VCS Methodology

VM0035

Methodology for Improved Forest Management through Reduced Impact Logging

Version 1.0

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Sectoral Scope 14

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1 SUMMARY DESCRIPTION OF THE METHODOLOGY

Additionality and Crediting Method	
Additionality	Performance Method
Crediting Baseline	Performance Method

This methodology is applicable to projects which implement reduced impact logging practices to reduce greenhouse gas (GHG) emissions (hereafter termed *RIL-C practices*) in one or more of three GHG emission source categories (ie, timber felling, skidding and hauling). RIL-C practices may entail a range of improved logging and harvest planning practices, including, but not limited to, directional felling, improved log bucking (to permit greater recovery), improved harvest planning via pre-harvest inventory, skid trail planning and/or monocable winching, and reduction in width of haul roads and size of log landings.

The effectiveness of RIL-C practices, and accounting of emission reductions attributable to those practices, is assessed on the basis of their impacts post-harvest. Emission reductions are accounted for by applying a performance method approach, whereby emission reductions (net of baseline and project emissions) are assigned as a function of the difference between a set crediting baseline for each emission source category (ie, felling, skidding and hauling) and the measured impact of those parameters in the project scenario.

To ensure credible estimation of emission reductions, the impact parameters applied by this methodology are quantitative and outcome-based, rather than process-based (which are typically limited to demonstrating that the practice is in place, but may provide no information on how successful the implementation of the practice is). Further, emission reductions are estimated as a continuous function of the impact parameter values with which they correspond, providing better resolution of outcomes than a flat default factor. This methodology has been designed to ensure that emission reductions achieved based on one impact parameter are not reversed by excessive emissions with respect to another impact parameter, by requiring that all impact parameters must be at or below the crediting baseline in order for credits to be generated based on any one impact parameter.

Accounting is further simplified by incorporating the assumption that leakage equals zero and the wood products pool can be excluded because the methodology requires that there is no reduction in harvest levels.

Accounting is focused on emissions at the time of harvest from operations including felling, skidding and hauling, and delayed emissions from belowground biomass. Any net sequestration from comparatively improved growth post-RIL-C harvest is conservatively ignored.

Accounting of emission reductions begins on the project start date and is determined on all harvests through the project crediting period.

This document provides the framework for the methodology, and serves to outline core accounting procedures. Key parameters such as additionality benchmarks, crediting baselines, impact parameters, emission reduction equations and monitoring procedures are provided in corresponding geographic-specific RIL-C performance method modules. This methodology must be used in conjunction with a region-specific performance method module. The list of approved performance method modules applicable to this methodology can be found on the VCS website.

2 DEFINITIONS

In addition to the definitions set out in VCS document *Program Definitions*, the following definitions apply to this methodology:

Additionality Benchmark
The level of a given impact parameter below which a project is deemed additional, specified in terms of impact parameter values which represent a certain base level of performance among logging operations within a sampled logging landscape.

Crediting Baseline
The level of a given impact parameter below which emission reductions may be credited, specified in terms of impact parameter values which represent a certain base level of performance among logging operations within a sampled logging landscape. The corresponding baseline scenario is represented by an aggregate of individual logging operations from the logging landscape operating at this specified level of performance.

Impact Parameter
Quantitative parameter based on field measurements which defines both the crediting baseline and the additionality benchmark. Each impact parameter has an established empirical relationship with emissions levels, and is thus used as a proxy for emissions that can be readily measured in the field.

Logging Landscape
The geography, class of actors/sector, major logging system (eg, selective harvest) and timeframe within which the relationships of the impact parameter (with emission reductions) are applicable, and which is defined in the corresponding region-specific RIL-C performance method module.

Reduced Impact Logging (RIL-C)

Measures that reduce emissions from timber harvest in one or more of three emission source categories: felling, skidding and hauling. Component practices may include, but are not limited to, directional felling, improved log bucking, improved harvest planning via pre-harvest inventory, skid trail planning, mapping, and oversight and/or long cable winching, and reduction in width of haul roads and size of log landings.[1, 2]

3 APPLICABILITY CONDITIONS

This methodology applies to project activities which implement RIL-C practices in forests. Projects applying this methodology must meet the following applicability conditions:

1) The project activity does not involve a deliberate reduction in harvest levels. The criteria to demonstrate no intentional reduction in harvest level are provided in the applicable RIL-C performance method module.
2) The project activity and the baseline scenario do not involve conversion of forest to a non-forest land use/land cover (ie, both represent forests remaining as forests, *sensu* IPCC GL 2006).
3) In every year credited, the project proponent must hold legal authorization for all logging activities referenced in the project from the relevant government authority.
4) The project area must be located in a logging landscape developed for a corresponding region-specific RIL-C performance method module. It must be demonstrated that the entire project area is contained within the applicable logging landscape.
5) The entire project area meets the definition of forest, either host country-specific, UNFCCC or FAO definition.
6) RIL-C practices implemented as part of the project activity must not increase business-as-usual levels of impact on pre-existing dead wood stocks through slash management, salvage harvesting or other planned removal of dead wood.[3]

Requirements for developing a new region-specific performance method can be found in 0.

[1] Note that some practices may apply to more than one emission source category. Directional felling, for example, can serve to align logs with the planned skidding network, reducing skidding damage, and reduce damage to the felled log, improving roundwood recovery.

[2] Note that RIL-C practices do not include slash management, salvage harvesting or other planned removal of dead wood.

[3] VVBs need only confirm that this is the case through one of the following: a qualitative assessment of no evidence of removal of dead wood onsite (ie, looking for evidence of removal, or comparing dead wood carbon stocks in the project area to surrounding areas), interviewing project proponents, reviewing management plans, or a quantitative assessment of inventory data of dead wood carbon stocks (if they exist).

4 PROJECT BOUNDARY

Geographic boundary

The project area is defined as the area over which the project proponent holds authorization to conduct timber harvest over the length of the project crediting period. The area in its entirety must meet the definition of *forest* (see Section 3 above for definition of *forest*). The project area may be a subset of the concession holdings of the project proponent, but that the full extent of the project area must be defined at validation.

The boundary of the project area must be clearly delineated and documented with digital maps in the format specified by the VCS rules.

Temporal boundary

The temporal boundary of the project is set from the project start date, marking the initial harvest on which RIL-C practices are implemented, and the end of the project crediting period.

Pools and Sources

Table 1 below discusses the carbon pools included in the project boundary. Pools included in the project boundary are restricted to above- and below-ground tree biomass.

Table 2 below discusses the emission sources that are included in the project boundary. Emissions from fossil fuel combustion are conservatively excluded. Note that there are no optional pools, and that the included pools/sources (above- and belowground tree biomass) are accounted in both the baseline and project scenarios.

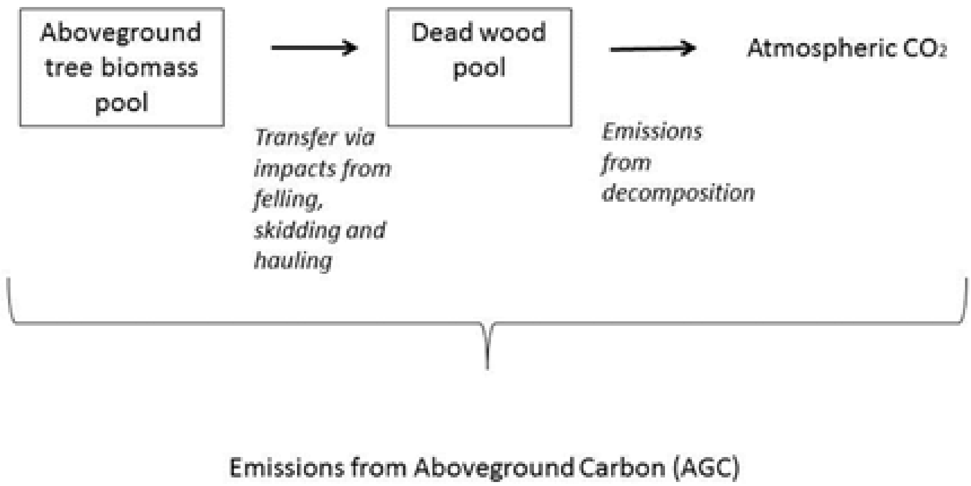
Table 1: GHG Pools Included in or Excluded from the Project Boundary

Carbon pools	Included?	Justification/Explanation
Aboveground tree biomass (included in *aboveground carbon*, AGC)	Yes	Must be included – represents a significant pool affected by the project activity
Aboveground non-tree biomass	No	Conservatively excluded – this pool is expected to increase relative to the baseline as a result of the project activity (from reduced skidding damage)
Belowground biomass	Yes	Must be included in all cases – represents a significant pool affected by the project activity

Dead wood (included in *aboveground carbon*, AGC)	Yes	Standing and lying dead wood produced by harvest are included. Changes in stocks of pre-existing dead wood are conservatively ignored (further explained below).
Harvested wood products	No	Applicability condition 1 obviates the inclusion of the wood products pool because there is no difference in harvest levels between the baseline and project scenarios.
Litter	No	No significant change is expected in this pool as a result of the project activity
Soil	No	No significant change is expected in this pool as a result of the project activity

Aboveground carbon stocks include both live and dead (standing and lying) pools. Emission reductions quantified for the aboveground carbon pool represent transfer of biomass carbon from live trees to dead wood, followed by steady emissions via decomposition, without explicitly separating the accounting of these elements, as described in Figure 1 below.

Figure 1: Schematic of Pools and Fluxes Incorporated in Aboveground Carbon (AGC) Emissions



Emissions from the dead wood pool included in accounting are from dead wood produced during harvest (ie, slash and new standing dead wood from harvest and collateral damage). This methodology conservatively does not account for changes in pre-existing standing and lying dead wood after harvest; these stocks would be expected to be greater in the project scenario post-harvest due to less-impactful RIL-C practices. As RIL-C practices implemented as part of the project activity do not include slash management, salvage harvesting or other planned removal of dead wood, this assumption is further assured.

Table 2: GHG Emission Sources Included In or Excluded From the Project Boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Fossil fuel emissions	CO_2	No	Conservatively excluded - project activity is expected to result in lower emissions (from more efficient use of skidders) from use of machinery
		CH_4	No	Conservatively excluded - project activity is expected to result in lower emissions (from more efficient use of skidders) from use of machinery
		N_2O	No	Conservatively excluded - project activity is expected to result in lower emissions (from more efficient use of skidders) from use of machinery
Project	Fossil fuel emissions	CO_2	No	Same as for baseline scenario
		CH_4	No	Same as for baseline scenario
		N_2O	No	Same as for baseline scenario

5 BASELINE SCENARIO

The baseline scenario is established by the applicable region-specific RIL-C performance method module, and represents logging operations in aggregate, operating at a specified level of performance, for the referenced logging landscape. The baseline scenario is represented by region-specific crediting baselines set for each impact parameter (ie, proxy factor) by the applicable region-specific RIL-C performance method module.

6 ADDITIONALITY

This methodology uses a performance method for the demonstration of additionality.

Step 1: Regulatory Surplus

The project proponent must demonstrate regulatory surplus in accordance with the rules and requirements regarding regulatory surplus set out in the latest version of the *VCS Standard*.

Step 2: Performance Benchmark

Projects must exceed the region-specific performance benchmark for each impact parameter (ie, proxy factor), as provided in the applicable RIL-C performance method module. One or more impact parameters are defined in the applicable RIL-C performance method module for each of three categories: felling impacts, skidding impacts and hauling impacts.

Projects may only be credited for emission reductions from one or more impact parameters if they are deemed additional. A project is deemed additional for one or more impact parameters if the impact parameter is below the additionality benchmark assigned for that impact parameter. **The project may only be credited for emission reductions if all impact parameters are at or below their respective crediting baselines.**

This benchmark threshold should be conservative and strike a balance between restriction of freeriders and feasibility of participation. This threshold may be different from (ie, lower than) the crediting baseline. Thus, while a project must be below the additionality benchmark in order to receive any emission reductions credits, once below the additionality benchmark, the amount of credits generated is measured using the crediting baseline.

7 QUANTIFICATION OF GHG EMISSION REDUCTIONS

7.1 Baseline and Project Emissions

Baseline and project emissions are addressed simultaneously, whereby an emission reduction value (specified in tonnes of CO_2 reduced (ie, net of baseline and project emissions)) is assigned as a function of the difference between the impact parameter (proxy variable) in the project and in the crediting baseline for each emission source category (felling, skidding and hauling). Assigned emission reductions, expressed on a per hectare basis, are then summed for the three emission source categories, and multiplied by the number of hectares in the harvest area in year *t*.

Step 1: Determine Harvest Area

The harvest area in year *t* should be delineated on the basis of paper maps or GIS files specifying the actual harvest area in year *t*. From this area, the project proponent must delineate and exclude any areas where timber harvest impacts will not happen for any reason (eg, due to geographic features, low stocking, set asides or poor planning). The resulting area is specified in hectares to produce parameter A_t.

Step 2: Calculate Emission Reductions Based on Measured Impact Parameters

Calculate emission reductions for each emission source category based on measured impact parameters. Each equation below calculates emission reductions in tCO_2/ha (the dependent variable) as a function of (ie, f_{AGC}) a specific impact parameter (the independent variable). Functions and corresponding units are provided in the applicable region-specific RIL-C performance method module.

$$ER_{fell\_AGC,t} = f_{AGC}\ (FELL_t) \quad (1)$$

$$ER_{skid\_AGC,t} = f_{AGC}\ (SKID_t) \quad (2)$$

$$ER_{haul\_AGC,t} = f_{AGC}\ (HAUL_t) \quad (3)$$

$$ER_{fell\_BGB,t} = f_{BGB}\ (FELL_t) \quad (4)$$

$$ER_{skid\_BGB,t} = f_{BGB}\ (SKID_t) \quad (5)$$

$$ER_{haul\_BGB,t} = f_{BGB}\ (HAUL_t) \quad (6)$$

Where:

$FELL_t$	= Felling impact parameter measured in year *t* (unit specified in performance module)
$SKID_t$	= Skidding impact parameter measured in year *t* (unit specified in performance module)
$HAUL_t$	= Hauling impacts measured in year *t* (unit specified in performance module)
$ER_{fell\_AGC,t}$	= Emission reductions from aboveground carbon related to felling in year *t* (t CO_2e/ha)
$ER_{skid\_AGC,t}$	= Emission reductions from aboveground carbon related to skidding in year *t* (t CO_2e/ha)
$ER_{haul\_AGC,t}$	= Emission reductions from aboveground carbon related to hauling in year *t* (t CO_2e/ha)
$ER_{fell\_BGB,t}$	= Emission reductions from belowground biomass related to felling in year *t* (t CO_2e/ha)
$ER_{skid\_BGB,t}$	= Emission reductions from belowground biomass related to skidding in year *t* (t CO_2e/ha)
$ER_{haul\_BGB,t}$	= Emission reductions from belowground biomass related to hauling in year *t* (t CO_2e/ha)
t	= 1, 2, 3, …*t* time elapsed since the start of project activity (years)

Step 3: Sum Emission Reductions

Sum all emission reductions to determine the combined emission reductions from above- and belowground biomass.

For any time *t,* if any impact parameter is greater than or equal to the crediting baseline for that year, parameters $RILC_{,AGC,t}$ and $RILC_{,BGB,t}$ must be set to zero.

$$\mathrm{RILC_{AGC,t} = ER_{fell\_AGC,t} + ER_{skid\_AGC,t} + ER_{haul\_AGC,t}} \tag{7}$$

$$\mathrm{RILC_{BGB,t} = ER_{fell\_BGB,t} + ER_{skid\_BGB,t} + ER_{haul\_BGB,t}} \tag{8}$$

If ER_{Fellt} and/or ER_{Skidt} and/or ER_{Hault} < 0 then $RILC_{AGCt}$ = 0 and $RILC_{BGBt}$ = 0.

Where:

$RILC_{,AGC,t}$	= Combined emission reductions from aboveground carbon from RIL-C in year *t* (t CO_2e/ha)
$RILC_{,BGB,t}$	= Combined emission reductions from belowground biomass from RIL-C in year *t* (t CO_2e/ha)
$ER_{fell\_AGC,t}$	= Emission reductions from aboveground carbon related to felling in year *t* (t CO_2e/ha)
$ER_{skid\_AGC,t}$	= Emission reductions from aboveground carbon related to skidding in year *t* (t CO_2e/ha)
$ER_{haul\_AGC,t}$	= Emission reductions from aboveground carbon related to hauling in year *t* (t CO_2e/ha)
$ER_{fell\_BGB,t}$	= Emission reductions from belowground biomass related to felling in yer *t* (t CO_2e/ha)
$ER_{skid\_BGB,t}$	= Emission reductions from belowground biomass related to skidding in year *t* (t CO_2e/ha)
$ER_{haul\_BGB,t}$	= Emission reductions from belowground biomass related to hauling in year *t* (t CO_2-e/ha)
t	= 1, 2, 3 …*t* time elapsed since the start of project activity (years)

Step 4: Determine Emission Reductions by Harvest Area

Emissions from aboveground carbon result from transfer of aboveground live biomass to the dead wood pool followed by steady decomposition.

Emission reductions from the aboveground carbon pool are determined either by applying an applicable dead wood decomposition rate, using equation 9a, or by applying a 10-year linear decay rate, using equation 9b.

Emission reductions from the belowground biomass pool must apply a 10-year linear decay rate (in both equations 9a and 9b). Thus, for a given year *t*, annual emission reductions from above- and belowground carbon are summed across areas previously harvested.

$$C_{RIL,t} = \sum_{t=1}^{t} A_t * RILC_{AGC,t} * (1-K)^{t-t*} * K + \sum_{t-10}^{t} A_t * RILC_{BGB,t} * (\frac{1}{10}) \quad (9a)$$

Where:

$C_{RIL,t}$ = Total emission reductions at time *t* (t CO_2e)

$RILC_{,AGC,t}$ = Combined emission reductions from aboveground carbon from RIL-C in year *t* (t CO_2e/ha)

$RILC_{,BGB,t}$ = Combined emission reductions from belowground biomass from RIL-C in year *t* (t CO_2e/ha)

K = Dead wood annual decomposition rate (percent/year)

A_t = Harvest area in year *t* (ha)

t = 1, 2, 3… *t* time elapsed since the start of the RIL project activity (years)

$$C_{RIL,t} = \sum_{t-10}^{t} A_t * RILC_{AGC,t} * (\frac{1}{10}) + \sum_{t-10}^{t} A_t * RILC_{BGB,t} * (\frac{1}{10}) \quad (9b)$$

Where:

$C_{RIL,t}$ = Total emission reductions at time *t* (t CO_2e)

$RILC_{,AGC,t}$ = Combined emission reductions from aboveground carbon from RIL-C in year *t* (t CO_2e/ha)

$RILC_{,BGB,t}$ = Combined emission reductions from belowground biomass from RIL-C in year *t* (t CO_2e/ha)

A_t = Harvest area in year *t* (ha)

t 1, 2, 3, …*t* time elapsed since the start of the RIL project activity (years)

***Ex-ante* Projections of GHG Emission Reductions**

At project validation and 10 year baseline re-assessment, an ex-ante estimate of GHG emission reduction must be produced in accordance with VCS rules. The projection will apply all calculations outlined above, incorporating impact parameters and functions to estimate emission reductions (ie, f_{AGC} and f_{BGB}) provided in the applicable region-specific RIL-C performance method module. Anticipated area harvested per year (A_t) will be referenced from annual authorized harvest areas specified in the project management authorization; it is understood that these areas may differ from the areas actually harvested ex post.

For each impact parameter (eg, $FELL_t$) that will be addressed through the project activity and for each year, the project proponent must assume a conservative level of effectiveness achieved, as a percent improvement from the crediting baseline value provided in the applicable region-specific RIL-C performance method module. The anticipated percent improvement is a value <1.0, and must be justified referencing specific operational management procedures and/or infrastructure to be put in place during project implementation.

For example, if a 30% improvement (indicating reduced emissions) from baseline is anticipated for a given impact parameter, and assuming that level of improvement meets the additionality benchmark, then multiply the crediting baseline value of the impact parameter by (1 – 0.30) = 0.70. The resulting value of the impact parameter is the basis for calculating emission reductions from the crediting baseline. Note that if a given impact parameter is constructed to increase from the baseline value with a decline in associated emission levels (rather than decline from baseline value with declining emissions as assumed above), then the example equation above would be modified accordingly.

7.2 Leakage

Since the applicability conditions do not allow for changes in harvest levels, it can be conservatively assumed that leakage is zero because there is no difference in harvest levels between the baseline and project scenarios.

7.3 Summary of GHG Emission Reduction and/or Removals

Uncertainty

Sources of uncertainty include uncertainty with respect to the calculation of emission reductions from impact parameters, and uncertainty with respect to estimates of impact parameters. These two sources of uncertainty are addressed by setting demonstrably conservative emission reductions associated with each impact parameter and through imposed minimum sampling intensity requirements for estimation of impact parameters, all established in the applicable region-specific RIL-C performance method module. Therefore, no uncertainty deduction is necessary. It is assumed that project area boundaries, A_t, are known exactly.

Net GHG emission reductions are calculated as follows:

$$ER_t = C_{RIL,t} \quad \textbf{(10)}$$

Where:

ER_T = Net GHG emission reductions in year *t* (t CO_2e)
$C_{RIL,t}$ = Total emission reductions at time *t* (t CO_2e)

Emission reductions eligible for issuance as Verified Carbon Units (VCUs) are calculated by subtracting the AFOLU pooled buffer account contribution from ER_t, referencing the project's risk rating at time *t* using the most recent version of the VCS *AFOLU Non-Permanence Risk Tool*.

8 MONITORING

The purpose of monitoring is to generate field measurements after each harvest from which emission reductions can be estimated. Thus, following completion of each harvest, all impact parameters from all logging emission source categories (felling, skidding and hauling), as identified in the applicable region-specific RIL-C performance method module, must be sampled in the field and estimated according to procedures detailed in the applicable region-specific RIL-C performance method.

Throughout the project crediting period, monitoring must be conducted within five years after each harvest unless otherwise specified in the applicable geographic-specific performance method module.

The expectation of users of this methodology and future modules developed based on this methodology is that verification audit teams are able to resample monitoring activities that have occurred over an entire verification period. The appropriate monitoring time frame will be dictated by regional forest regrowth rates and decomposition rates. For example, areas in dry forest with slow forest regrowth and decomposition may be able to monitor every 5 years, and areas in wet tropical forest with very fast growth rates and decomposition may need to be monitored every 2 years.

8.1 Data and Parameters Available at Validation

Data / Parameter	f_{AGC} $(FELL_t)$
Data unit	Dimensionless
Description	Equation estimating emission reductions from aboveground carbon related to felling in year *t* $(ER_{fell\_AGC,t})$ as a function of felling impacts measured in year *t* $(FELL_t)$
Equation	1
Source of data	Applicable RIL-C performance module

Value applied	
Justification of choice of data or description of measurement methods and procedures applied	Refer to applicable RIL-C performance method
Purpose of data	Calculation of emission reductions
Comment	

Data / Parameter:	f_{BGB} $(FELL_t)$
Data unit	Dimensionless
Description	Equation estimating emission reductions from belowground carbon related to felling in year *t* $(ER_{fell\_BGB,t})$ as a function of felling impacts measured in year *t* $(FELL_t)$
Equation	4
Source of data	Applicable RIL-C performance module
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	Refer to applicable RIL-C performance method
Purpose of data	Calculation of emission reductions
Comment	

Data / Parameter:	f_{AGC} $(SKID_t)$
Data unit	Dimensionless
Description	Equation estimating emission reductions from aboveground carbon related to skidding in year *t* $(ER_{skid\_AGC,t})$ as a function of skidding impacts measured in year *t* $(SKID_t)$
Equation	2
Source of data	Applicable RIL-C performance module
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	Refer to applicable RIL-C performance method

Purpose of data	Calculation of emission reductions
Comment	

Data / Parameter:	f_{BGB} $(SKID_t)$
Data unit	Dimensionless
Description	Equation estimating savings factor for emissions from belowground carbon related to skidding in year *t* $(ER_{skid\_BGB,t})$ as a function of skidding impacts measured in year *t* $(SKID_t)$
Equation	3
Source of data	Applicable RIL-C performance module
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	Refer to applicable RIL-C performance method
Purpose of data	Calculation of emission reductions
Comment	

Data / Parameter:	f_{AGC} $(HAUL_t)$
Data unit	Dimensionless
Description	Equation estimating savings factor for emissions from aboveground carbon related to hauling in year *t* $(ER_{haul\_AGC,t})$ as a function of hauling impacts measured in year *t* $(HAUL_t)$
Equation	3
Source of data	Applicable RIL-C performance module
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	Refer to applicable RIL-C performance method
Purpose of data	Calculation of emission reductions
Comment	

Data / Parameter:	f_{BGB} $(HAUL_t)$
Data unit	Dimensionless
Description	Equation estimating savings factor for emissions from belowground carbon related to hauling in year t $(ER_{haul\_BGB,t})$ as a function of hauling impacts measured in year t $(HAUL_t)$
Equation	6
Source of data	Applicable RIL-C performance module
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	Refer to applicable RIL-C performance method
Purpose of data	Calculation of emission reductions
Comment	

Data / Parameter:	K
Data unit	Percent/year
Description	Dead wood annual decomposition rate
Equation	9a
Source of data	Values from the literature (eg, Chambers *et al.* 2000) must be used
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	The rate used should be derived from a similar climate regime and forest type as the project area
Purpose of data	Calculation of emission reductions
Comment	Note that this rate is justified and applied in project accounting (using equation 9a ex post), and is not specified or incorporated in the RIL-C performance method modules.

8.2 Data and Parameters Monitored

Data / Parameter	A_t.
Data unit	Ha
Description	Area of actual harvest area in year *t.* It is expected that this area may be smaller than the authorized area of harvest due to un-stocked areas or areas where timber harvest and skidding are infeasible (eg, due to geographic features), or areas set aside from logging activity.
Equations	9a, 9b
Source of data	Paper maps or GIS files
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Following completion of each annual harvest
QA/QC procedures to be applied	Any imagery or GIS datasets used must be geo-registered referencing corner points, clear landmarks or other intersection points.
Purpose of data	Calculation of emission reductions
Calculation method	.
Comment	

Data / Parameter:	$FELL_t$
Data unit	Units as specified in the applicable RIL-C performance module
Description	Felling impact parameter, measured in year *t*
Equation	1, 4
Source of data	
Description of measurement methods and procedures to be applied	See procedures as specified in applicable RIL-C Performance Method
Frequency of monitoring/recording	Following completion of each annual harvest
QA/QC procedures to be applied	See applicable RIL-C performance module
Purpose of data	Calculation of emission reductions
Calculation method	

Comment	

Data / Parameter	$SKID_t$
Data unit	Units as specified in the applicable performance module
Description	Skidding impact parameter, measured in year *t*
Equation	2, 5
Source of data	
Description of measurement methods and procedures to be applied	See procedures as specified in the applicable performance module
Frequency of monitoring/recording	Following completion of each annual harvest
QA/QC procedures to be applied	See applicable performance module
Purpose of data	Calculation of emission reductions
Calculation method	
Comment	

Data / Parameter	$HAUL_t$
Data unit	Units as specified in the applicable performance module
Description	Hauling impact parameter, measured in year *t*
Equation	4, 6
Source of data	
Description of measurement methods and procedures to be applied	See procedures as specified in the applicable performance module
Frequency of monitoring/recording	Following completion of each annual harvest
QA/QC procedures to be applied	See applicable performance module
Purpose of data	Calculation of emission reductions
Calculation method	
Comment	

Data / Parameter	$ER_{fell\_AGC,t}$
Data unit	t CO_2 /ha
Description	Emission reductions from aboveground carbon related to felling in year *t*
Equation	1, 7
Source of data	Applicable RIL-C performance module
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Following completion of each annual harvest
QA/QC procedures to be applied	
Purpose of data	Calculation of emission reductions
Calculation method	
Comment	

Data / Parameter	$ER_{skid\_AGC,t}$
Data unit	t CO_2 /ha
Description	Emission reductions from aboveground carbon related to skidding in year *t*
Equation	2, 7
Source of data	Applicable RIL-C performance module
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Following completion of each annual harvest
QA/QC procedures to be applied	
Purpose of data	Calculation of emission reductions
Calculation method	
Comment	

Data / Parameter	$ER_{haul\_AGC,t}$
Data unit	t CO_2 /ha
Description	Emission reductions from aboveground carbon related to hauling in year *t*

Equation	3, 7
Source of data	Applicable RIL-C performance module
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Following completion of each annual harvest
QA/QC procedures to be applied	
Purpose of data	Calculation of emission reductions
Comment	

Data / Parameter	$ERf_{ell\_BGB,t}$
Data unit	t CO_2 /ha/year
Description	Emission reductions from belowground biomass related to felling in year *t*
Equation	4, 8
Source of data	Applicable RIL-C performance module
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Following completion of each annual harvest
QA/QC procedures to be applied	
Purpose of data	Calculation of emission reductions
Calculation method	
Comment	Emission reductions from the belowground biomass pool are applied annually over a 10 year period post-harvest (annual emission reductions from belowground biomass are equal to 1/10 of the total emission reduction)

Data / Parameter	$ER_{skid\_BGB,t}$
Data unit	t CO_2 /ha/year
Description	Emission reductions from belowground biomass related to skidding in year *t*
Equation	5, 8

Source of data	Applicable RIL-C performance module
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Following completion of each annual harvest
QA/QC procedures to be applied	
Purpose of data	Calculation of emission reductions
Calculation method	
Comment	Emission reductions from the belowground biomass pool are applied annually over a 10 year period post-harvest (annual emission reductions from belowground biomass are equal to 1/10 of the total emission reduction)

Data / Parameter	$ER_{haul\_BGB,t}$
Data unit	t CO_2 /ha/year
Description	Emission reductions from belowground biomass related to hauling in year *t*
Equation	6, 8
Source of data	Applicable RIL-C performance module
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Following completion of each annual harvest
QA/QC procedures to be applied	
Purpose of data	Calculation of emission reductions
Comment	Emission reductions from the belowground biomass pool are applied annually over a 10 year period post-harvest (annual emission reductions from belowground biomass are equal to 1/10 of the total emission reduction)

Data / Parameter	$RILC_{,AGC,t}$
Data unit	t CO_2 /ha

Description	Emission reductions from aboveground carbon from RIL-C in year *t*
Equation	7, 9a, 9b
Source of data	Calculated
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Following completion of each annual harvest
QA/QC procedures to be applied	
Purpose of data	Calculation of emission reductions
Calculation method	
Any comment	

Data / Parameter	$RILC_{,BGB,t}$
Data unit	t CO_2 /ha/year
Description	Emission reductions from belowground biomass from RIL-C in year *t*
Equation	8, 9a, 9b
Source of data	Calculated
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Following completion of each annual harvest
QA/QC procedures to be applied	
Purpose of data	Calculation of emission reductions
Calculation method	
Comment	Emission reductions from the belowground biomass pool are applied annually over a 10 year period post-harvest (annual emission reductions from belowground biomass are equal to 1/10 of the total emission reduction).

Data / Parameter	$C_{RIL,t}$
Data unit	t CO_2-e

Description	Total emission reductions at time *t*
Equation	9a, 9b
Source of data	Calculated
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Following completion of each annual harvest
QA/QC procedures to be applied	
Purpose of data	Calculation of emission reductions
Calculation method	
Comment	

8.3 Description of the Monitoring Plan

Monitored parameters, and sampling and measurement procedures are specified in the applicable region-specific RIL-C performance method module.

9 REFERENCES

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APPENDIX 1: REGION-SPECIFIC PERFORMANCE METHOD REQUIREMENTS

Performance method modules may be developed for various geographies. General requirements for crediting and additionality benchmarks, and proxy emission reduction relationships, include:

1) The performance method must clearly specify the logging landscape and timeframe within which the values/relationships are applicable (ie, the sample population[4]). The logging landscape must be defined by broad parameters of consistent forest structure and composition (eg, the WWF Forested Ecoregions (Olson *et al.* 2001)).

2) The performance method must define additionality and crediting baselines in terms of impact parameters. Impact parameters must cover the following three sources of logging emissions: felling, skidding and hauling. One or more impact parameters may be identified for each of the three emissions source categories. When more than one impact parameter is identified for an emission source category, they must be measures of distinct (non-overlapping) components of that emissions source category.

3) The performance method must relate emission reductions to impact parameters and quantify and discount uncertainty in the dependent variable (ie, emission reductions). Emission reductions are calculated from (baseline) emissions associated with the crediting baseline value. Relationships between impact parameters and emission reductions must be developed for above and belowground tree biomass for each emission category (logging, felling and hauling) and expressed in units of tCO_2e/ha.

4) The performance method must specify monitoring procedures for all defined impact parameters.

An example of the derivation of applicable benchmarks and proxy relationships is provided in *VMD0047 Performance Method for Reduced Impact Logging (RIL-C) in East and North Kalimantan*.

[4] Note that conservative bias is allowed in sampling (ie, skewed toward logging operations allowing access to researchers).

DOCUMENT HISTORY

Version	Date	Comment
v1.0	28 Apr 2016	Initial version released.