



Doug Lewis- Stewardship Evaluation Forester- May 18, 2022

# Overview of the FREP Stand-Level Retention Protocol: Using data collected in the field to evaluate stand-level retention practices



# Goals of this Session

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1. Introduce\review the FREP Stand-Level Retention Protocol
2. Overview of steps to used field data to assign ratings
3. Review field-based stand-Level retention questions:
  1. Importance of post-harvest forest structure
  2. Management considerations & existing guidance
  3. How questions were designed to evaluate retention practices and benchmarks used
  4. Field data collection tips to help assign\verify ratings





# Part 1: Overview of the Protocol

# Why Do We Evaluate Stand-Level Retention in FREP?

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- The Forest and Range Practices Act (FRPA) objective for wildlife tree retention is found in Section 9.1 of the Forest Planning and Practices Regulation (FPPR). It reads,

“the objective set by government for wildlife and biodiversity at the stand level is, without unduly reducing the supply of timber from British Columbia's forests, to retain wildlife trees.”



# The FREP Question

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“Is stand-level retention providing the range of habitat with the structural attributes understood as necessary for maintaining the species dependent on wildlife trees and CWD?”



# How do we Evaluate Stand-Level Retention Practices?

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- Original Stand-Level Biodiversity protocol developed in 2006
- Used from 2006 – 2019/2020
- A Revised FREP Stand-Level Retention(SLR) Protocol (2021) replaces the original Stand-Level Biodiversity Protocol.

## *Protocol for* Stand-level Biodiversity Monitoring

Steps for field data collection  
and administration

For the most current version of this document, please consult the  
FREP web site [Indicators-SLRD-Protocol-2009.pdf](#)

For other FREP information, please go to  
<http://www.for.gov.bc.ca/hfp/frep/>

Version 5.0

# How do we Evaluate Stand-Level Retention Practices?

## Overview of Changes:

- Name change to reflect what is actually being evaluated – retention amounts and practices – not biodiversity and wildlife habitat.
- Field sampling protocol measurements remain the same.
  - Allows continuity with previous samples
- Includes GIS-based measures of landscape context.
- Evaluates observed retention practices relative to guidance targets/benchmarks.
- Provides a rating on how 'likely' practices achieve the FREP question



## Protocol for Stand-level ~~Biodiversity~~ Retention Monitoring

### Steps for field data collection and administration

For the most current version of this document, please consult the FREP web site [Indicators-SLBD-Protocol-2009.pdf](#)

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Version 5.0

# Goal of the Protocol Revisions

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To utilize the existing Stand-level data collected since 2006 to provide an evaluation of stand-level retention practices. Benefits include:

- Immediate feedback - final score or rating as an outcome.
- Useful feedback on forest practices - where improvement can occur.
- An effective learning and teaching tool for new (or old) practitioners and others interested in understanding the role of retention in conserving biodiversity and wildlife habitat.



# Stand-Level Retention Monitoring Results to Date

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Revised SLR protocol applied to samples collected between 2006-2021 on blocks harvested from 1997-2019

- 2960 Blocks sampled
- 9784 different strata (Net Area to be Reforested (NAR) in the cutblock WTRAs)
- 21,186 Plots/Transects
- 98,736 Trees sampled
- 197,451 Logs sampled



# Principles and Assumptions when Evaluating Stand- Level Retention

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1. Assessing retention practices – not biodiversity and wildlife habitat. Measuring response of organisms to retention is beyond the scope of a 'routine' evaluation.
2. Following guidance more likely to meet biodiversity and wildlife habitat needs.
3. No 'correct' level of retention - emphasis on maintaining ecosystem functions for 'forest species', assuming forest harvest and other disturbance provides habitats for 'generalist' and 'open-forest' species.
4. Landscape context is important and determines what is necessary and appropriate for stand-level retention.



# FREP Stand –Level Retention Protocol Questions

- Practices Evaluated based on 8 Questions
- 7 sub-Questions used to answer 3 of the questions
- 4 landscape Context – using GIS Indicators
- 4 Questions using collected field data



## Category: Landscape Context

**Question #1** – Tree Retention Amount - is the amount of stand-level retention adequate considering the landscape context?

**Question #2** - Patch Size – Is the amount of stand-level retention in the cutblock adequate considering the size of the associated patch?

**Question #3** – Landscape Connectivity – Is the amount and spatial location of stand-level retention adequate to help maintain landscape-level connectivity?

**Question #4** - Micro-Environment - Does Wildlife Tree Retention and block shape contribute to a range of microenvironments and structural complexity within the block?

## Category: Wildlife Tree Retention Practices

**Question #5** - Standing Live and Dead Tree Size and Condition – Will the amount, size and condition of retained wildlife trees provide habitat refugia and structural complexity in the regenerating stand now and into the future?

5a) Large Live Trees >30cm DBH

5b) Snags >30cm DBH

5c) Soft Snags >30cm DBH

**Question #6** –Wildlife Tree Retention Practices - Do stand-level retention practices retain wildlife important habitat features by minimizing windthrow effects?

6a) average amount of blowdown

6b) Maximum amount of blowdown in one patch

## Category: Coarse Woody Debris Retention Practices

**Question #7** – Amount and Spatial Dispersion of Downed Wood – Does the amount and dispersion of CWD provide habitat refugia and structural complexity in the regenerating stand now and in the future?

7a) CWD Volume

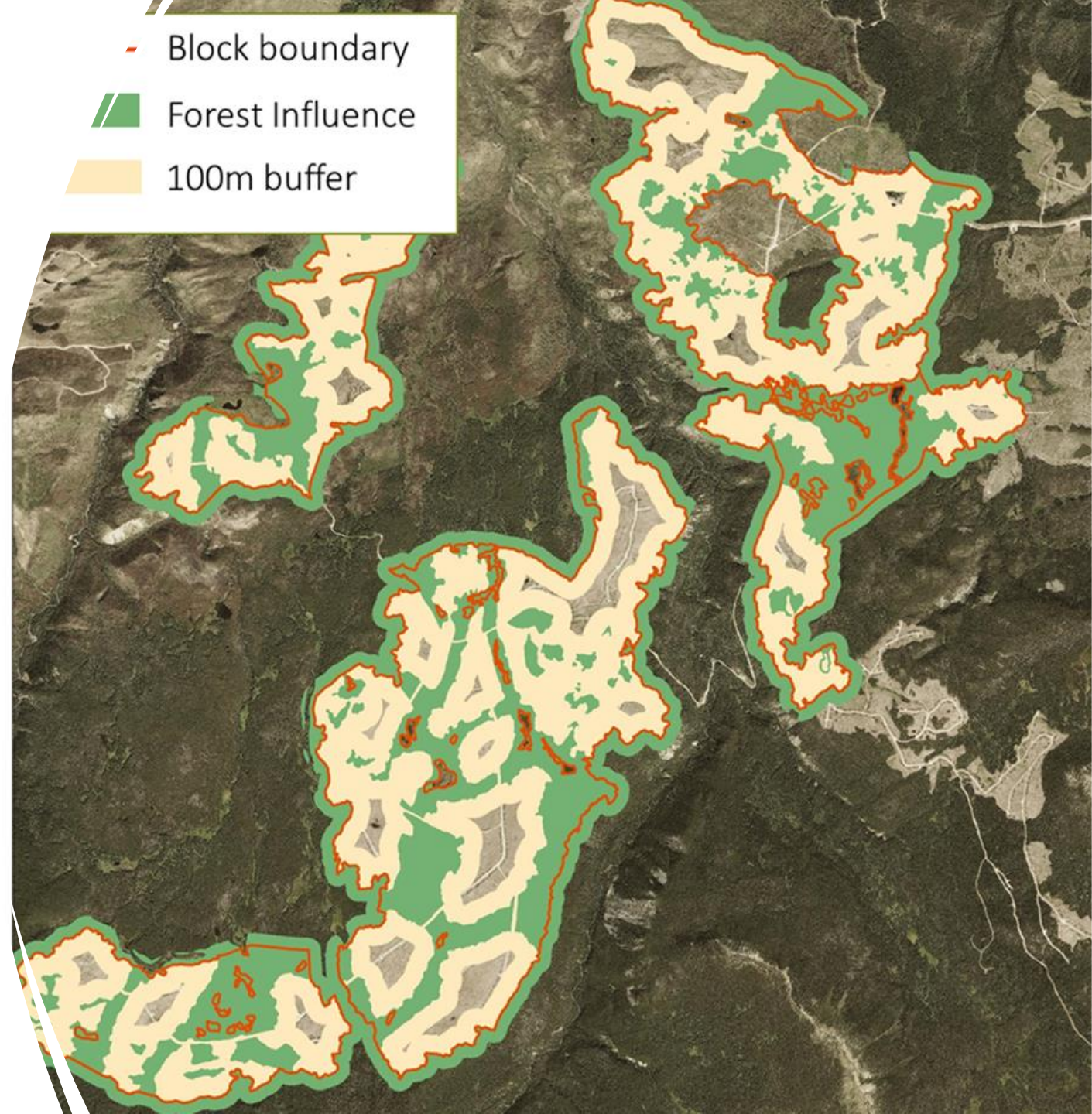
7b) Area contributing future CWD inputs

**Question #8** - Downed Wood Size and Condition – Does the size and condition of CWD provide habitat refugia and structural complexity in the regenerating stand now and in the future?

# FREP Stand-Level Retention Protocol: GIS Landscape Indicators

GIS analysis of random cutblocks provides information on:

- **Question #1-** Landscape context – Retention Amount
  - Area of operable land-base and % disturbance within the Landscape Unit associated with cutblock.
- **Question #2-** Patch Size – Retention Amount
  - Size of 'patch' or 'functional opening' to which the cutblock is associated.
- **Question #3-** Maximum distance across cutblock between retention and adjacent forest.
- **Question #4-** Area of Forest Influence
  - Area of cutblock within 1 tree length of retention or adjacent forest



# FREP Stand-Level Retention protocol: Stand Structure Indicators

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Field data collection of random cutblocks provides information on:

- **Question #5-**Stand Live and Dead Tree Size and Condition
  - Density of large (>30cm DBH) trees and snags .
- **Question #6-** Minimizing Windthrow
  - Average amount and maximum windthrow in WTRAs .
- **Question #7-**Coarse Woody Debris Amount
  - CWD volume in the Net area and forest influence contributing future CWD inputs
- **Question #8-** Coarse Woody Debris Condition
  - Number of large (>20cm Diameter and >10m length) CWD pieces



# Target Categories: Evaluating Retention Practices Against Guidance Targets

Depending on how closely the measured data aligns to the specified target, the outcome for each question is assigned to one of four target categories:

- **Exceeding** – retention levels exceed minimum guidance targets
- **Meeting** – retention levels meet minimum guidance targets
- **Below** - retention levels are below minimum guidance targets
- **Well Below** – retention levels are well below minimum guidance targets

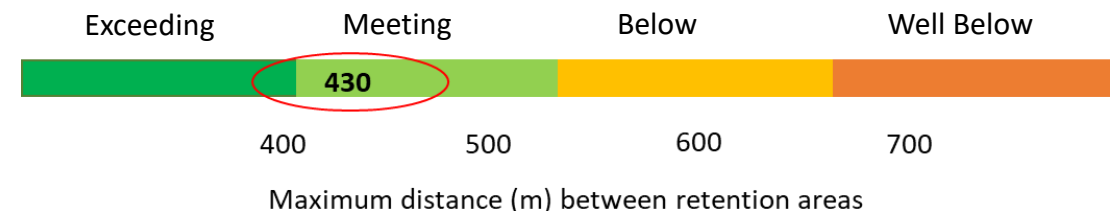
Flexibility incorporated to accounts for

- Measurement error
- Operational reality

**Table 4.** Recommended distances between retention areas >0.25ha within harvested openings relative to surrounding landscape condition. Table adapted from Klenner (2006).

|                                   |        | Percent (%) Forest Disturbance                                                                           |        |        |        |       |
|-----------------------------------|--------|----------------------------------------------------------------------------------------------------------|--------|--------|--------|-------|
|                                   |        | Percent of LU/BGC subzone harvested pre-1995, early seral forest and/or medium-high severity disturbance |        |        |        |       |
| Percent of THLB in LU/BGC subzone |        | <20%                                                                                                     | 21-40% | 41-60% | 61-80% | >80%  |
|                                   | <20%   | <500m <sup>a</sup>                                                                                       | <500m  | <500m  | <400m  | <300m |
|                                   | 21-40% | <500m                                                                                                    | <500m  | <400m  | <300m  | <300m |
|                                   | 41-60% | <400m                                                                                                    | <400m  | <300m  | <300m  | <200m |
|                                   | 61-80% | <300m                                                                                                    | <300m  | <300m  | <200m  | <150m |
|                                   | >80%   | <300m                                                                                                    | <300m  | <200m  | <150m  | <150m |

<sup>a</sup> 500m is the maximum recommended distance between wildlife tree patches in the Biodiversity Guidebook. The remaining distances are from Klenner (2006). Omenica Region Guidance (BCMFLNRORD 2018) also recommends <250m between retention consistent with ecosystems that experience fewer stand-replacing disturbances and more gap-phase dynamics (Delong 2011) and is consistent with recommended levels in the lower right of this table.



# Concluding on Stand-Level Retention

Each question is scored from 1 to 4 where:

- *Exceeding* = 4,
- *Meeting* = 3,
- *Below* = 2,
- *Well Below* = 1.

To be rated as *Likely* or *Very Likely*, the cutblock must be *Meeting* or *Exceeding* targets in at least half of questions, achieving a minimum combined score of >20.

Final Rating for the cutblock that speaks to FREP question:

“Is stand-level retention providing the range of habitat with the structural attributes understood as necessary for maintaining the species dependent on wildlife trees and CWD?”

| Rating          | Score (Out of 32) | Relationship to Evaluation Questions                                         |
|-----------------|-------------------|------------------------------------------------------------------------------|
| Very Likely     | >25               | Meeting or Exceeding retention guidance benchmarks for most or all questions |
| Likely          | 21-25             | Meeting or Exceeding retention guidance benchmarks for most questions        |
| Somewhat Likely | 16-20             | Meeting retention guidance on less than half of questions                    |
| Unlikely        | 12-15             | Below or Well Below retention guidance benchmarks for most questions         |
| Very Unlikely   | <12               | Below or Well Below retention guidance on most to all questions.             |

! Where no Wildlife Tree retention exists – ratings are based on average scores for Questions 3,4,7 and 8 only



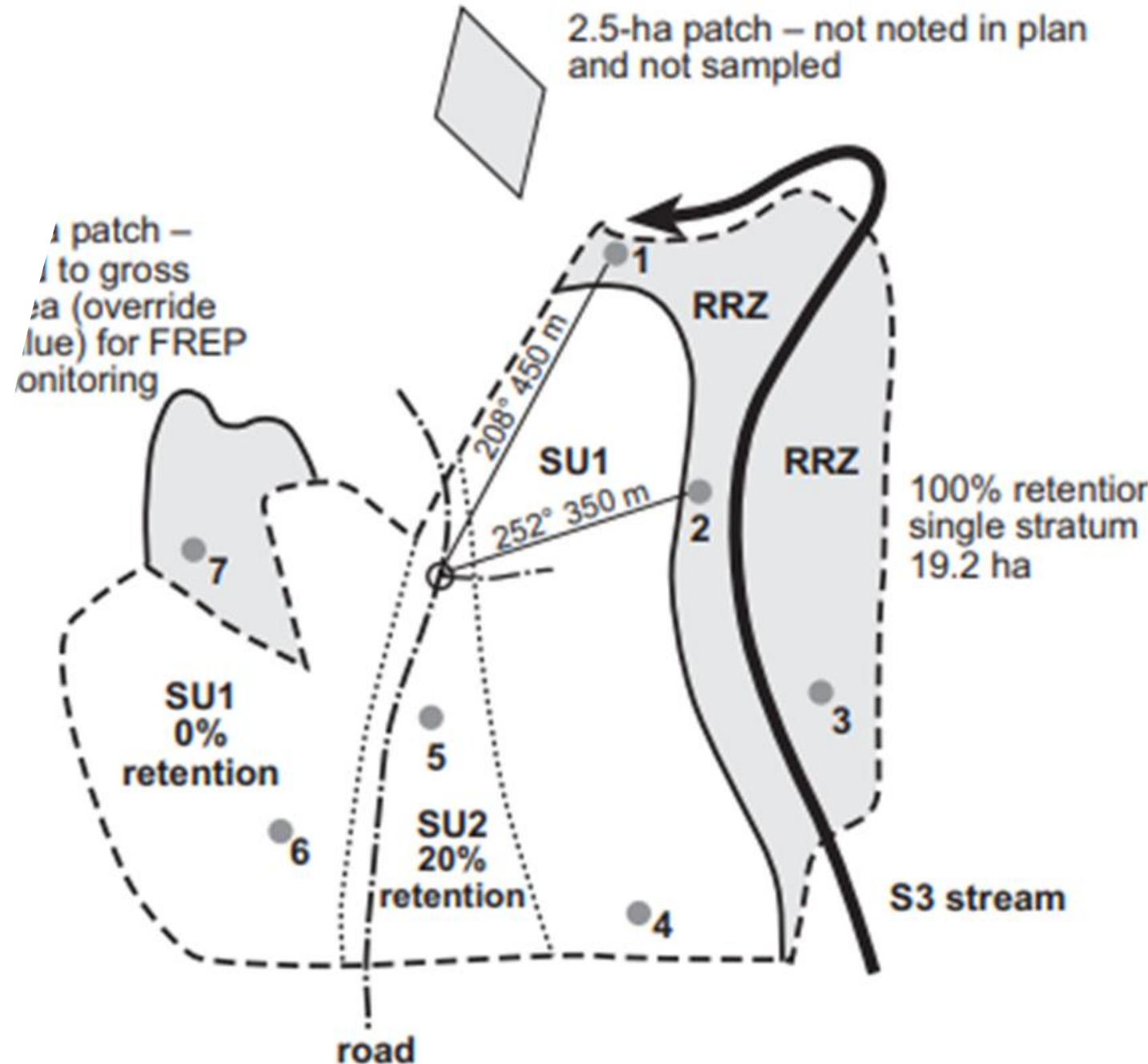
Questions?



## Part 2: Steps to use field data to assign ratings

# Field data is collected!

- Block is stratified
- Plot locations identified
- Strata Forms filled out
- Plots located and field data collected
- Data is submitted in FREP IMS
- What happens next?



# Steps in Using Field Data to Rate Stand-Level Retention Practices

The table illustrates the proposed steps and timeline to:

- Extract the collected field data once submitted into FREP IMS
- Combine field data with GIS-derived landscape context indicator for the cutblock
- Assign ratings for questions
- Work with district staff to verify and modify ratings as necessary

**Further training will be made available on verification and over-riding results!- Summer and Fall 2022**

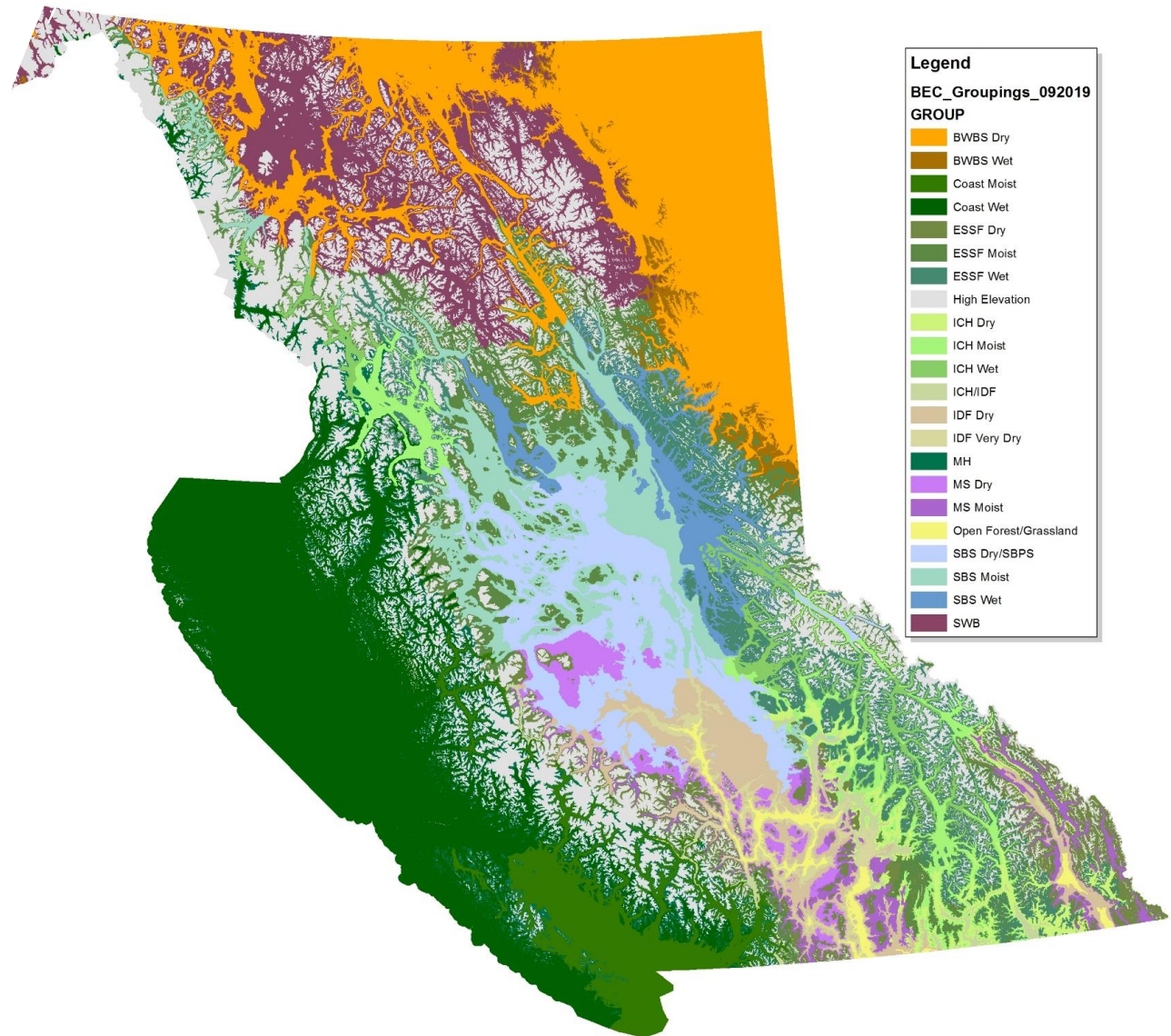
| Step | Procedures                                                                                                                                                                                                                             | Timeline          |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 1    | Field Information is extracted from FREP IMS (Value Lead) <ul style="list-style-type: none"><li>• Plot information is summarized to Strata-Level</li><li>• Strata information is area-weighted and summarized to Block level</li></ul> | November-December |
| 2    | Field data combined with Landscape Context indicators (Value Lead)                                                                                                                                                                     | November-December |
| 3    | Block level retention summary data is compared to pre-harvest benchmark data and ratings assigned (Value Lead)                                                                                                                         | November-December |
| 4    | Final Verification of Ratings with District staff and modification of ratings as necessary. (District Staff with help from Value Lead)                                                                                                 | January-February  |

| WTP_SPH   | WTP_SPH_GT30 | WTP_Snag_SPH_GT30 | WTP_Softsnag_SPH_GT30 |
|-----------|--------------|-------------------|-----------------------|
| 0         | 0            | 0                 | 0                     |
| 999.59162 | 0            | 0                 | 0                     |
| 999.59162 | 0            | 0                 | 0                     |
| 620.45178 | 38.15988598  | 0                 | 0                     |
| 1038.1188 | 179.6944155  | 41.81366548       | 41.81366548           |
| 0         | 0            | 0                 | 0                     |
| 791.64384 | 117.8905367  | 0                 | 0                     |
| 1063.5309 | 100.7035273  | 75.11950263       | 0                     |
| 0         | 0            | 0                 | 0                     |
| 487.26216 | 60.15607902  | 55.17123828       | 0                     |
| 0         | 0            | 0                 | 0                     |
| 0         | 0            | 0                 | 0                     |
| 781.52119 | 60.87396736  | 27.60354716       | 0                     |
| 1335.072  | 0            | 0                 | 0                     |

**FREP**  
Forest & Range  
Evaluation Program

# FREP Stand-Level Retention Protocol: Benchmarks for stand attributes

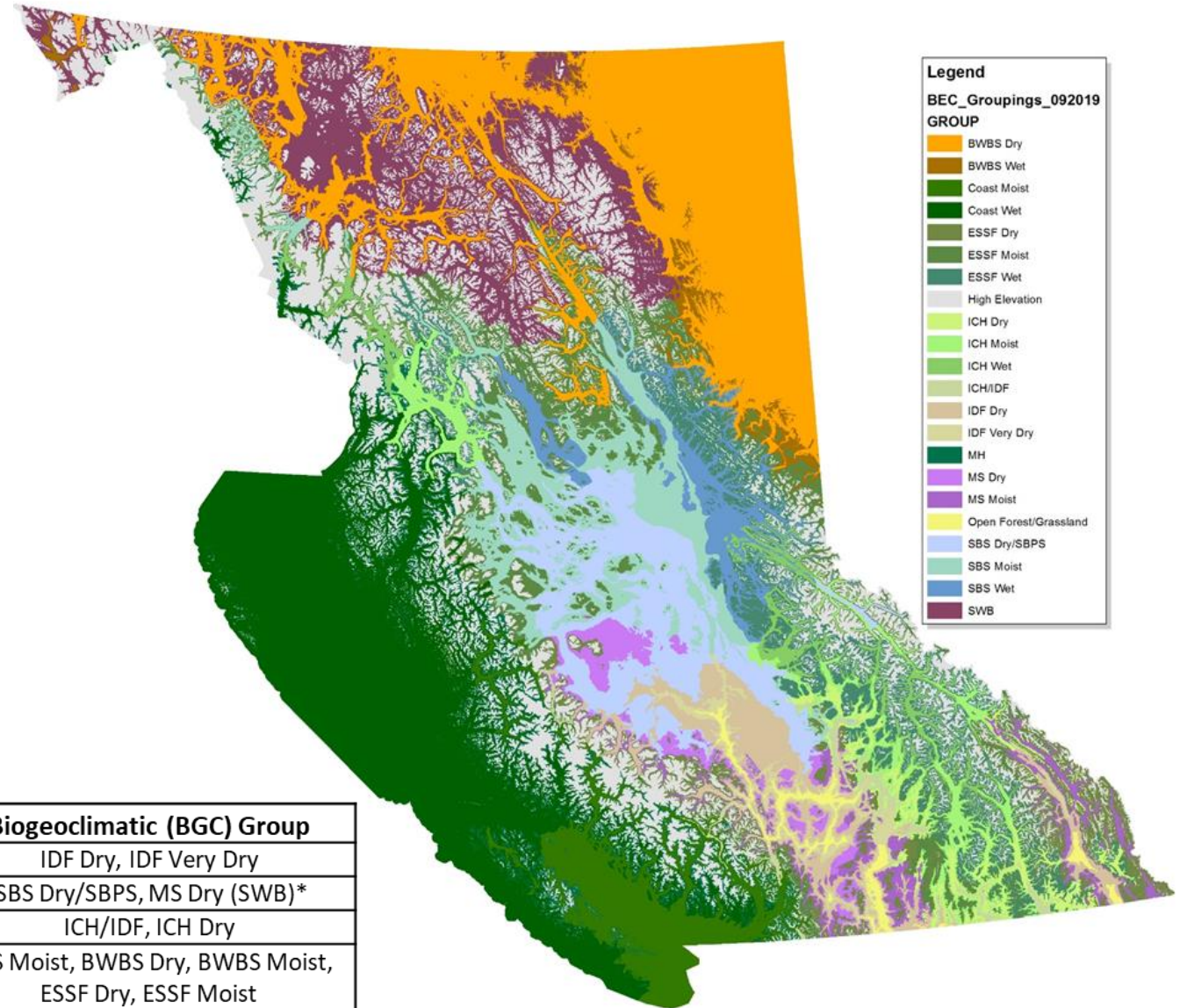
- Baseline levels for forest structure (Standing Live, Dead and Downed Wood) derived from plot\transect data including;
  - Cruise Plot data (2005-2010/2015-2020)
  - FREP data
  - Permanent Sample Plots
  - National Forest Inventory(NFI)
- Compiled by Biogeoclimatic Groups – groups of BGC subzone variants with similar climatic and disturbance characteristics.
- Used for Questions #5-#8 of the protocol



# Benchmarks by Forest Types

- Pre-harvest forest structure varies across the province
- Climate and productivity natural disturbance types
- General similarities in forest structure among broad forest types
- Benchmarks simplified to Forest Types

| Forest Type        | Biogeoclimatic (BGC) Group                            |
|--------------------|-------------------------------------------------------|
| Dry Forest         | IDF Dry, IDF Very Dry                                 |
| Cool Dry Montane 1 | SBS Dry/SBPS, MS Dry (SWB)*                           |
| Cool Dry Montane 2 | ICH/IDF, ICH Dry                                      |
| Cool Montane 1     | SBS Moist, BWBS Dry, BWBS Moist, ESSF Dry, ESSF Moist |
| Cool Montane 2     | SBS Wet, ESSF Wet, ICH Moist                          |
| Cool Wet Montane   | ICH Wet, CWH Moist, CWH Wet, MH                       |



# Target Categories: Evaluating Retention Practices Against Guidance Targets- Field Data

- Guidance Targets set around 20-80<sup>th</sup> quantiles of data from 'pre-harvest' stands
- Target categories are based on average levels of different stand attributes found in forest types:
  - Trees >30cm DBH
  - Snags >30cm DBH
  - Soft snags (WT class 6-8) >30cm DBH
  - CWD Volume (m<sup>3</sup>/ha)
  - Large CWD Pieces (>20cm Diameter and >10m length )

|                           | all trees      |                |                |                |
|---------------------------|----------------|----------------|----------------|----------------|
|                           | Trees>30cm DBH |                | Trees>50cm DBH |                |
|                           | % of all trees | stems/ hectare | % of all trees | stems/ hectare |
| NDT4 → Dry Forest         | 15-25%         | 90-125         | 1-4            | 10-20          |
| Cool Dry Montane 1        | 5-15%          | 70-85          | <1%            | 2-7            |
| NDT3 → Cool Dry Montane 2 | 25-30%         | 175-200        | 3-6            | 25-35          |
| Cool Montane 1            | 15-20%         | 125-175        | 1-3            | 5-20           |
| NDT2 → Cool Montane 2     | 25-35%         | 175-225        | 2-6%           | 20-35          |
| NDT1 → Cool Wet Montane   | 35-40%         | 250-350        | 10-15          | 75-125         |

Pre-harvest estimates

|                    | Trees>30cm |         |         |           |
|--------------------|------------|---------|---------|-----------|
|                    | Well Below | Below   | Meeting | Exceeding |
| Dry Forest         | <50        | 50-70   | 70-150  | >150      |
| Cool Dry Montane 1 | <25        | 25-50   | 50-110  | >110      |
| Cool Dry Montane 2 | <75        | 75-125  | 125-250 | >250      |
| Cool Montane 1     | <50        | 50-75   | 75-225  | >225      |
| Cool Montane 2     | <75        | 75-125  | 125-275 | >275      |
| Cool Wet Montane   | <150       | 150-200 | 200-400 | >400      |

Target categories

# Verifying and Over-Riding Ratings

- There are a number of reasons that outcomes of the field data collection should be verified against practices observed in the cutblock
  - Low sampling intensity may not capture all stand attributes
  - Benchmarks broadly represent 'pre-harvest' conditions found in different forest ecosystems - but these can vary by site
  - Management objectives may warrant use of a different benchmark
- Ratings that are automatically applied based on collected data may not always tell the true story
- Evaluators have the ability to over-ride ratings that are automatically generated
- Important to understand how the data collected is:
  - summarized,
  - used to assign ratings for each questions
  - Factors that may affect the accuracy of ratings

Recording some additional notes on observations in the cutblock during data collection can be important to help in the process





Questions?

# Part 3: Review field-based stand-Level retention questions

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- Importance of post-harvest forest structure
- Management considerations & existing guidance
- How questions were designed to evaluate retention practices and benchmarks used
- Field data collection tips to help assign\verify ratings



# Part 3: Review of SLR Protocol Questions that use field data:

## Wildlife Tree Retention

### Category: Landscape Context

**Question #1** – Tree Retention Amount - is the amount of stand-level retention adequate considering the landscape context?

**Question #2** - Patch Size – Is the amount of stand-level retention in the cutblock adequate considering the size of the associated patch?

**Question #3** – Landscape Connectivity – Is the amount and spatial location of stand-level retention adequate to help maintain landscape-level connectivity?

**Question #4** - Micro-Environment - Does Wildlife Tree Retention and block shape contribute to a range of microenvironments and structural complexity within the block?

### Category: Wildlife Tree Retention Practices

**Question #5** - Standing Live and Dead Tree Size and Condition – Will the amount, size and condition of retained wildlife trees provide habitat refugia and structural complexity in the regenerating stand now and into the future?

5a) Large Live Trees >30cm DBH

5b) Snags >30cm DBH

5c) Soft Snags >30cm DBH

**Question #6** – Wildlife Tree Retention Practices - Do stand-level retention practices retain wildlife important habitat features by minimizing windthrow effects?

6a) average amount of blowdown

6b) Maximum amount of blowdown in one patch

### Category: Coarse Woody Debris Retention Practices

**Question #7** – Amount and Spatial Dispersion of Downed Wood – Does the amount and dispersion of CWD provide habitat refugia and structural complexity in the regenerating stand now and in the future?

7a) CWD Volume

7b) Area contributing future CWD inputs

**Question #8** - Downed Wood Size and Condition – Does the size and condition of CWD provide habitat refugia and structural complexity in the regenerating stand now and in the future?

# Category: Wildlife Tree Retention Practices

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- Stand-level forest structure plays a key role in providing habitat for many wildlife species.
- Wildlife have life history traits (e.g. breeding, nesting, denning) associated with unique tree structural attributes (e.g. large size, large branches, loose bark or hollows on dead trees).
- Forest structural conditions that support these attributes may only occur or develop in some seral stages (e.g. post disturbance or late seral conditions)
- The amount and frequency at which these conditions occur varies with natural disturbance regimes.



# Managing Tree Retention

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To ensure a range of habitat structures are available to support wildlife use in managed stands requires careful consideration and planning during forest operations.

Maintaining and recruiting large structural attributes (large trees, snags, CWD) into managed forests is challenging:

- Rotation periods for managed stands are often short (60-80 years) relative to disturbance return intervals.
- Shortened rotation periods do not allow for the decades or even centuries of later seral forest conditions necessary to develop large trees and snags with important habitat attributes.



# Managing Tree Retention

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Guidance for wildlife tree retention includes:

- Target specific tree species, or large, rare, or uncommon larger trees as well as larger hard (class 3-6), or soft` snags (class 7-8),
- Plan WTRAS to incorporate 'ecological anchors' such as high densities of large snags or uncommon standing live (large veteran trees) or dead trees (large soft snags),
- Retain a buffer for windfirmness and to allow for safety tree removal on the perimeter of the WTRA without affecting targeted trees.
- Spatially locate wildlife tree retention to protect unique features within or adjacent to the cutblock such as wetter sites, riparian features or dry rocky outcrops that due to their unique site conditions may host uncommon or rare tree species.



# Question 5:

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**Question 5** - Standing Live and dead tree size and condition – Will standing live and dead trees provide habitat refugia and structural complexity in the regenerating stand now and into the future?

5a- Trees >30cm DBH

5b. Snags >30cm DBH

5c. Soft snags > 30cm DBH



# Wildlife Tree Benchmarks & Ratings

- Guidance Targets set around 20-80<sup>th</sup> quantiles for 'pre-harvest' stand conditions
- Target categories are based on average levels of different stand attributes found in forest types:
  - Trees >30cm DBH
  - Snags >30cm DBH
  - Soft snags (WT class 6-8) >30cm DBH

NDT4

NDT3

NDT2

NDT1

|                    | all trees      |                |                |                |
|--------------------|----------------|----------------|----------------|----------------|
|                    | Trees>30cm DBH |                | Trees>50cm DBH |                |
|                    | % of all trees | stems/ hectare | % of all trees | stems/ hectare |
| Dry Forest         | 15-25%         | 90-125         | 1-4            | 10-20          |
| Cool Dry Montane 1 | 5-15%          | 70-85          | <1%            | 2-7            |
| Cool Dry Montane 2 | 25-30%         | 175-200        | 3-6            | 25-35          |
| Cool Montane 1     | 15-20%         | 125-175        | 1-3            | 5-20           |
| Cool Montane 2     | 25-35%         | 175-225        | 2-6%           | 20-35          |
| Cool Wet Montane   | 35-40%         | 250-350        | 10-15          | 75-125         |

|                    | Trees>30cm |         |         |           |
|--------------------|------------|---------|---------|-----------|
|                    | Well Below | Below   | Meeting | Exceeding |
| Dry Forest         | <50        | 50-70   | 70-150  | >150      |
| Cool Dry Montane 1 | <25        | 25-50   | 50-110  | >110      |
| Cool Dry Montane 2 | <75        | 75-125  | 125-250 | >250      |
| Cool Montane 1     | <50        | 50-75   | 75-225  | >225      |
| Cool Montane 2     | <75        | 75-125  | 125-275 | >275      |
| Cool Wet Montane   | <150       | 150-200 | 200-400 | >400      |

# Question 6 – Minimizing Windthrow

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Managing post-harvest windthrow is important to ensure wildlife trees persist through the entire rotation of the managed stand.

Maintaining standing live wildlife trees can help ensure:

- life-boating functions and structural complexity help organisms disperse into and re-colonize the regenerating stand.
- continue to grow to develop many of the important wildlife attributes associated with larger older trees
- recruit large old snags
- wildlife trees persist into the next rotation(s) is particularly critical when harvesting 2nd growth stands or younger mature growth stands where important wildlife tree attributes haven't had the opportunity to develop.



# Managing Windthrow

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- Forest harvesting can increase the susceptibility of residual trees to windthrow by exposing residual trees to the effects of wind.
- Almost all forests experience some endemic windthrow but some areas of the province area also more susceptible to windthrow due to higher or more frequent winds.
- In most cases, by recognizing prevailing wind patterns, topography, soils, forest structure and composition, and applying appropriate mitigation mitigation treatments during harvesting, and patterns, windthrow residual tree can be minimized (Mitchell 1994, Zielke et al. 2010).



# Windthrow Benchmarks and Ratings

For biodiversity and wildlife habitat conservation purposes, acceptable windthrow levels applied in this protocol consider that:

- some level of post-harvest windthrow can be expected, and even desirable.
- windthrow or breakage is an important process to create snags and downed wood and create structural diversity in forest stands.
- However, significant levels of post-harvest windthrow level will reduce the intended benefits of wildlife tree retention for the duration of the rotation, or longer.
- Target levels specified here consider that >10% windthrow on average across all WTRAs, and >30% maximum windthrow in any one WTRA to be below acceptable level.

Question 6a: Average percent windthrow across all retention patches

| Average Percent (%) Windthrow | Assigned Rating |
|-------------------------------|-----------------|
| <1%                           | Exceeding       |
| 1-10%                         | Meeting         |
| 11-30%                        | Below           |
| >30%                          | Well Below      |

Question 6b: Maximum percent windthrow in a single retention patch

| Maximum Percent (%) Windthrow | Assigned Rating |
|-------------------------------|-----------------|
| <10%                          | Exceeding       |
| 11-30%                        | Meeting         |
| 31-50%                        | Below           |
| >50%                          | Well Below      |

# Factors Affecting Wildlife Tree Retention Practices

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- Several factors could limit retention opportunities to be consistent with pre-harvest benchmarks:
  - Harvesting 2<sup>nd</sup>/3<sup>rd</sup> growth or commercial thinning
  - Salvage following natural disturbances
    - Wildfire
    - Insect attack
    - Windthrow
- Evaluators should make note of any of these factors from site-plan or when observed in the field



# Notes on Calculating Ratings

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- Question 5 compares the density of trees & snags in WTPs and NAR as dispersed retention
- NAR dispersed trees are additive to WTPs when calculating total stems/ha for questions 5a-5c
  - Can't expect a comparable density of retained trees in NAR compared to pre-harvest conditions
  - Additional retained trees in NAR are beneficial to biodiversity and added to what is in WTPs
- Example:
  - 50 stems/ha >30cm DBH in WTP
  - 5 stems/ha >30cm in NAR
  - Total for block = 55 stems/ha



# Field Data Collection Considerations

- Relatively low sampling intensity of stand structure plots (plots/ha)
- Large trees & snags retained on the block are often rare and can easily fall outside of plots
- Where good wildlife tree retention practices occur
  - Record in your notes an estimated density in each strata
  - This can be later compared to the benchmarks for the questions and can be used to modify rating for this question

Number of stems/ha by tree DBH for each tree recorded in a plot using different basal area factors (BAF) for variable radius (prism) and fixed area plots

| BAF | # of stems/ha at different tree sizes |      |      |      |      |      |      |
|-----|---------------------------------------|------|------|------|------|------|------|
|     | 30cm                                  | 35cm | 40cm | 45cm | 50cm | 55cm | 60cm |
| 2   | 28                                    | 20   | 16   | 13   | 10   | 8    | 7    |
| 3   | 42                                    | 31   | 24   | 19   | 15   | 12.5 | 11   |
| 4   | 57                                    | .    | .    | .    | .    | .    | .    |
| 5   | 71                                    | .    | .    | .    | .    | .    | .    |
| 6   | 85                                    | .    | .    | .    | .    | .    | .    |
| 7   | 99                                    | .    | .    | .    | .    |      |      |
| 8   | 113                                   | .    | .    | .    |      |      |      |
| 9   | 127                                   | .    | .    |      |      |      |      |
| 10  | 142                                   | .    |      |      |      |      |      |

| Fixed radius<br>Plot size<br>(m) | Area<br>(m <sup>2</sup> ) | Stems/ha<br>trees<br>>30cm |
|----------------------------------|---------------------------|----------------------------|
| 3.99                             | 50                        | 200                        |
| 5.64                             | 100                       | 100                        |
| 7.98                             | 200                       | 50                         |
| 11.28                            | 400                       | 25                         |
| 12.62                            | 500                       | 20                         |
| 17.84                            | 1,000                     | 10                         |

# Verifying and Over-Riding Ratings for Questions 5 & 6

## Verification

- Summarized results for the block should be checked:
  - WTP & NAR stems/ha >30cm DBH
  - WTP & NAR stems/ha >30cm DBH
  - WTP & NAR stems/ha >30cm DBH
  - Average windthrow percent (%)
  - Maximum windthrow percent (%)
- Review the ratings (*Well Below, Below, Meeting, Exceeding*) for Question 5 & 6
  - Are the summarized results and ratings consistent with practices observed on the block
  - Why or Why Not?
  - Recording notes on observations of Wildlife Tree retention practices on the block is a good idea during sampling

## Over-Riding Results

Two situations where ratings applied for Questions 5 can be modified:

### 1) Limited Wildlife Tree Retention Opportunities

- Existing benchmarks for assigning ratings are too high based on retention opportunities
  - 2<sup>nd</sup> or 3<sup>rd</sup> growth stands
  - Post-disturbance salvage

### 2) Sampling Intensity does not fully capture WT Retention practices observed on the block

- Good WT Retention practices observed outside of transects
- Record a rationale for why initial ratings were modified



Questions?

# Part 3: Review of SLR Protocol Questions that use field data:

## Coarse Woody Debris Retention

|                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Category: Landscape Context</b>                                                                                                                                                                                                                                                                                             |
| <b>Question #1</b> – Tree Retention Amount - is the amount of stand-level retention adequate considering the landscape context?                                                                                                                                                                                                |
| <b>Question #2</b> - Patch Size – Is the amount of stand-level retention in the cutblock adequate considering the size of the associated patch?                                                                                                                                                                                |
| <b>Question #3</b> – Landscape Connectivity – Is the amount and spatial location of stand-level retention adequate to help maintain landscape-level connectivity?                                                                                                                                                              |
| <b>Question #4</b> - Micro-Environment - Does Wildlife Tree Retention and block shape contribute to a range of microenvironments and structural complexity within the block?                                                                                                                                                   |
| <b>Category: Wildlife Tree Retention Practices</b>                                                                                                                                                                                                                                                                             |
| <b>Question #5</b> - Standing Live and Dead Tree Size and Condition – Will the amount, size and condition of retained wildlife trees provide habitat refugia and structural complexity in the regenerating stand now and into the future?<br>5a) Large Live Trees >30cm DBH<br>5b) Snags >30cm DBH<br>5c) Soft Snags >30cm DBH |
| <b>Question #6</b> – Wildlife Tree Retention Practices - Do stand-level retention practices retain wildlife important habitat features by minimizing windthrow effects?<br>6a) average amount of blowdown<br>6b) Maximum amount of blowdown in one patch                                                                       |
| <b>Category: Coarse Woody Debris Retention Practices</b>                                                                                                                                                                                                                                                                       |
| <b>Question #7</b> – Amount and Spatial Dispersion of Downed Wood – Does the amount and dispersion of CWD provide habitat refugia and structural complexity in the regenerating stand now and in the future?<br>7a) CWD Volume<br>7b) Area contributing future CWD inputs                                                      |
| <b>Question #8</b> - Downed Wood Size and Condition – Does the size and condition of CWD provide habitat refugia and structural complexity in the regenerating stand now and in the future?                                                                                                                                    |

# Category: Coarse Woody Debris

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- Coarse woody debris (CWD) is an important structural component of forests that provides habitats for a broad range of wildlife species.
- The amount or volume of CWD is a key component to maintain biodiversity and habitats, but only one of many factors that determine how organisms utilize CWD.
- Several other important factors include (after Harmon et al. 1986):
  - Physical orientation – birds and bats use standing snags, while many mammals, amphibians and reptiles use downed logs.
  - Size –
  - Decay Class and tree species – variable use by invertebrates and fungi based on decomposition characteristics



# Coarse Woody Debris Management

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In managed stands, pre-harvest planning is required to ensure adequate amounts and types of CWD habitats are available throughout the rotation.

- Much of the pre-harvest CWD, particularly advanced decay classes, may be lost during harvest operations.
- removing tree biomass from the site, less of the pre-harvest stand volume will be available to provide initial CWD volume in the regenerating forest.

Four factors to consider to manage CWD through the full rotation of managed forests, include: (after Harmon et al. 1986, Densmore et al. 2004):

- The initial volume left at the time of harvest,
- Input of new CWD as the new stand grows and experiences mortality
- a shortened rotation cycle may result in less inputs of CWD
- Depletion of the initial CWD volume and new inputs of CWD by various decay processes, and
- Input of CWD from standing trees initially retained in reserves such as WTRAs or from dispersed or aggregated retained trees in the harvested area.



# CWD Management Guidance

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- Maintaining CWD volume on site at the time of harvest is critical to maintaining CWD habitats in the first few decades following harvest.
- Initial CWD will decay by 30-40 years post-harvest,
- To help maintain and recruit specific CWD attributes in managed stands:
  - Retain larger (diameter and length) CWD pieces - Large CWD pieces take longer to decay and thus CWD persists longer into the regenerating stand.
  - Maintain a full range of decay classes, diameters and tree species – to provide variability in post-harvest downed wood habitats.
  - Maintain overlapping or elevated logs to provide more structural diversity. Debris piles and windrows have been shown to provide important interim habitats in regenerating stands (Sullivan and Sullivan 2019).
  - Retain standing trees for CWD recruitment – a staggered input of CWD through falldown to recruit CWD in 50-80 years when deficits occur in later stages of managed stand development.



# Question 7: CWD Volume and Future CWD Inputs

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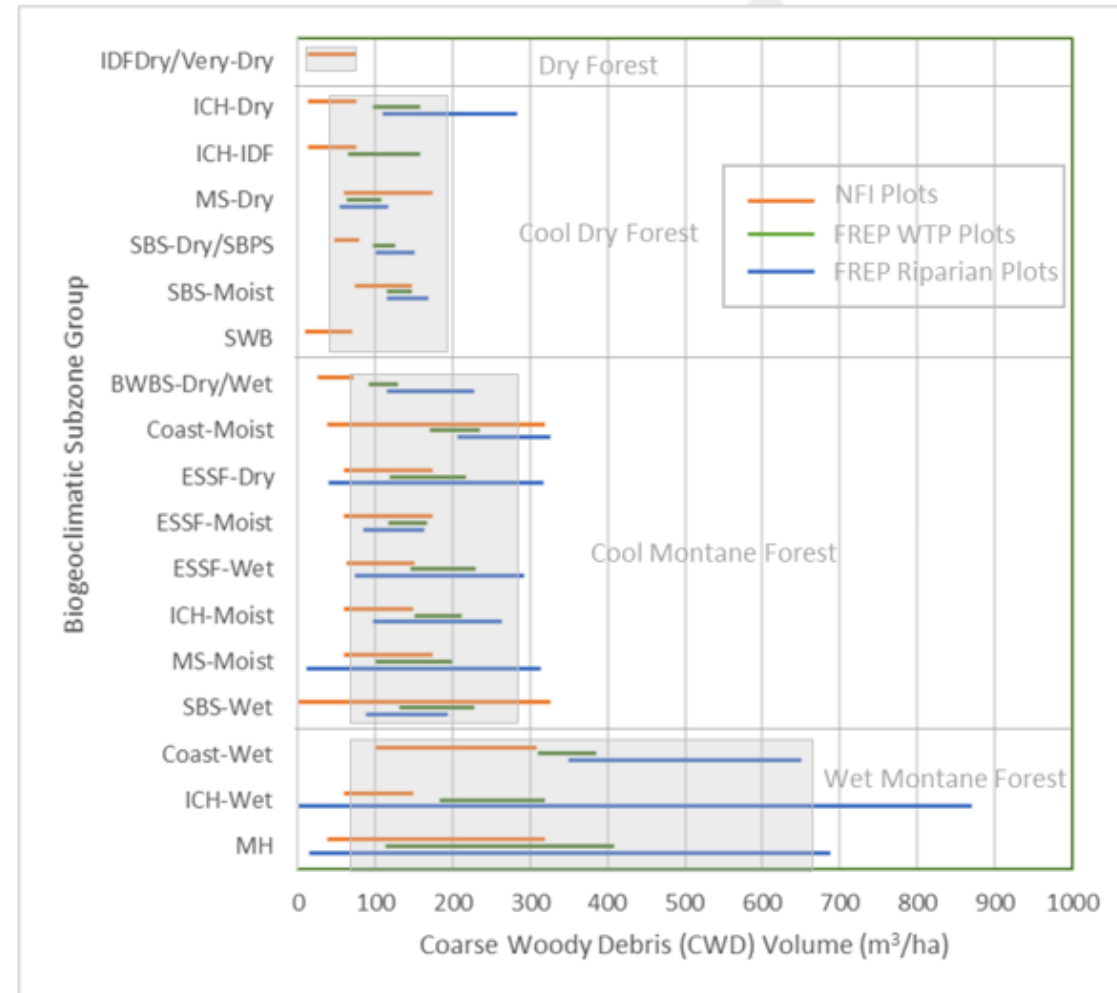
- **Question 7-** Amount and Spatial Dispersion of Downed Wood – Does the amount and dispersion of CWD provide habitat refugia and structural complexity in the regenerating stand now and in the future?
  - 7a) CWD Volume
  - 7b) Area contributing future CWD inputs



# Question 7a: CWD Volume Benchmarks

- Used existing data to identify ranges of CWD by BGC Groups
- Used existing literature review from US that identified 'optimal' levels in different ecosystem types

**Figure 8-1.** Range of stand-level CWD volume for based on available National Forest Inventory (NFI) transects and Forest and Range Evaluation Program (FREP) transects in Wildlife Tree Patches (WTP) and Riparian reserves. Shaded areas show 'optimal' CWD levels for as interpreted from Brown et al. (2003) and adapted to BC Forests.



# Question 7a: CWD Volume Benchmarks

- Used existing data to identify ranges of CWD by BGC Group.
- Used existing literature review from US that identified 'optimal' levels in different ecosystem types

**Table 8-1.** Preliminary estimates for optimal coarse woody debris (CWD) volume targets by broad forest types and Biogeoclimatic Groups considering different CWD management priorities.

| Forest Type         | Biogeoclimatic Group                                                         | Optimal Coarse Woody Debris (CWD) Volume Range (m3/ha) <sup>a</sup> |         |      |
|---------------------|------------------------------------------------------------------------------|---------------------------------------------------------------------|---------|------|
|                     |                                                                              | Low                                                                 | Medium  | High |
| Dry Forest          | IDF -Dry and Very Dry                                                        | 30-50                                                               | 50-70   | >70  |
| Cool Dry Forest     | ICH/IDF, ICH – Dry, MS Dry<br>SBS - Dry/SBPS, SBS Moist, SWB                 | 50-100                                                              | 70-150  | >150 |
| Cool Montane Forest | BWBS- Dry/Wet, Coast-Moist, <u>ESSF</u> -Dry/Moist/Wet, SBS-Wet, ICH – Moist | 70-150                                                              | 150-250 | >250 |
| Wet Montane Forest  | Coast – Wet, ICH-Wet, MH                                                     | 70-150                                                              | 150-350 | >350 |

<sup>a</sup> – CWD volume is measured from a database of CWD for each Biogeoclimatic zone or subzone group

## Question 7a CWD Volume Ratings

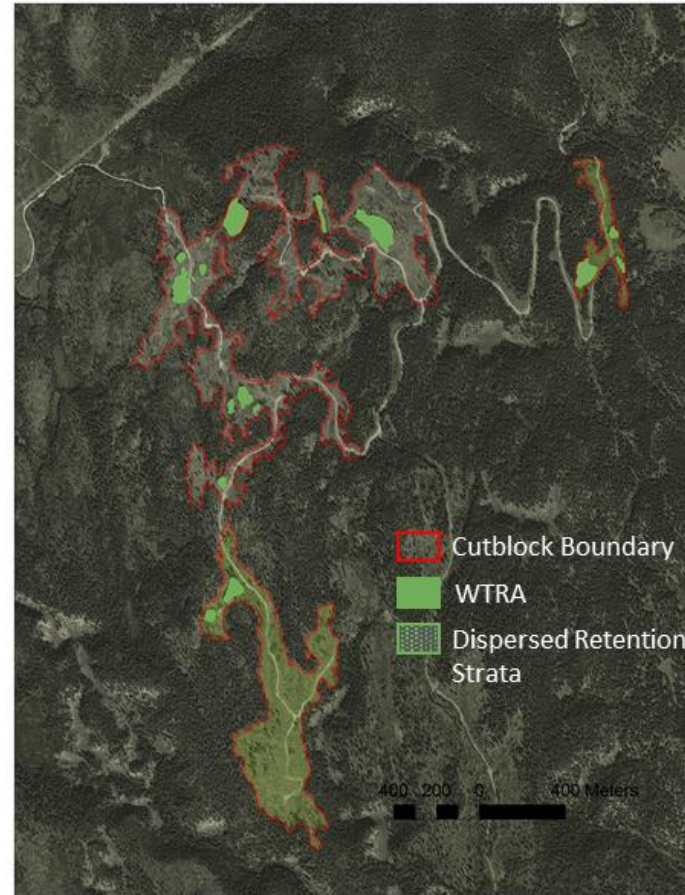
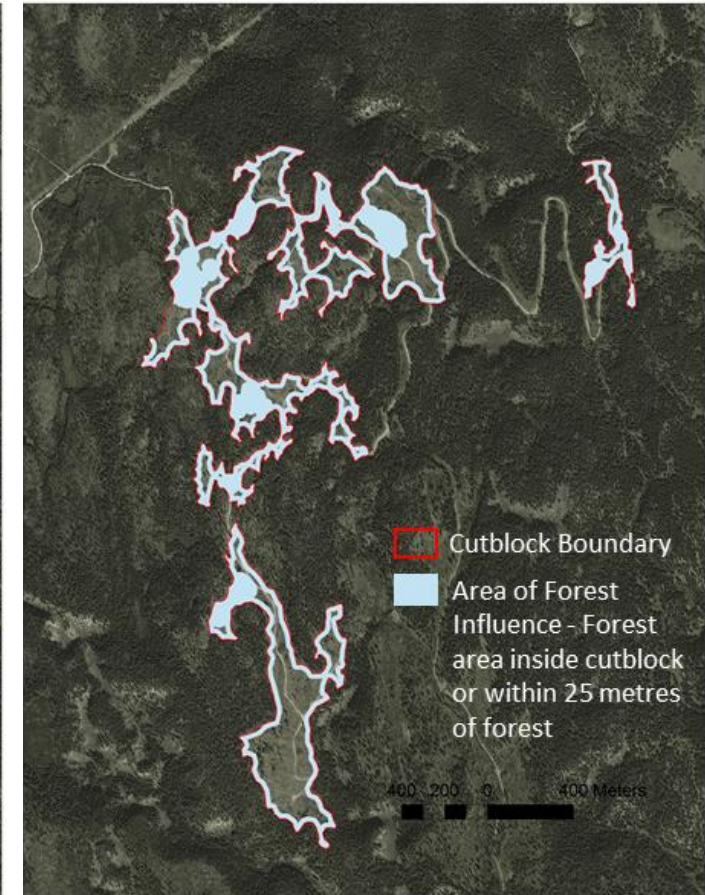
- Management targets simplified and set by Forest Type

| Forest Type            | Rating Category                                  |         |         |           |
|------------------------|--------------------------------------------------|---------|---------|-----------|
|                        | Well Below                                       | Below   | Meeting | Exceeding |
|                        | Coarse Woody Debris Volume ( m <sup>3</sup> /ha) |         |         |           |
| Dry Forest             | <10                                              | 10-30   | 30-80   | >80       |
| Cool Dry Montane 1 & 2 | <25                                              | 25-50   | 50-175  | >175      |
| Cool Montane 1 & 2     | <50                                              | 50-100  | 100-300 | >300      |
| Wet Montane            | <100                                             | 100-200 | 200-500 | >500      |

# Question 7b: Area contributing to future CWD inputs

- Question 7b – CWD recruitment based on forest influence
- Forest influence includes:
  - Area of block in WTPs
  - Area of NAR within 1 tree length ( 25m) of WTP or adjacent
  - Area of NAR in dispersed retention strata ( up to 50% of area of dispersed strata contributes to forest influence depending on basal area retained)
- All 3 Areas are summed and divided by gross cutblock area to calculate Percent Forest Influence
- Benchmarks for Forest Influence used for Question 7b area different than used in Question 3 of the protocol

| Percent (%) Forest Influence | Assigned Rating |
|------------------------------|-----------------|
| <30%                         | Well Below      |
| 30-45%                       | Below           |
| 45-60%                       | Meeting         |
| >60%                         | Exceeding       |



# Question 8: Large CWD Pieces

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- **Question #8** - Downed Wood Size and Condition – Does the size and condition of CWD provide habitat refugia and structural complexity in the regenerating stand now and in the future?



# Question 8: Benchmarks for large CWD Pieces

- Chief Forester Guidance on CWD ( 2010) asked for 20% increase in # of large CWD pieces in Net Area to be Reforested (NAR) over pre-2010 levels
- Target levels vary by ecosystem ( BGC Group)
- More productive areas and longer return intervals = more big logs

| Biogeoclimatic Group | Mean density (CWD pieces/Hectare) >10m long and large pieces (>20cm diameter and 10m long) |                |                                                    |                |                                        |                |
|----------------------|--------------------------------------------------------------------------------------------|----------------|----------------------------------------------------|----------------|----------------------------------------|----------------|
|                      | Net Area to be Reforested (Pre-2010 FREP data)                                             |                | Wildlife Tree Retention Areas (Pre-2010 FREP data) |                | Target Levels in NAR with 20% increase |                |
|                      | >10m                                                                                       | >20cm and >10m | >10m                                               | >20cm and >10m | >10m                                   | >20cm and >10m |
| BWBS- Dry            | 32                                                                                         | 15             | 118                                                | 48             | 49                                     | 22             |
| BWBS - Wet           | 39                                                                                         | 15             | 104                                                | 32             | 52                                     | 18             |
| Coast - Moist        | 39                                                                                         | 21             | 82                                                 | 48             | 48                                     | 26             |
| Coast - Wet          | 60                                                                                         | 39             | 92                                                 | 69             | 67                                     | 45             |
| ESSF - Dry           | 45                                                                                         | 19             | 161                                                | 59             | 68                                     | 27             |
| ESSF - Moist         | 40                                                                                         | 19             | 137                                                | 60             | 59                                     | 27             |
| ESSF - Wet           | 43                                                                                         | 25             | 129                                                | 83             | 60                                     | 37             |
| ICH - Dry            | 46                                                                                         | 15             | 136                                                | 54             | 64                                     | 23             |
| ICH - Moist          | 65                                                                                         | 29             | 119                                                | 58             | 76                                     | 35             |
| ICH - Wet            | 62                                                                                         | 41             | 86                                                 | 61             | 67                                     | 45             |
| ICH/IDF              | 50                                                                                         | 17             | 106                                                | 50             | 61                                     | 24             |
| IDF - Dry            | 34                                                                                         | 7              | 115                                                | 33             | 50                                     | 12             |
| IDF – Very Dry       | 33                                                                                         | 4              | 46                                                 | 13             | 35                                     | 5              |
| MH                   | 58                                                                                         | 41             | 68                                                 | 50             | 60                                     | 43             |
| MS - Dry             | 20                                                                                         | 4              | 146                                                | 34             | 45                                     | 10             |
| MS - Moist           | 46                                                                                         | 11             | 160                                                | 61             | 69                                     | 21             |
| SBS - Dry/SBPS       | 46                                                                                         | 11             | 178                                                | 49             | 72                                     | 19             |
| SBS Moist            | 48                                                                                         | 16             | 165                                                | 60             | 72                                     | 25             |
| SBS Wet              | 50                                                                                         | 19             | 186                                                | 85             | 77                                     | 32             |
| SWB                  | 32                                                                                         | 15             | 118                                                | 48             | 49                                     | 22             |

## Question 8: Benchmarks and Ratings for Large CWD Pieces

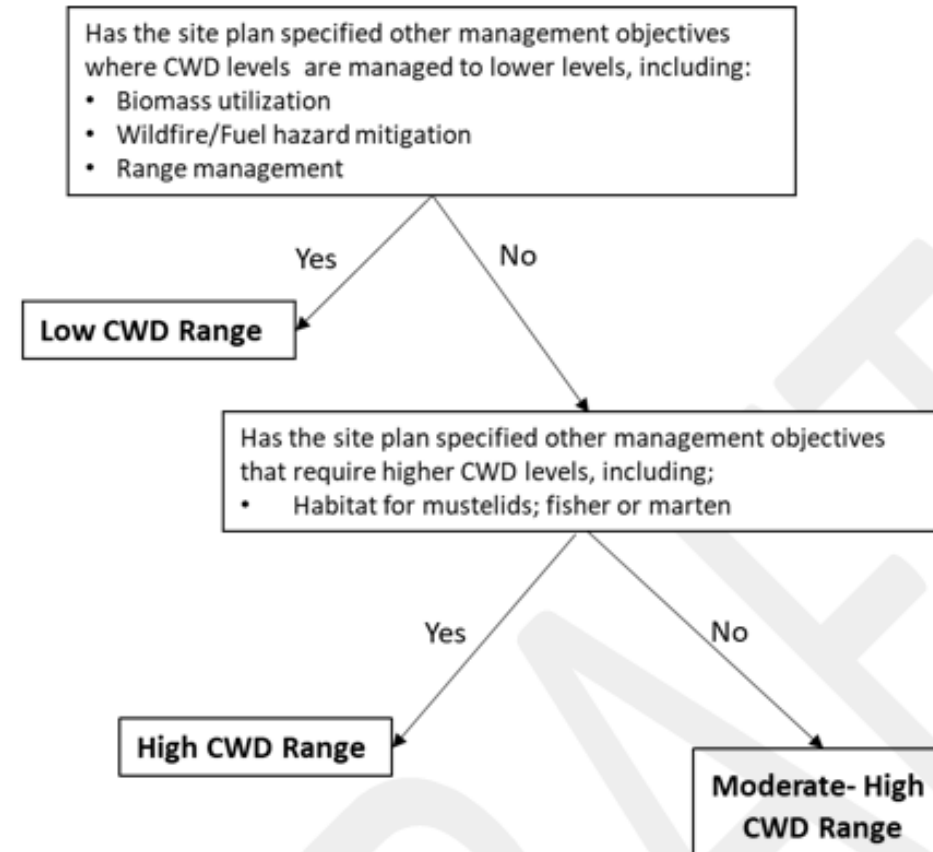
Management targets  
simplified and set by Forest  
Type

| Forest Type        | Large CWD Pieces/ha |       |         |           |
|--------------------|---------------------|-------|---------|-----------|
|                    | Well Below          | Below | Meeting | Exceeding |
| Dry Forest         | <5                  | 5-10  | 10-20   | >20       |
| Cool Dry Montane 1 | <5                  | 5-15  | 15-30   | >30       |
| Cool Dry Montane 2 | <5                  | 5-15  | 15-30   | >30       |
| Cool Montane 1     | <10                 | 10-20 | 20-30   | >30       |
| Cool Montane 2     | <15                 | 15-25 | 25-40   | >40       |
| Wet Montane        | <15                 | 15-25 | 25-45   | >45       |

# Factors Affecting CWD Management

- Different management objectives can dictate the amount of CWD maintained on the site.
- Management may emphasize:
  - Lower CWD to minimize fuel loads for wildfire risk reduction
  - Increased CWD to maintain habitat for a specific species (e.g. fisher)

Figure 8. Decision Tree to determine target post-harvest CWD volume range for evaluating measured CWD levels related to Question #8.



# Key Notes and Field Data Collection Considerations that Affect Ratings for Coarse Woody Debris ( Question 7&8)

## Notes on Calculating Ratings

- Question 7a: CWD Volume ( $\text{m}^3/\text{ha}$ ) is evaluated using the area-weighted average from WTPs and NAR
- Question 7b: Area contributing to future CWD inputs uses Forest Influence indicator calculated by GIS
  - Forest Influence should be checked and verified
- Question 8: Large CWD pieces/ha is evaluated for the NAR only
- Ratings utilize the benchmarks provided in the protocol that area based on:
  - 'pre-harvest' ecological benchmarks
  - Management guidance for large CWD pieces
- Specific site-level management objectives can vary from benchmark levels

## Field Data Collection Considerations

- Large piece density is based on size of log encountered along transect
  - Diameter recorded based on where you measure/transect crosses the log
- CWD Transects are random, but sampling intensity is generally low (few transects/hectare)
- May be large pieces retained – windrows, CWD piles or as individual downed logs outside of transects

Log length affects the probability a log will be encountered on a transect – and affects the # pieces/ha

- 1Log (>20cm and 10m length) = 52 pieces/ha
  - 11m length = 47 pieces/ha
  - 12m length = 44 pieces/ha
  - 13m length = 40 pieces /ha
  - 14m length = 37 pieces/ha
  - 15m length = 35 pieces/ha

# Verifying and Over-Riding Ratings for Questions 7 & 8

## Verification

- Summarized results for the block should be checked
  - WTP Volume
  - NAR Volume
  - NAR Large Pieces/ha
- Review the ratings (Well Below, Below, Meeting, Exceeding) for Question 7 & 8
  - Are the summarized results and ratings consistent with practices observed on the block
  - Why or Why Not?
  - Recording notes on observations of CWD practices on the block is a good idea during sampling

## Over-Riding Results

Two situations where ratings applied for Questions 7 and 8 can be modified:

1) CWD Management objectives vary from benchmarks

- Existing benchmarks for assigning ratings are too high or low based on CWD management guidance for the block

2) CWD Sampling intensity does not fully capture CWD management practices observed on the block

- Good CWD management practices observed outside of transects
- Record a rationale for why initial ratings were modified



Questions?