# I. INTRODUCTION AND HOW TO USE THIS METHODOLOGY

## 1.1 Purpose

This document serves as a technical guide for project proponents participating in the Malaysia Forest Carbon Offset (FCO) program. It provides a structured framework for quantifying and implementing projects that aim to remove, reduce or avoid Greenhouse Gas (GHG) emissions

This FCO Methodology support a range of project types. It enables project proponents to:

a. Assess project eligibility
b. Define project boundary
c. Establish baseline scenarios
d. Quantify GHG reductions, and
e. Monitor project performances.

This FCO Methodology is designed to be adaptable and can be used in conjunction with other FCO methodologies depending on project-specific needs.

Project proponents may reference the Theory of Change framework, which maps how interventions are expected to deliver emission reductions and co-benefits by identifying causal pathways, assumptions, and risks[1] to inform project design. Proponents may refer to *Theory of Change UNDAF Companion Guidance* by United Nations Development Group or other relevant frameworks developed by intergovernmental organisations, NGOs and NPOs, or jurisdictional authorities to guide the development of a project-specific Theory of Change.

## 1.2 Core FCO Methodologies

The FCO program currently supports four key FCO Methodologies which is as illustrated in Annex 1:

a. **Afforestation, Reforestation, and Restoration (ARR):** Focuses on forest establishment or restoration on degraded lands to boost carbon sequestration.
b. **Improved Forest Management (IFM):** Enhances carbon stocks in production forests through sustainable practices like reduced impact logging and longer rotation cycles.
c. **Reducing Emissions from Deforestation and Degradation (REDD):** Aims to prevent deforestation and degradation in all forest types
d. **Wetland Ecosystems (WE):** Activities on wetland ecosystems including restoration, vegetation establishment, deforestation and degradation prevention as well as rewetting.

Additional Methodologies may be incorporated in the future.

## 1.3 How to Use this Methodology

This FCO Methodology guides Project Proponents to assess and implement activities under the FCO framework. The process begins with a spatial and historical assessment of the land:

a. **Current Land Assessment:** Evaluate the present condition of the land using maps and satellite imagery.
b. **Historical Land Use:** Determine the land's previous state to establish a baseline.

[1] Theory of Change UNDAF Companion Guidance, United Nations Development Group, 2017

c. **Condition Classification:** Compare current and historical states to classify the land as either intact or disturbed.

Based on this classification, Project Proponents can identify suitable intervention types:

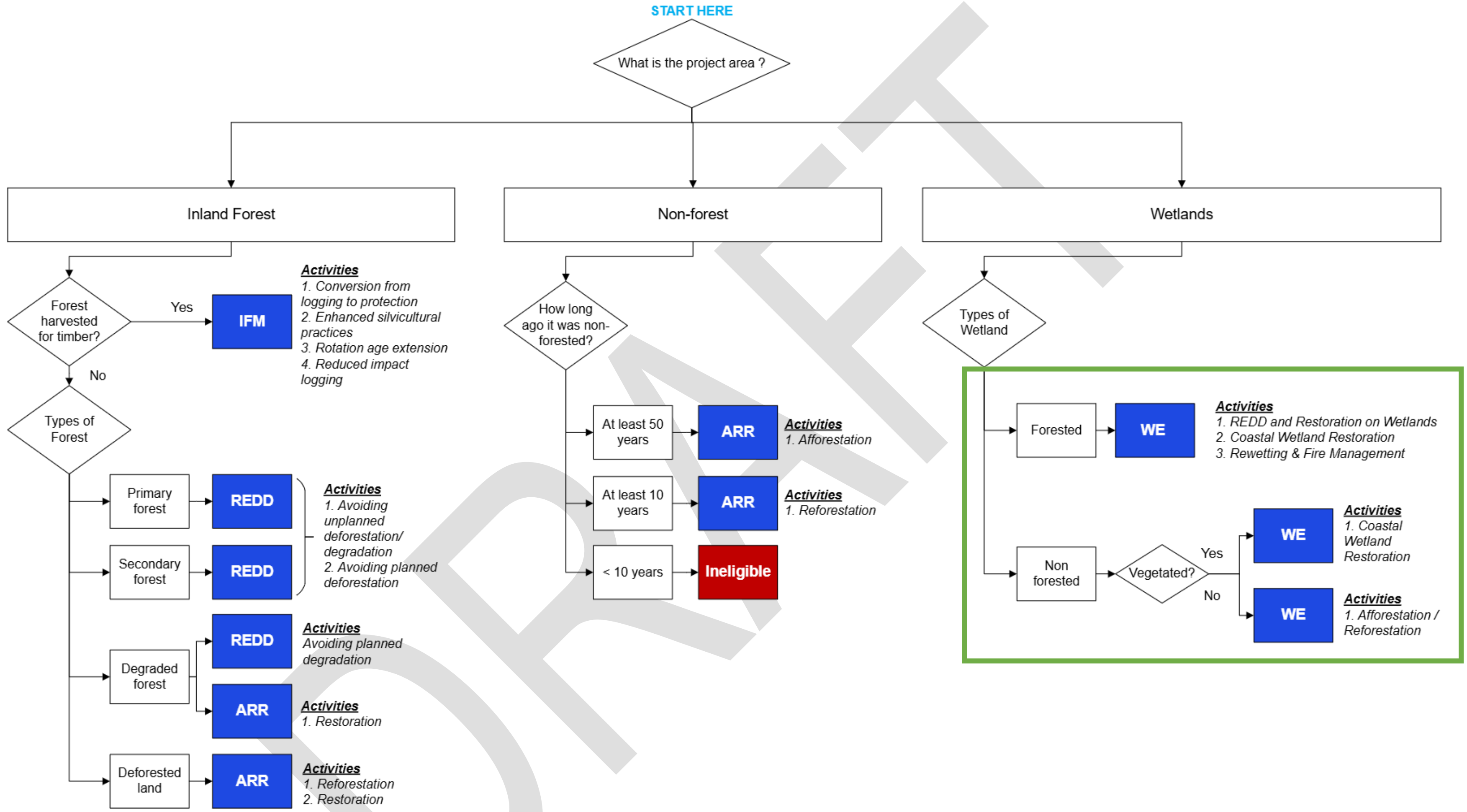
a. **GHG Avoidance Activities:** Actions that prevent emissions from occurring, such as avoiding planned or unplanned deforestation.
b. **GHG Reduction or Removal Activities:** Interventions that actively reduce or sequester emissions, tailored to forest lands, wetlands, or production forests.

1.4 Focus of this FCO Methodology Document

This document specifically focuses on the **Wetland Ecosystems: Coastal Wetland Restoration Methodology**. It should be used in conjunction with the overarching FCO Program Guidelines, Subsidiary Guidelines, and standardised FCO Tools. These resources collectively ensure that project design, monitoring, and reporting are accurate, consistent, and aligned with program requirements.

Project proponents may reference relevant sources such as national strategies, sectoral reports, or frameworks developed by international organisations, NGOs and NPOs, or jurisdictional authorities, such as *Wetland Restoration: Contemporary Issues & Lessons Learned* by the National Association of Wetland Managers, when identifying anticipated implementation challenges, including data limitations, technical constraints, and other contextual factors.

*Figure 1: Overall Flowchart for Methodologies under FCO*




The eligibility flowchart for WE activities is detailed in the following section.

## II. ELIGIBILITY FLOWCHART

This flowchart guides project proponents in determining whether a proposed project area qualifies for WE activities under the FCO program. It outlines the step-by-step decision process based on land type, forest condition, and ecosystem classification.

The Wetland Ecosystems methodology comprise four ("4") modules – Afforestation/Reforestation, REDD and Restoration on Wetlands, Coastal Wetland Restoration, as well as Rewetting and Fire Management. Figure 2 in the following page summarises the ecosystems applicable to each module.

Module 3: Coastal Wetland Restoration applies to project areas that are currently:

- Degraded seagrass meadows and salt marshes, classified as non-forested wetlands; and
- Degraded mangrove and nipa swamps, classified as forested wetlands.

Module 3: Coastal Wetland Restoration may be applied independently with the applicable project areas outlined above or in combination with Module 2: REDD and Restoration on Wetlands, when degraded mangrove or nipa areas face a risk of canopy loss, in line with the REDD+ concept. Table 1**Error! Reference source not found.** below provides a summary of applicable ecosystems, conditions, and activities under each module and their combined application.

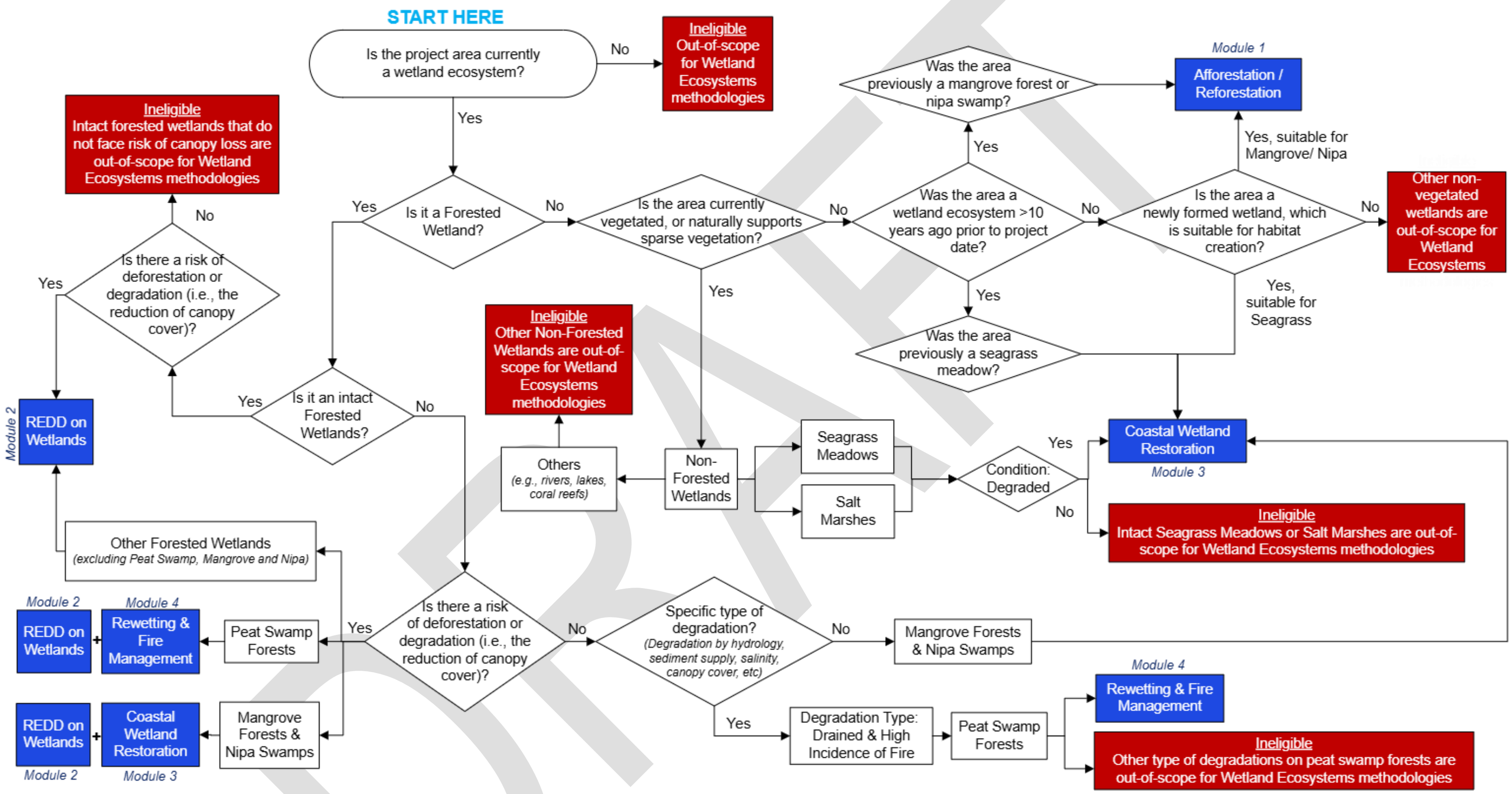
*Table 1: Overview of Eligible Ecosystems, Conditions, and Activities Across Modules*

| | Single Modules | | | Combined Application | |
|---|---|---|---|---|---|
| | **REDD & Restoration on Wetlands (REDD-W)** | **Coastal Wetland Restoration (CWR)** | **Rewetting & Fire Management (R&FM)** | **REDD-W + CWR** | **REDD-W + R&FM** |
| **Wetland Ecosystems** | • Mangrove Forests<br>• Nipa Swamps<br>• Peat Swamp Forests<br>• Freshwater Swamps | • Mangrove Forests<br>• Nipa Swamps<br>• Salt Marsh<br>• Seagrass Meadows | Peat Swamp Forests | • Mangrove Forests<br>• Nipa Swamps | Peat Swamp Forests |
| **Condition** | Land must have been a **forest** for at least 10 years prior that **faces the risk of canopy loss** | **Degraded**: Area experiencing direct human-induced declining forest values | **Drained:** Area with lowered water tables, drier vegetation, and aerobic peat decomposition, increasing fire risk and $CO_2$ emissions. | Land must have been a **forest** for at least 10 years prior, that faces the **risk of canopy loss** and is **currently degraded** | Land must have been a **forest** for at least 10 years prior, that faces the **risk of canopy loss** and is **currently drained** |

| | Single Modules | | | Combined Application | |
|---|---|---|---|---|---|
| | **REDD & Restoration on Wetlands (REDD-W)** | **Coastal Wetland Restoration (CWR)** | **Rewetting & Fire Management (R&FM)** | **REDD-W + CWR** | **REDD-W + R&FM** |
| **Activity** | 1. Avoiding Planned Deforestation; or<br>2. Avoiding Unplanned Deforestation/ Degradation | Restoration activities, that re-establishes or improves:<br>• Hydrological conditions<br>• Sediment supply<br>• Salinity<br>• Water quality<br>• Vegetation | Rewetting activities | 1. Avoiding Planned Deforestation; **or**<br>2. Avoiding Unplanned Deforestation/ Degradation<br>**and**<br>3. Restoration activities | 1. Avoiding Planned Deforestation; **or**<br>2. Avoiding Unplanned Deforestation/ Degradation<br>**and**<br>3. Rewetting activities |

*Figure 2: Eligibility Flowchart for Wetland Ecosystems modules*

**Note:** For project areas that are part of a larger forest or wetland complex, only clearly delineated sub-areas that meet eligibility conditions (e.g., degraded, non-vegetated, or at risk of deforestation) may be included. These must be supported with spatial evidence and should be implemented under an appropriate project modality (e.g. JPoA or GP).



## III. SUMMARY DESCRIPTION

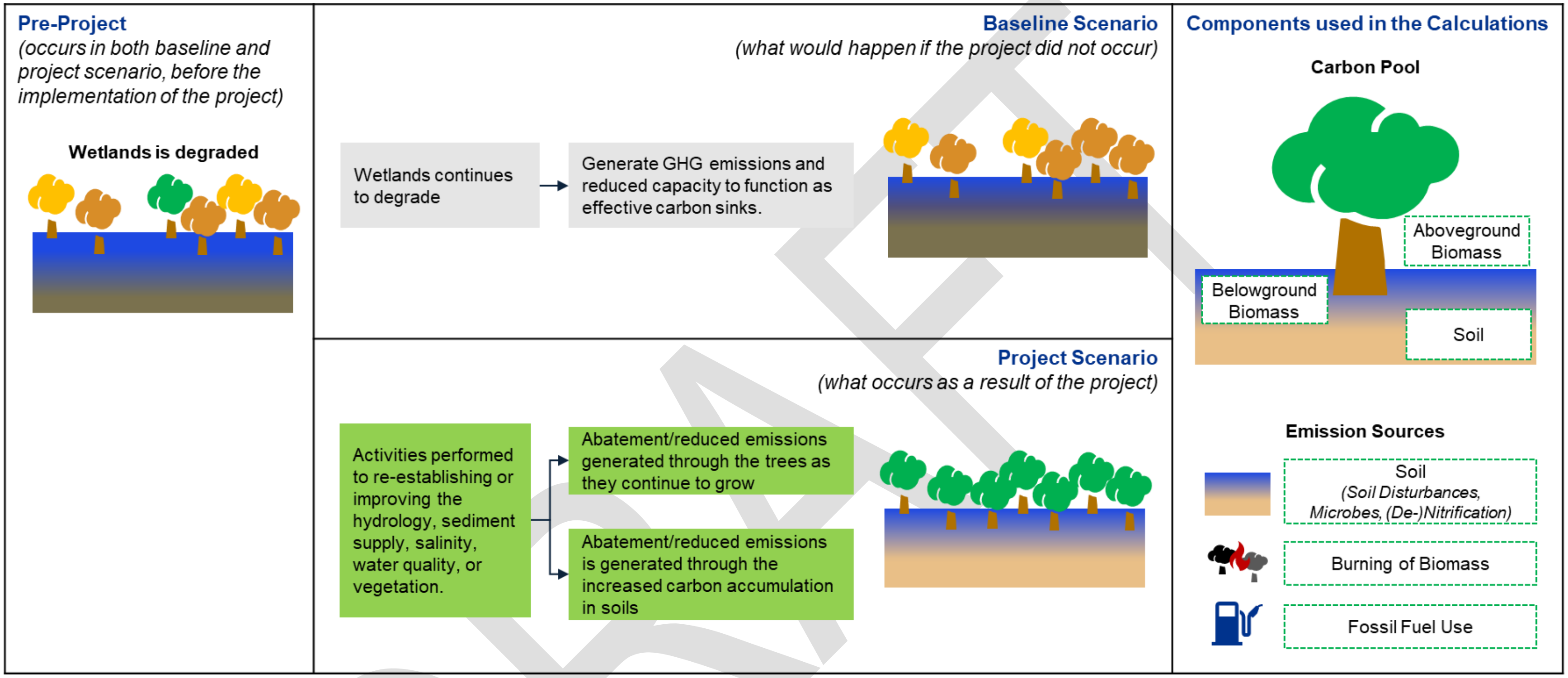
This methodology establishes a framework for quantifying carbon sequestrated, or GHG emission reductions and removals, from wetland ecosystems that are applicable for WE project activities in Malaysia. It encompasses an overview of the types of GHG emissions mitigation actions, guidance on when to apply the methodology, the applicable ecosystem, and an outline of the pre-project, baseline scenario, and project scenario considerations, as detailed below.

| | |
|---|---|
| **Type of GHG Emissions Mitigation Action**<br>*Refers to how the project reduces GHG emissions* | GHG emission reductions and removals generated from restoration activities, that re-establishes or improves:<br>• Hydrological conditions/rewetting activities *(e.g., activities that reverse drainage and/or remove obstructions to the hydrologic flow[2])*<br>• Sediment supply *(e.g., remove upper layer of upland soil or dredge material, raise soil elevation and grading the site[3])*<br>• Salinity<br>• Water quality<br>• Vegetation *(e.g., direct seeding and planting[4])* |
| **Applicable Ecosystem**<br>*Identifies the type of environment where the project can be implemented* | The applicable coastal wetlands in this methodology are **mangrove, nipa swamps, seagrass meadows and salt marshes**.<br>*When the term "coastal wetlands" is used in this document, it will be referring to the outlined four (4) applicable types of wetlands.* |
| **Pre-Project**<br>*Refers to the state of the land and forest prior to the start of the FCO project* | **Degraded coastal wetlands**: Coastal wetlands experiencing direct human-induced declining forest values – reductions in canopy cover[5], altered hydrological conditions, disrupted sediment supply, changes in salinity characteristics, degraded water quality and/or loss of native plant communities |
| **Baseline Scenario**<br>*Represents the "business-as-usual" projection on what would happen to the forest and its carbon stocks in the absence of the project* | Coastal wetlands continue to degrade, generating GHG emissions and a reduced capacity to function as effective carbon sinks. |
| **Project Scenario**<br>*Describes the proposed interventions to-be implemented under the FCO project to prevent or reduce GHG emissions* | Restoration activities are performed, resulting in the generation of GHG emissions reduction and removals from increase in biomass and soil organic carbon stock as well as changes in wetland conditions. |

Figure 3 in the following page illustrates the pre-project, baseline and project scenario as well as the relevant carbon pools and GHG emission sources for this methodology.

[2] *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, IPCC, 2013*
[3] *Ibid*
[4] *Ibid*
[5] *Data Hutan Malaysia: Definisi / Terminologi Utama Sektor Perhutanan Malaysia, NRES*

*Figure 3: Framework: Activity Conditions, Scenarios, and Carbon Accounting Components*



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## VII. MODULES & TOOLS

This methodology uses the following modules and tools:

- FCO Tool: Baseline Determination and Additionality Assessment
- FCO Tool: GHG Quantification Equations
- FCO Tool: Buffer Risk Assessment
- FCO Tool: Allometric Equations Guidance

## VIII. LIST OF ABBREVIATIONS

| Abbreviations | Definition |
|---|---|
| **ARR** | Afforestation, Reforestation and Restoration |
| **FCO** | Forest Carbon Offset |
| **FCU** | Forest Carbon Units |
| **GHG** | Greenhouse gas emissions |
| **GIS** | Geographic Information System |
| **IFM** | Improved Forest Management |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **PDT** | Peat depletion time |
| **REDD** | Reducing Emissions from Deforestation and Degradation |
| **SDT** | Soil organic carbon depletion time |
| **SOC** | Soil organic carbon |
| **WE** | Wetland Ecosystems |

## 1 Definitions

| Terms | Definition |
|---|---|
| **Degraded Costal Wetland** | **Degraded coastal wetlands**: Coastal wetlands experiencing direct human-induced declining forest values – reductions in canopy cover[6], altered hydrological conditions, disrupted sediment supply, changes in salinity characteristics, degraded water quality and/or loss of native plant communities |
| **Hydrologic Connectivity** | Water-mediated transfer of matter, energy and/or organisms within or between elements of the hydrologic cycle[7] |
| **Mangrove** | An association of halophytic trees, shrubs, and other plants growing in brackish to saline tidal waters of tropical and sub-tropical coastlines.[8] |
| **Mineral Soil** | Soils that do not fall within the definition of organic soil[9]. |
| **Nipa Swamps** | Tidal, monospecific stands of the Nipa Palm (*Nypa fruticans*). Nipa occurs in association with mangroves and extent further into brackish water, often lining the tidal reaches of rivers and forming huge swamp in delta areas[10]. |
| **Organic Soil** | Soils are identified based on criteria 1 and 2, or 1 and 3[11]:<br>1) Thickness of organic horizon greater than or equal to 10 cm. A horizon of less than 20 cm must have 12% or more organic carbon when mixed to a depth of 20 cm.<br>2) Soils that are never saturated with water for more than a few days must contain more than 20% organic carbon by weight (i.e., about 35% organic matter).<br>3) Soils are subject to water saturation episodes and has either:<br>a. At least 12% organic carbon by weight (i.e., about 20% organic matter) if the soil has no clay; or<br>b. At least 18% organic carbon by weight (i.e., about 30% organic matter) if the soil has 60% or more clay; or<br>c. An intermediate, proportional amount of organic carbon for intermediate amounts of clay. |
| **Salt Marshes** | Coastal wetlands that are flooded and drained by salt water brought in by the tides[12] |
| **Seagrass Meadow** | An accumulation of seagrass plants over a mappable area, found in shallow salty and brackish waters[13]. |
| **Water Table Depth** | Depth of water in the soil or above the soil relative to the soil surface. Depth may be positive (above surface) or negative (below surface) |



[6] *Data Hutan Malaysia: Definisi / Terminologi Utama Sektor Perhutanan Malaysia, NRES*
[7] *HYDROLOGIC CONNECTIVITY AND THE MANAGEMENT OF BIOLOGICAL RESERVES: A GLOBAL PERSPECTIVE, Catherine M. Pringle, 1st August 2001*
[8] *Protocols for the measurement, monitoring and reporting of structure, biomass and carbon stocks in mangrove forests, CIFOR, 2012*
[9] *2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4: Chapter 3), IPCC, 2006*
[10] *An Overview of Wetlands in Malaysia, Forest Research Institute Malaysia (FRIM), 2021*
[11] *2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4: Chapter 3), IPCC, 2006*
[12] *What is a salt marsh?, National Oceanic and Atmospheric Administration, 2019*
[13] *Seagrass and Seagrass Beds, Smithsonian: National Museum of Natural History, https://ocean.si.edu/ocean-life/plants-algae/seagrass-and-seagrass-beds*

## 2 Applicability Conditions

While the Eligibility Flowchart (Section II) provides a high-level visual guide to help project proponents quickly assess whether a proposed area may qualify for CWR activities under the FCO Program, this chapter on Applicability Conditions offers a more detailed technical criteria that must be met for a project to be formally considered eligible.

The Applicability Conditions outlined here, ensures that only those initiatives which align with the program's requirements proceed to quantification and crediting.

### 2.1 Eligibility

To qualify under this methodology, the project must meet the following criteria:

1. Project activities restore the specified coastal wetlands:
   a. Mangrove;
   b. Nipa swamps;
   c. Seagrass meadows; and/or
   d. Salt marshes.

   The classification of wetland ecosystems should refer to Malaysia's most current national forest or ecosystem classification system, where available. In the absence of such provisions, reference should be made to relevant scientific publications, research studies, or peer-reviewed literature concerning the species and ecological characteristics of the project area.

2. For mangrove and nipa swamps, the project area shall include transitional habitats that connect mangrove ecosystems to both oceanic (e.g., seagrass beds) and terrestrial habitats (e.g., back mangrove forests), provided they support the ecological integrity of the forested wetland system.

3. Project involves one or more of the following activity types:
   a. Creation, restoration, and/or management of hydrological conditions
   b. Alteration of sediment supply
   c. Changing salinity characteristics
   d. Improvement of water quality
   e. (Re-)introduction of native plant communities

   The design and monitoring of the project must be informed with appropriate site assessments (e.g., water quality, sedimentation rates, salinity levels, and surface water levels) where relevant, to ensure the ecological suitability of the restoration activities.

4. Demonstrate, using verifiable sources (e.g., legislation, management plans, annual reports, government studies, or land use planning documents) that, prior to the project start date, the project area meets one of the following conditions:

   a. **No Ongoing Land Use**: Project area is free from displaced/relocated land use, as demonstrated by at least one of the following:
      i. Area has been abandoned for more than two years prior to the project start date
      ii. Commercial use of the area is not profitable. Additionally, timber harvesting does not occur within the project area under the baseline scenario.

iii. Degradation of additional wetlands for new agricultural within the country will not occur or is explicitly prohibited by enforced law.

b. **Displaced Land Use**: Project area is under a land use that could be displaced/relocated outside the project area boundaries. In such cases, baseline emissions from the displaced land use shall not be accounted for, and the degradation of additional wetlands for new agricultural or aquacultural activities within the country will not occur or is explicitly prohibited by enforced law.

c. **Continuation of Land Use**: Project area is under a land use that is expected to continue at a similar level of service or production throughout the crediting period.

5. Replanting activities in strata containing organic soils must be implemented with rewetting activities.

6. Legal land-use rights on project ownership and to conduct project activities must be established before project initiation, and are documented (e.g. land title, lease agreements, government approval)

7. The project area may combine multiple sites together.

## 2.2 Ineligibility

While the above lists down the eligible project activities, certain scenarios are explicitly excluded to maintain the integrity, additionality and permanence of emission reductions. Projects are considered ineligible if they meet any of the following conditions:

1. Project activities qualify as IFM or REDD.
2. Project activities lower the water table.
3. Commercial forestry is a part of the baseline activities.
4. Significant increase in GHG emissions in adjacent areas is expected due to the hydrological connectivity of the project area.
5. Project activities include burning of organic soil.
6. Project activities include the use of nitrogen fertilisers.

# 3 Project Boundary

This section defines the spatial and temporal boundaries within which the project activities are implemented and monitored. Establishing a clear project boundary is essential for ensuring transparency, consistency and credibility in the quantification of GHG emission reductions. The project boundary encompasses five key dimensions.

1. **Geographical Boundaries**
These define the physical extent of the project area using spatial data such as satellite imagery, maps, and georeferenced coordinates. It includes the stratification requirements, the sea level rise prediction assessment as well as delineation of ineligible areas and buffer zones.

2. **Temporal Boundaries**
These refer to the timeframes over which project activities occur and emissions are measured. In this methodology, it includes the time-based limitations to claim emission reductions from the soil organic carbon pool.

3. **Carbon Pools**
   The project must identify which carbon pools are included or excluded in the accounting process. These typically include aboveground and belowground biomass, soil organic carbon, litter, deadwood, and harvested wood products.

4. **GHG Emission Sources**
   All relevant sources of GHG emissions within the project boundary must be identified and assessed. These may include emissions from biomass burning, fossil fuel combustion, and other project-related activities.

5. **SOC Carbon Accounting Boundary**
   This sub-chapter refers to the steps to quantify the maximum quantity of GHG emission reductions from the soil organic carbon pool.

## 3.1 Geographical Boundaries

### 3.1.1 Project Area

The project area refers to the specific land parcel(s) under the control of the project proponent where FCO activities will be implemented and must be delineated with clear geographical boundaries.

The project proponent shall define the geographic boundaries of the project area at the commencement of activities. Defined boundaries help ensure that carbon accounting is accurate, verifiable, and free from double counting with overlapping projects.

| | |
|---|---|
| Project Delineation | The project area may consist of more than one discrete area of land, and the following information must be provided for each discrete area:<br>1) Name of project area (including compartment numbers and local name, if applicable);<br>2) Unique identifier for each discrete area of land;<br>3) Map(s) of the area (preferably in digital format);<br>4) Geographic coordinates of each parcel, along with documentation of accuracy (from a geo-referenced digital map);<br>5) Total land area;<br>6) Details and documentation of land rights holder and user rights. |
| Verification | Field-verified data from ground-truthing or field surveys must be used to calibrate or validate remote sensing interpretations. |
| Site History Assessment | Project proponents shall assess the project area's history, including ecological, land use, and hydrological conditions, to determine its ecological suitability and long-term restoration viability, as well as to understand its evolution over time. Proponents should draw from the documentation above to assess historical land conditions and site development prior to intervention activities. |

### 3.1.2 Stratification

| | |
|---|---|
| Purpose | Stratification may be implemented for project areas that are not homogeneous, to improve the accuracy of GHG quantification. |

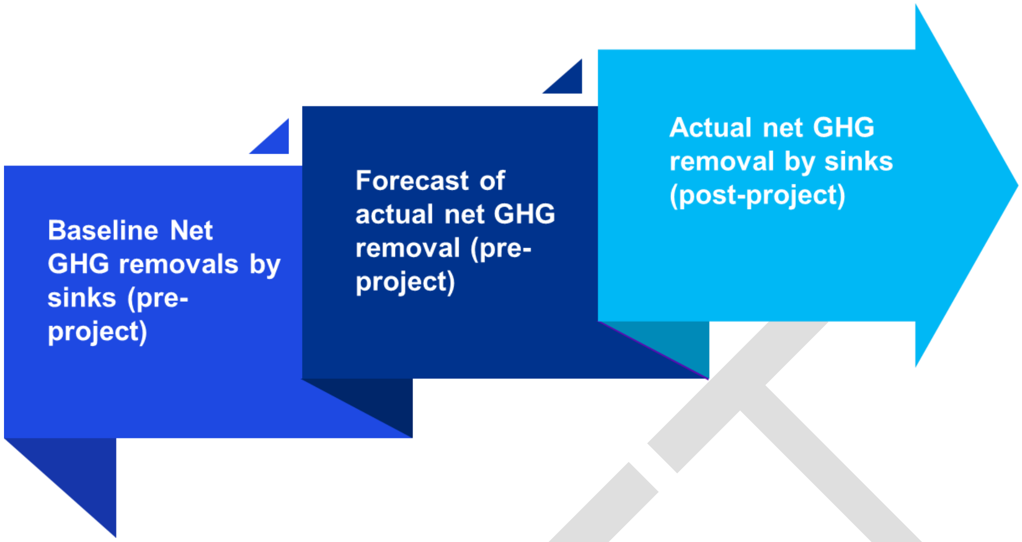
| | |
|---|---|
| Establishment & Revisions | • Stratification may be established ex-ante and revised ex-post if the original criteria are no longer relevant.<br>• Stratification applied in the baseline and project scenarios may differ.<br>• Baseline stratification must remain fixed unless the baseline scenario is reassessed.<br>• Project stratification must be reviewed at each monitoring event and updated if necessary. |
| Spatial Requirements | • The defined strata must be spatially discrete and identified through spatial data, as referenced in Section 3.1.1<br>• The total area of all strata must sum to the total project area. |

*Strata may be defined based on characteristics such as soil type and depth, water table depth, vegetation cover and composition, salinity, land type, expected changes, and frequency of tidal exchange. The table below provides examples of selected stratification characteristics, which project proponents may consider or supplement with other relevant criteria.Table 2: Examples for the Stratification Types*

| Characteristics | Examples |
|---|---|
| **Soil Type and Depth** | One possible approach is to stratify based on the Peat Depletion Time ("PDT") and Soil Organic Carbon Depletion Time ("SDT") requirements, as described in Section 3.2. This approach is particularly relevant for projects quantifying baseline emission reductions from the SOC pool. |
| **Vegetation Cover and Composition** | <u>Vegetative Cover Mangroves, Nipa Swamps, or Salt Marshes:</u><br>• This stratification is relevant for applying the default SOC accumulation factor for in-situ soils. The factor is proxied by vegetative cover, using the following thresholds: >50%, 15–50%, and <15%.<br>• Assessment of vegetative cover:<br>  • For the baseline scenario, assessment must be based on a time series of vegetation composition.<br>  • For the project scenario, vegetation mapping must follow established methods documented in scientific literature.<br><u>Seagrass Meadows</u><br>Seagrass productivity, shoot density, and carbon sequestration are influenced by water depth and light availability[14]. Therefore, project proponents may differentiate between seagrass meadow sections occurring at different depths. |
| **Salinity** | Areas may be stratified based on salinity, which is used to estimate $CH_4$ emissions, with the threshold of 18 parts per thousand. |

The stratification approach shall be adapted to the specific context of each project phase:

[14] *Influence of water depth on the carbon sequestration capacity of seagrasses, Serrano, Oscar, et al., 16th August 2014*




1. **Baseline (Pre-Project):** Stratification should be conducted based on the area's predominant characteristics and historical land use. This approach reflects the expected carbon stock in the absence of project intervention.
2. **Project (Pre-Project):** This stratification enables the application of appropriate growth models tailored to each stratum's characteristics, thereby improving the accuracy of projected carbon sequestration.
3. **Project (Post-Project):** Following project implementation, stratification must be updated to reflect the actual conditions on the ground. This includes:
   - Ex-Ante Stratification: Initially based on the intended restoration plan as submitted in the project design documentation.
   - Ex-Post Stratification: Revised to align with the actual implementation of restoration activities. This ensures that monitoring and reporting are based on real, rather than planned, interventions.
   - Adjustment for Disturbances: In the event of natural (e.g., fire, storms, pest outbreaks) or anthropogenic (e.g., harvesting, replanting) disturbances that significantly alter biomass growth patterns, strata must be redefined or adjusted accordingly.

   This dynamic approach ensures that carbon accounting remains accurate and reflective of on-the-ground realities.

### 3.1.3 Sea Level Rise

Coastal wetland ecosystems are dynamic in nature and may undergo changes due to natural processes, particularly anticipated sea level rise, including potential inland shifts of the project boundary due to wetland migration, inundation, and erosion. Project proponents must account for these evolving conditions when defining the project area and strata, and incorporate them into the design, implementation, and long-term monitoring of restoration activities.



| | |
|---|---|
| Projections | • Proponents must estimate sea level rise for both baseline and project scenarios.<br>• Projections should draw from IPCC regional forecasts, relevant peer-reviewed studies for Malaysia or subnational contexts, or expert assessments.<br>• Where global models are used, results must be downscaled to reflect local conditions. |
| Wetland Migration | Horizontal Migration<br>• **Definition**: Landward migration into adjacent upslope or upriver lands[15]<br>• **Relevant Factors[16]**: Tides, Land Cover<br>Vertical Migration<br>• **Definition**: Wetland elevation through the interaction of vegetation shaping the landform[17] (i.e., biogeomorphic feedback[18])<br>• **Relevant Factors[19]**: Sediment Dynamics |
| Inundation | • In the baseline scenario, areas that submerged are assumed to have no GHG removal.<br>• Aboveground biomass in stratums that are submerged, the carbon stocks are assumed to be entirely returned to the atmosphere. |
| Erosion | Where baseline emissions from erosion are not included, proponents may conservatively assume loss of the eroded portion of the project area. |

Spatial projections must be shown in maps identifying expected impacts from sea level rise throughout the crediting period, including a final projection at t = 100, with mapping intervals that reflect the anticipated rate of change.

### 3.1.4 Ineligible Areas

This section is relevant for projects that quantify reductions $CO_2$ emission reductions. Project areas that fail to achieve a ≥5% reduction in cumulative soil organic carbon loss over 100 years from the project start date are ineligible for crediting of baseline emission reductions. These areas must be delineated and mapped.

The significance is calculated, using the Equation 1, which each variable is derived in Section 3.5.

$$\sum_{i=0}^{M_{FCO}} (C_{FCO,i,t100} \times A_{FCO,i,t100}) \geq 1.05 \times \sum_{i=0}^{M_{BSL}} (C_{BSL,i,t100} \times A_{BSL,i,t100}) \quad \textbf{(1)}$$

Where:

[15] *Migration and transformation of coastal wetlands in response to rising seas, Osland, Michael J., et al., 29th June 2022*
[16] *Marshes on the Move: A Manager's Guide to Understanding and Using Model Results Depicting Potential Impacts of Sea Level Rise on Coastal Wetlands, The Nature Conservancy Global Marine Team & NOAA, October 2011*
[17] *Migration and transformation of coastal wetlands in response to rising seas, Osland, Michael J., et al., 29th June 2022*
[18] *Recovering wetland biogeomorphic feedbacks to restore the world's biotic carbon hotspots, Temmink, Ralph J. M., et al., 6th May 2022*
[19] *Marshes on the Move: A Manager's Guide to Understanding and Using Model Results Depicting Potential Impacts of Sea Level Rise on Coastal Wetlands, The Nature Conservancy Global Marine Team & NOAA, October 2011*

| Variable | Description | Unit |
|---|---|---|
| $C_{FCO,i,t100}$ | Soil organic carbon stock in the project scenario in stratum i at t = 100 | t C ha$^{-1}$ |
| $A_{FCO,i,t100}$ | Area of project stratum i at t = 100 | ha |
| $C_{BSL,i,t100}$ | Soil organic carbon stock in the baseline scenario in stratum i at t = 100 | t C ha$^{-1}$ |
| $A_{BSL,i,t100}$ | Area of baseline stratum *i* at *t* = 100 | ha |
| $i$ | 1, 2, 3 … $M_{FCO}$ strata in project scenario<br>1, 2, 3 …. $M_{BSL}$ strata in baseline scenario | - |
| $t$ | 1, 2, 3 … 100 … t* years elapsed since the project start date | - |

In addition, the following areas must be excluded from the project area:

1. Existing seagrass meadows
2. Natural expansion of seagrass, unless proven to originate from restored plots
3. Areas that were cleared within 10 years prior to the project start date, unless credible evidence is provided demonstrating that the clearing was not conducted with the intent of generating GHG credits.

### 3.1.5 Buffer Zones

For projects with a hydrologically connected adjacent area that may negatively affect the project area's hydrology (e.g., decrease in water table depth, sea level rise, erosion), resulting in a significant increase in GHG emissions, the proponents must either:

1. Implement project activities or a mitigation plan to prevent hydrological impacts from causing GHG emission increases; or
2. Establish a buffer zone, subject to these conditions:

    a. The buffer zone may be inside or outside of the project's geographic boundary
    b. If located outside the project area:
        i. It must be adjacent to the geographic boundary; and
        ii. Binding water management agreements must be established with land holders

Proponents must also consider impacts of natural retractions such as  sea level rise, tidal fluctuations, as well as sediment erosion and inputs[20] in the project design. Additionally, any GHG emissions resulting from mitigation activities or buffer zone interventions must be included in the project's GHG accounting if they exceed the de minimis threshold of ≥5% of the total GHG reduction or removal of the project.

## 3.2 Temporal Boundaries

The temporal boundary of this methodology applies to emission reductions in the soil organic carbon pool. Therefore, projects that do not quantify baseline emission reductions (i.e., those that account only for GHG removals) are not subject to the Peat Depletion Time ("PDT") and Soil Organic Carbon Depletion Time ("SDT") requirements.

[20] *The State of the World's Mangroves, Global Mangrove Alliance, 2024*

### 3.2.1 Peat Depletion Time

Drained organic soil is subject to oxidation and subsidence[21,22], where areas may lose the organic soil before the end of the crediting period.

| | |
|---|---|
| Definition | PDT is defined in which all organic soil has disappeared, or at the depth where no further oxidation or other losses occur. |
| Purpose | PDT is calculated in the baseline scenario to limit the period which the project is eligible to claim soil emission reductions from rewetting |

Estimation at start date for each stratum *i*:

$$t_{PDT-BSL,i} = \frac{Depth_{peat,i,t0}}{Rate_{peatloss-BSL,i}} \quad (2)$$

Where:

| Variable | Description | Unit |
|---|---|---|
| $t_{PDT-BSL,i}$ | PDT in the baseline scenario in stratum *i* | yr |
| $Depth_{peat,i,t0}$ | Average organic soil depth above drainage limit in in stratum *i* at project start date | m |
| $Rate_{peatloss-BSL,i}$ | Rate of organic soil loss due to subsidence and fire in the baseline scenario in stratum *i* | m $yr^{-1}$ |
| $i$ | 1, 2, 3 …. $M_{BSL}$ strata in baseline scenario | - |
| $t$ | 1, 2, 3 … 100 … t* years elapsed since the project start date | - |

If the PDT falls within crediting period, then the loss soil organic soil in the remaining mineral soil is to be estimated using SDT.

### 3.2.2 Soil Organic Carbon Depletion Time

| | |
|---|---|
| Purpose | SDT limits the period which the project is eligible to claim emission reductions from restoration |

The estimation of the start date for each stratum *i* varies depending on soil conditions and specific baseline circumstances. The applicable SDT temporal settings are as follows:

1. Strata with eroded soil; $t_{SDT-BSL,i} = 5\ years$
2. Strata with soil exposed to an aerobic environment through excavation or drainage;

$$C_{BSL,i,t0} = Depth_{soil,i,t0} \times VC \times 10 \quad (3)$$

[21] *Journal of Society of Wetland Scientists: Estimating primary and secondary subsidence in an organic soil 15, 20, and 30 years after drainage, Justin M Ewing, March 2006*
[22] *Subsidence in Drained Coastal Peatlands in SE Asia: Implications for Sustainability, 14th International Peat Congress: Hooijer, A, et al., 2012*

$$t_{SDT-BSL,i} = \frac{C_{BSL,i,t0}}{Rate_{carbonloss-BSL,i}} \quad (4)$$

*Alternatively, for the $C_{BSL,i,t0}$ in derivation of SDT, the following values may be used, for mineral soil with a depth of 1 m:*

*Table 3: Default Values for Mineral Soil Carbon Stock*

| Project Area | $C_{BSL,i,t0}$ (t C ha$^{-1}$)[23] |
|---|---|
| Mangrove | 286 |
| Marsh | 226 |
| Seagrass | 108 |

Where:

| Variable | Description | Unit |
|---|---|---|
| $C_{BSL,i,t0}$ | Average organic carbon stock in the baseline scenario in mineral soil in stratum *i* at the project start date | t C ha$^{-1}$ |
| $Depth_{soil,i,t0}$ | Mineral soil depth in stratum i at the project start date | m |
| $VC$ | Volumetric organic carbon content in organic or mineral soil | kg C m$^{-3}$ |
| $t_{SDT,i}$ | SDT in the baseline scenario in stratum *i* | yr |
| $Rate_{carbonloss-BSL,i}$ | Rate of soil organic carbon loss due to oxidation in the baseline scenario in stratum *i* | t C ha$^{-1}$ yr$^{-1}$ |
| $i$ | 1, 2, 3 …. $M_{BSL}$ strata in baseline scenario | - |
| $t$ | 1, 2, 3 … 100 … t* years elapsed since the project start date | - |

3. SDT is conservatively set to zero:

   a. Project area has been drained for more than 20 years prior to the project start date.
   b. There is significant baseline soil erosion, defined as more than 5% of the rate of soil organic carbon loss due to oxidation (i.e., >5% of $Rate_{carbonloss-BSL,i}$)

Extrapolation of $Rate_{carbonloss-BSL,i}$ must account for the possibility of non-linear decrease of SOC over time, including the linear decrease of soil organic carbon over time, including the tendency of organic carbon concentrations to approach steady state equilibrium[24]. In case of alternating mineral and organic horizons, $Rate_{carbonloss-BSL,i}$ may be determined for all individual horizons.

## 3.3 Carbon Pools

Carbon pools are essential components of forest ecosystems where carbon is sequestered and stored, playing a crucial role in maintaining the balance of carbon stocks over time. These pools are integral for accurately measuring and monitoring changes in carbon levels, particularly in the context of assessing the effectiveness of emission reduction strategies. Each carbon pool within the ecosystem

[23] *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, IPCC, 2013*
[24] *Nonlinear turnover rates of soil carbon following cultivation of native grasslands and subsequent afforestation of croplands, Hernandez-Ramirez, Guillermo, et al., 19th July 2021*

contributes uniquely to the carbon cycle, making it essential to understand how forest management practices, growth patterns, or disturbances can influence the overall carbon balance of a project.

In order to quantify emissions reductions or removals effectively, it is imperative to identify and differentiate specific carbon pools based on their significance and potential emissions impact.

Table below describes the relevant carbon pools essential for this methodology:

| | Carbon Pool | Description |
|---|---|---|
| Included | Aboveground tree biomass | May increase or decrease in project scenario, in the case of establishment or presence of tree vegetation. |
| Included | Aboveground non-tree biomass | May increase or decrease in project scenario, in the case of establishment or presence of herbaceous vegetation. |
| Included | Belowground biomass | May increase or decrease in project scenario, in the presence of tree vegetation. |
| Included | Soil | May increase in project scenario, whereby changes in soil organic carbon are accounted for through GHG emissions from soil disturbance, with net stock changes excluded to avoid double-counting and ensure conservativeness. |
| Excluded | Wood products | Excluded – the implemented restoration activities do not include harvestable biomass. |
| Excluded | Dead wood | Excluded – because decomposition of wood in wetlands is slow[25], and changes over the project duration are expected to be minimal, maintaining a conservative approach. |
| Excluded | Litter | Excluded – litter is highly unstable in coastal wetlands, with frequent export by tidal activity and variable carbon stocks influenced by inundation, oxidation, and vegetation cover[26]. |

## 3.4 GHG Emission Sources

This subsection outlines the relevant GHG emission sources that must be considered within the defined project boundaries.

| | Sources | Gas | Included | Description |
|---|---|---|---|---|
| Baseline | Production of methane by microbes | $CH_4$ | ✓ | May be conservatively excluded. |
| Baseline | Denitrification or nitrification process | $N_2O$ | ✓ | May be conservatively excluded. |
| Baseline | Burning of biomass | $CO_2$ | ✗ | May be conservatively excluded, as forest fires in Malaysia mainly occur in degraded peat |

[25] 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, IPCC, 2013
[26] Ibid

| | Sources | Gas | Included | Description |
|---|---|---|---|---|
| | | | | swamp forest, as compared to coastal wetlands[27]. |
| | | $CH_4$ | ✗ | May be conservatively excluded, as forest fires in Malaysia mainly occur in degraded peat swamp forest, as compared to coastal wetlands[28]. |
| | | $N_2O$ | ✗ | May be conservatively excluded, as forest fires in Malaysia mainly occur in degraded peat swamp forest, as compared to coastal wetlands[29]. |
| | Fossil fuel use | $CO_2$ | ✓ | May be conservatively excluded. |
| | | $CH_4$ | ✗ | Conservatively excluded. |
| | | $N_2O$ | ✗ | Conservatively excluded. |
| Project | Production of methane by microbes | $CH_4$ | ✓ | Potential major source of emissions in the project in low salinity areas[30]. |
| | Denitrification or nitrification process | $N_2O$ | ✓ | May increase because of the project activity. |
| | Burning of biomass | $CO_2$ | ✓ | $CO_2$ is addressed in carbon stock change quantification. |
| | | $CH_4$ | ✓ | $CH_4$ emission from burning for site preparation activities. |
| | | $N_2O$ | ✓ | $N_2O$ emission from burning for site preparation activities. |
| | Fossil fuel use | $CO_2$ | ✓ | Fossil fuel combustion is a major global source of $CO_2$ emissions[31], where project-related fuel use in vehicles and machines is included. |
| | | $CH_4$ | ✗ | $CH_4$ emissions is not a significant source of emissions in project fuel use. |
| | | $N_2O$ | ✗ | $N_2O$ emissions is not a significant source of emissions in project fuel use. |

## 3.5 SOC Carbon Accounting Boundary

[27] *Global Forest Fire Assessment 1990-2000: Fire Situation in Malaysia, FRIM, 2001, https://www.fao.org/4/ad653e/ad653e46.htm*
[28] *Ibid*
[29] *Ibid*
[30] *Effects of constant and fluctuating saltwater addition on CH4 fluxes and methanogens of a tidal freshwater wetland: A mesocosm study, He, Lulu, et al., 31st October 2022*
[31] *Global Greenhouse Gas Overview, US Environmental Protection Agency (EPA), https://www.epa.gov/ghgemissions/global-greenhouse-gas-overview*

Project proponents may claim a maximum quantity of GHG emission reductions from the SOC pool. This limit is grounded in the concept of SOC saturation, where soils have a finite capacity to store carbon, and carbon accumulation slows significantly as they approach this threshold[32]. This is calculated ex-ante using conservative parameters, in accordance with one of the following approaches:

### 3.5.1 Total Stock

Definition: The difference in remaining SOC stock between project and baseline scenarios at year 100.

$$C_{FCO-BSL,i,t100} = \sum_{i=0}^{M_{FCO}} (C_{FCO,i,t100} \times A_{FCO,i,t100}) - \sum_{i=0}^{M_{BSL}} (C_{BSL,i,t100} \times A_{BSL,i,t100}) \quad \textbf{(5)}$$

For organic soils, the estimation of the SOC stock is derived from:

| | |
|---|---|
| **Project** | $C_{FCO,i,t100} = Depth_{peat,FCO,i,t100} \times VC \times 10$ **(6)**<br>$Depth_{peat,FCO,i,t100} = Depth_{peat,i,t0} - \sum_{t=1}^{t=100} Rate_{peatloss,FCO,i,t}$ **(7)** |
| **Baseline** | $C_{BSL,i,t100} = Depth_{peat,BSL,i,t100} \times VC \times 10$ **(8)**<br>$Depth_{peat,BSL,i,t100} = Depth_{peat,i,t0} - \sum_{t=1}^{t=100} Rate_{peatloss,BSL,i,t}$ **(9)** |

Whereas, for mineral soils, the estimation of the SOC stock is derived from:

| | |
|---|---|
| **Project** | $C_{FCO,i,t100} = C_{BSL,i,t0} - \sum_{t=1}^{t=100} Rate_{carbonloss,FCO,i,t}$ **(10)**<br>$C_{BSL,i,t0} = Depth_{soil,i,t0} \times VC \times 10$ **(11)** |
| **Baseline** | $C_{BSL,i,t100} = C_{BSL,i,t0} - \sum_{t=1}^{t=100} Rate_{carbonloss,BSL,i,t}$ **(12)**<br>$C_{BSL,i,t0} = Depth_{soil,i,t0} \times VC \times 10$ **(13)** |

The carbon content of organic or mineral soils may be determined using measurements from the project area or sourced from relevant literature based on the site or comparable areas.



[32] *Soil Organic Carbon Storage (Sequestration) Principles and Management: Potential Role for Recycled Organic Materials in Agricultural Soils of Washington State, Department of Ecology State of Washington, January 2015*

Alternatively, for the $C_{BSL,i,t0}$ in derivation of SOC stock in mineral soils, the default values may be used in Table 3**Error! Reference source not found.**, for mineral soil with a depth of 1 m.

Where:

| Variable | Description | Unit |
|---|---|---|
| $C_{FCO-BSL,i,t100}$ | Difference between soil organic carbon stock in the project scenario and baseline scenario at *t* = 100 | t C $ha^{-1}$ |
| $C_{FCO,i,t100}$ | Soil organic carbon stock in the project scenario in stratum i at t = 100 | t C $ha^{-1}$ |
| $A_{FCO,i,t100}$ | Area of project stratum i at t = 100 | ha |
| $C_{BSL,i,t100}$ | Soil organic carbon stock in the baseline scenario in stratum i at t = 100 | t C $ha^{-1}$ |
| $A_{BSL,i,t100}$ | Area of baseline stratum *i* at *t* = 100 | ha |
| $Depth_{peat,FCO,i,t100}$ | Average organic soil depth in the project scenario in stratum i at t = 100 | m |
| $Depth_{peat,BSL,i,t100}$ | Average organic soil depth in the baseline scenario in stratum i at t = 100 | m |
| $VC$ | Volumetric organic carbon content in organic or mineral soil | kg C $m^{-3}$ |
| $Depth_{peat,i,t0}$ | Average organic soil depth above the drainage limit in stratum i at the project start date | m |
| $Rate_{peatloss,FCO,i,t}$ | Rate of organic soil loss due to subsidence and fire in the project scenario in stratum i in year t | m $yr^{-1}$ |
| $Rate_{peatloss,BSL,i,t}$ | Rate of organic soil loss due to subsidence in the baseline scenario in stratum i in year t | m $yr^{-1}$ |
| $C_{BSL,i,t0}$ | Soil organic carbon stock in the baseline scenario in mineral soil in stratum i at the project start date | t C $ha^{-1}$ |
| $Rate_{carbonloss,FCO,i,t}$ | Rate of organic carbon loss in mineral soil due to oxidation in the project scenario in stratum i in year t | t C $ha^{-1}$ $yr^{-1}$ |
| $Rate_{carbonloss,BSL,i,t}$ | Rate of organic carbon loss in mineral soil due to oxidation in the baseline scenario in stratum i in year t | t C $ha^{-1}$ $yr^{-1}$ |
| $Depth_{soil,i,t0}$ | Mineral soil depth in stratum i at the project start date | m |
| $i$ | 1, 2, 3 … $M_{FCO}$ strata in project scenario<br>1, 2, 3 …. $M_{BSL}$ strata in baseline scenario | - |
| $t$ | 1, 2, 3 … 100 … t* years elapsed since the project start date | - |

### 3.5.2 Stock Loss

Definition: The difference in cumulative SOC loss between project and baseline over period of 100 years

$$C_{FCO-BSL,i,t100} = \sum_{i=0}^{M_{FCO}} (C_{loss,BSL,i,t100} \times A_{BSL,i,t100}) - \sum_{i=0}^{M_{BSL}} (C_{loss,FCO,i,t100} \times A_{FCO,i,t100}) \quad \textbf{(14)}$$

For organic soils, the estimation of the SOC loss is derived from:

| | | |
|---|---|---|
| **Baseline** | $C_{loss,BSL,i,t100} = \sum_{i=0}^{100}(Rate_{peatloss,BSL,i,t} \times VC) \times 10$ | **(15)** |
| **Project** | $C_{loss,FCO,i,t100} = \sum_{i=0}^{100}(Rate_{peatloss,FCO,i,t} \times VC) \times 10$ | **(16)** |

Whereas, for mineral soils, the estimation of the SOC loss is derived from:

| | | |
|---|---|---|
| **Baseline** | $C_{loss,BSL,i,t100} = \sum_{i=0}^{100}(Rate_{carbonloss,BSL,i,t} \times VC) \times 10$ | **(17)** |
| **Project** | $C_{loss,FCO,i,t100} = \sum_{i=0}^{100}(Rate_{carbonloss,FCO,i,t} \times VC) \times 10$ | **(18)** |

Where:

| Variable | Description | Unit |
|---|---|---|
| $C_{FCO-BSL,i,t100}$ | Difference between soil organic carbon stock in the project scenario and baseline scenario at *t* = 100 | t C $ha^{-1}$ |
| $C_{loss,BSL,i,t100}$ | Cumulative soil organic carbon loss in the baseline scenario in stratum *i* at t = 100 | t C $ha^{-1}$ |
| $A_{BSL,i,t100}$ | Area of baseline stratum *i* at *t* = 100 | ha |
| $C_{loss,FCO,i,t100}$ | Cumulative soil organic carbon loss in the project scenario in stratum *i* at t = 100 | t C $ha^{-1}$ |
| $A_{FCO,i,t100}$ | Area of project stratum i at t = 100 | ha |
| $Rate_{peatloss,BSL,i,t}$ | Rate of organic soil loss due to subsidence in the baseline scenario in stratum i in year t | m $yr^{-1}$ |
| $Rate_{peatloss,FCO,i,t}$ | Rate of organic soil loss due to subsidence and fire in the project scenario in stratum i in year t | m $yr^{-1}$ |
| $VC$ | Volumetric organic carbon content in organic or mineral soil | kg C $m^{-3}$ |
| $Rate_{carbonloss,BSL,i,t}$ | Rate of organic carbon loss in mineral soil due to oxidation in the baseline scenario in stratum i in year t | t C $ha^{-1}$ $yr^{-1}$ |
| $Rate_{carbonloss,FCO,i,t}$ | Rate of organic carbon loss in mineral soil due to oxidation in the project scenario in stratum i in year t | t C $ha^{-1}$ $yr^{-1}$ |
| $i$ | 1, 2, 3 … $M_{FCO}$ strata in project scenario<br>1, 2, 3 …. $M_{BSL}$ strata in baseline scenario | - |
| $t$ | 1, 2, 3 … 100 … t* years elapsed since the project start date | - |

# 4 Baseline and Additionality

This section outlines the procedures for establishing and reassessing the baseline scenario and demonstrating additionality for projects under the FCO framework. A robust baseline scenario is essential to conservatively estimate GHG emissions or removals that would occur in the absence of project intervention. Additionality ensures that project activities result in real, measurable climate benefits beyond business-as-usual practices.

## 4.1 Baseline Determination and Additionality Assessment

The baseline scenario represents the most likely land use or management practices that would occur in the absence of the project. It serves as the reference point for estimating GHG emissions or removals.

To determine and justify this scenario, Project Proponents should refer to the **FCO Tool: Baseline Determination and Additionality Assessment.** This standardised tool guides Project Proponents through a series of steps to ensure that the selected baseline is realistic, evidence based and conservative.

| Item | Description | Significance |
|---|---|---|
| **Baseline Scenario** | The most plausible "without-project" situation, describing typical land use or forest management practices in the absence of the FCO project activity. | Provides a reference point to conservatively estimate net GHG emissions or removals. |
| **Additionality** | The requirement to demonstrate that the project would not have occurred under a business-as-usual scenario without carbon credit incentives. | Ensures the credibility and environmental integrity of the project by confirming that emissions reductions are not already mandated or financially viable without credits. |

## 4.2 Reassessment of Baseline

The baseline scenario must be reassessed every 10 years or earlier if there any significant changes are observed. The reassessment is to account for any changes in the underlying drivers or agents influencing land use, degradation, and carbon stocks. As part of this process, the validity of the original baseline must be reviewed, taking into consideration any new national or sectoral policies and evolving circumstances:

- If still valid – associated GHG emissions must be recalculated for the upcoming baseline period
- If deemed no longer valid – a new baseline scenario must be established

Additionally, the project proponent must re-determine the PDT at each 10-year interval, where applicable. This reassessment must follow the procedure outlined in Section 3.2.1 incorporating new relevant information that has become available.

# 5 Quantification of Estimated GHG Reductions and Removals

This section outlines the methodology for calculating the GHG emission reductions achieved through the project activities. It provides a structured approach to quantify the difference between baseline emissions (what would have occurred without the project) and actual project emissions (with FCO interventions in place).

## 5.1 Baseline Emissions

The baseline emissions shall be determined on a per stratum basis ($GHG_{BSL,i}$), attributed to the change in carbon stock in the biomass carbon pools, emissions for soil processes and where relevant, fossil fuel use. The detailed calculation methods for each carbon stock and GHG emission source can be found in **FCO Tool: GHG Quantification Equations**.

$$GHG_{BSL,i} = \sum_{t}^{t*} (-\Delta C_{BSL\_AGB,i,t} - \Delta C_{BSL\_BGB,i,t} - \Delta C_{BSL\_HB,i,t} + GHG_{BSL\_SOC,i,t} + GHG_{BSL\_FC,i,t}) \quad \textbf{(19)}$$

Where:

| Variable | Description | Unit |
|---|---|---|
| $GHG_{BSL,i}$ | Baseline emissions, per stratum $i$ | $tCO_2e$ |
| $\Delta C_{BSL\_AGB,i,t}$ | Change in carbon stock of aboveground biomass, per stratum $i$ in year $t$ in baseline scenario | $tCO_2e\ yr^{-1}$ |
| $\Delta C_{BSL\_BGB,i,t}$ | Change in carbon stock of belowground biomass, per stratum $i$ in year $t$ in baseline scenario | $tCO_2e\ yr^{-1}$ |
| $\Delta C_{BSL\_HB,i,t}$ | Change in carbon stock of herbaceous vegetation biomass, per stratum $i$ in year $t$ in baseline scenario | $tCO_2e\ yr^{-1}$ |
| $GHG_{BSL\_SOC,i,t}$ | Net GHG emissions from soil per stratum $i$ in year $t$ in baseline scenario | $tCO_2e\ yr^{-1}$ |
| $GHG_{BSL\_FC,i,t}$ | Net emissions from the fossil fuel combustion per stratum $i$ in year $t$ in baseline scenario | $tCO_2e\ yr^{-1}$ |

For all $\boldsymbol{\Delta C}$ variables, a positive value indicates an increase in carbon stock (i.e., carbon sequestration), while a negative value indicates a loss of carbon stock (i.e., emissions). In the equation, all $\boldsymbol{\Delta C}$ terms are preceded by a minus sign ($-\boldsymbol{\Delta C}$) to reflect their contribution to net GHG emissions.
The total baseline emissions are then calculated as the sum of all baseline emissions per stratum $i$ in the eligible project areas, as follows:

$$GHG_{BSL} = \sum_{i=1}^{M} GHG_{BSL,i} \quad \textbf{(20)}$$

Where:

| Variable | Description | Unit |
|---|---|---|
| $GHG_{BSL}$ | Total baseline emissions from all strata in the eligible project area | $tCO_2e$ |
| $GHG_{BSL,i}$ | Baseline emissions, per stratum $i$ | $tCO_2e$ |

## 5.2 Project Emissions

Project emissions, similarly, to the baseline emissions shall be determined on a per stratum basis ($GHG_{FCO,i}$). The emissions are attributed to the change in carbon stock in the biomass carbon pools, emissions for soil processes, fossil fuel use as well as burning of biomass for site preparation. The detailed calculation methods for each carbon stock and GHG emission source can be found in **FCO Tool: GHG Quantification Equations**.

$$GHG_{FCO,i} = \sum_{t}^{t*}\left(-\Delta C_{FCO\_AGB,i,t} - \Delta C_{FCO\_BGB,i,t} - \Delta C_{FCO\_HB,i,t} + GHG_{FCO\_SOC,i,t} + GHG_{FCO\_FC,i,t} + GHG_{FCO\_BURN,i,t}\right) \quad (21)$$

Where:

| Variable | Description | Unit |
|---|---|---|
| $GHG_{FCO,i}$ | Project emissions, per stratum $i$ | $tCO_2e$ |
| $\Delta C_{FCO\_AGB,i,t}$ | Change in carbon stock of aboveground biomass, per stratum $i$ in year $t$ in project scenario | $tCO_2e\ yr^{-1}$ |
| $\Delta C_{FCO\_BGB,i,t}$ | Change in carbon stock of belowground biomass, per stratum $i$ in year $t$ in project scenario | $tCO_2e\ yr^{-1}$ |
| $\Delta C_{FCO\_HB,i,t}$ | Change in carbon stock of herbaceous vegetation biomass, per stratum $i$ in year $t$ in project scenario | $tCO_2e\ yr^{-1}$ |
| $GHG_{FCO\_SOC,i,t}$ | Net GHG emissions from soil per stratum $i$ in year $t$ in project scenario | $tCO_2e\ yr^{-1}$ |
| $GHG_{FCO\_FC,i,t}$ | Net emissions from the fossil fuel combustion per stratum $i$ in year $t$ in project scenario | $tCO_2e\ yr^{-1}$ |
| $GHG_{FCO\_BURN,i,t}$ | Net emissions from the burning of biomass per stratum $i$ in year $t$ in project scenario | $tCO_2e\ yr^{-1}$ |

For all $\boldsymbol{\Delta C}$ variables, a positive value indicates an increase in carbon stock (i.e., carbon sequestration), while a negative value indicates a loss of carbon stock (i.e., emissions). In the equation, all $\boldsymbol{\Delta C}$ terms are preceded by a minus sign ($-\boldsymbol{\Delta C}$) to reflect their contribution to net GHG emissions.
The total project emissions are then calculated as the sum of all project emissions per stratum $i$ in the eligible project areas, as follows:

$$GHG_{FCO} = \sum_{i=1}^{M} GHG_{FCO,i} \quad (22)$$

Where:

| Variable | Description | Unit |
|---|---|---|
| $GHG_{FCO}$ | Total project emissions from all strata in the eligible project area | $tCO_2e$ |
| $GHG_{FCO,i}$ | Project emissions, per stratum i | $tCO_2e$ |
| $i$ | 1, 2, 3 …. $M_{FCO}$ strata in project scenario | - |

## 5.3 Leakage Emissions

Leakage emissions under this methodology is deemed not to occur if the applicability conditions are met. Only negative leakage, defined as an increase in emissions or a decrease in removals outside the project boundary attributable to the implementation of the FCO project, shall be accounted for. Where proponents can provide evidence that positive leakage consistently exceeds negative leakage, leakage emissions may be excluded from the calculation[33].

### 5.3.1 Activity-Shifting and Market Leakage

Activity-shifting and market leakage are assumed to be zero when the applicability conditions are met, except in areas where commercial forestry is expected under the baseline scenario.
The categories of leakage under commercial forestry are to be considered, are as follows:

*[33] Standard: Addressing leakage in mechanism methodologies, UNFCCC. Article 6.4 Supervisory Body, 19th May 2025*

1. Collection of wood (for firewood, charcoal, etc.)
2. Timber harvesting
3. Agriculture (crop cultivation, shrimp cultivation, etc.)

The leakages are calculated as follows:

$$GHG_{LK} = A_{LK} * Shift_{\%} * C_{Tree} \quad \textbf{(23)}$$

Where:

| Variable | Description | Unit |
|---|---|---|
| $GHG_{LK}$ | Net $CO_2$ emissions due to leakage | $tCO_2e$ |
| $A_{LK}$ | Area of land within the project area where the activity is taking place. | ha |
| $Shift_{\%}$ | Percentage of the activity that will be displaced during the crediting period and will impact the tree biomass outside the project area. | % |
| $C_{Tree}$ | Average stock of tree biomass in the area to where the activity will be displaced. | $tCO_2e\ ha^{-1}$ |

### 5.3.2 Ecological Leakage

In accordance with the applicability conditions, the project must be designed to avoid increases in GHG emissions in adjacent areas resulting from hydrological connectivity, specifically by preventing changes to mean annual water table levels and flooding frequency or duration. Compliance must be demonstrated through expert assessment, hydrologic modelling, or direct monitoring of water table fluctuations within the project area.

## 5.4 Net GHG Emission Reductions and Removals

The total net GHG emission reductions or removals is calculated as follows:

$$NER = GHG_{BSL} - GHG_{FCO} - GHG_{LK} \quad \textbf{(24)}$$

Where:

| Variable | Description | Unit |
|---|---|---|
| $NER$ | Net $CO_2$ emissions reductions/removals from project activity | $tCO_2e$ |
| $GHG_{FCO}$ | Net $CO_2$ emissions in the project scenario | $tCO_2e$ |
| $GHG_{BSL}$ | Net $CO_2$ emissions in the baseline scenario | $tCO_2e$ |
| $GHG_{LK}$ | Net $CO_2$ emissions due to leakage | $tCO_2e$ |

A positive $NER$ value indicates that the implemented FCO project has reduced emissions and/or increased removals compared to the baseline scenario, and thus represents a climate benefit. Conversely, a negative $NER$ implies that the FCO project results in higher emissions or lower removals than the baseline.

## 5.5 Uncertainty

Uncertainty in emissions and carbon stock change estimates for both the baseline and project shall be determined following the procedures outlined in **FCO Tool: GHG Quantification Equations**.

### 5.6 Calculation of Forest Carbon Units

The calculation of FCU issued must account for the buffer credits deposited in the FCO Buffer Account. The percentage of buffer credits to be contributed is determined using **FCO Tool: Buffer Risk Assessment**.

The number of FCU is calculated as follows:

$$FCU_{t2} = (adj\_NER_{t2} - adj\_NER_{t1}) * (1 - Buffer\_Factor_{t2}) \quad \textbf{(25)}$$

Where:

| Variable | Description | Unit |
|---|---|---|
| $FCU_t$ | Number of Forest Carbon Units in year t | - |
| $adj\_NER_{t2}$ | Net $CO_2$ emissions reductions/removals from project activity up to year t2 adjusted to account for uncertainty | $tCO_2e$ |
| $adj\_NER_{t1}$ | Net $CO_2$ emissions reductions/removals from project activity up to year t1 adjusted to account for uncertainty | $tCO_2e$ |
| $Buffer\_Factor_{t2}$ | Percentage of buffer credits to be contributed to the FCO Buffer Account in year t2 | % |

## 6 Monitoring

This section outlines the monitoring framework required to ensure the integrity, transparency, and accuracy of the project implementation and its associated GHG emission reductions. It provides guidance on the data and parameters to be validated and tracked throughout the project lifecycle.

### 6.1 Monitoring Plan

Project Proponents must develop a Monitoring Plan, which outlines the procedures for measuring and verifying the project's carbon sequestration and emissions reductions, which contain at least the following:

a. Description of each monitoring task to be undertaken
b. Parameters to be measured
c. Data to be collected and data collection techniques
d. Frequency of monitoring
e. Quality assurance and quality control procedures
f. Data archiving procedures
g. Roles, responsibilities and capacity of monitoring team and management

Project Proponents must ensure continued compliance with the applicability conditions throughout the project crediting period.

## 6.2 Data and Parameters

### 6.2.1 Data and Parameters at Validation

| Variables | Definition | Unit | Equation |
|---|---|---|---|
| $A_{BSL,i,t}$ | Area of baseline stratum i at time t | ha | 1, 5, 14 |
| $Depth_{peat,i,t0}$ | Average organic soil depth above drainage limit in in stratum *i* at project start date | m | 2, 7, 9 |
| $Rate_{peatloss-BSL,i}$ | Rate of organic soil loss due to subsidence and fire in the baseline scenario in stratum *i* | m $yr^{-1}$ | 2, 9, 15 |
| $VC$ | Volumetric organic carbon content in organic or mineral soil | kg C $m^{-3}$ | 3, 6, 8, 11, 13, 15, 16, 17, 18 |
| $Depth_{soil,i,t0}$ | Mineral soil depth in stratum i at the project start date | m | 3, 11, 13 |
| $Rate_{carbonloss-BSL,i,t}$ | Rate of soil organic carbon loss due to oxidation in the baseline scenario in stratum i in year t | t C $ha^{-1}$ $yr^{-1}$ | 4, 12, 17 |
| $Rate_{peatloss,FCO,i,t}$ | Rate of organic soil loss due to subsidence and fire in the project scenario in stratum i in year t | m $yr^{-1}$ | 7, 16 |
| $Rate_{carbonloss,FCO,i,t}$ | Rate of organic carbon loss in mineral soil due to oxidation in the project scenario in stratum i in year t | t C $ha^{-1}$ $yr^{-1}$ | 10, 18 |

### 6.2.2 Data and Parameters Monitored

| Variables | Definition | Unit | Equation |
|---|---|---|---|
| $A_{FCO,i,t100}$ | Area of project stratum i at year t | ha | 1, 5 |
| $A_{LK}$ | Area of land within the project area where the activity is taking place. | ha | 23 |
| $Shift_{\%}$ | Percentage of the activity that will be displaced during the crediting period and will impact the tree biomass outside the project area. | % | 23 |
| $C_{Tree}$ | Average stock of tree biomass in the area to where the activity will be displaced. | $tCO_2e$ $ha^{-1}$ | 23 |

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# IX. ANNEXES

## A1. Annex 1

General Principles of Forest Lifecycle