Version 2.0
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High Integrity Forest Investment Initiative SM

Methodology for HIFOR units

Contents

Acronyms

AGB: Aboveground Biomass
BGB: Belowground Biomass
C: Carbon
CO_2: Carbon dioxide
D: Carbon Density (biomass carbon per hectare)
DM: Dry matter
DBH: (Stem) Diameter at Breast Height
FLII: Forest Landscape Integrity Index
MU: Management Unit
FPIC: Free, Prior and Informed Consent
GHG: Greenhouse Gas
Ha: Hectare
HAA: HIFOR Accounting Area
HBZ: HIFOR Buffer Zone
HIFOR: High Integrity Forest Investment Initiative
HMA: HIFOR Monitoring Area
IPs & LCs: Indigenous Peoples and Local Communities
QA/QC: Quality Assurance and Quality Control
S: Carbon Stock
SDGs: Sustainable Development Goals

1 Introduction

The High Integrity Forest Investment Initiative (HIFOR)SM aims to mobilize finance for the protection of high integrity tropical forest landscapes and provide tangible incentives for the maintenance of their nature- and climate-positive attributes, through the issuance of tradeable HIFOR units.

This methodology defines requirements that Project Proponents shall follow to quantify HIFOR units and enable their issuance. The methodology must be read in conjunction with the HIFOR Program Guide & Standard which covers HIFOR objectives, principles, governance, procedures, definitions, and other topics.

HIFOR utilizes the Forest Landscape Integrity Index (FLII)[1] and additional applicability conditions defined in this methodology to identify eligible forest areas from which HIFOR units can be generated.

A HIFOR Project Proponent shall demonstrate that a comprehensive intervention strategy for the Project area exists, that all relevant safeguards are being applied, and that effective interventions aimed at conserving high integrity tropical forests are being undertaken.

The HIFOR unit represents a hectare of well-conserved, high integrity tropical forest in an effectively and equitably managed HIFOR Accounting Area (HAA). The HIFOR unit is an indicator of nature-positive outcomes achieved through the conservation of high biodiversity ecosystems. An additional metric associated with this unit is the number of tons of net CO_2 removal from the atmosphere (as a climate-positive indicator for climate change mitigation impact)[2].

Buyers of HIFOR units may make non-compensatory claims regarding their contribution to achieving global net zero and global nature positive goals. HIFOR units may not be utilized for compensatory claims such as carbon- or biodiversity-offsetting because they do not aspire to meet offset market requirements of formal adherence to additionality and permanence definitions or leakage estimates. The methodology has been designed to avoid double-counting with jurisdictional programs that credit emission reductions. It is beyond the scope of this short introduction to define the position of HIFOR units within the complex and rapidly evolving biodiversity/nature credits/certificates space.

Ecological integrity represents the aggregate of the structure, composition, and functions of an ecosystem and the degree to which they are within their natural ranges of variation. It can be thought of as the inverse of degradation, in a broad ecological sense. Integrity is an increasingly important concept in the scientific literature and in policy. It is referenced at several points in the Paris Climate Agreement. Further, Goal

[1] The Forest Landscape Integrity Index (FLII) integrates data on observed and inferred forest pressures and lost forest connectivity to generate the first globally consistent, continuous index of forest integrity as determined by degree of anthropogenic modification. FLII scores range from 0 (lowest integrity) to 10 (highest integrity) (Grantham et al., 2020). Dataset available at https://www.forestintegrity.com/. The FLII is closely conceptually aligned with the definition of ecological integrity used in the Global Biodiversity Framework.
[2] A Brief summarizing the science that underlies this approach can be found in the 'Background' section of the webpage https://www.wcs.org/our-work/climate-change/forests-and-climate-change/hifor. It makes clear that higher integrity is strongly related to higher levels of biodiversity on many measures.

A of the 2022 Kunming-Montreal Global Biodiversity Framework under the Convention on Biological Diversity calls for Parties to ensure that ‘The integrity, connectivity and resilience of all ecosystems are maintained, enhanced, or restored..’ whilst Action Target 1 calls on them to ‘…to bring the loss of areas of high biodiversity importance, including ecosystems of high ecological integrity, close to zero by 2030, while respecting the rights of Indigenous Peoples and local communities.’

Figure 1 provides a high-level overview of the required steps covered in this methodology. The essence of the approach is to measure the extent of high integrity tropical forest that is maintained within the Project area over a ten-year period. As long as the various other tests of project quality are also met, this extent translates into the number of HIFOR units that can be issued. A parallel process of measuring net change in biomass carbon stock over the same ten-year period allows a conservative estimate of the volume of net CO_2 removals and this forms the basis for the climate claim associated with the units. Project design is presented in the Project Description Document (PDD) and Project results/impacts in the periodic Project Performance Reports (PPRs).

The quantitative threshold for integrity used in this methodology (Section 4) is high, and as such indicates that the great majority of aspects of composition, structure, and function of the ecosystem are likely to have been maintained, although it does not exclude the possibility that some impacts have occurred for the most vulnerable elements of the system either before or during the project period. Projects that achieve exceptional performance above the required threshold can choose to demonstrate this additional success using supplementary indicators if they wish, although quantification of these will not form part of the third-party validation and verification process.

The HIFOR approach is not designed to reward conservation of tropical forest areas of medium or low ecological integrity, but such areas may also embody very significant environmental value in some contexts and where they do their conservation should be incentivized using other instruments.

Figure 1. Overview of the main steps to initiate a HIFOR Project under this methodology

	Step	Details
Project Description Document	Define geographic & temporal boundaries	Map HIFOR Accounting Area, Buffer Zone, and Geographic Scope Define Project Start Date, Project Period, and first Monitoring Period
	Demonstrate applicability conditions met	Required and excluded activities; size of project area Land ownership rights; compatibility with laws
	Demonstrate ecological integrity conditions met	Forest area Proportion of high and low integrity forest and anthropogenic land cover
	Describe project area & interventions	Vegetation cover and trends, threats to forest integrity Human populations, wellbeing and development needs Conservation strategy including roles & responsibilities, safeguards and budget
	Validate Project design	Submit Project Description Document to third-party assessor; positive assessment Project Validation document issued
	Implement interventions	Implement Project Intervention Strategy Implement Monitoring Strategy
	Complete measurements for first Monitoring Period	Assess sustained compliance with all conditions and safeguards Assess recent performance in maintaining forest extent and integrity Assess recent net removals of CO_2
	Verify results of first Monitoring Period	Project Performance Report submitted to third-party assessor; positive assessment Project Verification document issued, enabling issuance of HIFOR Units

2 Applicability conditions

Projects must define their spatial and temporal boundaries as set out in Section 3 and their intervention strategy, including key social elements, as set out in Section 5. Projects must meet the following applicability conditions from the Project Start Date unless otherwise indicated. Project Proponents shall demonstrate how applicability conditions have been met and shall provide documentary evidence to auditors.

1. A HIFOR Project must be focused on a defined HIFOR Accounting Area (HAA) within which HIFOR units will be generated. In particular:
    - The HAA must be comprised of one or more entire Management Units (MUs) that meet the requirements listed in Section 3.1.1.
    - The total area of the HAA at the time of each Monitoring Event[3] shall meet a minimum threshold of 100,000 ha to ensure that nature- and climate-positive impacts will be significant and to increase the likelihood of delivering sustained results. See Section 4 for criteria on the extent and ecological integrity of the tropical forest within this area.
2. The Project Proponent must demonstrate, from the Project Start Date (with the exceptions noted in Section 3.2.1 item 1a) ownership of the proposed HAA via a legal institutional mandate or legal title, or an exclusive long-term management agreement with the landowner. By the time of Validation the land ownership or management agreement must include the rights to transact ecosystem service assets that have been generated since the

[3] The variable $A_{tot,x}$, see Annex 7.

Project Start Date. The Project Proponent shall demonstrate that legal conflicts regarding land ownership have been resolved prior to the Project Start Date and that relevant stakeholders have been appropriately consulted and integrated into the Project and its Intervention Strategy. This will include demonstrating that any unrecognized land rights, including collective titles or outstanding claims, have been satisfactorily addressed by all parties[4].

3. Where the territorial governance authority of the sub-national or national jurisdiction is not a party to the HIFOR Project (e.g., as landowner or implementing partner), the Project Proponent shall inform such authority of the intent to develop the Project prior to the start of Validation.
4. The activities undertaken by a HIFOR Project must be designed primarily to conserve high integrity tropical forest within the HAA. For each MU, the Project Proponent shall demonstrate that a comprehensive Project Intervention Strategy, as defined in Section 5, exists and is being/will be implemented.
5. Permitted activities within the HAA, and activities promoted by the Project in or beyond the HIFOR Buffer Zone, shall exclude activities associated with significant deforestation, forest degradation or greenhouse gas emissions[5], i.e.:
    - The drainage or other disruption of the hydrology of wetlands, including peatlands.
    - Timber harvesting, mining, and/or non-timber forest product harvesting at industrial scales.
6. The Project Proponent must demonstrate that under applicable law:
    - The proposed management regime of forest conservation is permissible or explicitly required (e.g., the land ownership type, zoning, or management rights do not require the Project Proponent to engage in activities such as commercial extraction of timber or other resources that would conflict with HIFOR applicability conditions).
    - The Project Proponent has complied with relevant regulations including but not limited to approval of management plans by and reporting to relevant authorities, payment of taxes, levies, and fees.
7. The Project Proponent must use the latest approved version of this methodology. When a new version is approved, all Project Proponents shall apply the new version either from Validation or from after the next Verification Event as applicable, unless the new version was approved within 6 months immediately prior to an auditor having been contracted for the Verification or Validation as applicable.

[4] Requirements relating to consent and other safeguards are treated separately in Section 5 and Annex 1.

[5] Any impact of Project activities on overall forest integrity or on net CO_2 removals in the HAA will be accounted for as defined in Section 6.

3 Geographic and temporal boundaries

3.1 Geographic boundaries

The Project Proponent shall delineate geographic boundaries for the **HIFOR Accounting Area (HAA)** and the **HIFOR Buffer Zone (HBZ)**, which combined constitute the **HIFOR Monitoring Area (HMA)** (Figure 2). The Proponent shall also delineate a **Geographic Scope**.

Project Proponents shall delineate and provide a map of the HAA, HBZ, and Geographic Scope included in a HIFOR Project. The map shall be provided in pdf or png format, indicating relevant towns, roads, rivers, and political/regional borders. The accompanying GIS file shall be a kml, kmz, or GeoJSON file, in an equal-area projection.

3.1.1 HIFOR Accounting Area (HAA)

An HAA represents the extent of one or more Management Units (MUs) defined by formal documentation, e.g., one or more protected areas, Indigenous territories, and/or forestry concessions being managed by or on behalf of the Project Proponent, within which the Project Proponent or its designee is eligible to generate HIFOR units. The total area of the HAA at each Monitoring Event shall be equal to the sum of the area of all MUs included in the HIFOR Project[6]. No part of an MU may be excluded from the HAA. All the MUs grouped into a single Project must lie at least partly in the same first-level subnational jurisdiction (e.g., province or state) but need not be contiguous.

An HAA must lie at least 95% within the tropics (i.e., latitude between 23.5°N and 23.5°S).

3.1.2 HIFOR Buffer Zone (HBZ)

An HBZ represents a zone surrounding the HAA. Monitoring of threats that may affect, or spread into, the HAA should be conducted in the HBZ to inform Project activities.

The following criteria apply to the delineation of the HBZ:

1. The HBZ is defined as the 10km buffer around the HAA.
2. Where the HAA includes several, non-contiguous MUs, the HBZ shall be delineated as the combined area of 10km buffers around each MU.
3. The entire HBZ shall be located within the same country as the respective HAA.

The total area of the HBZ[7] at each Monitoring Event shall be calculated and specified in the PDD and PPRs.

3.1.3 HIFOR Monitoring Area (HMA)

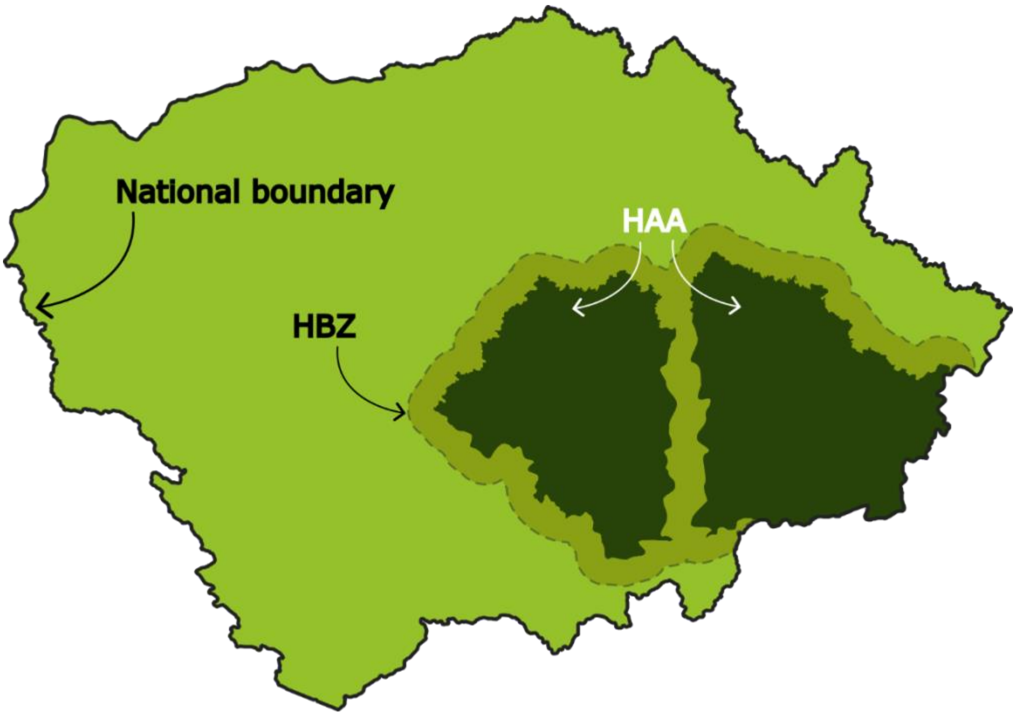
The HMA is defined as the combined area of the HAA and HBZ.

[6] The variable TA_{tx}, see Annex 7.
[7] The variable TZ_{tx}, see Annex 7.

3.1.4 Geographic Scope

The Geographic Scope shall be the combination of the HAA, the HBZ, and any other areas within the same country that are relevant to the Project because they are used significantly by communities that also use the HAA for legally permitted purposes, or because they are otherwise the locations of planned Project activities. This Geographic Scope shall be mapped and justified with relevant evidence. The total area of the Geographic Scope at each Monitoring Event[8] shall be calculated and specified in the PDD and PPRs.

Figure 2. Schematic overview of the HAA and HBZ and how they play out at the intersection with national boundaries. HAA and HBZ are non-overlapping, and combined they constitute the HMA. The HAA can be comprised of one or more management units.



3.2 Project duration and monitoring

The HIFOR Project takes place over the Project Period, which begins at the Project Start Date and is the period during which HIFOR units can be generated. The Project Period must be at least 30 years.

Within a defined period of time (see below) the Project must undergo Validation of its design as embodied in a Project Description Document (see Annex 5).

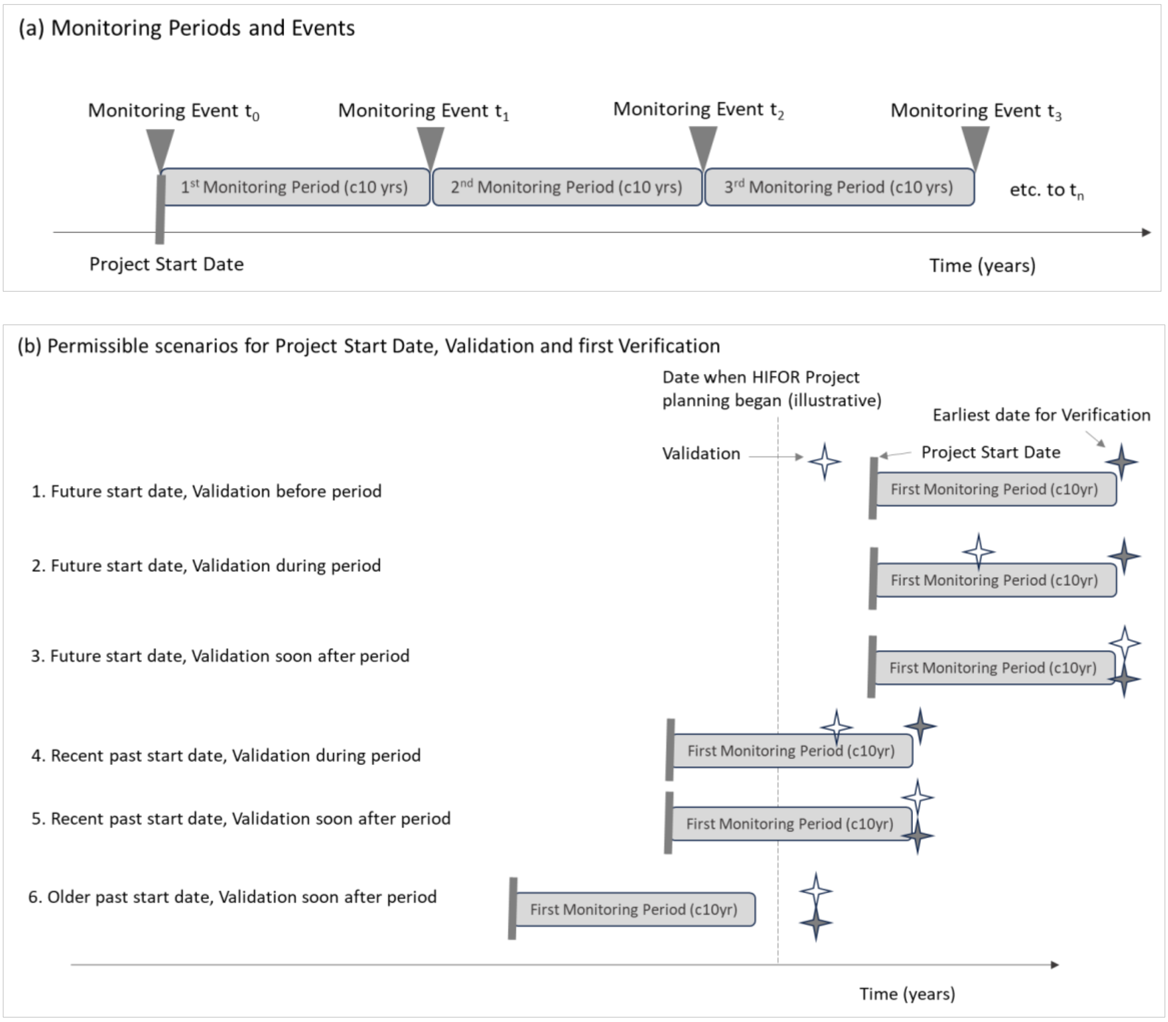
The whole Project Period is broken into successive Monitoring Periods, each typically 10 years long, with some limited flexibility (see below). Project performance is measured between the beginning and end of each Monitoring Period, then documented in a Project Performance Report (see Annex 6), after which a Verification Event takes place.

[8] The variable TG_{tx}, see Annex 7.

A Monitoring Event marks the beginning and end of each Monitoring Period. Individual Monitoring Events are numbered as t_x, from t_0 to t_n. Individual Monitoring Periods are numbered as the interval between two subsequent Monitoring Events (i.e., t_0t_1, t_1t_2, …, $t_{n-1}t_n$). Other periods of interest can be annotated in an analogous way.

An overview of the HIFOR Project temporal boundaries is provided in Figure 3. In Figure 3b, Scenario 1 is the simplest (with Validation before the Project Start Date), but the rules also allow later Validation, either during the first Monitoring Period (Scenarios 2 and 4) or for a limited period after the end of the first Monitoring Period (Scenarios 3, 5 and 6).

Figure 3a & b. Overview of temporal boundaries of a HIFOR Project (a) The sequence of Monitoring Periods and Monitoring Events; and (b) Six examples of permissible combinations of Validation, Project Start Date, First Monitoring Period, and the earliest possible date for Verification (see Sections 3.2.1—3.2.6 for details).



3.2.1 Project Start Date

The Project Start Date may be set at the discretion of the Proponent at a date advantageous for financing and operationalizing the Project which may be before, at, or after the date when planning of the HIFOR Project began (Figure 3b) *as long as effective, equitable, well documented conservation action was already underway at the site* (point 1 below) and points 2 and 3 are also met.

1. At the Project Start Date the HAA must (i) already be/have been under formal management and (ii) meet/have met all applicability, integrity, and operational conditions defined in Sections 2, 4, and 5.
    a. In the case of areas under customary management by IPs and/or LCs, the *date the site came under formal management* is defined as the date at which this customary management can be shown to have started, using appropriate written evidence or oral testimony[9], irrespective of whether the area had a formal legal designation throughout that period.
    b. In the case of other management modalities (e.g., protected area, concession) the *date the site came under formal management* is the date at which the site received a formal legal designation such as gazettement or issuance that is consistent with participating in the HIFOR Initiative.
2. The Project Start Date must also be a date within a period for which all necessary datasets are available to enable an initial Monitoring Event.
3. The earliest permissible Project Start Date is January 1, 2010, even if the HAA was under formal management before that date.

The Project Proponent shall provide documentary evidence to justify the selection of the Project Start Date.

3.2.2 Project Period

The Project Period ($t_0 t_n$) is the period during which HIFOR units can be generated. It begins at the Project Start Date and shall be a minimum of 30 years up to a maximum of 100 years. The Project Period duration may be updated at the discretion of the Project Proponent throughout the Project Period, with any changes documented at future Verification Events.

The Project Proponent shall conduct monitoring and reporting of HIFOR related activities and results periodically across the entire Project Period.

3.2.3 Validation

The Validation Date is the date on which the Validation process has been completed and the Validation document issued.

Validation shall be completed within six years of the end of the first Monitoring Period.

3.2.4 Monitoring Event

A Monitoring Event is a full monitoring campaign for the determination of Project performance, including the determination of compliance with management requirements and safeguards, measurement of ecological integrity, estimation of carbon stocks, and (except at the Project Start Date) quantification of net removals, as detailed in later sections.

[9] This evidence should derive from a representative cross-section of recognized community leaders, either directly in the case of oral testimony and directly or indirectly in the case of written evidence and should be consistent across sources.

For calculation purposes the campaign, and hence the Monitoring Event, shall be assigned to a nominal date that is either the Project Start Date or an integer number of years after the Project Start Date and lies within the period covered by most of the available imagery used for the analysis.

3.2.5 Monitoring Periods

A Monitoring Period shall be 10 years in length, except in the case of limited data availability. Only if critical data are not available to allow a 10-year monitoring period then a period of 9 or 11 years is permissible. If neither of these is possible, then a period of 8 or 12 years is permissible, and if neither of these is possible then a period of 7 or 13 years is permissible.

In cases where a Project fails to meet certain performance tests at a Monitoring Event, the Monitoring Period must be extended until the tests are met, and through this process can come to exceed 13 years in length. This is described in Section 6.5.

3.2.6 Verification

The Verification Date is the date on which the Verification process has been completed and the Verification document issued.

The first Verification Date must be the same as, or after, the Validation Date. Other Verification Dates can take place at any point after the end of the relevant Monitoring Period.

4 Ecological integrity criteria

At the Project Start Date the Project must meet four criteria for the level of ecological integrity of the HAA. At subsequent Monitoring Events two additional criteria for the maintenance of ecological integrity must also be met. All six criteria are specified below.

Criteria that must be met at each Monitoring Event

At the Project Start Date and all subsequent Monitoring Events an HAA must contain a large tropical forest area and be of high ecological integrity, as defined by the four ecological integrity criteria listed below[10]. Projects that fail to meet any of these conditions at the Project Start Date shall not be Validated. Projects that fail to meet any of these conditions at the end of a given Monitoring Period are deemed ineligible for the issuance of HIFOR units for that Monitoring Period, and shall remain ineligible, until the Project Proponent has demonstrated that the conditions are met again:

1. *Total forest extent*: the total forest extent within the HAA at each Monitoring Event[11] must be ≥ 80,000 ha.

[10] In practice these criteria mean that the HAA must be largely free from anthropogenic disturbances other than traditional practices adopted by Indigenous Peoples and Local Communities (IPs & LCs), which may include, for example, small-scale timber harvest for local use, low intensity shifting or permanent cultivation, tourism, and/or research activities. As noted in Section 2, industrial-scale extractive activities are not permitted.
[11] The variable TFE_{tx}, see Annex 7.

2. *Proportion of high integrity forest*: the proportion of the forest in the HAA at each Monitoring Event that is of high integrity[12], as determined by a Forest Landscape Integrity Index (FLII)[13] score at the pixel level of ≥ 9.6[14].must be ≥ 80%.
3. *Proportion of low integrity forest*: the proportion of the forest in the HAA at each Monitoring Event that is of low integrity[15], as determined by a FLII score at the pixel level ≤ 6.0 must be ≤ 5%.
4. *Proportion of anthropogenic non-forest land cover*: The proportion of the HAA that is non-natural, non-forest land cover[16] (e.g., agricultural land, intensively managed pastureland, mining, urban land, deforested but unused open lands, etc.), excluding from the area of the HAA for the purposes of the calculation any areas of natural non-forest, must be ≤ 5%.

Compliance with all criteria relating to forest, including forest extent and forest integrity classes shall be assessed using the publicly available global map of the FLII for the appropriate year or years[17]. The FLII dataset is only available from 2017 onwards. Hence, in cases where the Project Start Date is earlier than 2017, criteria 1-4 only need to be assessed for 2017, and it is assumed that if the HAA meets the criteria at that date it also met them at the Project Start Date.

Criteria that must be met at each Monitoring Event after the first

At each subsequent Monitoring Event after the first, two additional criteria must be met, to demonstrate that conservation efforts have been effective at keeping the rate of decline in the ecological condition of the site, if any, within acceptable levels:

5. *Deforestation rate*: mean annual net permanent deforestation in the HAA measured over the full duration of the Monitoring Period[18] must be ≤ 0.20% of forest area per year.
6. *Rate of decline in high integrity forest*: mean annual net rate of decline in the extent of high integrity forest across the whole HAA measured over the full duration of the Monitoring Period[19] must be ≤ 0.75% per year.

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[12] The variable $PHIF_{tx}$, see Annex 7.
[13] The Forest Landscape Integrity Index (FLII) dataset (Grantham et al., 2020) is publicly available at https://www.forestintegrity.com/.
[14] The thresholds for High, Medium and Low integrity were derived by Grantham *et al.* (2020) using a global benchmarking approach against sites of known ecological integrity.
[15] The variable $PLIF_{tx}$, see Annex 7.
[16] The variable $PANFE_{tx}$, see Annex 7. The overall extent of non-forest land cover shall be determined by deducting the Total Forest Extent (see ecological integrity criterion 1) from the area of the HAA. The portion of this area attributable to anthropogenic causes shall then be assessed using a credible spatially explicit landcover dataset chosen and justified by the Project Proponent which is published in the peer-reviewed literature, provides coverage at national, regional or global level for a nominal year within +/- 3 years of the year for which an assessment is required, contains relevant land-cover classes, and has a spatial resolution of 300 m or finer. The remainder of the non-forest area shall be assumed to be natural in origin e.g., water, rock, ice, desert, open wetlands, grasslands, heathlands, scrub, open woodlands, and other natural non-forest vegetation. Note that non-natural *tree* cover (eg tree plantations) generally falls within the definition of forest cover used under Criterion 1; it will usually be categorized as having low integrity.
[17] As such, the definition of forest used in the FLII applies, noting that it is derived from the Global Forest Cover product of the University of Maryland, uses a canopy cover threshold of 20%, has a spatial resolution of 300 m and does not treat temporary tree cover loss due to drivers such as swidden agriculture or rotational forestry as deforestation under certain defined conditions (Grantham et al. 2020).
[18] Variable $MANPD_{tx-1tx}$, see Annex 7.
[19] Variable $MADHIF_{tx-1tx}$, see Annex 7.

The deforestation rate and rate of decline in integrity shall be assessed using the publicly available global map of the FLII for the appropriate year or years. The FLII dataset is only available from 2017 onwards so in cases where criteria 5 and 6 call for the assessment of rates of change in a period that extends prior to 2017, it is permissible instead for that period to begin in 2017.

Projects that fail to meet either of these conditions at the end of a given Monitoring Period are deemed ineligible for the issuance of HIFOR units for that Monitoring Period and shall remain ineligible until the Project Proponent has demonstrated that the conditions are met again in the future.

5 Situation Analysis, Intervention Strategy, and Description of Past Interventions

The Project Proponent shall provide the following information as part of the Project Description Document: a Project Situation Analysis; a Project Intervention Strategy; and, if applicable, a Description of Past Interventions, as detailed below.

At each Verification the Project Proponent shall provide in the Project Performance Report evidence of adherence to the Project Intervention Strategy, with a justification for any deviations, as well as updates to the strategy, where necessary, for the following Monitoring Period (see Annex 6).

Project Situation Analysis

The Project Situation Analysis is a comprehensive assessment, within the Geographic Scope except where otherwise noted, of the relevant threats to ecological integrity and the sustainable development opportunities and risks. This shall include at a minimum the following aspects, each supported by evidence from credible published sources or other data collection using documented, credible methods:

A. Land cover and forest types from 2017[20] or the Project Start Date, whichever is later.
   i. Land cover (both forests and other ecosystems) and landcover change (at minimum, permanent changes between forest and non-forest shall be presented).
   ii. Principal forest ecological types using a published categorization at local, national, or supra-national scale, as appropriate.
   iii. Extent and distribution of forest integrity classes as defined by the Forest Landscape Integrity Index (FLII).
B. All social groups, explicitly including IPs & LCs, women, and youth[21], living in the HAA or regularly using it for legally permitted activities, including[22]:
   i. a detailed description of their disaggregated population size and trends over time,

[20] 2017 is the first year for which the FLII is available.
[21] Defined as people under 35 years of age.
[22] Specify unique considerations for IPs & LCs, gender, youth, special religious or ethnic groups and any other relevant characteristics that would compound marginalization within the dominant society.

ii. their social and economic conditions, and
iii. their dependence on natural goods or services derived from the HAA, quantified where possible.

C. The relationship of the Project Proponent with IPs & LCs, including any significant conflicts with the Proponent, between IP&LC groups, or with other stakeholders, that have been active in the ten years prior to the project start date. This must include special attention to any outstanding claims of land rights or collective titles that may or may not be recognized by the state.
D. Past, current, and expected future threats to forests and their biodiversity, quantified where possible, including the specific drivers and agents of deforestation and loss of forest integrity[23].
E. Past and present conservation activities[24] (if any), including the entities involved in management, the specific roles and relationships of the involved entities, a qualitative assessment regarding the effectiveness of prior conservation activities, and, at a minimum for the HAA, any financial resources and funding sources deployed during the period since the Project Start Date.
F. Past and present social and development programs conducted by government, NGOs, Indigenous Peoples Organizations, and community-based organizations.

Project Intervention Strategy

The Project Intervention Strategy sets out the actions that are needed to ensure the long-term conservation of the HAA and drive sustainable development in the HAA and the broader geographic scope.

For projects with a Project Start Date in 2024 or later, the intervention strategy shall describe the plan from the Project Start Date forwards, and shall include at a minimum the following aspects:

A. The consultative, participatory processes and approaches that have been employed by the Project to develop the Intervention Strategy in collaboration with relevant stakeholders.
B. Description of planned interventions and rationale, based on a detailed theory of change, including long-term HIFOR Project goals, activities, expected outcomes, assumptions and indicators. At a minimum it shall include, but need not be limited to:
    i. Resolution of any previously identified or expected conflicts with or between stakeholders.
    ii. Plans to achieve the effective control or reduction of specific threats to forest and biodiversity in the HAA identified as being significant in the situation analysis.
    iii. Specific plans to promote sustainable development and achieve both (i) one or more substantive, equitably distributed social benefits (defined to

[23] Threats that drive loss of forest integrity are not limited to the proxies captured by the Forest Landscape Integrity Index. They include the full range of significant threats, including over-hunting, over-harvest of plant resources, changes to fire or hydrological regimes, invasive species etc.
[24] There is no need to repeat any information presented in the Intervention Strategy or Description of Past Interventions.

include social, economic, and/or cultural benefits[25]) as determined or prioritized by the communities concerned and (ii) the avoidance and management of negative social impacts, in accordance with the framework described in Annex 4.

iv. Specific plans for an equitable and transparent benefit distribution mechanism, developed through effective, fully documented consultations and subject to Free Prior and Informed Consent from the relevant stakeholders.

v. Plans to avoid (to the greatest extent feasible) negative impacts caused by project activities, directly or indirectly, on natural ecosystems (forest or otherwise) and their constituent species anywhere in the geographic scope, and to address appropriately any unavoidable losses.

vi. A description of internal risks and external threats to project delivery, as well as targeted mitigation strategies for these.

vii. A plan for frequent (e.g., annual) monitoring of key operational indicators (e.g., delivery of activities, trends in key threats and outcomes) to support effective adaptive management. This is distinct from the decadal monitoring plan required in Section 7 to support Verification.

C. An institutional structure designed to implement the planned activities and achieve the desired outcomes, including the roles and responsibilities of relevant stakeholders. IPs and LCs must have a significant, ongoing role in implementation of the project.

D. A strategy to comply with and demonstrate compliance with all safeguards requirements as defined in Annex 1, including a grievance redress procedure (Safeguard 1.2) and Free Prior and Informed Consent (Safeguard 2.3).

E. An overview of the intended long-term budget (minimum 10 years) and financing strategy, including both HIFOR proceeds and other sources.

For projects with a Project Start Date before 2024, the Intervention Strategy shall describe the plan (as specified above) from the date of Validation forwards, and in addition the Project Proponent shall provide a Description of Past Interventions from the Project Start Date forwards (see following sub-section).

Description of Past Interventions

The Description of Past Interventions shall show that the Project has been implemented to date in a way likely to minimize deforestation and loss of ecological integrity and provide social benefits, and that it has respected key safeguards. It shall include at a minimum the following aspects:

[25] Illustrative examples of such benefits could include improved availability of education or health services, improved provision of water and sanitation, creation of community-run small grants schemes, creation of social hardship funds, enhancement of critical infrastructure such as bridges, enhancement of intangible cultural assets, increased stocks of sustainably harvestable natural resources such as fish, or direct payments schemes to families/individuals.

A. The processes and approaches that have been employed to develop past interventions, showing that they were designed and implemented in collaboration with relevant stakeholders, in particular rightsholders such as IPs & LCs.
B. A description of actions undertaken, essential monitoring conducted, indicators measured, and results achieved, with an emphasis on:
    i. Description of how any conflicts were identified and resolved.
    ii. Steps taken to address the key threats causing deforestation and loss of forest integrity prevalent at that time.
    iii. Steps taken to achieve sustainable development and achieve both one or more substantive, equitably distributed social benefits and the avoidance and management of negative social impacts, in accordance with the framework described in Annex 4.
    iv. Steps taken to avoid negative impacts caused directly or indirectly by project activities on natural ecosystems (forest or otherwise) and their constituent species anywhere in the geographic scope.
C. The institutional framework used, including the roles and responsibilities of relevant stakeholders such as IPs and LCs, and a summary of the budgetary resources mobilized during the period.
D. Evidence that the Project has complied to the greatest extent possible with safeguards requirements as defined in Annex 1. In particular:
    i. Show that the Exclusions List has been fully complied with, and that any failures to comply with the other parts of the safeguards have been relatively minor in their impacts and have been or will be responded to with full and effective remedial action.
    ii. Provide demonstration of clear communication sufficiently ahead of time with IPs & LCs in local languages and through media that they understand, as well as consent through their traditional institutions on the nature, distribution and intended use of the HIFOR units generated during a preceding timeframe (see Annex 1, section 2.3).
    iii. Provide clear evidence of co-development of a socially inclusive benefits distribution plan for any benefits generated from the past period, including a demonstration of adequate stakeholder engagement and consideration of potential impacts on vulnerable and marginalized social groups (see Annex 1, section 2.10).

Because the first HIFOR methodology was finalized in 2024, the Description of Past Interventions does not have to demonstrate that previous interventions were conducted with specific reference to HIFOR but do nonetheless have to demonstrate that they met the requirements set out above.

6 Quantification of HIFOR units and environmental services and demonstration of social benefits

After successful Verification, the Project may issue HIFOR units with their associated environmental metrics.

A HIFOR unit represents a hectare of well-conserved, high integrity tropical forest where 'well-conserved' means that high ecological integrity is maintained over a decade[26] of monitoring as part of equitable, effective management of a site and 'high ecological integrity' means a score of >9.6 on the Forest Landscape Integrity Index[27].

This unit can form the basis of quantified claims by buyers, including a claim to have achieved biodiversity benefits. This is based on the results of the literature review summarized in the HIFOR science brief [28]. Tropical forests represent one of the most biodiverse ecosystems on Earth, and high ecological integrity is consistently associated with higher biodiversity and better conservation outcomes for biodiversity in tropical forests across a range of measures. Maintaining high integrity thus contributes strongly to maintaining high biodiversity.

Associated with a HIFOR unit is a metric that quantifies climate regulation benefits (in terms of the number of tons of net CO_2 removals into forest biomass). This metric can also form the basis of a quantified claim by buyers.

The literature on the value of intact forests[29] makes it clear that a HIFOR unit can also be assumed to embody many other environmental services including a "biophysical cooling" effect that adds an extra 50% to the cooling value beyond CO_2-related benefits[30], watershed protection, and maintenance of many individual wildlife populations. Metrics for these may be reported by individual projects but do not currently fall within the scope of the third-party Validation and Verification that will be conducted against this methodology. Standardized HIFOR metrics may be developed for some of these other services in future.

The current version of the methodology does not require that social benefits be quantified with a standardized metric that is associated with the issued units or recorded in the registry. Nonetheless, Verification of project performance requires the demonstration that one or more substantive equitably-distributed benefits resulting from project interventions (potentially including, but not limited to, the outcomes of the benefit distribution mechanism), have occurred, in accordance with the Project Intervention Strategy (Section 5) and that negative impacts have been avoided and/or satisfactorily addressed, in both cases measured using indicators specific to the Project. Standardized metrics for HIFOR social benefits across projects may be developed in the future.

As part of the Validation process and each Verification event, a Project Proponent is required to demonstrate, using credible assumptions, that there is a reasonable expectation by the time of the next Monitoring Event of meeting all the requirements of the methodology, including an estimation of the results expected in relation to sections 6.1-6.3 (see Annexes 5 and 6 for more detail).

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[26] The exact period may vary slightly, as noted in section 3.2.5.
[27] See Section 4 for more detail.
[28] High Integrity Forest (HIFOR) Investment Initiative: The Science Basis https://www.wcs.org/our-work/climate-change/forests-and-climate-change/hifor
[29] High Integrity Forest (HIFOR) Investment Initiative: The Science Basis https://www.wcs.org/our-work/climate-change/forests-and-climate-change/hifor
[30] https://www.wri.org/insights/how-forests-affect-climate

6.1 Quantification of HIFOR units

The number of HIFOR units to be issued at a Verification Event is the number of hectares of well-conserved, high integrity tropical forest reported in the HAA for the previous Monitoring Period.

Ecological integrity criterion 2 (Section 4) requires that the extent of high integrity tropical forest within the HAA be estimated at the Project Start Date (or 2017, whichever is later) and each subsequent Monitoring Event.

Conservatively, the number of hectares of well-conserved, high integrity tropical forest is taken to be the lower of the extent at the beginning of the Monitoring Period and the extent at the end (Equation 1).

$$HIFORU_{t_{x-1}t_x} = min\left(EHIF_{t_{x-1}}, EHIF_{t_x}\right) \quad (1)$$

$HIFORU_{t_{x-1}t_x}$ = number of HIFOR units that can be issued for Monitoring Period $t_{x-1}t_x$

$EHIF_{t_{x-1}}$ = extent of high integrity forest (ha) in the HAA at Monitoring Event t_{x-1} or 2017, whichever is later

$EHIF_{t_x}$ = extent of high integrity forest (ha) in the HAA at Monitoring Event t_x

At certain points, as specified in Annexes 5 and 6, the Project Proponent must also make an evidence-based projection of the expected number of HIFOR units that will be generated. Each projection shall estimate the area of high integrity forest that will remain at the relevant time point, taking into account (as appropriate) the extent at the start of the period, recent observed rates of change, expected changes in threat levels based on the situation analysis, and any changes to the rate of change which can be expected as a result of the project's interventions, based on stated and justified assumptions.

6.2 Quantification of net CO_2 removals

The number of Reported Net CO_2 Removals associated with a set of HIFOR units issued for a given Monitoring Period ('batch of HIFOR units') is the conservative estimate of the number of removals that took place during the Monitoring Period that the HIFOR units relate to.

This number shall be estimated using the methods set out in Annex 2 of this methodology.

The number of Reported Net CO_2 Removals associated with each HIFOR unit (tCO_2/unit) is the total number of Reported Net CO_2 Removals associated with a given batch of HIFOR units divided by the number of HIFOR units in that batch, rounded down to one decimal place[31]. This number shall be recorded on the same electronic registry as the units themselves.

[31] For example, if a site generated 1 million HIFOR units and reported net CO_2 removals of 6.57 million tonnes, then 6.5 tCO_2 would be associated with each added to the electronic registry and a purchaser buying 100,000 units could make a claim relating to 650,000 tCO_2 of net removals.

At certain points, as specified in Annexes 5 and 6, the Project Proponent must also make an evidence-based projection of the expected number of Reported Net CO_2 Removals using one of the following methodological options, as applicable:

A. Where statistically reliable data for the relevant period have already been collected for the site following the methods in Annex 2, these shall be used, including any conservativeness deduction for measurement uncertainty.
B. Where statistically reliable data for the *preceding* Monitoring Period been collected for the site following the methods in Annex 2 these shall be projected forwards for the subsequent Monitoring Period using the average annual rate for the observed period, including any conservativeness deduction for measurement uncertainty. The projection for any years after 2020 shall be reduced to allow for expected declines in tropical sinks, using the ratio of the expected rates per unit area in 2020-2030 vs. 2010-2020 derived from information for the relevant continental region found in Table 1 of Hubau et al. (2020).
C. Where statistically reliable data for the site do not yet exist, simple estimates shall be made by multiplying the expected area of high integrity forest at the end of the period by the expected annual rate of removals and the length of the Monitoring Period. The expected area of high integrity forest shall be derived from the projection in Section 6.1. The expected annual rate of removals shall be derived from the continent-specific, decade-specific average rates estimated by Hubau et al. (2020). A 20% deduction shall be applied to allow for measurement uncertainty.

6.3 Demonstration of social benefits

Each Project shall develop clear, transparent, measurable indicators of social benefits, following the guidance in Annex 4, tailored to local circumstances and to the form of the expected benefits, using credible approaches that follow good practices in the published literature. Where it is found to be the case, the Verification report will record that at least one substantive, equitably distributed social benefit has been credibly demonstrated, but will not specify quantitative outcomes, and no quantification of individual benefits will be recorded on the electronic registry.

Each Project is also required to demonstrate that any negative impacts have been appropriately minimized, assessed, and addressed, in accordance with Annex 4. The Verification report will record this fact.

At certain points, as specified in Annexes 5 and 6, the Project Proponent must also make an evidence-based projection to show that at least one substantive, equitably distributed social benefit is expected to be achieved. This projection must combine a consideration of the expected level of effort or investment in providing such benefits with documented, justified assumptions regarding the expected effectiveness of these efforts or investments.

6.4 Action required when performance requirements are not met

In a case where a Monitoring Event shows that one or more of the requirements or safeguards in sections 2, 4, 5, or Annex 1 are no longer met the Project is not eligible to issue HIFOR units. This includes a failure to demonstrate social benefits and/or avoidance/management of negative social impacts, as set out in section 6.3.

If possible, remedial action shall be taken, involving all relevant stakeholders to the degree necessary, after which a new Monitoring Event shall take place (extending the same Monitoring Period) to confirm whether or not all criteria are now met and to re-estimate metrics of project performance. The Project Performance Report shall state which criteria were not initially met and describe the remedial action taken so that the body conducting the Verification can assess whether credible, appropriate, effective and lasting steps were taken. If in their judgement this was not the case, they can require further remedial action and the submission of another revised monitoring report for further assessment, and so on. Until successful remedial action is possible the Project will remain unable to issue new HIFOR units.

In a case where, over a Monitoring Period, there has been successful, sustained conservation of the specified extent of high integrity forest, including all required social outcomes, but the Reported Net CO_2 Removals are found to be ≤0 (due for example to a period of unfavorable climatic conditions or high measurement uncertainty) HIFOR units may still be issued, but a note stating 'No claim permitted for this period' shall be recorded in relation to the Reported Net CO_2 Removals both in the Verification Report and in the electronic registry used for the units, where applicable.[32].

7 Monitoring

The Project Description Document shall present a clear Monitoring Plan for the information required in Section 6 and Annex 6, including quality assurance and quality control (QA/QC) procedures. Monitoring shall be performed according to the requirements and procedures defined in this methodology.

At Verification, Project Proponents shall present a Project Performance Report (PPR) covering the most recent Monitoring Period as defined in Section 3.2.5. Monitoring reports shall include at a minimum the information set out in Annex 6.

Annex 7 lists selected variables that must be available or estimated at Validation and at Verification in almost all project contexts. Depending on the individual project design, it is expected that other variables will also be required.

8 References

Baccini, A., Goetz, S. J., Walker, W. S., Laporte, N. T., Sun, M., Sulla-Menashe, D., et al. (2012). Estimated carbon dioxide emissions from tropical deforestation improved by carbon-density maps. Nature Climate Change, 2(3), 182–185.

[32] To maintain environmental integrity, the methods set out in Annex 2 ensure that, if there are positive Reported Net CO_2 Removals during a later Monitoring Period, these are required to take account of any declines in carbon stocks observed in earlier periods.

Baccini, A., Walker, W., Carvalho, L., Farina, M., Sulla-Menashe, D., & Houghton, R. A. (2017). Tropical forests are a net carbon source based on aboveground measurements of gain and loss. Science, 358(6360), 230–234.

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Grantham, H. S., Duncan, A., Evans, T. D., Jones, K. R., Beyer, H. L., Schuster, R., et al. (2020). Anthropogenic modification of forests means only 40% of remaining forests have high ecosystem integrity. *Nature Communications*, 11(1), 5978.

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Saatchi, S. S., Harris, N. L., Brown, S., Lefsky, M., Mitchard, E. T. A., Salas, W., et al. (2011). Benchmark map of forest carbon stocks in tropical regions across three continents. Proceedings of the National Academy of Sciences, 108(24), 9899–9904.

Annex 1 HIFOR Safeguard Principles

All Projects generating HIFOR units are required to abide by the HIFOR Safeguard Principles.

The HIFOR Safeguard Principles were developed through the review of existing WCS safeguarding documents and of the safeguards established by other carbon and environmental certification bodies. The text of the principles draws heavily from the WCS Social Safeguard Mechanisms; GS4GG Safeguarding Principles & Requirements, Version 2.1; the ART/TREES Environmental, Social, and Governance Safeguards Document, Version 2, and the UN-REDD Cancun Safeguards.

Overarching Principles

Projects shall:

1.1. Abide by requirements and guidance in relevant international, regional, and national conventions, agreements, and laws to ensure consistency between Project activities and such laws. Such conventions, agreements, and laws include, but are not limited to, the united Nations Framework Convention on Climate Change (UNFCCC) and subsequent agreements (e.g., the Paris Agreement); the United Nations Convention on Biological Diversity; the United Nations Declaration on the Rights of Indigenous Peoples; ILO Convention 169 on Indigenous and Tribal Peoples; other international human rights treaties and relevant instruments; national sustainable development plans; and national and subnational forest legal frameworks.

1.2. Establish a clear feedback and grievance redress procedure that any stakeholders or impacted parties can use to raise disputes and concerns—including about violations of these safeguard principles. The grievance redress procedure will be adapted for each Project to respect local customs for conflict resolution. The feedback and grievance redress procedure shall be available in an official national language and presented following local practices for communicating information.

1.3. Provide sufficient training and capacity building for safeguard compliance, as well as time and financial resources, for Project staff, contractors, and partners to apply these safeguards to their local contexts.

Social Safeguard Principles

Projects shall:

2.1. Recognize the significance of human rights in Project activities and ensure the utmost respect for internationally recognized human rights. Avoid any involvement in or support of acts of violence or human rights violations as defined by the Universal Declaration of Human Rights.

2.2. Establish clear consultation processes before important Project decisions and respect local customs, values, and institutions. Provide open communication channels among stakeholders and with the Project developers. Ensure all relevant stakeholders have access to timely information presented in their local language. Ensure the Project Description Document and methodology are available in an official national language and presented following local practices for communicating information. Consult with stakeholders continuously throughout the life of the Project.

2.3. Engage meaningfully with Indigenous Peoples and local communities, through a free, prior, and informed consent (FPIC) process, in decisions related to creating and managing Project sites. Design the Project with the full and effective participation and partnership of Indigenous People, local communities, and others who depend on the Project area economically or culturally. Where the Project seeks to operate in Indigenous and Traditional Territories, the Project shall consult and cooperate with the Indigenous Peoples or traditional communities concerned through their own representative institutions to obtain their free, prior, and informed consent in ways that adhere to their traditional cultural practices for decision-making before finalization of the project. The Project will assist impacted people to secure their rights to land and resources. Where the Project entails generating HIFOR units from a period preceding the anticipated date at which consent is to be confirmed, this shall be clearly communicated and explicitly consented to in languages that they understand and through their traditional institutions during the FPIC process.

2.4. Ensure that no Project activities lead to involuntary removal or relocation of property rights holders from their lands or territories nor force property rights holders to relocate activities important to their culture or livelihood. Reserve voluntary resettlement as a last resort and ensure that resettlement decisions are accompanied by full and effective FPIC processes.

2.5. Promote gender equality and women's empowerment, incorporating the principles of non-discrimination, equal treatment, and fair compensation for equal work. Avoid perpetuation of gender-based discrimination and prevent any negative impacts on gender equality or marginalized gender groups.

2.6. Comply with all applicable laws, donor requirements and international standards regarding the welfare and protection of children and vulnerable adults.

2.7. Promote and support the protection and preservation of cultural heritage and the equitable sharing of benefits from the use of cultural heritage, including Indigenous and traditional knowledge of ecosystem management and natural resources.

2.8. Ensure that access to food resources by Indigenous Peoples and local communities is maintained or enhanced and is not impeded in any way by Project activities.

2.9. Not engage in, contribute to, or reinforce corruption of any kind. Establish robust mechanisms to prevent corruption in the context of its activities and funding streams.

2.10. Consider potential positive and negative economic impacts on the local economy and take these into account in Project design, implementation, and operation. Focus on potential negative impacts on vulnerable and marginalised social groups. Ensure that people are not involuntarily displaced economically. Develop benefits that are socially inclusive and sustainable with stable economic contributions. Engage stakeholders in designing benefit sharing, accounting for local socio-economic disparities.

2.11. Ensure that the Project complies with all labor and occupational health and safety laws—national and international—including the principles and standards in the International Labour Organization (ILO) fundamental conventions. Ensure that there is no forced labor or child labor and that steps to prevent gender-based violence in the work environment have been taken.

2.12. Anticipate and avoid any adverse impacts on human health that could result from the Project, including decreased access to food for Indigenous Peoples and local communities and increased risk exposure to Project employees. Ensure that the Project has a safety and security plan in the event of emergencies.

Environmental Safeguard Principles

Projects shall:

3.1. Assess the risks to high conservation value (HCV) areas and ecological assets, and identify, design, and implement measures to minimize impact on HCV areas, using the best available data and latest guidance.

3.2. Assess the risks, both direct and indirect (such as displacement of threats), from Project activities that may affect the extent and ecological integrity of natural non-forest ecosystems in the HAA and HBZ and identify, design, and implement measures to minimize impact.

3.3. Apply best practices for sustainable forest management, especially where small-scale timber and non-timber forest product harvesting is allowed in Project sites.

3.4. Conserve and sustainably manage water systems, including by preventing water pollution and soil erosion.

3.5. Implement measures to ensure healthy soils and reduce soil degradation.

3.6. Promote the conservation, restoration, and sustainable management of natural habitats, biodiversity, and ecosystem services beyond greenhouse gas sequestration.

3.7. Anticipate and adopt measures to mitigate the negative impacts of natural disasters on the Project site as well as disasters to which Project activities could contribute.

3.8. Avoid and prevent the release of pollutants and hazardous waste (as identified by a published national or international list, to be identified by the Project Proponent) into ecosystems, including into the atmosphere, bodies of water, or on land.

3.9. Avoid or minimize the use of chemical pesticides and fertilizers and ensure the safe management of these materials when utilized.

3.10. Prevent the introduction and spread of invasive species. If using seedlings from nurseries or engaged in tree planting, take care to use appropriate species to the ecosystem and avoid the introduction of invasive plant, animal, and/or pathogen species.

3.11. Ensure that Project interventions related to domesticated animals include consideration for animal welfare consistent with, or better than, national legal requirements.

3.12. Ensure that there is no loss of or negative impacts on recognized Critically Endangered, Endangered, or Vulnerable species, and protect or enhance those species' habitats.

Exclusions List

A HIFOR Project shall not be developed, Project implementation shall be halted or paused, and funds associated with the Project shall not be spent (except for necessary *remedial activities, the maintenance of any ongoing programs delivering social benefits, and the operation of the benefit distribution mechanism) if the Project:*

4.1 Involuntarily resettles people to develop or implement the Project or people are involuntarily displaced as a result of the Project.
4.2 Contravenes major international and regional conventions on environmental issues.
4.3 Proposes to create or facilitate significant degradation and/or conversion of natural habitats of any type (e.g., forests, wetlands, grasslands, coastal/marine ecosystems) including those that are legally protected, officially proposed for protection, identified by authoritative sources for their high conservation value, recognized as protected by Indigenous and local communities, or have significant negative socioeconomic and cultural impacts that cannot be cost-effectively avoided, minimized, mitigated, and/or offset.
4.4 Involves adverse impacts on critical natural habitats, including forests that are critical natural habitats, including from the procurement of natural resource commodities, except for adverse impacts on a limited scale that result from conservation actions that achieve a net gain of the biodiversity values associated with the critical natural habitat.
4.5 Proposes to carry out unsustainable harvesting of natural resources – animals, plants, timber and/or non-timber forest products (NTFPs) or the establishment of forest plantations in critical natural habitats.
4.6 Proposes the introduction of species that can potentially become invasive and harmful to the environment unless there is a credible mitigation plan to avoid this from happening.
4.7 Contravenes major international and regional conventions on human rights, including rights specific to Indigenous Peoples or those meeting the characteristics of distinct social groups.
4.8 Proposes activities that result in the exploitation of and access for outsiders to the lands and territories of Indigenous Peoples in voluntary isolation and in initial contact.
4.9 Proposes the use and/or procurement of materials deemed illegal under host country laws or regulations or international conventions and agreements, or subject to international phase-outs or bans, such as ozone depleting substances, polychlorinated biphenyls (PCBs) and other specific, hazardous pharmaceuticals, pesticides/herbicides or chemicals.
4.10 Proposes the generation of significant amounts of harmful wastes and effluents.
4.11 Involves the removal, alteration or disturbance of any non-replicable or critical cultural heritage, or the use of any intangible cultural heritage without the Free, Prior and Informed Consent (FPIC) of the communities to whom it belongs.
4.12 Includes the use of forced labor, trafficking in persons, and child labor. Child labor includes both (i) labor below the minimum age of employment and (ii) any other work that may be hazardous, may interfere with the child’s education, or may be harmful to the child’s health or to the child’s physical, mental, spiritual, moral, or social development.

Annex 2 Methodology for estimating Net CO_2 removals

The following section describes procedures required for ex-post estimation of Reported Net CO_2 Removals (RNR) achieved by the project within the HAA within the scope of this methodology.

To estimate RNR, Project Proponents shall produce and present at each Monitoring Event, for the HAA:

1 Carbon stock estimation

- Raster maps of carbon density (D) and their uncertainty (Sections A1.1 and A1.2)
- Quantification of total carbon stocks (S) and their uncertainty (Section A1.3)

2 Carbon stock change estimation

- Quantification of the aggregate carbon stock changes since the Project Start Date (DS) and their uncertainty (Section A2.1)
- Conservative estimation of Net Carbon Removals (CNR) since the last Monitoring Event (Section A2.2)
- Conversion of CNR (expressed in tC) to Reported Net CO_2 Removals (RNR; expressed in tCO_2) (Section 8.2.3).

The following steps may be undertaken either for the entire HAA or within the extent of forest within the HAA at the Project Start Date, at the discretion of the Project Proponent. In the latter case the extent of forest at the Project Start Date shall be determined using a credible, technically robust and well-documented map of forest extent at 30 m resolution or better. Whichever choice is made to define the area of analysis, it must then be used consistently throughout the Project Period.

In the case where Reported Net CO_2 Removals at t_{x-1} were ≤0 (and hence, potentially, a net loss of carbon stocks during the period $t_{x-2}t_{x-1}$) carbon stock change to t_x shall not be calculated in relation to t_{x-1} since this entails a risk of over-estimating total net removals over the life of the project. Instead, carbon stock change shall be calculated since the last Monitoring Event at which positive RNR were found, which may be t_{x-2}, t_{x-3} or an earlier time point depending on circumstances. Before proceeding, this time point (e.g. t_{x-2}) shall be substituted for t_{x-1} in all equations in the remainder of this section. For clarity, any Reported Net Removals for this extended accounting period shall nonetheless be wholly associated with the HIFOR units arising from the Monitoring Period $t_{x-1}t_x$.

A1 Quantification of carbon stocks

Carbon stocks of live-tree biomass, hereafter referred to as 'carbon stocks', shall be estimated and reported at each Monitoring Event. The general procedure to estimate carbon stocks includes the following steps:

1. Select and describe the approach used to generate, for the HAA, spatially continuous maps of carbon density ($D_{t_x,p,m}$), i.e., biomass carbon per hectare, using remote-sensing, allometric equations, and modeling (Section A1.1).
2. Generate maps of carbon density ($D_{t_x,p,m}$) for each Monitoring Event and calculate their best estimate ($D_{t_x,p,median}$) and uncertainty ($D_{t_x,p,lower}$, $D_{t_x,p,upper}$) (Section A1.2).
3. Calculate total carbon stock of the HAA ($S_{HAA,t_x,m}$) and its best estimate ($S_{HAA,t_x,median}$) and uncertainty ($S_{HAA,t_x,lower}$, $S_{HAA,t_x,upper}$) for each Monitoring Event (Section A1.3).

A1.1 Select approach for remote-sensing based mapping of biomass carbon density

The chosen approach for generating spatially continuous maps of carbon density ($D_{t_x,p,m}$, tC ha^{-1}) requires the following main steps:

1. *Identification and description of the remote-sensing based approach for mapping AGB based on published peer-reviewed literature.* Where stand-level physical properties are estimated by remote sensing, and these properties are used as predictors of AGB, this description shall comprehensively detail any assumed relationships between such stand-level properties (e.g., forest canopy height) and stand-level (i.e. forest inventory plot scale) AGB, hereafter referred to as 'stand-level allometric relationships'. It shall also demonstrate that the relationships have been calibrated and validated against estimates of biomass derived from ground-measurements representative for the geography and forest type where the HMA is located. If valid stand-level allometric relationships are not available from peer-reviewed literature, a network of ground plots shall be established with the purpose of estimating AGB and calibrating and validating stand-level allometric relationships. For establishing a network of ground plots and estimating stand-level biomass, Project Proponent shall follow the procedures defined in Annex 3.
2. *Stratification, if necessary.* Where the HAA contains two or more distinct types of forest for which distinct stand-level allometric relationships should be used to reduce uncertainty in AGB estimates, these forests should be treated as different strata, and distinct allometric relationships shall be applied to each stratum. If a stratum constitutes less than 10% of the total forest area of the HAA, then the relationship for the stratum that is most similar to it in the remainder of the Project area may be used.[33]
3. *Remote-sensing based estimation of stand-level physical properties that then allow the estimation of AGB through stand-level allometric relationships*. Depending on the remote-sensing product used, maps with discontinuous

[33] For this purpose, forests are considered different if, over a large area, fewer than 30% of individual trees with diameter at breast height (dbh) over 10 cm are expected to be the same species (this can be based on expert judgement, or if necessary rapid field surveys), or have similar sets of species but with very different morphologies between the two habitats. An example of clearly different strata would be if an area contained an area dominated by conifers on steep slopes/high elevations, and separate lowland forest dominated by broadleaved trees. Individual strata can contain a high variation in biomass and level of past disturbance, as long as they are the same species type. It is expected that most HAAs will have a single stratum: it is not always a requirement for multiple strata and stand-level allometric relationship to be developed, but it will be necessary for some projects.

spatial coverage may be generated in this step, see Step 7. However, the spatial resolution of these maps shall be 30 m or better (i.e., ≤30m).

4. *Estimation of stand-level AGB from these remotely sensed stand-level physical properties* using the allometric relationships between such variables and AGB identified in Step 1.
5. *Estimation of BGB as a function of AGB, via root-to-shoot ratios, or other allometric equations*, for the given forest type and geography from peer-reviewed literature.
6. *Estimation of total-biomass density per pixel as the sum of AGB and BGB densities*, which are then converted to carbon density per pixel using Equation 2.
7. If maps produced in steps 1-4 are discontinuous in spatial coverage (e.g. spaceborne LiDAR passes), spatially continuous (i.e., raster) maps of carbon density shall be generated via modelling approaches that relate the discontinuous carbon density maps to auxiliary data (i.e., other remote sensing products, with a resolution of ≤30m) with continuous coverage.

Maps from different years shall be comparable and therefore be generated through the same methodological procedure. If technology and estimation approaches evolve over time (e.g., new satellite products are made available and incorporated), the Project Proponent shall harmonize the new and old maps (e.g., through bias correction), and, where permanent plots exist in the area of interest, demonstrate comparability with the plot data.

Carbon density maps shall be produced for each Monitoring Event, shall have a spatial resolution of 30m or better (i.e., ≤30m), and be calculated using an equal area projection.

Maps of carbon density ($D_{t_x,p,m}$, tC ha^{-1}) represent the amount of total carbon of live-tree biomass per hectare, which shall be calculated as the carbon fraction of the sum of two live-biomass pools, namely aboveground biomass ($AGB_{t_x,p,m}$) and belowground biomass ($BGB_{t_x,p,m}$). Biomass values shall be converted into carbon values through the biomass-to-carbon conversion factor (Equation 2).

$$D_{t_x,p,m} = \frac{\left(AGB_{t_x,p,m} + BGB_{t_x,p,m}\right)}{A_p} \times 0.47 \tag{2}$$

Where:

$D_{t_x,p,m}$ = carbon density (tC ha^{-1}) of pixel p in the HAA at Monitoring Event t_x for a given modelled map m;

$AGB_{t_x,p,m}$ = aboveground biomass (tDM) of pixel p in the HAA at Monitoring Event t_x for a given modelled map m;

$BGB_{t_x,p,m}$ = belowground biomass (tDM) of pixel p in the HAA at Monitoring Event t_x for a given modelled map m;

0.47 = biomass-to-carbon conversion factor (gC/gDM);

A_p = area (ha) of pixel p in the HAA, which shall be calculated using an equal area projection;

$t_x = t_0, t_1, \ldots, t_n$ Monitoring Event;

$p = 1, 2, 3 \ldots, p_{HAA}$ pixel in the HAA;

p_{HAA} = number of pixels in the HAA;

$m = 1, 2, 3 \ldots, m_D$ map of the D-maps set (see Section A1.2.1 for details);

m_D = number of maps in the D-maps set.

A1.2 Generate carbon density maps and estimate uncertainty

Maps of carbon density ($D_{t_x,p,m}$, tC ha^{-1}) shall be generated following the selected remote-sensing based approach as from Section A1.1 and accompanied by pixel-level uncertainty estimates. The following sources of uncertainty shall be evaluated where applicable:

- choice and parameterization of stand-level allometric relationships
- wood density parameters
- prediction error of the model used to generate spatially continuous maps of biomass
- other assumptions made

Thereby, the uncertainty shall be propagated to the final carbon stock estimate. The sources of uncertainty and the uncertainty propagation approach are specific to the mapping technique, but Project Proponents may choose between two options:

1. Use the recommended approach set out in this methodology, described in Section A1.2.1. or
2. Use another conservative, credible, and transparent method based on published peer-reviewed literature (e.g., Saatchi et al., 2011; Baccini et al., 2012; Duncanson et al., 2021) that addresses all relevant sources of uncertainty including those listed above; or

A1.2.1 Recommended approach for uncertainty estimation of carbon density maps

Considering the different sources of uncertainty in the selected mapping approach, a set of (at least) 1000 carbon density maps of the HAA ($D_{t_x,p,m}$), hereafter referred to as the 'D-map set', shall be generated at each Monitoring Event (t_x) as a representative sample of the uncertainty distribution.

In order to minimize the computational power required for generating the D-map set, the mapping algorithm may be run on a sub-set (at least 10%) of evenly distributed pixels in the HAA (e.g. selecting systematically every 10^{th} pixel of a raster map).

Uncertainty sources shall be categorized into two groups:

1. Static: sources of uncertainties that are expected to not change over time (i.e. between Monitoring Events) and, therefore, err equally in each time period;

2. Independent: sources of uncertainties that may err independently in each time period.

In the 'static' category are sources of uncertainty, such as wood density and allometric equations parameters, which have their own uncertainty distribution. Values for each of these parameters shall be randomly drawn from their uncertainty distribution at the first Monitoring Event, and at least 1000 unique combinations of the different static parameters values be defined. These parameter values and their combinations shall then be re-used at each following Monitoring Event for both carbon density maps and carbon density change maps.

In the 'independent' category are sources related to the selected remote sensing algorithm, imagery sources, and locational accuracy. Sets of parameters with independently varying error over time periods may be randomly drawn (e.g., by bootstrapping the training dataset for the model used to create the spatially continuous maps) at each Monitoring Event for each map in the 'D-map set', with the same randomly drawn values also applied to the carbon density change maps.

Once the uncertainty sources and combinations of parameter values have been defined, a D-map for each parameter combination shall be generated by the mapping algorithm to obtain the D-map set. The parameter combination used to generate an individual D-map shall be saved along with the map itself (i.e. as map metadata). In each previous and following monitoring period, each D-map shall have corresponding maps, which share the same values for static sources of uncertainties but may differ for parameters in the independent category. For an individual Monitoring Event, parameters for each map in both the static and independent categories shall be fixed and used in the generation of carbon density change maps.

The D-map set from the process described above shall be used to calculate three key maps ($D_{t_x,p,median}$, $D_{t_x,p,lower}$, $D_{t_x,p,upper}$), to be made available for auditing purposes: one for the pixel-level median value, one for the lower bound of the 95% confidence interval, and one for the upper bound of the 95% confidence interval. These maps are calculated by ranking the D-map set in order of mean carbon density and selecting the middle (50%) map for the median, the 2.5% map for the lower bound of the confidence interval, and the 97.5% map for the upper bound of the confidence interval. Where no exact map exists for those confidence intervals, the pixel-level mean of the two closest maps shall be used. For example, if there are 1000 maps, the median is the mean of the 500th and 501th map (Equation 3a), the 2.5% confidence map is the mean of the 25th and 26th maps (Equation 3b), and the 97.5% confidence map is the mean of the 975th and 976th maps (Equation 3c).

$$D_{t_x,p,median} = \frac{Sort\left(D_{t_x,p,1}, D_{t_x,p,2}, \dots, D_{t_x,p,m_D}\right)[500] + Sort\left(D_{t_x,p,1}, D_{t_x,p,2}, \dots, D_{t_x,p,m_D}\right)[501]}{2} \quad (3a)$$

$$D_{t_x,p,lower} = \frac{Sort(D_{t_x,p,1}, D_{t_x,p,2}, \dots, D_{t_x,p,m_D})[25] + Sort(D_{t_x,p,1}, D_{t_x,p,2}, \dots, D_{t_x,p,m_D})[26]}{2} \quad (3b)$$

$$D_{t_x,p,upper} = \frac{Sort(D_{t_x,p,1}, D_{t_x,p,2}, \dots, D_{t_x,p,m_D})[975] + Sort(D_{t_x,p,1}, D_{t_x,p,2}, \dots, D_{t_x,p,m_D})[976]}{2} \quad (3c)$$

Where

$D_{t_x,p,median}$ = median of the $D_{t_x,p,m}$ confidence interval, with [500] and [501] indicating the 500th and 501th maps of the D-maps set sorted in increasing order according to the mean carbon density of the map;

$D_{t_x,p,lower}$ = lower bound of the $D_{t_x,p,m}$ confidence interval, with [25] and [26] indicating the 25th and 26th maps of the D-maps set sorted in increasing order according to the mean carbon density of the map;

$D_{t_x,p,upper}$ = upper bound of the $D_{t_x,p,m}$ confidence interval, with [975] and [976] indicating the 975th and 976th maps of the D-maps set sorted in increasing order according to the mean carbon density of the map;

$D_{t_x,p,1}, D_{t_x,p,2}, \dots, D_{t_x,p,m_D}$ = D-maps set sorted according to the mean carbon density of each map.

If the procedure to generate the three maps $D_{t_x,p,median}$, $D_{t_x,p,lower}$, $D_{t_x,p,upper}$ has been run on a subset of pixels, an additional step is required in order to generate spatially-continuous maps. This involves re-running the model six more times for all pixels in the HAA, using the same settings that were used to generate the 25th, 26th, 500th, 501th, 975th, and 976th maps, respectively. Thereafter, applying Equations 1a-1c to obtain three full-coverage maps for the pixel-level median value, lower bound of the 95% confidence interval, and upper bound of the 95% confidence interval.

A1.3 Calculate total carbon stocks of the site and its uncertainty

Carbon stocks at a given Monitoring Event ($S_{HAA,t_x,m}$) are calculated as the sum of total biomass carbon (above and belowground) of all pixels in the HAA for a given map. Total biomass carbon is obtained by weighting the carbon density of each pixel ($D_{t_x,p,m}$) by the size of the pixel (A_p) (Equation 4).

$$S_{HAA,t_x,m} = \sum_{p=1}^{p_{HAA}} D_{t_x,p,m} \times A_p \quad (4)$$

Where

$S_{HAA,t_x,m}$ = carbon stock (tC) of the HAA at Monitoring Event t_x and for a given modelled map m;

$D_{t_x,p,m}$ = carbon density (tC ha^{-1}) of pixel p in the HAA at Monitoring Event t_x and for a given modelled map m;

A_p = area (ha) of pixel p in the HAA, which shall be calculated using an equal area projection;

$t_x = t_0, t_1, \ldots, t_n$ Monitoring Event;

$p = 1, 2, 3 \ldots, p_{HAA}$ pixel in the HAA;

p_{HAA} = number of pixels in the HAA;

$m = 1, 2, 3 \ldots, m_D$ map of the D-map set;

m_D = number of maps in the D-map set.

To estimate the level of uncertainty of the carbon stock, Equation 2 shall be applied to the three spatially-continuous maps $D_{t_x,p,median}$, $D_{t_x,p,lower}$, $D_{t_x,p,upper}$ generated as from Section A1.2.1, to obtain the median ($S_{HAA,t_x,median}$), lower bound of the 95% confidence interval ($S_{HAA,t_x,lower}$), and upper bound of the 95% confidence interval ($S_{HAA,t_x,upper}$) of the carbon stock, respectively.

A2 Quantification of carbon stock change

The Conservative estimate of Net Carbon Removals (CNR) for each Monitoring Period is calculated as the conservative estimate of positive change, if any, in total carbon stocks within the HAA, relative to the carbon stock at the previous Monitoring Event ($\Delta S_{HAA,t_{x-1}t_x,lower}$).

Positive values for $\Delta S_{HAA,t_{x-1}t_x,lower}$ indicate that there is sufficient confidence that the HAA has functioned as a net carbon sink over the Monitoring Period. In this case the Reported Net CO_2 Removals will be positive.

Negative values of $\Delta S_{HAA,t_{x-1}t_x,lower}$ indicate there is not sufficient confidence that the HAA has functioned as a net carbon sink over the Monitoring Period, and a reasonable possibility that it may have served as a net emission source. In this case, no claim is permitted in relation to Reported Net CO_2 Removal for the units issued in the Monitoring Period (see Section 6.5), strengthening the environmental integrity of the units.

CNR are converted from units of C to units of CO_2 to provide the Reported Net CO_2 Removals.

A2.1 Calculate carbon stock changes since the Project Start Date and their uncertainty at site level

The change in carbon stocks within the HAA between year t_x and the Project Start Date (t_0) ($\Delta S_{HAA,t_0t_x,m}$) is calculated as the sum across the HAA of all per-pixel differences of carbon density ($\Delta D_{t_0t_x,m}$) (Equation 5) weighted by the size of the pixels (A_p) (Equation 6).

$$\Delta D_{t_0t_x,p,m} = D_{t_x,p,m} - D_{t_0,p,m} \qquad (5)$$

$$\Delta S_{HAA,t_0t_x,m} = \sum_{p=1}^{p_{HAA}} \left(\Delta D_{t_0t_x,m} \times A_p\right) \quad (6)$$

Where

$\Delta D_{t_0t_x,p,m}$ = per-pixel change in carbon density between the Monitoring Events t_0 and t_x for a given modelled map m;

$\Delta S_{HAA,t_0t_x,m}$ = change in carbon stock (tC) of the HAA in the Accounting Period t_0t_x for a given modelled map m;

$D_{t_x,p,m}$ = carbon density (tC ha^{-1}) of pixel p in the HAA at Monitoring Event t_x for a given modelled map m;

$D_{t_0,p,m}$ = carbon density (tC ha^{-1}) of pixel p in the HAA at Monitoring Event t_0 for a given modelled map m;

A_p = area (ha) of pixel p in the HAA, which shall be calculated using an equal area projection;

t_x = $t_0, t_1, \dots, t_n$ Monitoring Event;

p = $1, 2, 3 \dots, p_{HAA}$ pixel in the HAA;

p_{HAA} = number of pixels in the HAA;

m = $1, 2, 3 \dots, m_{\Delta D}$ map of the DD-maps set;

$m_{\Delta D}$ = number of maps in the DD-maps set.

As with the quantification of carbon stocks (Section A1), the sources of uncertainty and the uncertainty propagation approach are specific to the mapping technique, and Project Proponents may choose between two options to propagate uncertainty to the final carbon stock change estimate:

1. Use the recommended approach set out in this methodology, described in Section A2.1.1, or
2. Use conservative, credible, and transparent methods based on published peer-reviewed literature (e.g., Baccini et al., 2017) that address all relevant sources of error listed above.

A2.1.1 Recommended approach for uncertainty estimation of carbon stock change

To estimate the level of uncertainty of the carbon stock change, the pixel-level difference shall be computed on a minimum of 1000 pairs of the D-map set at year t_x

and year t_0. This procedure shall return a set of 1000 differential maps, hereafter referred to as the 'DD-maps set'.

In each D-map at each Monitoring Event, the combination of 'static' and 'independent' parameters, shall be the same as that already selected for the equivalent map for the same time point in the D-map set (Section 7.1.2.1). Pairs of the D-maps set at year t_x and year t_0 shall be selected ensuring that each map in the pair shares the same set of 'static' parameters.

In order to minimize the computational power required for this process, the algorithm may be run on a sub-set (at least 1%) of evenly distributed pixels in the HAA (e.g. selecting systematically every 100th pixel of a raster map).

Equation 6 shall than be applied for each map of the DD-maps set to derive the same number ($m_{\Delta D}$) of samples of carbon stock change ($\Delta S_{HAA,t_0 t_x,m}$).

The lower (upper, and median) bounds of the $\Delta S_{HAA,t_0 t_x,m}$ confidence interval are estimated as the 2.5th (97.5th, and 50th) percentiles of the $\Delta S_{HAA,t_0 t_x,m}$ samples distribution. In practical terms, if 1000 $\Delta S_{HAA,t_0 t_x,m}$ samples were generated, these shall be sorted in increasing order of their average value, and the mean of their 25th and 26th, (975th and 976th, and 500th and 501st) value extracted to obtain the lower (upper, and median) bounds of the $\Delta S_{HAA,t_0 t_x}$ confidence interval (Equations 7a-7c).

$$\Delta S_{HAA,t_0 t_x,median} = \frac{Sort(\Delta S_{HAA,t_0 t_x,1}, \ldots, \Delta S_{HAA,t_0 t_x,m_{\Delta D}})[500] + Sort(\Delta S_{HAA,t_0 t_x,1}, \ldots, \Delta S_{HAA,t_0 t_x,m_{\Delta D}})[501]}{2} \quad (7a)$$

$$\Delta S_{HAA,t_0 t_x,lower} = \frac{Sort(\Delta S_{HAA,t_0 t_x,1}, \ldots, \Delta S_{HAA,t_0 t_x,m_{\Delta D}})[25] + Sort(\Delta S_{HAA,t_0 t_x,1}, \ldots, \Delta S_{HAA,t_0 t_x,m_{\Delta D}})[26]}{2} \quad (7b)$$

$$\Delta S_{HAA,t_0 t_x,upper} = \frac{Sort(\Delta S_{HAA,t_0 t_x,1}, \ldots, \Delta S_{HAA,t_0 t_x,m_{\Delta D}})[975] + Sort(\Delta S_{HAA,t_0 t_x,1}, \ldots, \Delta S_{HAA,t_0 t_x,m_{\Delta D}})[976]}{2} \quad (7c)$$

Where

$\Delta S_{HAA,t_0 t_x,median}$ = median of the $\Delta S_{HAA,t_0 t_x,m}$ confidence interval, with [500] and [501] indicating respectively the 500th and 501th values of the 1000 values sorted in increasing order;

$\Delta S_{HAA,t_0 t_x,lower}$ = lower bound of the $\Delta S_{HAA,t_0 t_x,m}$ confidence interval, with [25] and [25] indicating respectively the 25th and 26th values of the 1000 values sorted in increasing order;

$\Delta S_{HAA,t_0t_x,upper}$ = upper bound of the $\Delta S_{HAA,t_0t_x,m}$ confidence interval, with [975] and [976] indicating respectively the 975th and 976th values of the 1000 values sorted in increasing order;

$\Delta S_{HAA,t_0t_x,1}, \dots, \Delta S_{HAA,t_0t_x,m_{\Delta D}}$= samples of carbon stock change ($\Delta S_{HAA,t_0t_x,m}$)sorted in increasing order.

If the procedure to generate $\Delta S_{HAA,t_0t_x,median}$, $\Delta S_{HAA,t_0t_x,lower}$, $\Delta S_{HAA,t_0t_x,upper}$ has been run on a subset of pixels, an additional step is required in order to calculate the carbon stock change based on spatially-continuous maps. This involves re-running the model to estimate carbon density maps for all pixels in the HAA, twelve more times (i.e. six more times for t_0 and six more times for t_x) using the same settings that were used to generate the 25th, 26th, 500th, 501th, 975th, and 976th percentiles, respectively. Thereafter, apply Equations 6a-6c to obtain carbon stock changes based on three full-coverage maps for the pixel-level median value, lower bound of the 95% confidence interval, and upper bound of the 95% confidence interval.

A2.2 Conservative estimate of Net Carbon Removals since the previous Monitoring event, considering uncertainty

The Conservative estimate of Net Carbon Removals (CNR) across the HAA for a given Monitoring Period is calculated as the positive difference, if any, between (i) the lower bound of the confidence interval of the carbon stock change between the Project Start Date (t_0) and the present Monitoring Event (t_x) and (ii) the lower bound of the confidence interval of the carbon stock change between the Project Start Date (t_0) and the previous Monitoring Event (t_{x-1}) (Equations 8 and 9). The latter quantity, the lower bound of the confidence interval of the carbon stock change between the Project Start Date (t_0) and the Monitoring Event t_{x-1} will already have been calculated at the Monitoring Event t_{x-1}.

In addition to the consideration of the lower bound of the confidence interval for the change, a further test is introduced in Equation 9 to ensure that CNR can only be considered positive if the median estimate of carbon stocks across the HAA has also increased since t_{x-1}. This excludes cases where the median estimate has declined but the lower bound of the estimated change is positive due to improving estimate precision, since reporting positive net removals in such cases might lack market credibility.

$$\Delta S_{HAA,t_{x-1}t_x,lower} = \Delta S_{HAA,t_0t_x,lower} - \Delta S_{HAA,t_0t_{x-1},lower} \qquad (8)$$

$$CNR_{t_{x-1}t_x} = \begin{cases} \Delta S_{HAA,t_{x-1}t_x,lower} & if \quad \Delta S_{HAA,t_{x-1}t_x,lower} > 0 \; \& \; S_{HAA,t_x,median} > S_{HAA,t_{x-1},median}; \\ 0 & otherwise. \end{cases} \qquad (9)$$

Where

$CNR_{t_{x-1}t_x}$ = conservative estimate of net removals (tC) in the HAA in the Monitoring Period $t_{x-1}t_x$;

$\Delta S_{HAA,t_{x-1}t_x,lower}$ = conservative estimate of change in carbon stock (tC) of the HAA in the Monitoring Period $t_{x-1}t_x$;

$\Delta S_{HAA,t_0 t_x,lower}$ = conservative estimate of change in carbon stock (tC) of the HAA between the Project Start Date (t_0) and the present Monitoring Event (t_x);

$\Delta S_{HAA,t_0 t_{x-1},lower}$ = conservative estimate of change in carbon stock (tC) of the HAA between the Project Start Date (t_0) and the previous Monitoring Event t_{x-1};

t_x = $t_0, t_1, \ldots, t_n$ Monitoring Event;

t_{x-1} = Monitoring Event before Monitoring Event t_x.

A2.3 Estimation of Reported Net CO_2 Removals

Reported Net CO_2 Removals (RNR; tCO_2) for a given Monitoring Period are calculated as the Conservative estimate of Net Carbon Removals (CNR) for that period multiplied by the C-to-CO_2 conversion factor (Equation 10).

$$RNR_{t_{x-1}t_x} = NCR_{t_{x-1}t_x} \times \frac{44}{12} \qquad (10)$$

Where

$RNR_{t_{x-1}t_x}$ = Reported Net CO_2 Removals for the Monitoring Period $t_{x-1}t_x$;

$CNR_{t_{x-1}t_x}$ = conservative estimate of net removals (tC) in the HAA in the Monitoring Period $t_{x-1}t_x$;

$44/12$ = is the C to CO_2 conversion factor.

Annex 3 Generation of reference data from a network of permanent sample plots

Plot network establishment

A network of permanent sample plots shall be established when there is no suitable pre-existing, ground-truthed statistical relationship between stand-level AGB and the remote-sensed variables that will be used to model AGB across the HIFOR Accounting Area (HAA). The plots are used to estimate the parameters of such a relationship, to revise it over time as necessary, and to strengthen understanding of the dynamics of CO_2 removals in the Project area. Plots are placed only in forest areas, mapped according to the forest definition in use by the Project.

Where an HAA has two or more very distinct types of forest, then these shall be treated as different strata, and a separate statistical relationship shall be estimated for each stratum. For this purpose, forest types are considered different if over a large area fewer than 30% of individual trees with diameter at breast height (dbh) over 10 cm are expected to be of the same species (this can be based on expert judgement, or if necessary rapid field surveys), or have similar sets of species but with very different morphologies between the two types[34]. Individual strata can contain a high variation in biomass and level of past disturbance, as long as they are of the same broad species composition throughout. If a stratum makes up less than 10% of the total forest area, then the relationship for the stratum that is most similar to it in the remainder of the HAA may be used.

The area within which **new plots** are to be located is termed the sampling area. By default, the sampling area, which shall be explicitly delimited, will lie entirely within the HIFOR Accounting Area (HAA) since this is the area within which long-term protection of and access to the plots can best be assured. However, the sampling area may also be expanded to include a part or all of the HBZ, at the discretion of the Project Proponent, if there are strong logistical reasons for doing so, with the requirement that long-term protection of and access to the plots placed in the HBZ is reasonably assured.

In addition to newly established plots, **previously established plots** may also be used. They must meet all the requirements set out below for new plots other than the requirement for random placement. There is no limit on the number of previously established plots *within* the sampling area that may be used. Previously established plots *outside* the sampling area and no more than 100 km distant from the HMA may also be used, if it can be demonstrated that each plot falls within a stratum also found in the HMA and that long-term protection of, access to and financing for remeasurement of each of them is reasonably assured. Up to a maximum of 15 plots from outside the sampling area may be used per stratum.

Locations of new plots must be selected randomly with replacement within each stratum in the sampling area. In the event that subsequent randomly selected plot

[34] An example of clearly different strata would be if an area contained an area dominated by conifers on steep slopes/high elevations, and separate lowland forest dominated by broadleaved trees.

locations overlap, the later plot must be discarded and another random selection made. Plot coordinates shall be assigned prior to field establishment and measurement. Before coordinates are assigned, parts of the sampling area deemed likely to be inaccessible now or in the foreseeable future (e.g., due to physical constraints, security, or land tenure restrictions), or subject to substantial past or anticipated anthropogenic disturbance (according to criteria to be determined by the Project Proponent) shall be delineated and excluded from sampling.

Positional accuracy of plots used in calibrating remote sensing models is critical. The error in positional accuracy of each in-situ plot location reported by the GPS system used must be equal to or less than 10 m and must accompany documentation of the application of this methodology (e.g., project description, etc.). The manufacturer and model of the global positioning system (GPS) used, and the number of times each corner location has been averaged, must accompany documentation of the application of this methodology.

The number of plots per stratum shall be defined taking into consideration desired precision, forest characteristics, costs, logistical feasibility and other factors as appropriate, with a **minimum number of 30 plots per stratum**, including both new and previously established plots. To improve estimation accuracy, strata with higher internal variability or lower rates of carbon removals relative to carbon stocks may require higher plot numbers.

Plots shall be maintained throughout the Project Period. Where individual plots cannot be maintained for reasons beyond the control of the Proponent, new replacement plots shall be established within the sampling area prior to the next Verification Event and in accordance with the requirements set out above.

Plot measurements

Field measurements shall be conducted at plot establishment and then at least every 5-7 years. Ideally remeasurements shall be aligned with the reference years used in the analysis of remote sensing products. If no exact match occurs, a range of ± 2 years between the plot measurement and the remote sensing products can be accepted.

Plots should have a square or rectangular shape, and the size of the individual plots shall be 0.5-1 ha (50 x 100 m – 100 x 100 m) in closed canopy forest types, with larger sizes also permissible in all forest types and a smaller minimum of 0.25 ha (50 x 50 m) acceptable in open canopy forest types (e.g. woodlands or savannas, where canopy cover is normally <60% and maximum tree diameter normally <60 cm). Plots of this size are considered large enough to avoid excessive edge effects and can inform the development of a clear relationship between AGB and remote sensing imagery. When plots of ≥0.5 ha cannot be used for practical reasons e.g., steep terrain, lack of accessibility, use of plots established in the past, etc. then a larger number of smaller plots (e.g., two 0.25 ha plots in substituting for a 0.5 ha plot) may be used. The total area of all plots shall be at least 15 ha.

Each plot shall have a unique identification code and have all corners georeferenced via GPS coordinates, with high accuracy and reported uncertainty following recommendations by Duncanson et al. (2021). It must be possible to relocate plots, but any permanent markers used must not attract too much attention to reduce the risk of human perturbation of the plot. Burying 1 m lengths of rebar at plot corners is the ideal way to permanently mark plot corners without attracting attention of people or animals.

A data collection and recording protocol shall be established based on standard forest monitoring practices, such as publicly available protocols from existing plot networks in tropical forests (e.g., RAINFOR, ForestGEO). For the specific purpose of estimating aboveground biomass (AGB), a minimum list of variables needs to be recorded for each stem (tree, large lianas, palms, ferns) with stem diameter (DBH) > 100 mm determined to lie within the plot according to the chosen protocol:

- Stem tag number. Stems should be tagged systematically.
- Family, genus and, if possible, species name
- Stem diameter (mm) at 1.3 m height (DBH), or other appropriate point of measurement, in accordance with the established protocol. For large lianas, measuring the maximum diameter is also recommended. The point of measurement shall be marked for subsequent measurements.
- Stem status (living/dead and broken/fallen). This information will be used for estimating mortality rates (from second monitoring period)
- Tree height (m) shall ideally be estimated for a sample of ten trees in each smaller diameter class (100-200, 200-300, 300-400, 400-500 and 500-800 mm) as well as for every tree over 800 mm diameter. Where this is not logistically feasible, the heights of at least the five tallest trees in the plot shall be recorded, to allow estimation of dominant canopy height. A clinometer or vertex hypsometer shall be used to estimate tree height, from a vantage point where the top and bottom of the tree can be clearly seen.

During the field campaign standard quality control / quality assurance (QA/QC) procedures for field data collection and data management must be applied following good practices with the aim of minimizing measurement errors. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or from the chapter 5.5 of Good Practice Guidance for Land Use, Land-Use Change and Forestry (Intergovernmental Panel on Climate Change 2003), is recommended.

Subsequent estimation of the AGB of each measured stem, and hence overall plot AGB, will be based on field measurements combined with relevant allometric equations using standard approaches. The allometric equations and parameters used shall be reported, along with their associated uncertainty. To estimate stem-level AGB, it is permitted to use either peer-reviewed pantropical multispecies allometric equations (e.g., Chave et al. 2014), or locally calibrated equations. Estimated wood density for each stem shall be determined from credible sources at the family, genus or species level, as appropriate.

If lianas and palms are present in the field plots, these tend to have a very different structure compared to trees. Thus, distinct and appropriate allometries shall be applied for these.

Annex 4 Framework for assessment of social benefits and impacts

As stated in Section 5, the Project Implementation Strategy must include specific plans to promote sustainable development and achieve both (i) at least one substantive, equitably distributed social benefit and (ii) the avoidance and management of negative impacts.

These benefits must be in addition to any benefits associated with the continued availability (at pre-existing levels) of healthy ecosystems and natural resources important for sustainable livelihood activities.

Benefits

The Project must demonstrate delivery of one or more positive benefits (point i above) in two ways:

1. Delivery of investments and/or funded activities that are expected to improve social outcomes, including through the Benefit Distribution Mechanism and other pathways as appropriate AND;
2. Evidence that these investments/activities have then resulted in one or more demonstrable, substantive social benefits, as identified by those receiving the benefits, and according to one or more quantitative indicators which are measured using documented, technically robust, widely recognized good practices.

It must be shown that both (1) and (2) have been achieved in ways that are equitable, meaning that they achieve by design a reasonably even distribution both across and within social groups that are dependent on the HAA for legitimate uses[35], including, where relevant, to sub-groups within these groups made marginalized or vulnerable in the dominant societal context [36].

Negative impacts

The Project must attempt to avoid negative impacts from its actions to the greatest extent feasible, including by implementation of the strategy to comply with all safeguards required in Section 5.

The Project must establish a participatory system, using documented, technically robust, widely recognized good practices, to identify and investigate perceived negative impacts of the Project among social groups that are dependent on the HAA for legally permitted uses. Any significant instances of such impacts must be

[35] As identified by the Situation Analysis described in Section 5.

[36] This approach should take account of historical injustices, where identified. Illustrative examples of social benefits designed to enhanced equitable distribution include support for: women-led or Indigenous women-led programs or activities; improved value chains that benefit women, Indigenous Peoples, and any other group made vulnerable in the dominate societal culture around the HIFOR site; projects that advance land tenure security or collective titles, especially for women and youth; projects that foster sustainable livelihoods, especially for Indigenous Peoples, women, youth, religious minorities, etc.

addressed to the satisfaction of the affected groups, for example by reducing/ preventing them and/or by providing sufficient alternative benefits.

Annex 5 Content of the Project Description Document

The Project Description Document submitted for Validation will describe the design and starting conditions of the project in sufficient detail for the Validation Body to determine whether the requirements of this methodology have been met.

The most recent version of the official template for the Project Description Document shall be used, to help ensure that all necessary content is provided.

The following content is mandatory:

Project Design

A description, with supporting evidence where necessary, of **how the project has met the design requirements set out in Sections 2, 3, 4 and 5**.

A **clear Monitoring Plan** as required by Section 7, including quality assurance and quality control (QA/QC) procedures, covering at a minimum all the parameters listed as necessary for Validation in Annex 7, plus any others that are found to be essential.

Prospects of Project success

An assessment, using documented assumptions, of whether the **applicability conditions** and **ecological integrity criteria** were likely to have been met at the time of any past Monitoring Event and are feasible to meet at the next Monitoring Event.

An **evidence-based projection of the expected benefits** of the Project, consistent with the approach set out in Section 6, which shows that it is likely, conditional on securing sufficient finance, that the Project will achieve results in the following categories:

- **Expected number of HIFOR units** that will be generated. See Section 6.1 for guidance on acceptable methods.
- **Expected number of Reported Net CO_2 Removals** that will be generated. See Section 6.2 for guidance on acceptable methods.
- **The feasibility of delivering one or more substantive, equitably distributed social benefits** and avoiding/ managing negative impacts (see Section 6.3 for guidance) and meeting all safeguards.

These projections are required for any past Monitoring Event after the first, and for the next expected Monitoring Event.

Other elements

Any other content specified in the official template.

Annex 6 Content of the Project Performance Report

The Project Performance Report will demonstrate the Project's continued compliance with applicability and other conditions, demonstrate that social benefits have been achieved and appropriately distributed, and accurately quantify environmental performance in terms of the generation of HIFOR units and associated net carbon removal.

The most recent version of the official template for the Project Performance Report shall be used, to help ensure that all necessary content is provided.

The following content is mandatory:

Evidence of Project success

An updated description, with references to supporting evidence where necessary, of **whether the project has delivered the implementation strategy set out in the Project Description Document and thereby met the requirements set out in Sections 2, 3, 4 and 5 and Annex 1**.

A thorough description of:

- The number of HIFOR units that are reported for the Monitoring Period and the underlying calculations and evidence. See Section 6.1 for guidance on acceptable methods.
- The number of Reported Net CO_2 Removals for the Monitoring Period and the underlying calculations and evidence. See Section 6.2 for guidance on acceptable methods.
- One or more substantive, equitably distributed social benefits delivered by the project over the Monitoring Period, including through Project activities and the benefit-share system, together with the underlying calculations and evidence, as well as evidence that negative impacts have been effectively avoided and managed, as described in Section 6.3.

Updates to Project design

A reassessment of all key design elements of the project, including but not limited to the Implementation Strategy and Monitoring Plan, with any necessary changes documented.

Prospects of future Project success

An assessment, using documented assumptions, of whether the **applicability conditions and ecological integrity criteria** are feasible to meet at the next Monitoring Event

An **evidence-based projection of the expected benefits** of the Project, consistent with the approach set out in Section 6, which shows that it is likely, conditional on securing sufficient finance, that the Project will achieve results in the following categories over the next Monitoring Period:

- **Expected number of HIFOR units** that will be generated. See Section 6.1 for guidance on acceptable methods.
- **Expected number of Reported Net CO_2 Removals** that will be generated. See Section 6.2 for guidance on acceptable methods.
- **The feasibility of delivering one or more substantive, equitably distributed social benefits** and avoiding/managing negative impacts (see Section 6.3 for guidance) and meeting all safeguards.

Other

Any other content specified in the official template.

Annex 7 Selected variables available or estimated at Validation and/or Verification

Lists are given separately for the main text and (in grey) items relating to Annex 2. Each list is in alphabetical order. Variables which specify the position of an item in a counted sequence, or the total number of items in a sequence, or are physical constants, are deemed self-explanatory and not listed here.

List 1 - Items relating to the main text

Variable/parameter	$EHIF_{tx}$ Total Extent of High Integrity Forest in the HAA at the time of Monitoring Event t_x
Unit	ha
Description	Specifies the area of forest in the HAA that exceeds the threshold score for high integrity at the time of a given Monitoring Event t_x (x=0, 1, 2…,n).
Used in equations	-
Source	Calculated by the Project Proponent using the global FLII data product for the relevant year, according to the guidance in Section 4.
Value	As determined by calculation.
Purpose	Used to calculated $PHIF_{tx}$
Notes	The threshold for high integrity is a FLII of ≥9.6 at the pixel level.

Variable/parameter	$ELIF_{tx}$ Total Extent of Low Integrity Forest in the HAA at the time of Monitoring Event t_x
Unit	ha
Description	Specifies the area of forest in the HAA that is below the threshold score for low integrity at the time of a given Monitoring Event t_x (x=0, 1, 2…,n).
Used in equations	-
Source	Calculated by the Project Proponent using the global FLII data product for the relevant year, according to the guidance in Section 4.
Value	As determined by calculation.
Purpose	Used to calculate $PLIF_{tx}$
Notes	The threshold for low integrity is a FLII of ≤6.0 at the pixel level.

Variable/parameter	$HIFORP_{txtx+1}$ Projected number of HIFOR units that will be generated in a given Monitoring Period t_xt_{x+1}
	Dimensionless

Description	Projected number of HIFOR units that will be generated for a given period, equivalent to the number of hectares expected to be maintained with high integrity.
Used in equations	-
Source	Calculated by the Project Proponent using methods set out in Section 6.1.
Value	As determined by calculation.
Purpose	Demonstrate to all stakeholders that Project is credibly expected to continue generating HIFOR s.
Notes	

Variable/parameter	$HIFORU_{tx-1tx}$ Number of HIFOR units that can be issued for Monitoring Period $t_{x-1}t_x$
Unit	Dimensionless
Description	Number of HIFOR units that can be issued for a given period, equivalent to the number of hectares that have been maintained with high integrity.
Used in equations	Eqn 1
Source	Calculated by the Project Proponent.
Value	As determined by calculation.
Purpose	Key measure of performance of the Project over a decadal timespan.
Notes	

Variable/parameter	$MADHIF_{tx-1tx}$ Mean annual net rate of decline in high integrity forest across the Monitoring Period $t_{x-1}t_x$
Unit	$\%yr^{-1}$
Description	The rate of decline in extent of high integrity forest, calculated using a simple average.
Used in equations	-
Source	The net loss of high integrity forest over the Monitoring Period is $EHIF_{tx-1}$ minus $EHIF_{tx}$. The percentage change is calculated as 100 times this value divided by $EHIF_{tx-1}$ and this is converted to an annual rate by dividing by the number of years in the Monitoring Period.
Value	As determined by calculation.
Purpose	Used at Verification in Ecological Integrity Criterion 6.
Notes	

Variable/parameter	$MANPD_{tx-1tx}$ Mean annual net permanent deforestation rate across the Monitoring Period $t_{x-1}t_x$
Unit	$\%yr^{-1}$
Description	The rate of decline in total forest extent, calculated using a simple average.

Used in equations	-
Source	The net permanent deforestation over the Monitoring Period is TFE_{tx-1} minus TFE_{tx}. The percentage change is calculated as 100 times this value divided by TFE_{tx-1} and this is converted to an annual rate by dividing by the number of years in the Monitoring Period.
Value	As determined by calculation.
Purpose	Used at Verification in Ecological Integrity Criterion 5.
Notes	

Variable/parameter	$PANFE_{tx}$ Proportion of Anthropogenic Non-forest in the HAA at the time of Monitoring Event t_x
Unit	%
Description	The proportion of the HAA classified as anthropogenic non-forest at the time of a given Monitoring Event t_x (x=0, 1, 2…,n), excluding any areas of natural non-forest.
Used in equations	-
Source	This variable is calculated as the extent of anthropogenic non-forest divided by the extent of the HAA **minus** any natural non-forest, i.e. $TANFE_{tx}$ / (TA_{tx} minus $TNNFE_{tx}$)
Value	As determined by calculation.
Purpose	Used in Ecological Integrity test 4.
Notes	

Variable/parameter	$PHIF_{tx}$ Proportion of Forest in the HAA that has High Integrity at the time of Monitoring Event t_x
Unit	%
Description	Specifies the proportion of forest in the HAA that exceeds the threshold score for high integrity at the time of a given Monitoring Event t_x (x=0, 1, 2…,n).
Used in equations	-
Source	Calculated as $EHIF_{tx}$ divided by TFE_{tx}
Value	As determined by calculation.
Purpose	Used in Ecological Integrity tests 2 and 6.
Notes	The threshold for high integrity is a FLII of ≥9.6 at the pixel level.

Variable/parameter	$PLIF_{tx}$ Proportion of Forest in the HAA that has Low Integrity at the time of Monitoring Event t_x
Unit	%
Description	Specifies the proportion of forest in the HAA that is below the threshold score for low integrity at the time of a given Monitoring Event t_x (x=0, 1, 2…,n).
Used in equations	-

Source	Calculated as $ELIF_{tx}$ divided by TFE_{tx}
Value	As determined by calculation.
Purpose	Used in Ecological Integrity test 3.
Notes	The threshold for low integrity is a FLII of ≤6.0 at the pixel level.

Variable/parameter	PNR_{txtx+1} Projected net CO_2 removals for Monitoring Period t_xt_{x+1}
Unit	tCO_2
Description	Conservative projection of the net CO_2 removal service that will be performed by the forests of the HAA (or the whole HAA, at the choice of the Proponent) during a given Monitoring Period, allowing for statistical uncertainty and any fluctuations during earlier periods.
Used in equations	-
Source	Calculated by the Proponent using method A, B or C, section 6.2, as appropriate.
Value	As determined by calculation.
Purpose	Demonstrate to all stakeholders that the Project is credibly expected to continue delivering reportable net CO_2 removals.
Notes	

Variable/parameter	RNR_{tx-1tx} Reported net CO_2 removals for Monitoring Period $t_{x-1}t_x$
Unit	tCO_2
Description	Conservative estimate of the net CO_2 removal service performed by the forests of the HAA (or the whole HAA, at the choice of the Proponent) during a given Monitoring Period, allowing for statistical uncertainty and any fluctuations during earlier periods.
Used in equations	Eqn 10 (Annex 2).
Source	Calculated by the Proponent using the methodology set out in Annex 2.
Value	As determined by calculation.
Purpose	The key measure of project performance in relation to climate regulation, see Section 6.2.
Notes	

Variable/parameter	TA_{tx} Total Area of HAA at Monitoring Event t_x
Unit	ha
Description	The HAA is made up of one or more Management Units. This variable is the sum of the areas of all the individual Management Units at the time of a given Monitoring Event t_x (x=0, 1, 2…,n).
Used in equations	-
Source	Calculated by the Project Proponent.

Value	As determined by calculation.
Purpose	Used in Applicability Condition 1 and Ecological Integrity criterion 4.
Notes	

Variable/parameter	$TANFE_{tx}$ Total Anthropogenic Non-forest Extent in the HAA at the time of Monitoring Event t_x
Unit	ha
Description	The extent of ecosystems classified as anthropogenic (as opposed to natural) within the part of the HAA defined as non-forest at the time of a given Monitoring Event t_x (x=0, 1, 2…,n).
Used in equations	-
Source	The polygon/s which contribute to the area $TNFE_{tx}$ must be analyzed to determine which part of it is covered by areas classified as anthropogenic ecosystems, using a land cover dataset that meets the requirements listed in Section 4.
Value	As determined by calculation.
Purpose	Used to calculate $PANFE_{tx}$
Notes	

Variable/parameter	TFE_{tx} Total Forest Extent in the HAA at the time of Monitoring Event t_x
Unit	ha
Description	This variable specifies the area of forest in the HAA at the time of a given Monitoring Event t_x (x=0, 1, 2…,n), as identified using the FLII.
Used in equations	-
Source	Calculated by the Project Proponent using the extent of forest indicated by the FLII for the relevant year, according to the guidance in Section 4.
Value	As determined by calculation.
Purpose	Used directly or indirectly in Ecological Integrity Criteria 1-3 and 5.
Notes	The use of other datasets to calculate this variable is not permitted, but they may be used for the more fine-scale calculations set out in Annex 2, and for the ecological descriptions required for the Situation Analysis.

Variable/parameter	TG_{tx} Total Area of Geographic Scope at Monitoring Event t_x
Unit	ha
Description	The total area of the Geographic Scope relating to all Management Units in the project at the time of a given Monitoring Event t_x (x=0, 1, 2…,n).

Used in equations	-
Source	Calculated by the Project Proponent.
Value	As determined by calculation.
Purpose	Provides descriptive information about the Project.
Notes	

Variable/parameter	$TNFE_{tx}$ Total Non-forest Extent in the HAA at the time of Monitoring Event t_x
Unit	ha
Description	Specifies the extent of the HAA that is not classified as forest at the time of a given Monitoring Event t_x (x=0, 1, 2…,n), as identified using the FLII.
Used in equations	-
Source	Calculated as TA_{tx} minus TFE_{tx}
Value	As determined by calculation.
Purpose	Used to calculate $TNNFE_{tx}$ and $TANFE_{tx}$
Notes	The area of non-forest for the purpose of the Ecological Integrity tests is all areas of the HAA that are not classified as forest.

Variable/parameter	$TNNFE_{tx}$ Total Natural Non-forest Extent in the HAA at the time of Monitoring Event t_x
Unit	ha
Description	The extent of ecosystems deemed to be natural (as opposed to anthropogenic) within the part of the HAA defined as non-forest at the time of a given Monitoring Event t_x (x=0, 1, 2…,n).
Used in equations	-
Source	The non-forest areas within the HAA that have not been positively identified as anthropogenic are assumed to be natural. Hence this variable is calculated as $TNFE_{tx}$ minus $TANFE_{tx}$.
Value	As determined by calculation.
Purpose	Used to calculate $PANFE_{tx}$
Notes	Examples include water, rock, ice, desert, open wetlands, grasslands, heathlands, and other natural non-forest vegetation; these are not indicative of either deforestation or lost integrity.

Variable/parameter	TZ_{tx} Total Area of HBZ at Monitoring Event t_x
Unit	ha
Description	The total area of the HBZ relating to all Management Units in the project at the time of a given Monitoring Event t_x (x=0, 1, 2…,n).

Used in equations	-
Source	Calculated by the Project Proponent.
Value	As determined by calculation.
Purpose	Provides descriptive information about the Project.
Notes	

List 2 - Items relating to Annex 2

Variable/parameter	$AGB_{tx,p,m}$ Aboveground biomass of pixel p in the HAA at Monitoring Event t_x for a given modelled map m.
Unit	tDM (dry matter)
Description	Pixel-specific aboveground biomass estimated for a specific time point in one of an ample of partially randomized map products, the 'D-maps set'.
Used in equations	Eqn 2 and others
Source	Calculated by the Proponent following the methods in Annex 2 Section A1.
Value	As determined by calculation.
Purpose	The map products are designed to provide a bottom-up estimate of overall carbon stocks with a credible estimate of uncertainty.
Notes	

Variable/parameter	A_p Area of pixel p in the HAA
Unit	ha
Description	Area of a specified pixel, calculated using an equal area projection.
Used in equations	Eqn 2 and others.
Source	Calculated by the Proponent following the methods in Annex 2 Section A1.
Value	As determined by calculation.
Purpose	
Notes	

Variable/parameter	$BGB_{tx,p,m}$ Belowground biomass of pixel p in the HAA at Monitoring Event t_x for a given modelled map m.
Unit	tDM (dry matter)
Description	Pixel-specific belowground biomass estimated for a specific time point in one of a sample of partially randomized map products (the 'D-maps set').
Used in equations	Eqn 2 and others

Source	Calculated by the Proponent following the methods in Annex 2 Section A1.
Value	As determined by calculation.
Purpose	The map products are designed to provide a bottom-up estimate of overall carbon stocks with a credible estimate of uncertainty.
Notes	

Variable/parameter	CNR_{tx-1tx} Conservative estimate of net carbon removals in the Monitoring Period $t_{x-1}t_x$.
Unit	tC
Description	Very similar to $\Delta S_{HAA,lower,\ tx-1tx}$ but with an additional test to avoid cases where removals could be estimated to have occurred despite the median estimate decreasing.
Used in equations	Eqn 9
Source	Calculated by the Proponent following the methods in Annex 2 Section A2.
Value	As determined by calculation.
Purpose	Key figure in estimating the change in carbon stocks over time.
Notes	

Variable/parameter	$D_{tx,p,lower}$ Lower bound of the confidence interval for the variable $D_{tx,p,m}$
Unit	$tC\ ha^{-1}$
Description	Lower bound (95% range) of pixel-specific biomass carbon density estimated for a specific time point across a sample of partially randomized map products.
Used in equations	Eqn 3b
Source	Calculated by the Proponent following the methods in Annex 2 Section A1.
Value	As determined by calculation.
Purpose	The confidence range for carbon estimates for each time point is a useful interim figure in estimating the confidence interval for the change over time.
Notes	

Variable/parameter	$D_{tx,p,m}$ Carbon density of pixel p in the HAA at Monitoring Event t_x for a given modelled map m.
Unit	$tC\ ha^{-1}$
Description	Pixel-specific biomass carbon density estimated for a specific time point in one of a sample of partially randomized map products (the 'D-maps set').
Used in equations	Eqn 2 and others

Source	Calculated by the Proponent following the methods in Annex 2 Section A1.
Value	As determined by calculation.
Purpose	The map products are designed to provide a bottom-up estimate of overall carbon stocks with a credible estimate of uncertainty.
Notes	

Variable/parameter	$D_{tx,p,median}$ Median of the confidence interval for the variable $D_{tx,p,m}$
Unit	$tC\ ha^{-1}$
Description	Median of pixel-specific biomass carbon density estimated for a specific time point across a sample of partially randomized map products.
Used in equations	Eqn 3a
Source	Calculated by the Proponent following the methods in Annex 2 Section A1.
Value	As determined by calculation.
Purpose	The confidence range for carbon estimates for each time point is a useful interim figure in estimating the confidence interval for the change over time.
Notes	

Variable/parameter	$D_{tx,p,upper}$ Upper bound of the confidence interval for the variable $D_{tx,p,m}$
Unit	$tC\ ha^{-1}$
Description	Upper bound (95% range) of pixel-specific biomass carbon density estimated for a specific time point across a sample of partially randomized map products.
Used in equations	Eqn 3c
Source	Calculated by the Proponent following the methods in Annex 2 Section A1.
Value	As determined by calculation.
Purpose	A useful interim figure in estimating the confidence interval for the change over time.
Notes	

Variable/parameter	RNR_{tx-1tx} Reported net CO_2 removals for Monitoring Period $t_{x-1}t_x$
Unit	tCO_2
Description	Conservative estimate of the net CO_2 removal service performed by the forests of the HAA (or the whole HAA, at the choice of the Proponent) during a given Monitoring Period, allowing for statistical uncertainty and any fluctuations during earlier periods. Represents the variable CNR_{tx-1tx} converted from tC to tCO_2.
Used in equations	Eqn 10.

Source	Calculated by the Proponent using the methodology set out in Annex 2.
Value	As determined by calculation.
Purpose	The key measure of project performance in relation to climate regulation, see Section 6.2.
Notes	

Variable/parameter	$S_{HAA,tx,lower}$ Lower bound of the confidence interval for the variable $S_{HAA,tx,m}$
Unit	tC
Description	Lower bound (95% range) of total carbon stock in the HAA, estimated for a specific time point across a sample of partially randomized map products.
Used in equations	-
Source	Calculated by the Proponent following the methods in Annex 2 Section A1.3.
Value	As determined by calculation.
Purpose	The variable is a useful interim figure in estimating the confidence interval for the change over time.
Notes	

Variable/parameter	$S_{HAA,tx,m}$ Carbon stock of the HAA at Monitoring Event t_x for a given modelled map m.
Unit	tC
Description	Sum across the HAA of pixel-specific biomass carbon stock estimates for a specific time point for a given map from the sample of partially randomized map products (the 'D-maps set').
Used in equations	Eqn 4
Source	Calculated by the Proponent following the methods in Annex 2 Section A1.
Value	As determined by calculation.
Purpose	A useful interim figure in estimating the confidence interval for the change over time.
Notes	

Variable/parameter	$S_{HAA, tx,median}$ Median of the confidence interval for the variable $S_{HAA,tx,m}$
Unit	tC
Description	Median estimate of the total carbon stock for the HAA for a specific time point across a sample of partially randomized map products.
Used in equations	-
Source	Calculated by the Proponent following the methods in Annex 2 Section A1.3.

Value	As determined by calculation.
Purpose	The variable is a useful interim figure in estimating the confidence interval for the change over time.
Notes	

Variable/parameter	$S_{HAA,tx,upper}$ Upper bound of the confidence interval for the variable $S_{HAA,tx,p,m}$
Unit	tC
Description	Upper bound (95% range) of the total carbon stock for the HAA for a specific time point across a sample of partially randomized map products.
Used in equations	-
Source	Calculated by the Proponent following the methods in Annex 2 Section A1.3.
Value	As determined by calculation.
Purpose	A useful interim figure in estimating the confidence interval for the change over time.
Notes	

Variable/parameter	$\Delta D_{totx,p,m}$ Change in carbon density between the Monitoring Events t_0 and t_x for a given pixel in a given modelled map m.
Unit	tC ha^{-1}
Description	The change in the carbon density of a given pixel from the project start date to a given time point, for a given map from the sample of partially randomized map products.
Used in equations	Eqn 5.
Source	Calculated by the Proponent following the methods in Annex 2 Section A2.
Value	As determined by calculation.
Purpose	A useful interim figure in estimating the confidence interval for the change over time.
Notes	

Variable/parameter	$\Delta S_{HAA,tx-1tx, lower}$ Conservative estimate of change in carbon stock of the HAA in the Monitoring Period $t_{x-1}t_x$.
Unit	tC
Description	Conservative estimate of change in carbon stock across the Monitoring Period comparing (i) change from Project Start Date to start of Monitoring Period and (ii) change from Project Start Date to end of Monitoring Period.
Used in equations	Eqn 8

Source	Calculated by the Proponent following the methods in Annex 2 Section A2.
Value	As determined by calculation.
Purpose	A useful interim figure in estimating the confidence interval for the change over time.
Notes	

Variable/parameter	$\Delta S_{HAA,t0tx,lower}$ Lower bound of the confidence interval for the variable $\Delta S_{HAA,t0tx,m}$
Unit	tC
Description	Lower bound, at the 95% confidence level, across a sample of partially randomized map products, of the estimated total change in carbon stock over a specific time period.
Used in equations	Eqn 7b
Source	Calculated by the Proponent following the methods in Annex 2 Section A2.
Value	As determined by calculation.
Purpose	A useful interim figure in estimating the confidence interval for the change in stocks over time.
Notes	

Variable/parameter	$\Delta S_{HAA,t0tx,m}$ Total change in carbon stock of the HAA between the Monitoring Events t_0 and t_x in a given modelled map m.
Unit	tC
Description	The sum of the changes in carbon stock across all pixels from the project start date to a given time point for a given map from the sample of partially randomized map products.
Used in equations	Eqn 6
Source	Calculated by the Proponent following the methods in Annex 2 Section A2.
Value	As determined by calculation.
Purpose	A useful interim figure in estimating the confidence interval for the change over time.
Notes	

Variable/parameter	$\Delta S_{HAA,t0tx,median}$ Median of the confidence interval for the variable $\Delta S_{HAA,t0tx,m}$
Unit	tC
Description	Median, across a sample of partially randomized map products, of the estimated total change in carbon stock over a specific time period.
Used in equations	Eqn 7a
Source	Calculated by the Proponent following the methods in Annex 2 Section A2.
Value	As determined by calculation.

Purpose	A useful interim figure in estimating the confidence interval for the change in stock over time.
Notes	

Variable/parameter	$\Delta S_{HAA,t0tx,upper}$ Upper bound of the confidence interval for the variable $\Delta S_{HAA,t0tx,m}$
Unit	tC
Description	Upper bound, at the 95% confidence level, across a sample of partially randomized map products, of the estimated total change in carbon stock over a specific time period.
Used in equations	Eqn 7c
Source	Calculated by the Proponent following the methods in Annex 2 Section A2.
Value	As determined by calculation.
Purpose	A useful interim figure in estimating the confidence interval for the change in stock over time.
Notes	

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For further information contact Dr. Tom Evans tevans@wcs.org

For HIFOR system documents see https://www.wcs.org/our-work/forests-and-climate-change/hifor