methods:

Table 9-4 Waste Stratum Assessment Method Codes

Code Position	Assessment Method	Code
3rd	Estimate Percent	E
	100% Measure	S
	Plot	*

*When plot method is used select code that corresponds with the plot in table below:

Table 9-5 Plot Size Codes

0 - 50 m^2	5 - 500 m^2
1 -100 m^2	6 - 600 m^2
2- 200 m^2	7 - 1 000 m^2
3 - 300 m^2	8 - 5 000 m^2
4 - 400 m^2	9 - 10 000 m^2

The FOURTH character (alphanumeric) identifies any sub stratification of waste types within a predefined stratum within the waste assessment area.

When significantly different levels of waste occur within a waste type and they can be easily identified and mapped, the waste surveyor may sub stratify them into unique waste levels.

Table 9-6 Waste Stratum Sub Stratification Codes

Code Position	**Sub Stratification**	**Code**
4th	Not stratified	X
	Light	L
	Medium	M
	Heavy	H

If no sub stratification is done, or for 100 percent piece scales, record X under waste level.

Example: Stratum code SB2X

S= Open slash/clearcut dispersed waste type

B= Hoe chucking or machine yarding

2= 200 m^2 plot

X= Not stratified waste level

9.6.2.2 Standing Tree Stratum Codes

Depending on the assessment method used, the stratum codes are:

Table 9-7 Standing Tree Stratum Codes

STRS	Where standing trees are measured individually using the one hundred percent measure method.
STRE	Where standing tree volumes in a patch are estimated using the estimate percent method.

9.6.3 Completion of the Plot Tally Card

Refer to Appendix 8 for example tally card.

A Plot Tally card must be completed for each plot established.

1. If a plot has no pieces, record Nil Plot in the notes section.
2. If using paper tally cards and more than one page is required
    a. Record the page number on all pages, and
    b. Fill out the header line on all individual plot cards so they can be identified and reunited should they become separated.

9.6.3.1 Plot Tally Card

The plot tally card data fields contain the general identification information for the waste assessment area.

Note: the fields shown below may vary depending on what method is used for data collection (i.e. FS 444 card versus EForwasteBC).

Table 9-8 Plot Tally Card Header Description

Field	Requirement	Format	Description
LICENCE	Required for aggregates	Alpha Numeric	The Licence number under which harvesting of the cutblock was authorized
CP	Required for aggregates	Alpha Numeric	The cutting permit number under which harvesting of the cutblock was authorized
BLOCK	Required for aggregates	Alpha Numeric	The cutblock being sampled
DATE	Required	Alpha Numeric	Identifies the year, month and day when the plot was established.
CERTIFICATE NUMBER	Required	Alpha Numeric	Identifies the certificate number of the waste surveyor responsible for the establishment of the plot. Those without a waste licence number may use the following: Southern Forest Region = WASI Northern Forest Region= WANI
RETURN NUMBER	Required	Numeric	Identifies the return number of the waste surveyor responsible for the establishment of the plot.
BASELINE	Optional	Alpha	Identifies the baseline the plot is tied to. Use codes such as “A” “B” “C” etc.
STRIP	Optional	Alpha Numeric	Identifies the strip number that plots are located on.
PLOT NO.	Required	Numeric	Identifies the plot number as identified on the waste survey plan.

Field	Requirement	Format	Description
PLOT SHAPE	Required	Alpha	Identifies the plot shape. Use codes "C" =Circular, "R" =Rectangular, "S" = Square. Must be blank for estimated plots and 100 percent measure plots.
MEASURE %	Required (default 100)	Numeric	Quantifies the percentage of the volume within the plot boundaries that has been measured and recorded.
TYPE STRATUM	Required	Alpha Numeric	Identifies the stratum the plot is located within.

9.6.3.2 Plot Tally Card Piece Descriptions

The piece dimensions recorded in this section are inclusive of decay (i.e. they are not reduced to account for the volume of decay) and only include the portion of the piece within the plot boundaries. The length is measured to the plot boundary and the diameter of that end is taken at that point.

Table 9-9 Plot Tally Card Piece Description

Tally Card Heading	Description	
PIECE NO.	The unique numeric identifier for each tally piece. Increment by one for each new piece. For pieces that are segmented for classification purposes (i.e. a stump with one avoidable segment and one unavoidable segment), use a different piece number for each segment and record MP in the comment column to indicate multiple pieces.	
BORDERLINE	Identifies pieces that lay across the plot boundary.	
	I	Piece completely inside plot.
	B	Borderline piece (measure inside portion only).
	X	Pieces that exceed the plot diameter.

Tally Card Heading	Description			
SPECIES	Identifies the species of the piece. Acceptable codes are as follows:			
	DOUGLAS FIR	FI	WHITEBARK PINE	WB
	RED CEDAR	CE	CYPRESS	CY
	WHITE PINE	WH	BIRCH or CHERRY	BI
	YELLOW PINE	YE	LARCH	LA
	ASPEN	AS	BALSAM	BA
	COTTONWOOD	CO	SPRUCE	SP
	LODGEPOLE PINE	LO	ALDER	AL
	HEMLOCK	HE	MAPLE	MA
	WILLOW	WI	PACIFIC YEW	UU
	ARBUTUS	AR		
KIND	Identifies the nature or shape of the piece.			
	Logs (L)	Includes all logs and slabs at least 3.0 m in length.		
	Down Trees (D)	Includes all down trees exceeding the timber merchantability specification.		
	Standing Trees (T)	Includes all standing trees exceeding the timber merchantability specifications.		
	Stumps (S)	Includes all stumps greater than 0.3m above high side		
	Bucking Waste (W)	Includes all portions of logs and slabs and less than 3 m in length and cut on at least one end in accumulations and cut at the larger or both ends in dispersed waste types.		
	Special Products (X)	Includes already manufactured products less than 3 m in length such as shake bolts or fence posts that have been left on the cutblock.		

Tally Card Heading	Description
WASTE CLASS	Identifies the waste class (avoidable/unavoidable) class of the piece. Acceptable codes: A, U
LENGTH (dm)	Quantifies in decimeters the "in plot" length of the piece.
TOP (R)	Quantifies in rads the gross diameter, inside bark, of the top (small) end.
TOP END	Describes the top end. Acceptable codes: natural (N), cut (C), broken (B) or buried (X).
BUTT (R)	Quantifies in rads the gross diameter, inside bark, of the butt (large) end.
BUTT END	Describes the butt end. Acceptable codes: undercut (U), cut (C), natural (N), broken (B) or buried (X).
GRADE	Identifies the grade of the piece regardless of the kind of wood or waste class. Acceptable codes: 1,2,4,5,6, Z (Interior)
COMMENT CODE	Additional descriptive information that may be useful. Acceptable codes: Table 9-12
PIECE VOLUME	This column displays the net piece volume. A simple formula for computing volume with a pocket calculator is: VOLUME = [(t * t) + (b * b)] * L * K Where V = volume in cubic metres t = top diameter in rads B = butt diameter in rads L = Length in metres K = 0.0001571

9.6.3.3 Deductions for Rot or Missing Wood

Waste surveyors must be able to calculate these deductions accurately and record them on the plot tally card.

Table 9-10 Deduction Descriptions

LENGTH	Quantifies the length deduction in tenths of metres.
TOP	Quantifies in rads the diameter deduction for the top end.
BUTT	Quantifies in rads the diameter deduction for the butt end.
D-DEFECT TYPE	Identifies the type of decay in the piece. Must be recorded whenever a deduction has been recorded.

9.6.3.4 Outside Plot Measurements

Outside plot measurements are optional to collect.

If collected, the comment codes are very useful for explaining the waste classification or grade assigned to the piece. This information is not subject to audit.

Table 9-11 Optional Outside Plot Measurement Descriptions

FAR END	Quantifies the diameter in rads of the actual end of the piece when it is outside the plot boundary. This diameter can be estimated.
ADD LENGTH - ADDITIONAL LENGTH	Quantifies in metres the additional length of the piece that is outside the plot boundary. This length can be estimated.

9.6.3.5 Comment Codes

The comment codes are used to help explain a waste piece. A code is required for all unavoidable waste pieces. The acceptable codes are:

Table 9-12 Comment Codes

Code	Description	Code	Description
BK	Breakage	LB	Long butt
BN	Bunch knots	LN	Large knots
BR	Buried	MB	Machine breakage
CA	Candelabra	MP	Multiple part piece
CC	Creek cleaning	NP	Nil plot
CF	Cat face	OB	Obstructed
CK	Crook	ON	Oversize knots
CL	Culvert log	PR	Pocket rot
CP	Company piece	RE	Reconstructed
CR	Severe Crook	S1	Segment 1
DP	Dead potential	S2	Segment 2
DU	Dead useless	S3	Segment 3
FC	Frost crack	SA	Sapling
FK	Fork	SB	Shake block
FL	Fluted Butt	SH	Shatter
FP	Fence post	SL	Slab
FW	Firewood	ST	Standing tree
GL	Guy line stump	SW	Sweep
HK	Hooked	TR	Whole tree
HN	Heavy knots	US	Unsafe
HP	Helipad	WD	Coarse woody debris
HS	Holding stump	WF	Windfall
IN	Inaccessible	WS	Wind shear
KN	Knots		

9.7 Field Standards

Those responsible for waste assessments must ensure that proper field procedures are followed including the use of industry standard equipment, materials, and conventions.

9.7.1 Field Equipment and Supplies

The waste survey crew should use equipment that can perform the work within the allowable error limits. The recommended equipment is:

1. Hand compass
2. Clinometer
3. Submeter real time GPS
4. Hip chain or 50m chain
5. Logger's tape
6. BC metric scale stick
7. Axe
8. Tree marking paint
9. Flagging ribbons
10. Felt markers
11. Tally book with waterproof paper
12. iPad with EForwasteBC software

9.7.2 Field Survey Standards

When a field assessment requires traversing areas, standard field survey methods must be used including proper notes to support the area compilations. These notes will show:

1. The forward sighting of the bearings,
2. The slope in degrees or percent,
3. Slope distances in metres,
4. Horizontal distances in metres, and
5. Retain traverse notes with all other working papers for inspection by check survey or audit staff.

9.7.3 Marking Partial Cutblock Waste Assessment Areas

Where a partial cutblock will be submitted in a waste assessment, the surveyed portion must be clearly identifiable in the field and on the waste survey plan map. This may require field marking prior to survey.

10. Quality Assurance

10.1 Check Surveys

10.1.1 Introduction

Timber Pricing Branch is responsible for setting the standards for waste surveys, while licensees are responsible, under contract, to meet these minimum standards.

The Ministry audits waste survey information to ensure the standards within this Manual are followed, support the principles of the Take or Pay Policy, revenue, cut control objectives, and to ensure the consistent application of waste information in the billing process.

10.1.2 Objectives

The objectives of the quality assurance review are to ensure:

1. The integrity of the sample design by assessing the accuracy and completeness of:
    a. The sampling plan, and
    b. The waste assessment area survey map.
2. Waste measurements, classifications, and procedures were carried out as described in this Manual,
3. The survey has been completed within the net volume and value and individual parameters identified in this section,
4. Field assessments and reports were completed and submitted on time, and
5. The reports generated from the HRC are consistent with the survey plan and reflect the data collected in the field.

If any of the preceding components of the survey are not acceptable, the Licensee must undertake corrective actions to ensure the survey meets the minimum Ministry standards.

Timber Pricing Branch may consider exceptions to these standards in extenuating circumstances on a case by case basis.

10.1.3 Check Survey Timing

It is the Ministry prerogative to conduct a check survey at any time.

Post harvest treatments cannot commence until the waste survey audits have been completed, audited, and approved in the Waste System.

10.2 Check Survey Standards and Procedures

Check surveys verify that the sampling plan was developed according to the standards and that the field measurements were collected and recorded correctly.

Check surveys may be comprised of office checks of the survey planning process or checking of the field survey work and data submitted to the Waste System.

Field checking may constitute audits of plot location attributes, waste assessment area strata delineation, piece data audits, or a combination of all.

The check survey will remeasure the attributes that were measured in the original survey. The full survey or parts of a survey of a waste assessment area or a reporting unit can be accepted or rejected based on the results of the check survey.

Field Services staff may check more than the minimum requirement if it is necessary to ensure compliance with the manual standards (i.e. previous check(s) showed borderline acceptable work).

When requested by the Ministry, the licensee must submit the original waste survey data in the format it was collected (either digital format or paper tally cards), a copy of the final survey plan map, area calculations, and any notes related to the survey. Digital plot data must be submitted in a format compatible with Ministry equipment.

10.2.1 Field Check Requirements

In check surveys, the following number of plots are remeasured:

1. Small Populations
    a. In each accumulation stratum, at least 10 percent of the measure plots, or a minimum of two plots, whichever is greater, and
    b. In each dispersed stratum, at least 10 percent of the measure plots, or a minimum of five plots, whichever is greater.

In an aggregate population, the minimum number of plots to be checked are based on the number of plots from the sample plan and any other strata that exist within the waste assessment area being checked. Prediction plots may be checked at the discretion of the auditor. To reject a survey based on prediction plot volumes, at least 10 percent of the prediction plots, or a minimum of five, whichever is greater, must be checked.

In order to reject a waste survey on the basis net volume and value, the auditor will audit the number of measure plots specified above within the sample population.

Otherwise, to reject a survey based on the individual parameters, the minimum number of check plots will include both prediction and measure plots. If fewer plots have been audited and there is mutual agreement between the waste surveyor or licensee representative and the auditor, the survey may be rejected.

10.2.2 Field Checking Standards

10.2.2.1 Maximum Allowable Errors

Measurement of a random selection of samples within a waste assessment area is used to assess the acceptability of the survey results. The items to be checked and their acceptable limits of errors are specified below.

10.2.2.2 Net Volume and Value

Exceeding the parameter for either the net volume or net value of waste (avoidable and unavoidable) is grounds for rejection of the survey.

Table 10-1 Net Volume and Value

Net Volume	The net volume of waste within a waste assessment area must not vary by 10.0 percent from the net volume of waste determined by the check surveyor.
Net Value	The net value of waste within a waste assessment area must not vary by 10.0 percent from the net value of the waste determined by the check surveyor. The net value is derived by multiplying the volume of each species/grade combination by the applicable waste rate.

10.2.2.3 Individual Parameters

Although the net volume and net value are the main determining factors for accepting or rejecting a survey, a survey may be rejected if any of the individual parameters identified below have been exceeded. Additionally, even when the volume and value standards have been achieved within a waste assessment area, if continuous or repeated errors are identified, the District Manager may order a resurvey as required.

Table 10-2 Individual Parameters

Attribute	Standard
Conifer/deciduous identification	Plus or minus two (2.0) percent of all pieces
Species identification	Plus or minus five (5.0) percent of all pieces
Area (stratum)	Plus or minus two (2.0) percent.
Strata identification	No variation allowed
Measure percent	Plus or minus ten (10) percent.
Plot boundary marking	Plus or minus 0.10m (10 cm) when measured on borderline pieces.
Location of plots	No variation allowed (plots must be located in the stratum they were meant to sample)
Count of waste piles	Less than twenty (20) check piles – no variation allowed. Greater than or equal to twenty (20) piles - the count must be within 5% of the checked number.

Failure to follow the procedures specified throughout this manual may result in rejection of the survey. Some examples are:

1. Incorrect location of plots (not using the correct POC and Grid Spacing Distance),
2. Establishing more plots or less plots than required from the pre-determined sampling intensity,
3. Establishing a plot which samples outside the stratum it is located in,
4. Check surveyor is unable to audit the layout of the plots,
5. Check surveyor **is** unable to audit the plots and pieces due to poor marking,
6. Using an incorrect method of selecting the piles to be sampled, and
7. Using an incorrect or biased method of determining the prediction volumes.

10.2.2.4 Plot Location Standards

Plot establishment audits will be conducted using the same form of survey equipment used to establish the plots. Where hand traverse methods are used field audits will be completed with hand traverse equipment of equal or higher quality. Where GPS plot location methods are used submeter real time GPS data collectors will be used to audit the work.

10.2.2.5 Hand Traverse Plot Location

Hand traverse plot locations will be audited using hand compass, tight chain and Suunto. Traverse auditing will follow the same direction of travel as the original survey. Audit standards will be calculated by totaling the cumulative survey distance divided by the cumulative audit distance.

Table 10-3 Hand Traverse Plot Location Standards

Attribute	Standard
Horizontal Distance	Plus or minus 2.0 percent (2.0 m per 100m).
Bearings	Plus or minus 2.0 degrees (+/- 3.5 m per 100m).

Note: Plus or minus 2 degrees translates to 3.5 m in 100 m using the formula:

(100 (tan 2 degrees)) = 3.49 percent, therefore,
3.49 % * 100 m = 3.49 m (rounds to 3.5m)

10.2.2.6 GPS Plot Location for Auditors

1. Submeter real time GPS data collectors must be used to audit the work.
2. The auditor will travel to the surveyed plot location and collect a GPS data point, a minimum of 50 GPS data points will be required to collect a point.
3. In order for a survey to be rejected for waste plot location, either both of the first two standards (a and b) must be exceeded, or the last standard (c), when a Plot Reference Point (PRP) is used, must be exceeded:
    a. The average variation of all waste plot locations checked must be within 3.0m of the check survey plot locations.
    b. Individual variations between the check survey plot locations and the original plot locations must be within 5.0m. A tolerance of one plot location outside of 5.0m will be allowed for every ten (or less) plots checked.

c. The distance and bearing between the waste surveyor's PRP (if established) and waste plot must meet the same standards as those for hand traverse methods:

   i. Horizontal distance: plus or minus 2.0 percent

   ii. Bearing: plus or minus 2.0 degrees

4. In order to require a resurvey based on these standards, a minimum of 5 measure plot locations, or 10% of the measure plot locations, whichever is greater, must be checked.

10.2.3 Acceptability of Check Survey Results

If the net value and volume of the checked plots falls within the specified variance, then the survey is deemed to be acceptable unless the procedures specified in the manual were not adhered to (i.e., incorrect area used, log decks not included in the survey). Any obvious bias in volumes, grades and/or waste class which affect monetary billing will also result in rejection of the survey.

If the net volume or value parameters are not met, then the check survey will pinpoint the areas of weakness and allow that portion or entire survey to be redone.

If more than two check surveys or 20 percent of the checked waste assessment areas within a reporting unit or sampling plan are rejected, the District Manager may order that all the waste assessment areas within that reporting unit or sampling plan be resurveyed. However, if continuous or repeated errors are identified, the District Manager may order a resurvey of the reporting unit or sampling plan after one check survey.

10.2.4 Non-Compliance with Check Survey Standards

If the survey work is rejected after a check survey, the District Manager may order the licensee to resurvey the entire waste assessment area or those portions of the original survey that do not meet the standards. The resurvey must be completed prior to any post harvest treatment occurring and/or within 60 days of the District Manager's notification.

The licensee will be responsible for any costs they incur in the resurvey.

A full or partial resurvey may be subject to a second check survey carried out at the District Manager's discretion.

10.2.5 Dispute Resolution

A licensee who has been ordered to perform a resurvey may request a second check survey in writing to the District Manager.

The District Manager may have a second check survey performed using ministry personnel that were not involved in the first check survey. The second check survey will be completed within 30 days of the original survey rejection, or on another date as determined by the District Manager depending on staff availability and the accessibility of the waste assessment area.

If the second check survey:

1. Finds the original survey in non-compliance with check survey standards:
    a. The licensee will perform a resurvey to replace the original survey at their expense, and
    b. The licensee who requested the second check survey must pay to the government the charges, costs and expenses incurred by the government in respect of conducting the second check survey.
2. Finds the original survey in compliance with check survey standards:
    a. The original survey will be accepted as submitted, and
    b. No charges, costs, and expenses in respect of the second check survey will be charged.

10.2.6 Dispute Resolution (BCTS)

Where there are billable waste volumes on a Timber Sale Licence, Forestry Licence to Cut or permit issued by BCTS following a waste assessment conducted by BCTS, the Timber Sales Manager may notify the TSL holder about the waste assessment results. In the event that the TSL holder disputes the waste assessment results, the holder may submit a letter in writing specifying the grounds of dispute to the TSM within thirty (30) days of receiving the assessment results.

If the TSL holder is notified of the assessment results and no letter of dispute is received by the TSM, the TSL holder is deemed to have accepted the waste assessment results.

Once the TSM has forwarded the TSL waste assessments to the District Manager, subject to the field check that may be carried out by the district staff, the results are deemed to be final.

Any disputes relating to the check surveys and waste billing rates should be directed to the District Manager.

10.3 Waste Submission Review

The Ministry staff will review all data submitted to the Waste System and/or the District and either approve or reject the waste assessment(s).

10.3.1 Office Review Standards

Table 10-4 Office Review Standards

Attribute	Standard
Final sample plan configuration	Completed in accordance with section 6.3
Final aggregate sample plan configuration	No variation of waste assessment areas allowed
Net waste area (strata or waste assessment area)	Plus or minus 2.0 %
Multiple mark identification	No variation allowed
Multiple mark area	Plus or minus 2.0 %
Number of plots	Plus or minus one (1), except in aggregate populations where no variation is allowed
Grid spacing distance	Plus or minus 2.0 %
SPIF	Plots must be located in accordance with the assigned SPIF
Waste survey map	Completed in accordance with section 6.8.1
Site Type	No variation
Benchmark value	No variation

10.3.2 Processing Waste Volume Estimates

Once checking is completed, the Ministry will:

1. Process the submission and forward to HBS for billing or,
2. Advise the licensee if the submission has been rejected.

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11. Appendices

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Appendix 1 Glossary

Words and expressions used but not defined in this Manual, unless the context otherwise requires, have the same meaning as in the Forest Act.

"**AAC**" means Allowable Annual Cut as defined in the *Forest Act*;

"**Act**" means *Forest Act*;

"Aggregate Waste Submission" means a waste submission relating to two (2) or more waste assessment areas but not exceeding 19 waste assessment areas;

"**Agreement**" means a form of agreement granting rights to harvest Crown timber referred to in section 12 of the *Act*, or a pulpwood agreement;

"Avoidable Waste" means wood material that meets or exceeds the Timber Merchantability Specifications that does not fall within the definition of unavoidable waste;

"**Batch**" means a grouping of one or more waste assessment areas selected from a population that have been selected to be surveyed;

"**BCTS**" means BCTS as defined in the *Forest Act*;

"**Bernoulli selection process**" means to sample cutblocks where each cutblock is selected individually for inclusion into the sample, using the same selection probability as in previous batches;

"**Breakage**" means any piece of a tree, meeting the minimum diameter set by the TMS, which has a gross length shorter than 3.0 m in length and is broken at the large end or broken at both ends. This definition is not consistent with the inventory definition of breakage nor is it intended to be;

"**Bucking Waste**" means a portion of a tree or log greater than the top diameter set by the TMS that is less than 3.0 m in length and which has been cut at the large or both ends. To be measured as bucking waste the piece must have originated from a tree or log at least 3.0 m in length;

"**Cardinal direction**" means North, South, East and West. All references to azimuths or bearings mean the "true" value;

"**Cold deck**" means five or more grade 1, 2, 4 or 6 (when required to be measured) logs that are mechanically placed together in a deck;

"**Conventional**" means any harvest method that does not use a helicopter;

"**Cruise Based**" means a cutting authority where under section 106 of the *Act* the stumpage payable is calculated using information provided by a cruise of the timber conducted before the timber is cut;

"**Cutblock**" means an area that meets the cutblock requirements as specified in the Interior Appraisal Manual;

"**Cutting Authority**" means:

1. A cutting permit issued under a Forest Licence, Timber Sale Licence, a Timber Licence, a Tree Farm Licence, a Community Salvage Licence, a Master Licence to Cut, a Forestry Licence to Cut, or a First Nation Woodland Licence;
2. A Timber Sale Licence that does not provide for the issuance of a cutting permit;
3. All other Licences to Cut; or
4. A Road Permit;

"**Cutting Authority Area**" means the area where timber may be harvested under the cutting authority being appraised, and which has a unique timber mark;

"**Deciduous Timber**" means timber that is not of a coniferous species;

"**Decked Timber**" has the same meaning as a cold deck;

"**Director**" means the Director of Timber Pricing Branch of the Ministry of Forests, Lands and Natural Resource Operations and Rural Development;

"**Firmwood**" means the amount of solid wood within a log or waste piece after accounting for rot, hole, char and missing wood.

"**Forest Professional**" means a Registered Professional Forester (RPF), a Registered Forest Technologist (RFT) or a special permit holder acting within the scope of their permit, registered and in good standing with the Association of BC Forest Professionals;

"GPS (Global Positioning System)" means a method of determining or relocating a ground position using the signal from several satellites simultaneously. A small portable computer evaluates the time for each signal to reach it and then computes a three-dimensional location;

"**GIS Software**" means a Geographic Information System designed to capture, store, manipulate, analyze, manage, and present geographical data;

"Harvest" means to cut, cut and remove, or remove timber from a cutting authority, other than on road permit areas within a cutblock;

"Harvest Residue Compiler" means a data compilation software application used to create sample populations and to calculate waste data for input into the Waste system;

"HBS" means the Harvest Billing System administered by the Ministry;

"HDOP" means horizontal dilution of precision, which is a measure of the precision of GPS results related to the satellite positions. As HDOP decreases, the level of precision increases;

"**Licensee**" means the holder of a cutting authority;

"**Log**" means any near-round piece with more than half of its original diameter remaining and with an average diameter equal to or larger than the timber merchantability specification diameter for at least 3.0m of length;

"**Manual**" means the Provincial Logging Waste and Measurement Procedures Manual-Interior Version;

"**Merchantable Timber**" means timber that meets or exceeds the timber merchantability specifications that are described in Table 3-1 in this Manual. Timber that is graded 6 or Z (Interior) is not merchantable;

"**Minister**" means the Minister of Forests, Lands, Natural Resource Operations and Rural Development;

"**Ministry**" means the Ministry of Forests, Lands, Natural Resource Operations and Rural Development;

"Net Waste Area" means the area of a cutblock in hectares reported in a waste submission as the area in which merchantable timber that was authorized to be cut was harvested less any non-productive area created during harvest operations (i.e. roads);

"**North Area**" means Northeast, Omineca, and Skeena Regions excluding that portion that lies geographically within the North Coast Timber Supply Area;

"Number of Samples" means the number of samples of either waste assessment areas or plots in a waste survey;

"Other related sections" in the context of the *Forest Act*, means sections 13(3)(b)(ii), 14(1)(d)(ii), 20(3)(b)(ii), 22(f)(ii), 30(f)(ii), 33(5)(b)(ii), 35(1)(c)(ii), 43.3(1)(d)(ii), 43.55(1)(d)(ii), 43.7(2)(e)(ii), 43.8(e)(ii), 45(1)(d)(ii), 47.5(1)(a)(ii), 47.5(2)(b)(ii), 47.7(f)(ii), 118(1)(c)(ii);

"PDOP" means positional (3D) dilution of precision, which is a measure of the precision of GPS results related to the satellite positions. As PDOP decreases, the level of precision increases;

"Pencil Buck" means the act of recording bucking waste or stumps as two or more pieces of waste material. Surveyors will divide (pencil buck) the piece of waste at the point where the waste class changes from avoidable to unavoidable waste as a result of a defect in the piece;

"Pile" means an accumulation of woody material created by a machine that contains one or more pieces of waste;

1. Roadside Pile means a pile in which the majority of the pile area (footprint) is located adjacent to and within 20 metres of a road edge.
2. Dispersed Pile means a pile in which the majority of the pile area (footprint) is located greater than 20 metres from the road edge.

"POC" means 'Point of Commencement' – a point in or near a cutblock used to locate sample plots or to start a sampling procedure;

"Population" means a single item or group of items for which an estimate through the sampling process is made including but not limited to an estimate for a group of cutblocks, sample cutblocks, plots or waste pieces;

"**Primary Logging**" the cutting of timber and the yarding of that timber to a central landing, road side, or drop area in a logging operation;

"Primary Logging Completion Date" the earlier of the date on which:

- the yarding of all the timber that is cut in a cutblock to a central landing, roadside, or drop area in a logging operation is completed; or
- one month after the date in which the yarding of all the timber that is cut in a cutblock to a central landing, roadside, or drop area in a logging operation is completed for waste assessment areas authorized under the Concurrent Residual Harvest System.

"**Reporting Unit**" means a tracking mechanism to store, track and report waste information;

"**Regulations**" means regulations under the *Act*;

"**Ready for Survey**" means the earlier of:

1. The primary logging complete date, or
2. The date that the cutting authority authorizing harvest expires, is suspended or otherwise terminated;

"Reserved Timber" means merchantable standing timber left after completion of primary logging within the cutting authority area that is intentionally retained for silviculture, riparian management, biodiversity or forest management reasons. It must be identified as:

1. Areas reserved from harvest on a map submitted by the licensee for waste assessment purposes, and/or
2. Standing timber retained in accordance with a partial cutting regime, or otherwise reserved from cutting, when identified in the cutting authority and appraisal;

"Residue" means timber, whether standing or felled, except timber reserved from harvest, which does not meet or exceed the timber merchantability specifications described in this Manual that was not removed from the cutting authority area;

"**Road Permit**" means road permit as defined in the *Forest Act*;

"Sampling Plan" contains the waste assessment areas to be reported, the sampling methodology, and the other criteria that will be used to define the sample size;

"Sample size" means the number of samples included in a waste survey to meet the objectives of the Sample Plan;

"**Scale Based**" means a cutting authority where the stumpage payable is calculated using a scale of the timber;

"**SPIF**" (**S**tarting **P**oint **I**nterval **F**actor) means a value determined on a monthly basis by the Ministry to be used by Agreement holders to generate a random starting point for sampling grids. The SPIF will be randomly determined at 10% intervals ranging from 10 to 90%;

"Slab" means any non-round piece of timber that has fractured along a plane roughly parallel to the longitudinal axis of the original log that has a minimum thickness of 10 cm for at least 3.0m of its length and an average diameter equal to or larger than the TMS diameter;

"**South Area**" means Cariboo, Kootenay-Boundary and Thompson-Okanagan Regions;

"Standing trees" means trees authorized for harvest under the cutting authority (excepting reserved trees) but at the discretion of the licence holder are not cut and removed.

"**Stub (Stubbed) trees**" means the practice of harvesting or removing a portion of the tree so that part of the bole (stem) above stump height remains;

"**Stump"** means any piece of timber in which more than one half (1/2) of its original diameter is remaining, is less than 3.30 m in length and which has a cut top and is still attached to the roots;

"Tie point" means a falling corner. A specific point on the ground whose location is readily identifiable on a digital image, aerial photograph or map (i.e. road intersection, corner of a field or swamp, field located station) may be used if agreed to by the District and surveyor;

"Timber Merchantability Specifications or TMS" means the stump height and diameter, log top diameter, slab thickness and log length specified in this Manual;

"**Timber Pricing Branch or TPB**" means the Timber Pricing Branch of the Ministry;

"**Timber Pricing Branch website**" is:
https://www2.gov.bc.ca/gov/content/industry/forestry/competitive-forest-industry/timber-pricing/forest-residue-waste

"**Timber Sales Manager or TSM**" means the Timber Sales Manager or the Timber Sales Manager's designate;

"Tree" means any live or dead piece of a tree still attached to its roots having an average diameter equal to or larger than the TMS diameter for at least 3.0m of its length;

"Unavoidable Waste" means wood material that meets or exceeds the Timber Merchantability Specifications that:

1. Is inaccessible or physically obstructed;
2. Could not be felled, bucked or removed due to safety reasons;

3. Could not be felled, bucked or removed due to physical, environmental or stewardship reasons;

"Unharvested" means a cutblock where:

- no timber is cut, or
- the timber is cut and not removed to a scale site.

"Volume Estimate" means the determination of a volume of material using sampling principles and measurements in accordance with this Manual;

"Volume Prediction" means a forecast of waste volume at the waste assessment areas or plot level;

"Waste" means timber, whether standing or felled, except timber reserved from cutting, which meets or exceeds the Timber Merchantability Specifications described in this Manual that was not removed from the cutting authority area by the Agreement holder;

"Waste Assessment" means an assessment conducted in accordance with the procedures set out in the Manual for determining the volumes of Waste and Residue left on a harvested area following completion of harvesting operations;

"Waste Benchmark" means the volume of avoidable waste, expressed in cubic metres per hectare that can be left on a harvested area without being subject to a monetary waste assessment;

"**Waste System**" means the online Waste System;

"**WMRF**" (waste monetary reduction factor) means a factor applied to the waste rate to generate a waste billing rate.

Appendix 2 WMRF and Billing Calculations

BRITISH COLUMBIA

INTERIOR

Worksheet for Waste Billing Against Benchmarks

Ministry of Forests

To be Completed by by Licensees

Licence No.		CP No.	Cut Block
Timber Mark		Reporting Unit No.	
Primary Logging Completion Date		Cut Block Net Area	ha
Location		Stand/Site Type	

Calculations

Avoidable waste conifer sawlog (grades 1 and 2) _____ M^3/ha..... (A)

Established benchmark = _____ M^3/ha..... (B)

(A) - (B) = _____ M^3/ha..... (C)

If (C) < or = 0.0000, stop

If (C) > 0.0000, proceed as follows:

Waste Monetary Reduction Factor (WMRF) = (C)/(A) = _____ .....(D)
(to four decimals)

To be Completed by Forest Service

Processing

If (C) is < or = 0.0000, on FS 702, code:

Avoidable all species sawlogs (grades 1 and 2): $0.00/$m^3$

Avoidable all species grade 4: $0.25/$m^3$

Unavoidable all species all grades: $0.00/$m^3$

If (C) is > 0.0000, request average sawlog rate from HBS

Average coniferous sawlog rate (HBS) = $ _____ /m^3 .....(E)

Deciduous sawlog rate = $ _____ /m^3 .....(F)

On FS 702, code

Avoidable coniferous species sawlogs (D x E) = $ _____ /m^3

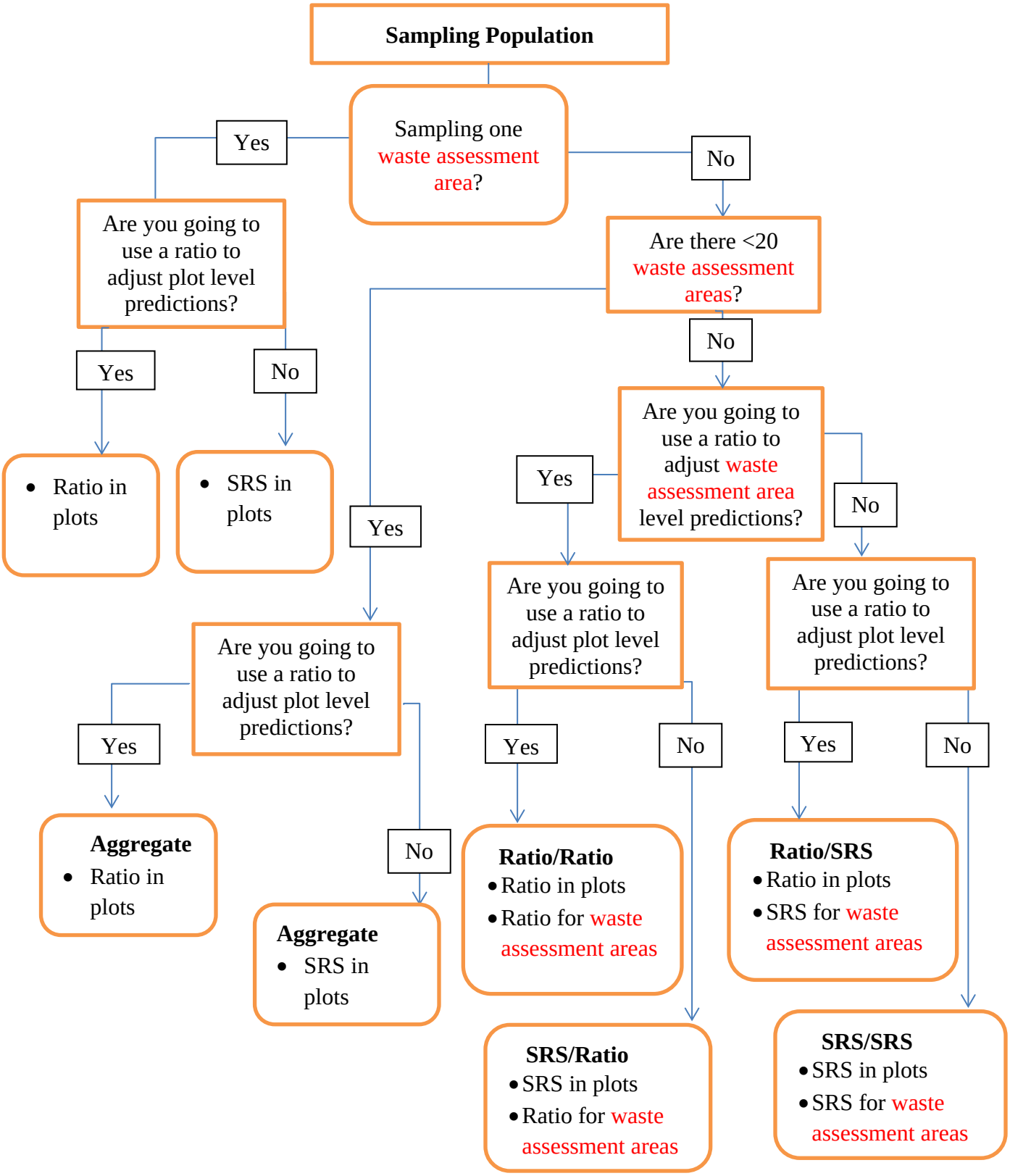
Avoidable deciduous species sawlogs: (F) = $ _____ /m^3

Avoidable all species grade 4: $0.25/$m^3$

Unavoidable all species all grades: $0.00/$m^3$

Approved by Forest Officer (signature)	Date

Appendix 3 Sampling Population Flowchart



Appendix 4 Plot Table Charts for Single Waste Assessment Area Populations

Spot Accumulation (Pile) Strata - Minimum # of Plots			
Total Number of Piles (greater than or equal to)	**# of Measure Plots for SRS**	**# of Prediction Plots for Ratio**	**# of Measure Plots for Ratio**
1*	10	12	4
13	11	12	4
15	11	13	4
18	12	13	4
20	12	14	5
23	13	14	5
25	13	15	5
28	14	15	5
30	14	16	5
33	15	16	5
35	15	17	6
38	16	17	6
40	16	18	6
43	17	18	6
45	17	19	6
48	18	19	6
50	18	20	7
53	19	20	7
55	19	21	7
58	20	21	7
60	20	22	7
63	21	22	7
65	21	23	8
68	22	23	8
70	22	24	8
75	23	25	8
78	24	25	8
80	24	26	9
83	25	26	9
85	25	27	9
88	26	27	9
90	26	28	9
93	27	28	9
95	27	29	10
98	28	29	10
100	28	30	10
103	29	30	10
108	30	30	10

* If there are more plots required than spot accumulations, evenly disperse as many plots as possible on the spot accumulation(s) in the waste assessment area.

Dispersed Strata - Minimum # of Plots			
Total Stratum Area (Ha) (greater than or equal to)	**# of Measure Plots for SRS**	**# of Prediction Plots for Ratio**	**# of Measure Plots for Ratio**
0.01	3	4	1
1.0	6	9	3
2.0	10	18	6
10.5	11	18	6
11.5	12	18	6
12.5	13	18	6
13.5	14	18	6
14.5	15	18	6
15.5	16	18	6
16.5	17	18	6
17.5	18	18	6
18.5	19	18	6
19.5	20	18	6
20.1	20	24	8
20.5	21	25	8
21.5	22	26	9
22.5	23	28	9
23.5	24	29	10
24.5	25	30	10
25.5	26	31	10
26.5	27	32	11
27.5	28	34	11
29.5	30	36	12
33.5	31	37	12
40.5	32	38	13
47.5	33	40	13
54.5	34	41	14
61.5	35	42	14
68.5	36	43	14
75.5	37	44	15
82.5	38	46	15
89.5	39	47	16
96.5	40	48	16
103.5	41	49	16
110.5	42	50	17
117.5	43	52	17
124.5	44	53	18
131.5	45	54	18
138.5	46	55	18
145.5	47	56	19
152.5	48	58	19
159.5	49	59	20
166.5	50	60	20

Other Accumulation Strata (i.e. Roadside) - Minimum # of Plots			
Total Stratum Area (Ha) (greater than or equal to)	**# of Measure Plots for SRS**	**# of Prediction Plots for Ratio**	**# of Measure Plots for Ratio**
0.01	2	3	1
1.0	5	6	2
2.0	10	12	4
12.5	11	12	4
14.5	11	13	4
17.5	12	13	4
19.5	12	14	5
22.5	13	14	5
24.5	13	15	5
27.5	14	15	5
29.5	14	16	5
32.5	15	16	5
34.5	15	17	6
37.5	16	17	6
39.5	16	18	6
42.5	17	18	6
44.5	17	19	6
47.5	18	19	6
49.5	18	20	7
52.5	19	20	7
54.5	19	21	7
57.5	20	21	7
59.5	20	22	7
62.5	21	22	7
64.5	21	23	8
67.5	22	23	8
69.5	22	24	8
72.5	23	24	8
74.5	23	25	8
77.5	24	25	8
79.5	24	26	9
82.5	25	26	9
84.5	25	27	9
89.4	26	27	9
89.5	26	28	9
92.5	27	28	9
94.5	27	29	10
97.5	28	29	10
99.5	28	30	10
102.5	29	30	10
107.5	30	30	10

Appendix 5 Grid Spacing Worksheet

Waste Grid Spacing Worksheet					
Sample Plan:		Example			
Required Plots:		45			
Plot Grid formula:		SQRT(10,000 * Area/ # plots)			
Column Number	(1)	(2)	(3)	(4)	(5)
Block	**Block Area (ha)**	**Ha/plot Ratio** (Col 1 / Total)	**Plots per Block** (Col 2 /total Plots) (Rounded)	**Calculated Grid Spacing (m)** (Col 1/Col 3)	**Adjusted Grid Spacing (m)**
1	10	0.13	6	129	125
2	5	0.06	3	129	125
3	15	0.19	8	137	135
4	20	0.25	11	135	135
5	30	0.38	17	133	130
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
Total	80		45		

Appendix 6 Net Waste Area Example Calculation

This example of waste area calculations is based on the following map of A92837 Cutblock 2.

1. Assumptions
    a. Right of way width 20 m
    b. Road surface width 5 m
    c. Roads marked to RP20172
2. Cutblock harvested area calculation
    a. Cutblock Area (from ECAS/Cruise) = 17.31 ha
    b. WTRA (from map) = 3.62 ha
    c. Net harvested = 13.69 ha
3. Add external roads (20m Right of way)

a. Spur A 0 m-430 m	= 430 m * 20 m	= 8600 m^2 (0.86 ha)
b. Spur B 0m-200 m	= 200 m * 20 m	= 4000 m^2 (0.40 ha)
c. Spur C 425 m-625 m	= 200 m * 20 m	= 4000 m^2 (0.40 ha)
a. 735 m-800 m	= 65 m * 20 m	= 1300 m^2 (0.13 ha)
d. Spur D 10 m-091 m	= 81 m * 20 m	= 1620 m^2 (0.16 ha)
a. 166 m-213 m	= 47 m * 20 m	= 940 m^2 (0.09 ha)
e. Total Roads		= 20460 m^2 (2.05 ha)

4. Subtract non-productive (road surface) areas (Road surface 5 m width):

a. Spur A 0 m-564 m	= 564 m * 5 m	= 2820 m^2 (0.28 ha)
b. Spur B 0 m-1200 m	= 1200 m* 5 m	= 6000 m^2 (0.60 ha)
c. Spur C 425 m-925 m	= 500 m * 5 m	= 2500 m^2 (0.25 ha)
d. Spur D 0 m-250 m	= 250 m * 5 m	= 1250 m^2 (0.13 ha)
e. Total Roads	= 2514 m	= 12570 m^2 (1.26 ha)

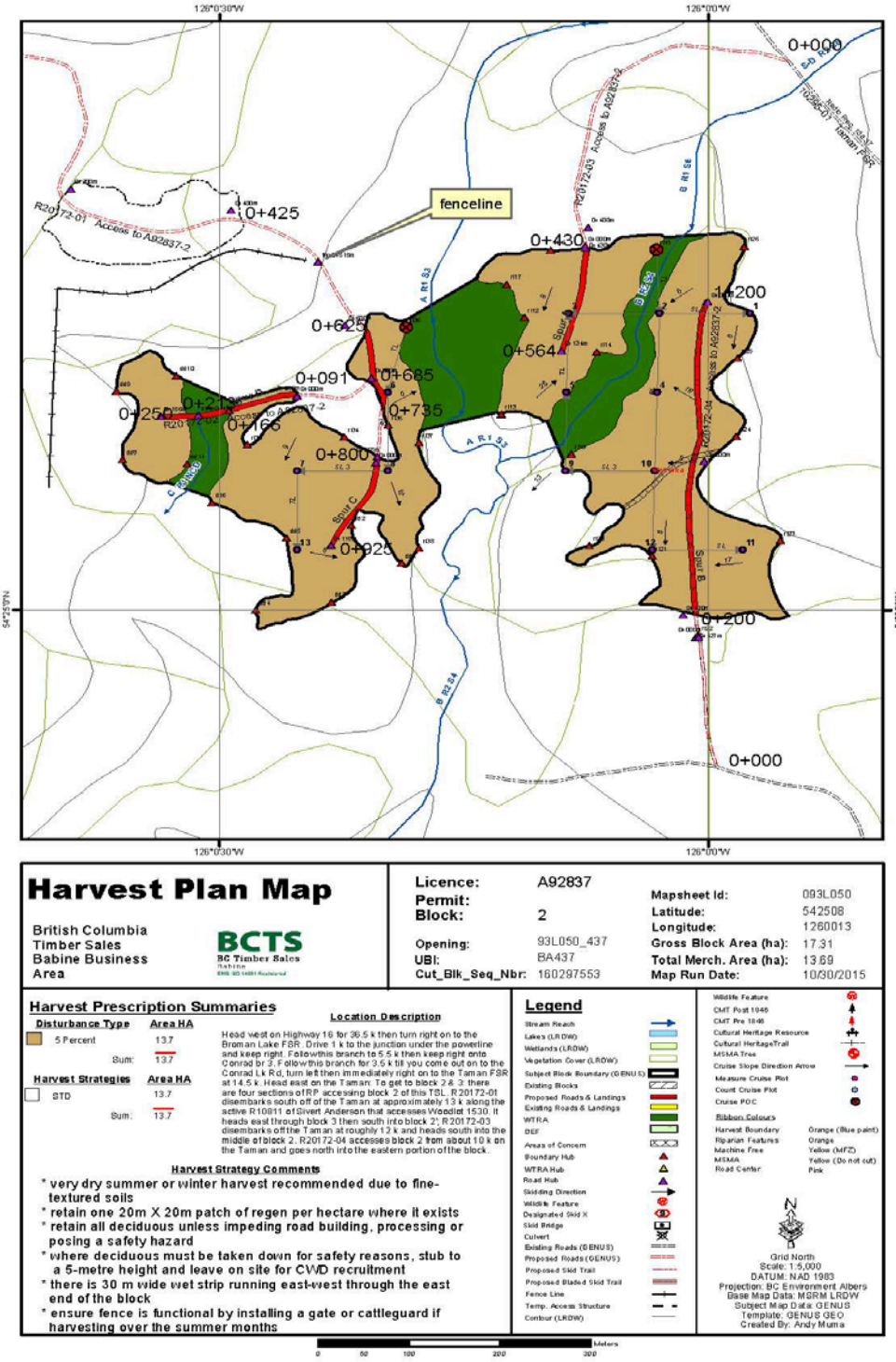
5. Cutblock Net Waste Area

a. Cutblock Net Harvested area	13.69 ha
i. + External Roads	2.05 ha
ii. - Non-Productive	1.26 ha
b. Cutblock Net Waste Area	14.48 ha

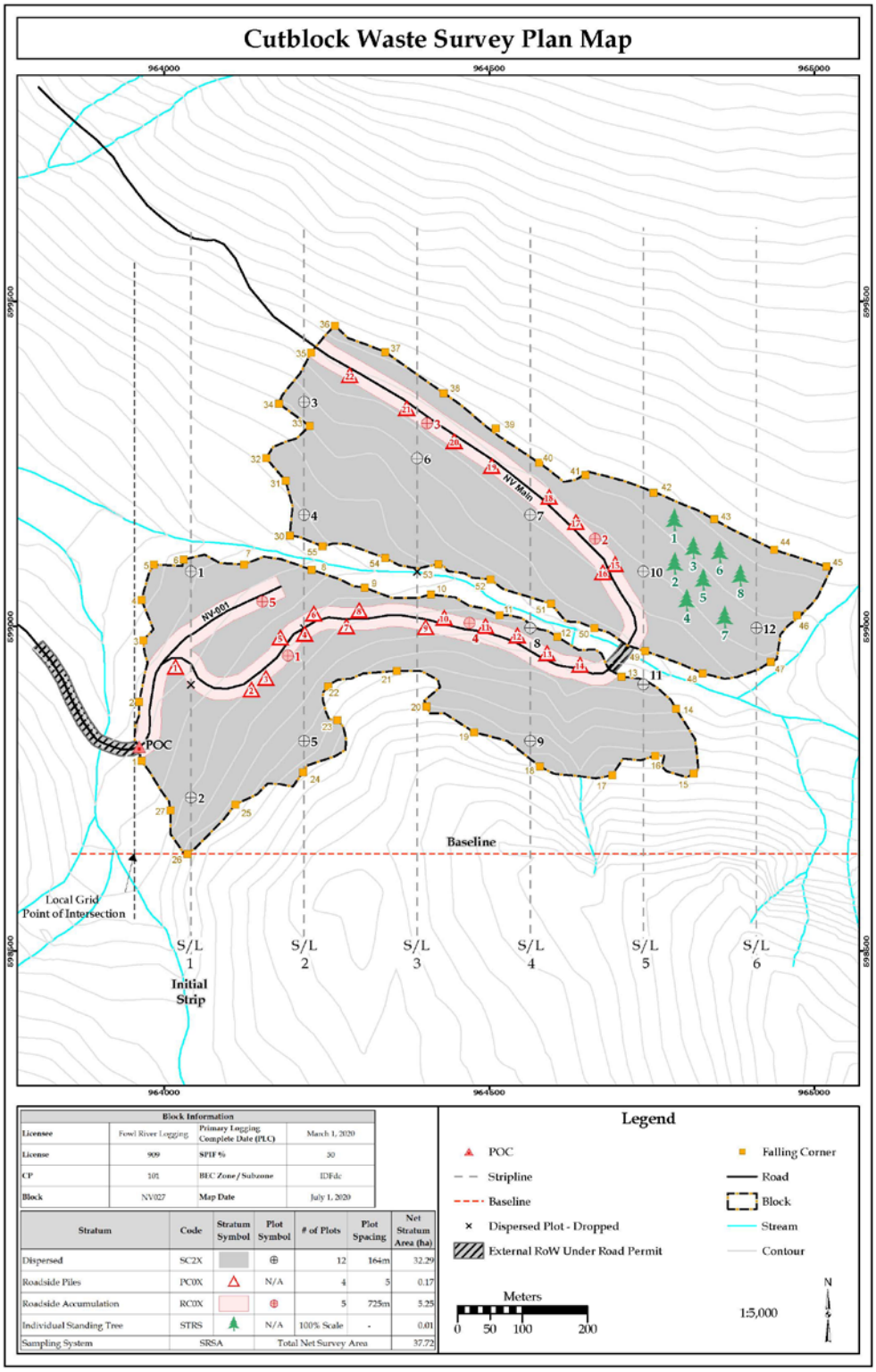
6. Timber Mark Area (Multi Mark Submission)

a.	Road Permit Mark:	- Total Road Length of 2514 m * 15 m*	= 3.77 ha
b.	Primary CP Mark:	14.48 ha -3.77	= 10.71 ha
c.	Total		= 14.48 ha

* Road permit width is 20 m R/W – 5m road surface = 15 m.


126°0'30"W
126°0'0"W
54°5'9"N
54°2'0"N
0+000
0+425
fenceline
0+430
1+200
0+625
0+564
0+091
0+685
0+735
0+800
0+925
0+200
0+000
R20172-01 Access to A92837-2
R20172-03 Access to A92837-2
R20172-04 Access to A92837-2
Spur B
Spur C
Harvest Plan Map
British Columbia Timber Sales Babine Business Area
BCTS
BC Timber Sales
Licence: A92837
Permit:
Block: 2
Opening: 93L050_437
UBI: BA437
Cut_Blk_Seq_Nbr: 160297553
Mapsheet Id: 093L050
Latitude: 542508
Longitude: 1260013
Gross Block Area (ha): 17.31
Total Merch. Area (ha): 13.69
Map Run Date: 10/30/2015
Harvest Prescription Summaries
Disturbance Type Area HA
5 Percent 13.7
Sum: 13.7
Harvest Strategies Area HA
STD 13.7
Sum: 13.7
Location Description
Head west on Highway 16 for 36.5 k then turn right on to the Broman Lake FSR. Drive 1 k to the junction under the powerline and keep right. Follow this branch to 5.5 k then keep right onto Conrad br 3. Follow this branch for 3.5 k till you come out on to the Conrad Lk Rd, turn left then immediately right on to the Taman FSR at 14.5 k. Head east on the Taman. To get to block 2 & 3: there are four sections of RP accessing block 2 of this TSL. R20172-01 disembarks south off of the Taman at approximately 1.3 k along the active R10811 of Sivert Anderson that accesses Woodlet 1530. It heads east through block 3 then south into block 2; R20172-03 disembarks off the Taman at roughly 1.2 k and heads south into the middle of block 2. R20172-04 accesses block 2 from about 1.0 k on the Taman and goes north into the eastern portion of the block.
Harvest Strategy Comments
* very dry summer or winter harvest recommended due to fine-textured soils
* retain one 20m X 20m patch of regen per hectare where it exists
* retain all deciduous unless impeding road building, processing or posing a safety hazard
* where deciduous must be taken down for safety reasons, stub to a 5-metre height and leave on site for CWD recruitment
* there is 30 m wide wet strip running east-west through the east end of the block
* ensure fence is functional by installing a gate or cattleguard if harvesting over the summer months
Legend
Stream Reach
Lakes (LRDW)
Wetlands (LRDW)
Vegetation Cover (LRDW)
Subject Block Boundary (GENUS)
Existing Blocks
Proposed Roads & Landings
Existing Roads & Landings
WTRA
DEF
Areas of Concern
Boundary Hub
WTRA Hub
Road Hub
Skidding Direction
Wildlife Feature
Designated Skid X
Skid Bridge
Culvert
Existing Roads (GENUS)
Proposed Roads (GENUS)
Proposed Skid Trail
Proposed Bladed Skid Trail
Fence Line
Temp. Access Structure
Contour (LRDW)
Wildlife Feature
CMT Post 1946
CMT Pre 1946
Cultural Heritage Resource
Cultural HeritageTrail
MSMA Tree
Cruise Slope Direction Arrow
Measure Cruise Plot
Count Cruise Plot
Cruise POC
Ribbon Colours
Harvest Boundary Orange (Blue paint)
Riparian Features Orange
Machine Free Yellow (MFZ)
MSMA Yellow (Do not cut)
Road Center Pink
N
Grid North
Scale: 1:5,000
DATUM: NAD 1983
Projection: BC Environment Albers
Base Map Data: MSRM LRDW
Subject Map Data: GENUS
Template: GENUS GEO
Created By: Andy Munro
Meters
0 50 100 200 300

Appendix 7 Example Waste Assessment Area Survey Map



Block Information			
Licensee	Fowl River Logging	Primary Logging Complete Date (PLC)	March 1, 2020
License	909	SPIF %	30
CP	101	BEC Zone / Subzone	IDFdc
Block	NV027	Map Date	July 1, 2020

Stratum	Code	Stratum Symbol	Plot Symbol	# of Plots	Plot Spacing	Net Stratum Area (ha)
Dispersed	SC2X		⊕	12	164m	32.29
Roadside Piles	PC0X	△	N/A	4	5	0.17
Roadside Accumulation	RC0X		⊕	5	725m	5.25
Individual Standing Tree	STRS	🌲	N/A	100% Scale	-	0.01
Sampling System	SRSA		Total Net Survey Area			37.72

Appendix 8 Waste Survey Plot Tally Card

BRITISH COLUMBIA

Ministry of Forests

RESIDUE SURVEY PLOT TALLY

PAGE ____ OF ____

LICENCE	C.P.	BLOCK	DATE Y	DATE M	DATE D	CERT / RET #	B. LINE	STRIP	PLOT NO.	PLOT TY	PLOT SH	MEAS. %	TYPE STRATUM

PIECE NO.																							
SPECIES																							
KIND																							
CLASS																							
GROSS DIMENSIONS FOR PIECES INSIDE PLOT: LENGTH																							
TOP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E																							
BUTT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E																							
GRADE																							
BOR.LINE																							
DEDUCTION FOR ROT/HOLES: LENG																							
TOP																							
BUTT																							
D																							
OUTSIDE MEASURMENT: FAR END																							
ADD LENGTH																							
COMMENT CODE																							
PIECE VOLUME (optional)																							

PLEASE BE ADVISED THAT THIS INFORMATION MAY BE RELEASED UNDER THE *FREEDOM OF INFORMATION AND PROTECTION OF PRIVACY ACT.*

FS161 HVA 2001/04

PIECE NO.	SPECIES	KIND	CLASS	GROSS DIMENSIONS FOR PIECES INSIDE PLOT					GRADE	BOR.LINE	DEDUCTION FOR ROT/HOLES				OUTSIDE MEASUREMENT		COMMENT CODE		PIECE VOLUME (optional)
				LENGTH	TOP	E	BUTT	E			LENG.	TOP	BUTT	D	FAR END	ADD LENGTH			

NOTES _____

TIE-POINT _____

LOCATION	
RESIDUE SURVEYOR	ASSISTANT
SIGNATURE	WEATHER

FS 161 HVA 2001/04

Appendix 9 Slope Distances for 7.98m plot radius

Slope distances for 7.98m Plot Radius					
Slope %	**Plot Radius**	**Slope %**	**Plot Radius**	**Slope %**	**Plot Radius**
5	7.99	39	8.57	73	9.88
6	7.99	40	8.59	74	9.93
7	8.00	41	8.62	75	9.98
8	8.01	42	8.66	76	10.02
9	8.01	43	8.69	77	10.07
10	8.02	44	8.72	78	10.12
11	8.03	45	8.75	79	10.17
12	8.04	46	8.78	80	10.22
13	8.05	47	8.82	81	10.27
14	8.06	48	8.85	82	10.32
15	8.07	49	8.89	83	10.37
16	8.08	50	8.92	84	10.42
17	8.09	51	8.96	85	10.47
18	8.11	52	8.99	86	10.53
19	8.12	53	9.03	87	10.58
20	8.14	54	9.07	88	10.63
21	8.15	55	9.11	89	10.68
22	8.17	56	9.15	90	10.74
23	8.19	57	9.19	91	10.79
24	8.21	58	9.23	92	10.84
25	8.23	59	9.27	93	10.90
26	8.25	60	9.31	94	10.95
27	8.27	61	9.35	95	11.01
28	8.29	62	9.39	96	11.06
29	8.31	63	9.43	97	11.12
30	8.33	64	9.47	98	11.17
31	8.35	65	9.52	99	11.23
32	8.38	66	9.56	100	11.29
33	8.40	67	9.61	110	11.86
34	8.43	68	9.65	120	12.47
35	8.45	69	9.70	130	13.09
36	8.48	70	9.74	140	13.73
37	8.51	71	9.79	150	14.39
38	8.54	72	9.83	160	15.06

Appendix 10 Bucking Waste Grading Matrix and Field Card

Bucking Waste Grading Matrix

1. **Pieces Less than 50% Sound**
    a. Must meet Z Grade criteria as per the *Scaling Manual* section 9.5
    b. Measurement is not required.
2. **Pieces Greater than 50% Sound**
    a. Grade 6
        i. Must meet Grade 6 requirements of the *Scaling Manual* section 9.1.3
        ii. Measurement is **required** when specified in a cutting authority.
    b. Avoidable pieces

    Avoidable pieces are classified by the location in the tree they were cut from: the top, the middle, or butt.

        i. **Top** – Pieces cut from the top of the tree with a cut butt greater than 5 rads (10 cm) and extend to the maximum utilization point 5 rads (10 cm).
            1. **Grade 4**:
                a. Any piece with 1 or more checks to the heart, or
                b. One or more oversize knots, or
                c. Greater than 4 cm Spiral Grain.
        ii. **Middle** – Pieces cut from the middle portions of the tree. No evidence of the felling cut or utilization top exist. The top must be greater than 6 rads (12 cm).
            1. **Grade 4**:
                a. Any piece with 2 or more 4 cm deep checks, or
                b. 3 or more oversize knots, or
                c. Severe shatter, or
                d. Greater than 15% Spiral Grain.
        iii. **Butt** – Pieces cut from the base of the tree which must include evidence of the felling cut.
            1. **Grade 4**:
                a. Any piece with 3 or more 4 cm checks, or
                b. Severe shatter, or
                c. Greater than 15% spiral grain, or

d. Severe scar/defect from surface to heart greater than 25% of diameter, or

e. 25-50% heart rot.

Note: checks on green pieces can only be considered when present on a dead or dry side of the piece.

All pieces that are better than the top, middle, butt requirements are assigned Grade 1 or 2 as per the bucking card.

Bucking Waste Grading Field Card

	Waste Class	Piece Grade			Description
<50%	A/U	Grade Z			No tally. *Scaling Manual* Section 9.5, must show rot at both ends. Contains 3/4 or 4/4 through running heart rot or hole.
>50%	A/U	Grade 6			Must contain evidence of felling cut. Lodgepole 15 cm (7.5R), other species <20 cm (10R) at 15 cm from the felling cut
	U	Grade 1,2			Class auditable, grade not auditable, non billable
		Grade 4			Grade defined as below, non billable
	A	SL (1,2)			Sound/round, no severe defect or deformity, <3 checks, butt rot must be conical shape, slabs >7.5R
		Top	**Middle**	**Butt**	
		4			1 or more checks to heart, >1 OS knots, >4 cm SG
			4		2 or more checks >4 cm, >3 OS knots, severe shatter, >15% SG
				4	Shatter, >3 4 cm checks, >15% SG, severe scar/defect from surface to heart >25% of diameter, 25-50% heart rot
Piece Type		Top = cut butt extending to utilization or broken top (<5R) Middle = cut or broken with no evidence of utilization top or felling cut Butt = piece includes evidence of felling cut			

Appendix 11 Best Practices for Establishing Plots Using GPS

1. Use the GPS to navigate to the waste plot.
2. When you are within 20 metres of the waste plot location, locate a suitable PRP (Plot Reference Point). The most suitable location for the PRP is generally the least obstructed or most open location.
    a. Note: the PRP must be a fixed feature that cannot be moved by hand, such as: a cut stump, small standing tree (<3m tall), etc. Trees that may be large enough to incur deflection and interference of GPS signals are not acceptable.
3. Review the data displayed on the GPS receiver screen. When the number of satellites (PDOP/HDOP) and Mean Difference of Hits are within tolerances establish the PRP using the GPS receiver and software. Collect a minimum of 50 hits or coordinates and record the required data in the PRP table.
4. If the default tolerances have been exceeded, the PRP must be relocated. Where GPS coverage is poor or a PRP cannot be established, the waste plot must be located using conventional methods (i.e. chain and compass) from an existing tie point or waste plot location.
5. Once the PRP has been established, calculate the final horizontal distance and bearing to plot center. Flag the PRP well and label it with the bearing and distance to the waste plot.
6. Use conventional methods (i.e. chain and compass) to navigate to the waste plot from the PRP.

In order to use GPS technology to establish waste plots, the GPS receiver must meet the following standards:

- Able to achieve submeter accuracy under ideal conditions (i.e. open area, not interference, good satellite coverage)
- Real time correction system with external antenna
- Minimum satellite elevation angle/mask is 15 degrees above the horizon
- RMS (Root Mean Square) minimum rating of 100 cm

If GPS is used to establish waste and residue plots, the following data must be submitted to the Ministry in a Plot Reference Point (PRP) table (if requested):

- Cutblock
- Stratum type
- Waste plot number
- Horizontal distance (m) from PRP to waste plot

- Calculated bearing (degrees) from PRP to waste plot
- Average PDOP – maximum of 6.0
- Average HDOP – maximum of 4.0
- Number of satellites when establishing PRP – *minimum of 4*
- Number of hits received when establishing PRP – *minimum of 50 hits*
- Mean difference of hits in metre (MDH) – *maximum of 1.0*
- Time of PRP establishment – *Local date and time*
- PRP coordinates – specify UTM of BC Albers*
- Waste plot coordinates – specify UTM or BC Albers*

*The map projection system used (i.e. BC Albers or UTM.) must be consistent with the waste plan.

An example of a PRP table is shown below.

Sample PRP Table

CB	Str. Type	Plot	HD (m)	BRG	PDOP	HDOP	# SAT	# HITS	MDH (m)	Local Date, Time	PRP Easting (UTM)	PRP Northing (UTM)	PT Easting (UTM)	PT Northing (UTM)
7	SC2X	1	16.6	110	3.4	1.9	6	50	0.3	13:52:23 8/16/2019	683417.473	5657508.768	683433.292	5657503.723
7	SC2X	2	2.2	329	3.9	2.3	8	50	0.1	14:12:29 8/16/2019	682934.854	5657577.685	682929.529	5657585.834
7	SC2X	3	9.7	157	2.3	2.9	8	50	0.5	15:23:58 8/16/2019	683125.834	5657600.981	683129.624	5657592.922
7	SC2X	4	8.9	111	2.0	1.7	9	50	0.4	16:02:41 8/16/2019	683219.529	5657590.781	683229.672	5657596.466
7	SC2X	5	4.6	278	2.0	2.2	9	50	0.2	16:51:13 8/16/2019	683332.437	5657588.624	683329.720	5657600.010