Volume and Lumber Recovery Reports 11

11.1 Volume and Lumber Recovery Reports - Overview

Volume and lumber recovery reports are produced for Interior compilations only. Most reports are 1 page per Species in the compilation (see "Exceptions" below). Segregate the logs from each Species by Risk Group and Top Diameter Class.

Risk Group determination is described in section 3.3.1 (step 3).

Top Diameter Classes are found, by species, in Appendix 7.

The LRF reports are based on logs that meet the merchantability requirements specified in the Map Area Statement.

Exceptions:

Use Appendix 10.1 to assign LRF to Hemlock.

Interior White Pine logs from trees recorded as tree class 3,7 and 9 will use Appendix 10.2 to determine LRF.

The LRF compiled for Balsam is to be based on the sawlog component only. The compilation will assess each balsam tree and segregate those with decay, waste and breakage of less than 48% as all sawlogs. Those balsam trees with greater than or equal to 48% DWB will have zero LRF assigned to the complete volume of the tree. The average LRFs will be lowered due to the reduction of the sawlog net volume over the total net volume.

Lodgepole pine will be broken down into categories for reporting. One page each for categories: green, green attack, red attack, grey attack and dead potential.

11.2 Header Information

Include the following header information on the LRF reports.

1. License from card type A.
2. Cutting Permit from card type A.
3. Species.
4. Message indicating whether compilation is for appraisals or not.
5. Total merchantable area from card type A.
6. Message indicating whether Interior Fir is in wet belt or dry belt. (see Appendix 12)
   - If column 14 of card type B is coded 1, Fir is in the wet belt.
   - If column 14 of card type B is coded 2, Fir is in the dry belt.
7. Special compilation messages for:
   a. Reduction compilation.
   b. Stump cruise compilation.
   c. Tree class combination - useless volumes are included or excluded, from column 15 of card type B (0 or blank - snags excluded, 1 - snags included).
   d. Selective cut indicator - which trees to compile depends on column 12 of card type B (blank - include all trees, 'C' - include cut-indicated and non-indicated trees, 'L' - include leave-indicated trees).
   e. Double sampling, if count plots are used.
8. Compiler program name and version.
9. Compile date and time.
10. Page number.

11.3 Detail Information

Variable Definitions used in this chapter.

DMP_c	=	Midpoint of Top Diameter Class c (see Appendix 7):
	DMP_1 - 5cm	(Top diameter class 4.5 - 5.49)
	DMP_2 - 6cm	(Top diameter class 5.5 - 6.49)
	DMP_3 - 7cm	(Top diameter class 6.5 - 7.49)
	DMP_4 - 8cm	(Top diameter class 7.5 - 8.49)
	DMP_5 - 9.25cm	(Top diameter class 8.5 - 9.99)
	If c > 5, then	$DMP_c = (c-5)*5 + 7.5$ cm
$\%D_{s,c,r,i}$	=	Percent Decay of Gross volume for Species s, Top Diam. Class c, Risk Group r and Type i.
$\%D_{s,r,i}$	=	Percent Decay for Species s, Risk Group r and Type i. The Risk Group r may be a combination of two risk groups
$\%DT_{s,r,i}$	=	Percent Decay for species s, Risk Group r and Type i.
$\%LA_{s,r,i}$	=	Percent Large Logs in Species s, by Risk Group r in Type i.
$\%SM_{s,r,i}$	=	Percent Small Logs in Species s, by Risk Group r in Type i.
$\%ST_{s,r,i}$	=	Percent Stud Logs in Species s, by Risk Group r in Type i.
A_i	=	Area of Type i.
$D_{s,c,r,i}$	=	Decay volume for Species s, Top Diameter Class c, Risk Group r and Type i.
$FBM_{G,i}$	=	Foot Board Measure of Lodgepole Pine in category G within Type i.
$FBM_{s,c,r,i}$	=	Foot board measure for Species s, Top Diameter Class c, Risk Group r and Type i.
$FBM_{s,r,i}$	=	Total Foot Board Measure for Species s, Risk Group r and Type i. The Risk Group r, may be a combination of two risk groups.
$LRF_{s,c}$	=	LRF for Species s and Top Diameter Class c - see Appendix 7.
m_i	=	Number of measure plots in Type i.

$LRF_{PI,G,i}$	=	Lumber recovery factor for Lodgepole Pine in Category G within Type i.
$LRF_{PI,i}$	=	Average LRF for Lodgepole Pine within Type i.
$LRF_{s,r,i}$	=	LRF for Species s and Type i. The Risk Group r, may be a combination of several risk groups
$VG_{p,s,c,r,i}$	=	Gross volume for plot p for Species s, Top Diameter Class c, Risk Group r and Type i.
$VG_{s,c,r,i}$	=	Gross volume for Species s, Top Diameter Class c, Risk Group r and Type i.
$VGT_{s,r,i}$	=	Total gross volume for Species s, Risk Group r and Type i. The Risk Group r, may be a combination of two risk groups.
$V_{G,i}$	=	Net merchantable volume of Lodgepole Pine in Category G within Type i.
$V_{p,s,c,r,i}$	=	Net volume for plot p for Species s, Top Diameter Class c, Risk Group r and Type i.
$V_{s,c,r,i}$	=	Net volume for Species s, Top Diameter Class c and Risk Group r and Type i.
$VT_{s,r,i}$	=	Total net volume for Species s and Type i. The Risk Group r, may be a combination of two risk groups.
$VT_{s,r,i,la}$	=	Total net volume (large logs only) for Species s and Type i. The Risk Group r, may be a combination of two risk groups.
$VT_{s,r,i,sm}$	=	Total net volume (small logs only) for Species s and Type i. The Risk Group r, may be a combination of two risk groups.
$VT_{s,r,i,st}$	=	Total net volume (stud logs only) for Species s and Type i The Risk Group r, may be a combination of two risk groups.

Report the following information by Risk Group and Top Diameter Class for the Species and Type.

11.3.1 Base Lumber Recovery Factor

The base lumber recovery factor (LRF) for the Species and Top Diameter Class is in Appendix 7 and is applied for all Risk Groups.

For interior appraisal cruises, Douglas Fir is broken down into wet or dry variants with separate LRFs (see Section 12.3.4 for details). Optionally, ("Not for Appraisal Purposes"), Douglas Fir may be broken down into quality class 1 or quality class 2 with separate LRF's (see Section 12.3.4 for details).

11.3.2 Gross Merchantable Volume by Top Diameter Class

Gross volume per log is calculated as per Appendix 13.

Sum the gross volumes for logs in the same Species, Type, Risk Group and Top Diameter Class.

$$VGs,c,r,i = \frac{\sum_{p=1}^{m_i} VG_{p,s,c,r,i}}{m_i} * A_i$$

Report to the nearest whole number.

11.3.3 Percent Decay by Top Diameter Class

Determine decay percent for individual trees as described in section 3.3.1 step 3. All logs in a tree will have the same decay percent applied to them. Multiply the decay percent by the gross volume of the log to get the decay volume of the log. Sum the decay volumes of all the logs in the same Species, Type, Risk Group and Top Diameter Class. Divide by the gross volume of all the logs in the same Species, Type, Risk Group and Top Diameter Class. Multiply by 100.

$$\%Ds,c,r,i = \frac{D_{s,c,r,i}}{VG_{s,c,r,i}} * 100$$

Report to one decimal place.

Example 11.1

Log top diameter class: 10.0 - 14.9

Log top Diameter	Log Gross Volume by Type	Tree Decay %	Log Decay Volume by Type
10.00	27.41	0.02	0.55
14.77	55.32	0.02	1.11
10.00	3.12	0.36	1.13

$D_{s,c,r,i} = 0.55 + 1.11 + 1.13$

$= 2.79\ m^3$

$VG_{s,c,r,i} = 27.41 + 55.32 + 3.12$

$= 85.85\ m^3$

$\%D_{s,c,r,i} = \frac{2.79}{85.85} * 100$

$= 3.2$

11.3.4 Net Merchantable volume by Top Diameter Class

The net merchantable volume is calculated the same way as the gross merchantable volume, only the loss factors (decay, waste and breakage) have been applied.

$$V_{s,c,r,i} = \frac{\sum_{p=1}^{m_i} V_{p,s,c,r,i}}{m_i} * A_i$$

Report to the nearest whole number.

11.3.5 Foot Board Measure by Top Diameter Class

The calculation for Cedar is different than for other species.

Cedar -

$$FBM_{s,c,r,i} = V_{s,c,r,i} * [LRF_{s,c} – (34.256(0.147- 0.00122 * DMP_c)*(\%D_{s,c,r,i} / 2))]$$

All other Species -

$$FBM_{s,c,r,i} = V_{s,c,r,i} * [LRF_{s,c} * (1 – (\%D_{s,c,r,i} * 0.01 / 2))]$$

Example 11.2

There is a Cedar log in Risk Group 1 within the diameter class (40 - 44.9 cm) in Type 2. The log represents 63.07 m^3 of net merchantable volume in Type 2. The decay for the log is 17.3 percent.

FBM = $63.07 * [LRF_{s,c} – (34.256(0.147- 0.00122 * 42.5)*(17.3 / 2))]$

= $63.07 * [235 – (34.256(0.147 – 0.05185)*(8.65)]$

= $63.07 * [235 – 28.191]$

= 13 043

Example 11.3

There is a Hemlock log in Risk Group1 within the diameter class (40 - 44.9 cm) in Type 1. The log represents 93.8 m^3 of net merchantable volume in Type 1. The decay for the log is 7.3 percent.

FBM = $93.8 * [LRF_{s,c} * (1 - (7.3* 0.01 / 2))]$

= $93.8 * [222 * (1 – 0.0365)]$

= $93.8 * [213.89256]$

= 20 064

11.4 Totals and Averages

11.4.1 Total Gross Merchantable Volume by Risk Group

For each Risk Group, sum the gross volumes of each Top Diameter Class. The 24 Top Diameter Classes are listed in Appendix 7.

$$VGT_{s,r,i} = \sum_{c=1}^{24} VG_{s,c,r,i}$$

Report to nearest whole number.

11.4.2 Percent Decay by Risk Group

Calculate individual top diameter class decay volumes by multiplying the decay percent by the class gross volume then sum individual parameters in the risk group. Divide by the gross volume for the risk group.

$$\%DT_{s,r,i} = \frac{\sum_{c=1}^{24} \%D_{s,c,r,i} * VG_{s,c,r,i}}{VGT_{s,r,i}} * 100$$

Report to one decimal place.

11.4.3 Total net merchantable Volume by Risk Group

For each Risk Group, sum the net volumes of each Top Diameter Class.

$$VT_{s,r,i} = \sum_{c=1}^{24} V_{s,c,r,i}$$

Report to nearest whole number.

11.4.4 Total Foot Board Measure by Risk Group

For each Risk Group, sum the foot board measure of each Top Diameter Class.

$$FBM_{s,r,i} = \sum_{c=1}^{24} FBM_{s,c,r,i}$$

Report to nearest whole number.

11.4.5 LRF by Risk Group

The average LRF for a risk group is determined by dividing the total foot board measure by the total net volume.

$$LRF_{s,r,i} = \frac{FBM_{s,r,i}}{VT_{s,r,i}}$$

Report to nearest whole number.

11.5 Risk Group Combinations

The Risk groups are combined in the following groups: (Group 1), (Group 1 and 2), and (Group 2 and 3). LRF is also reported in a (Group 1, 2 and 3) combination.

11.5.1 LRF by Risk Group Combination

Sum the net volume and foot board measure of the Risk Groups that are included. Divide the summed foot board measure by the summed net volume.

$$LRF_{s,r,i} = \frac{\sum_{r=1}^{3} FBM_{s,r,i}}{\sum_{r=1`}^{3} VT_{s,r,i}}$$

Report to nearest whole number.

Lodgepole Pine (Pl):

LRF Adjustment factors for Lodgepole Pine will be applied to the Group 1, 2 and 3 LRF by Risk Group Combination.

Pl is divided into several categories; green stems, green beetle attack, red beetle attack, grey beetle attack and dead potential stems.

Green stems are described as living stems with no Mountain Pine Beetle (MPB) damage codes associated with them. Green attack stems are those that are marked with insect code 1, red attack stems are those marked with insect code 2 and grey attack stems are those marked with insect code 3. Dead potential stems are dead potential trees with no MPB insect damage codes. Each category will be reported on a separate page.

Category	**Tree Classes**	**Damage code**	**Pl Adjustment Factor**
Green	1, 2, 5, 8	No Mountain Pine beetle code	0
Green attack	1, 2, 5, 8	1	3
Red attack	1, 2, 5, 8	2	33
Grey Attack	3, 7, 9	3	83
Dead potential	3, 7, 9	No Mountain Pine beetle code	0

Cruise LRFs will be calculated separately for each category of Pl. Reduction factors will then be applied separately to the Cruise LRFs calculated for the green beetle attack, red beetle attack, grey beetle attack and dead potential categories.

Total Lodgepole Pine average LRF will be reported as the weighted average, by net volume, of these categories after the adjustments have been applied. See Section 12.3.6.

Calculate the LRF of a category:

$$LRF_{Pl,G,i} = \frac{FBM_{G,i}}{V_{G,i}}$$

Example 11.4

There are 3 categories of Pl in a CP: green, red attack and grey attack.

Category	Net Volume	Foot Board Measure	LRF	MPB Reduction	MPB LRF
Green	361	70469	195	0	195
Red Attack	377	71716	190	33	157
Grey Attack	362	70677	195	83	112

Weight the LRFs in each category by net volume to get Pl species LRF.

$$\overline{LRF_{Pl,i}} = \frac{361 \times 195 + 377 \times 157 + 362 \times 112}{361 + 377 + 362}$$

$$= 155$$

Report to nearest whole number.

11.5.2 Pl Adjustment

On Lodgepole Pine summaries a field headed “Pl ADJUSTMENT” will contain the adjustment factor used for the specific category being reported.

The adjustment factors are:

Green	0
Green attack	3
Red attack	33
Grey attack	83
Dead Potential	0

11.5.3 Percent Decay by Risk Group Combination

Calculate the decay volume of individual risk groups by multiplying the percent decay of the risk group by the gross volume of the risk group as in 11.4.2. Sum the decay volumes of the risk groups in the combination as well as the gross volumes of the same risk groups. Divide the resulting decay volume by the resulting gross volume.

$$\%DT_{s,r,i} = \frac{\sum_{r=1}^{2} \%D_{s,r,i}}{\sum_{r=1}^{2} VGT_{s,r,i}}$$

Report to 1 decimal place.

11.5.4 Percent Stud Log by Risk Group Combination

A stud log has a top diameter less than 20 cm. The combinations of Risk Groups are (Risk Group 1), (Risk Group 1 and 2) and (Risk Group 2 and 3). Report the percent stud log for Fir, Balsam, Spruce, Lodgepole Pine, and Larch only.

Sum the stud log net volumes of the risk groups in the combination. Divide by the summed net volumes of the risk groups in the combination. Multiply by 100.

$$\%ST_{s,r,i} = \frac{VT_{s,r,st,i}}{VT_{s,r,i}} * 100$$

Report to nearest whole number.

11.5.5 Percent Small Log by Risk Group Combination

A small log has a top diameter less than 30 cm. The combinations of Risk Groups are (Risk Group 1), (Risk Group 1 and 2) and (Risk Group 2 and 3). Calculate in the same manner as the stud log percent but include all species.

$$\%SM_{s,r,i} = \frac{VT_{s,r,i,sm}}{VT_{s,r,i}} * 100$$

Report to nearest whole number.

11.5.6 Percent Large Log by Risk Group Combination

A large log has a top diameter 30 cm or greater. Therefore, percent small log and percent large log should sum to 100 percent. The combinations of Risk Groups are (Risk Group 1), (Risk Group 1 and 2) and (Risk Group 2 and 3). Calculate in the same manner as the stud log percent but include all species.

$$\%LA_{s,r,i} = \frac{VT_{s,r,i,la}}{VT_{s,r,i}} * 100$$

Report to nearest whole number.

11.6 Volume and Lumber Recovery report - Sample Listing

Report 008 - Required for Interior compilations.

```
FOREST REVENUE BRANCH - 2001.0                VOLUME AND LUMBER RECOVERY FACTOR INFORMATION          (008)      PAGE    1
NOT FOR APPRAISAL PURPOSES DUE TO NON-STANDARD UTILIZATION **** DOUBLE SAMPLING CRUISE ****           COMPUTED 2001-03-19  17:42:56
                                   NOTE - NET VOLUME (G-DWB) IN M3 IN  5. M LOGS 12.5 CM+ DBH
    LICENCE  NUMBER CF7080             INTERIOR FIR - WET BELT                                       USELESS VOLUMES EXCLUDED
    CUTTING  PERMIT 000                                      CEDAR                                   TOTAL MERCH AREA      12.5 HA

                     *          RISK GROUP 1               *          RISK GROUP 2               *          RISK GROUP 3
                     *                                     *                                     *
                     *                                     *                                     *
  LOG                *  GROSS      %       NET             *  GROSS      %       NET             *  GROSS      %       NET
TOP DIA (CM)     LRF * MERCH.    DECAY    MERCH.    F.B.M.* MERCH.    DECAY    MERCH.    F.B.M.* MERCH.    DECAY    MERCH.    F.B.M.
                     *                                     *                                     *
  6.5 -  7.49  103.  *                                     *                                     *
  7.5 -  8.49  108.  *                                     *                                     *
  8.5 -  9.9   115.  *                                     *                                     *
 10.0 - 14.9   132.  *    180.     4.4       163.   20013.*     17.   30.0         9.     553.*
 15.0 - 19.9   156.  *    236.     4.1       214.   31654.*     22.   28.8        12.    1140.*
 20.0 - 24.9   177.  *    298.     7.5       256.   41643.*     49.   29.4        26.    3026.*
 25.0 - 29.9   197.  *    121.    13.6        92.   15779.*     69.   29.5        36.    5038.*
 30.0 - 34.9   215.  *     43.    17.3        30.    5519.*    189.   29.1       101.   16296.*
 35.0 - 39.9   227.  *     54.    17.3        38.    7577.*     31.   31.2        15.    2555.*
 40.0 - 44.9   235.  *     89.    17.3        63.   13043.*     50.   31.2        24.    4412.*
 45.0 - 49.9   238.  *                                     *                                     *
 50.0 - 54.9   239.  *                                     *                                     *
-------------------------------------------------------------------------------------------------------------------------------------
TOTAL FOR ALL LOGS   *   1021.     8.7       857.  135227.*    426.   29.6       222.   33020.*
       L.R.F.        *                                158.*                                149.*
                     *                                     *                                     *
AVERAGE L.R.F.       * GROUP 0 + 1     158.                * GROUP 1 + 2     156.                * GROUP 2 + 3     149.
AVERAGE L.R.F.       * GROUP 1+2+3     156.                *                                     *
CHIP RECOVERY        * GROUP 0 + 1        .13 UNITS/M3     * GROUP 1 + 2        .13 UNITS/M3     * GROUP 2 + 3        .13 UNITS/M3
   % DECAY           * GROUP 0 + 1       9.                * GROUP 1 + 2      15.                * GROUP 2 + 3      30.
% STUD LOG NET MER   * GROUP 0 + 1      44.                * GROUP 1 + 2      37.                * GROUP 2 + 3       9.
% SMALL LOG NET MER  * GROUP 0 + 1      85.                * GROUP 1 + 2      75.                * GROUP 2 + 3      37.
% LARGE LOG NET MER  * GROUP 0 + 1      15.                * GROUP 1 + 2      25.                * GROUP 2 + 3      63.
```

Figure 11.1 Volume and Lumber Recovery Report - Sample Listing (Partial).

This page is intentionally left blank.