I. INTRODUCTION AND HOW TO USE THIS METHODOLOGY

1.0 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 supports 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.

2.0 Core FCO Methodologies

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

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.

3.0 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:

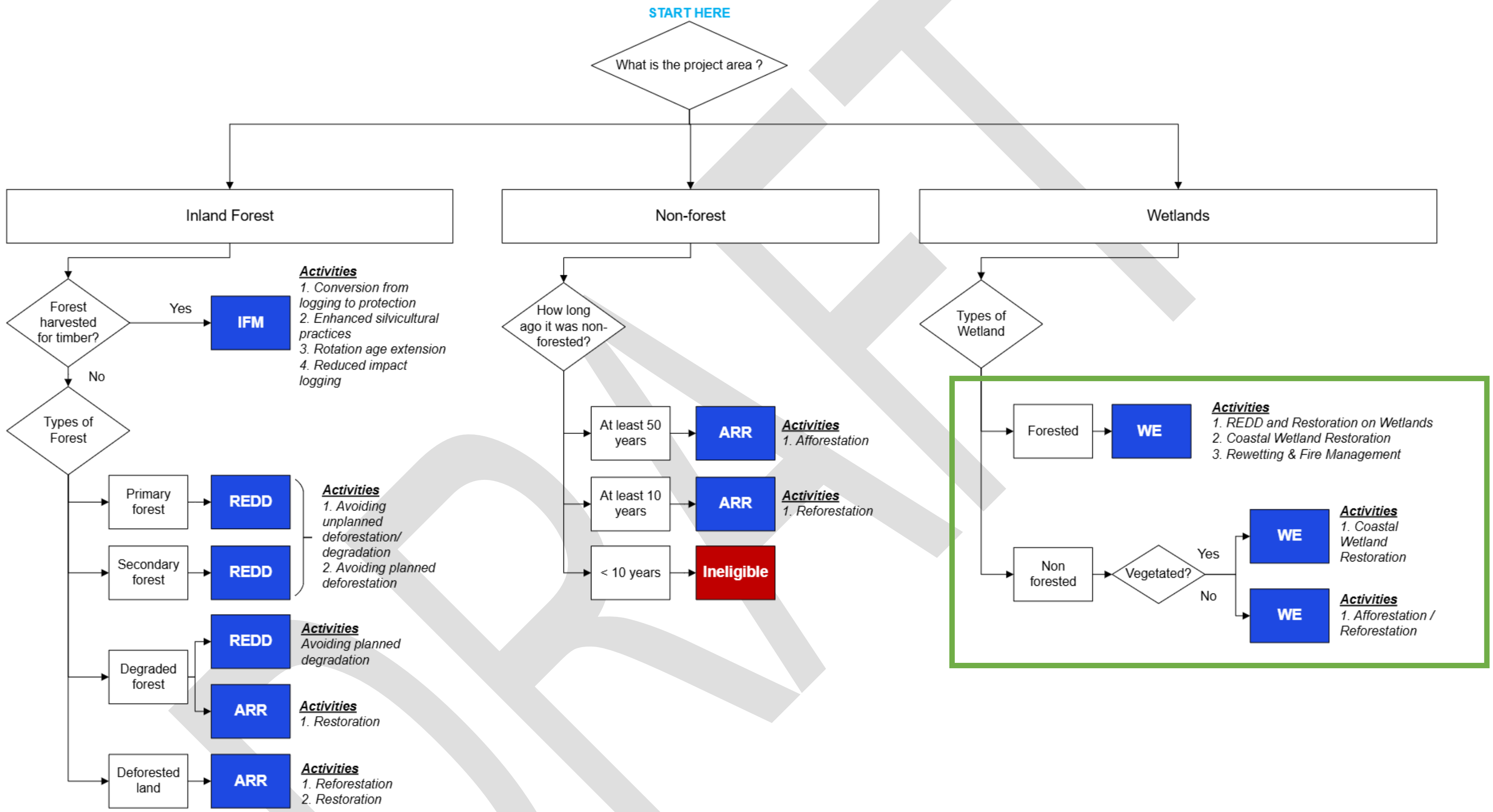
a. **GHG Avoidance Activities:** Actions that prevent emissions from occurring, such as avoiding planned or unplanned deforestation.
b. **GHG Reduction or Removal Activities:** Interventions that actively reduce or sequester emissions, tailored to forest lands, wetlands, or production forests.

4.0 <u>Focus of this FCO Methodology Document</u>

This document specifically focuses on the **Wetland Ecosystems: Rewetting & Fire Prevention**. It should be used in conjunction with the overarching FCO Main 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. **Error! Reference source not found.** in the following page summarises the ecosystems applicable to each module.

Module 4: Rewetting & Fire Management applies to project areas that are currently:

- Drained peat swamp forest which may have increased susceptibility to peat fires

Module 4: Rewetting & Fire Management may be applied independently with the applicable project areas outlined above or in combination with Module 2: REDD and Restoration on Wetlands when degraded peat swamp forests 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 • Nipa Swamps • Peat Swamp Forests • Freshwater Swamps	• Mangrove Forests • Nipa Swamps • Salt Marsh • Seagrass Meadows	Peat Swamp Forests	• Mangrove Forests • 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 2. Avoiding Unplanned Deforestation/ Degradation	Restoration activities, that re-establishes or improves: • Hydrological conditions • Sediment supply • Salinity • Water quality • Vegetation	Rewetting activities	1. Avoiding Planned Deforestati on; **or** 2. Avoiding Unplanned Deforestati on/ Degradatio n **and** 3. Restoration activities	1. Avoiding Planned Deforestati on; **or** 2. Avoiding Unplanned Deforestati on/ Degradatio n **and** 3. Rewetting activities

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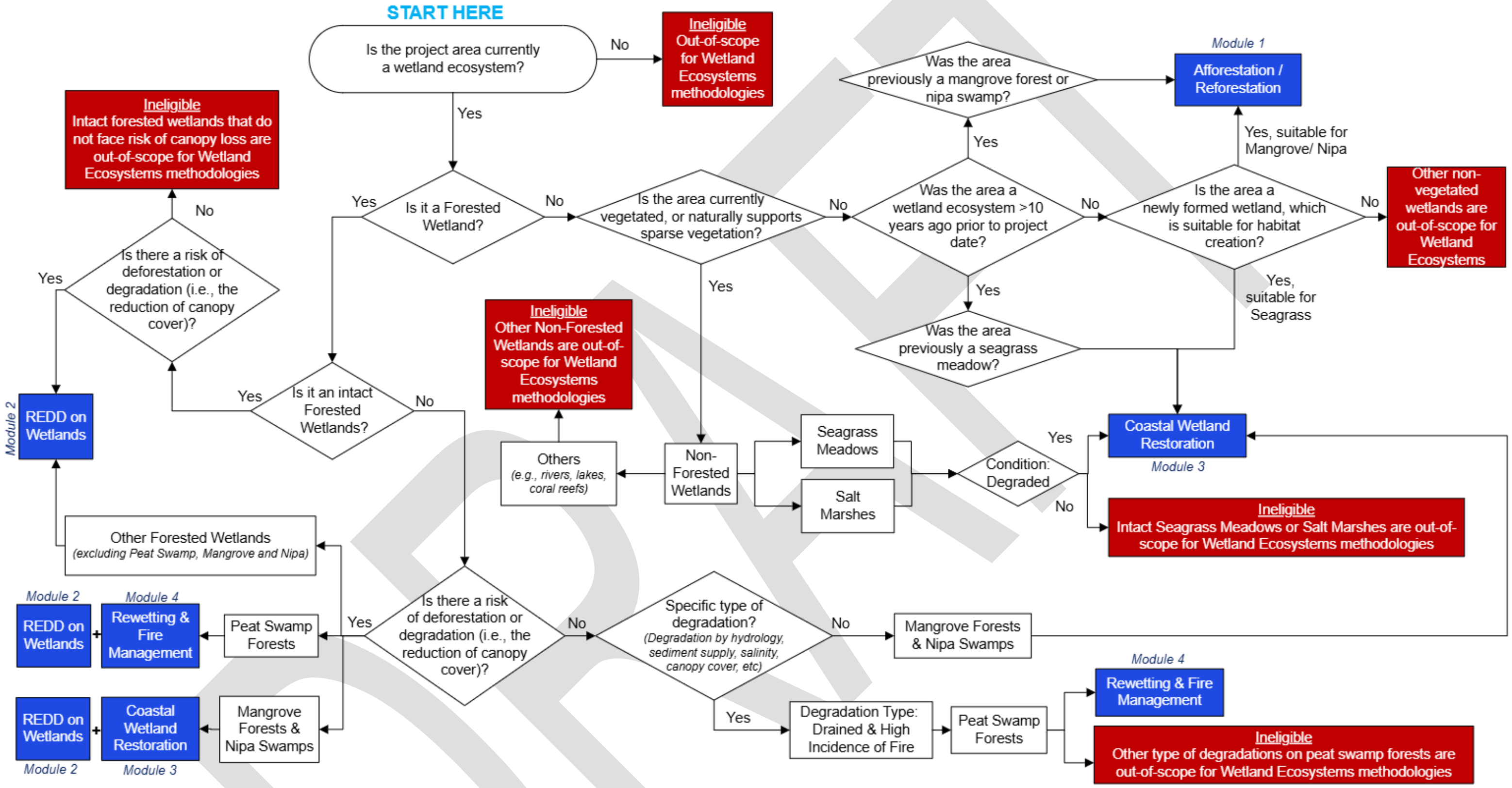
Figure 2: Eligibility Flowchart for Wetland Ecosystems modules

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).



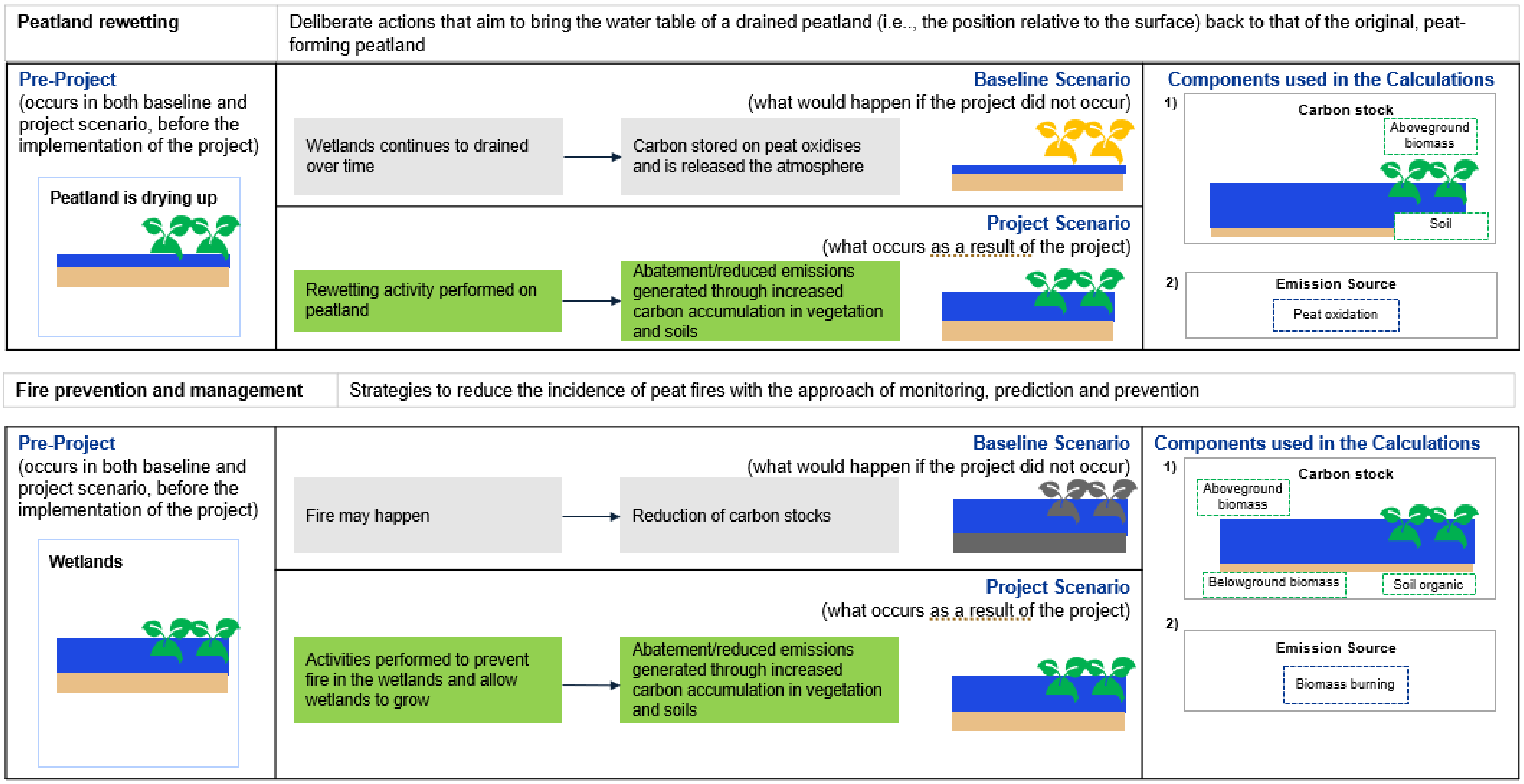
III. SUMMARY DESCRIPTION

This methodology establishes a framework for quantifying carbon sequestrated, or GHG emission reductions and removals, from wetlands ecosystem 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 *Refers to how the project reduces GHG emissions*	Project activities that increase carbon sequestration and/or reduce GHG emissions through: • Rewetting activities that reduce the release of carbon dioxide (CO_2) from the oxidation of previously drained peat soils, while simultaneously fostering conditions conducive to long-term carbon sequestration through the accumulation of new organic matter in the waterlogged environment.
Applicable Ecosystem *Identifies the type of environment where the project can be implemented*	The applicable inland wetlands in this methodology are **peat swamp forests in Malaysia that meets the definition of *ombrogeneous* tropical wetlands**.
Pre-Project *Refers to the state of the land and forest prior to the start of the FCO project*	**Drained peat swamps**: Pre-conditions exhibiting lowered water tables, altered vegetation composition favoring drier species, aerobic decomposition of peat. The drained and drier condition often make peatlands highly susceptible to fire ignition and CO_2 emissions.
Baseline Scenario *Represents the "business-as-usual" projection on what would happen to the forest and its carbon stocks in the absence of the project*	Soil in the peat continues to drain over time causing the carbon stored within the peat undergo oxidation and is released into the atmosphere as CO_2
Project Scenario *Describes the proposed interventions to-be implemented under the FCO project to prevent or reduce GHG emissions*	Rewetting activity performed on peatland which abate or reduce the emissions generated through increased carbon accumulation in vegetation and soils

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.

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 Determinations and Additionality Assessment
- FCO Tool: GHG Quantification Equations
- FCO Tool: Buffer Risk Assessment
- FCO Tool: Buffer Risk Assessment

VIII. LIST OF ABBREVIATIONS

Abbreviations	Definition
FCO	Forest Carbon Offset
GHG	Greenhouse Gasses
GPS	Global Positioning System
LiDAR	Light Detection and Ranging
SAU	Spatial Assessment Units
PDD	Project Design Document
UAV	Unmanned Aerial Vehicles
WRC	Wetland Restoration and Conservation

1 Definitions

Terms	Definition
Domed Peatland	Peat dome is a unit of land on peatland. Dome-shaped peat landform usually located between interfluvial divides[2]. Peat dome can store more water than the surrounding land units in the same area
Gross Project Area	Designated boundary of the project, including all land within it, regardless of whether specific areas are classified as eligible or non-eligible for project activities or carbon accounting.
Hydrologic Connectivity	Water-mediated transfer of matter, energy and/or organisms within or between elements of the hydrologic cycle[3]
Net Project Area	Project's boundary, encompassing only the areas that meet the eligibility criteria after all non-eligible portions have been clearly marked and excluded.
Ombrogenous	A peatland that is raised above the surrounding landscape and that receives water only from precipitation[4]
Peatland	Peat swamp forests are waterlogged forests growing on a layer of dead leaves and plant material up to 20 meters thick. They comprise an ancient and unique ecosystem characterized by waterlogging, with low nutrients and dissolved oxygen levels in acidic water regimes. Their continued survival depends on a naturally high-water level that prevents the soil from drying out to expose combustible peat matter.[5]
Peat Oxidation	Process where the organic matter in peat soil breaks down due to exposure to oxygen. Typically occurs when peatlands are drained, lowering the water table and allowing air to penetrate the peat layers.
Peat Subsidence Rate	Speed at which the surface of a peatland lowers over time. A form of land subsidence, which is the downward movement of the Earth's surface due to the removal of subsurface earth materials.[6]
Spatial Assessment Units	Grid cells overlaid on the project area map. These cells serve as the basis for stratifying the project area, enabling the calculation of emissions and the tracking of the project's progress across different zones. Hereinafter referred to as "**SAU, x**" in specifically for rewetting methodology. Referred as "**stratum, *i***" in **FCO Tool: GHG Quantification Equations.**

[2] Peat Dome Conservation and Its Problems Based on Geomorphometry: Case Study in Tebing Tinggi Island. IOP Conference Series on Earth & Environmental Science. 2020. Turmudi and Nursugi 2020 IOP Conf. Ser.: Earth Environ. Sci. 412 012031
[3] HYDROLOGIC CONNECTIVITY AND THE MANAGEMENT OF BIOLOGICAL RESERVES: A GLOBAL PERSPECTIVE, Catherine M. Pringle, 1st August 2001
[4] Types of Peatlands – International Peatland Society (More reads on: Craft, C., 2016. Creating and Restoring Wetlands: From Theory to Practice. Elsevier | Joosten, H. & Clarke, D. 2002: Wise Use of Mires and Peatlands: Background and principles including a framework for decision making. IMCG/IPS)
[5] Peat Swamp Forests - Conservation and Sustainable Use, Ministry of Natural Resources and Environment Malaysia, UNDP. April 2008
[6] "What is Peat Subsidence and How can Countries Prevent this Natural Disaster?" by World Research Institute Indonesia. Dede Sulaeman October 2023.

Terms	Definition
Water Table Depth	Depth of the water table relative to the soil surface. Depth may be positive (above surface) or negative (below surface)
Watershed(s)	Watersheds are areas of land where all water drains to a common waterway, such as a lake, river, or ocean. As the water runs through the watershed, it will pick up and carry with it all materials, like sediment or nutrients from the soil, present in the drainage basin.[7]
Wetlands	Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters.

[7] *Environmental Protection Agency (EPA) on Healthy Watershed(s) Protection Programme, Official Webpage of US EPA*

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 WE: Rewetting & Fire Management 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.

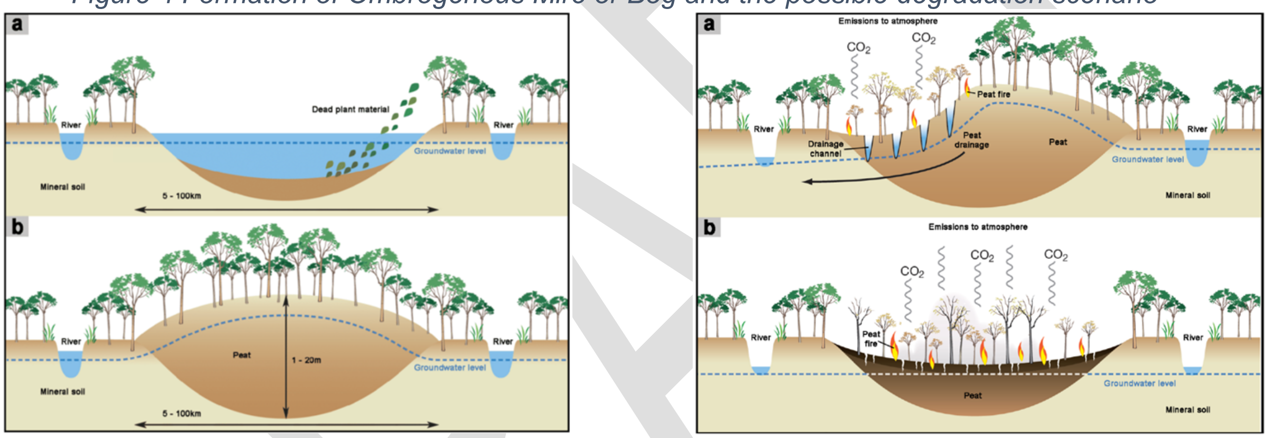
The Applicability Conditions outlined here ensures that only those initiatives which align with the program's requirements proceed to quantification and crediting.

2.1 Eligibility

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

1. The project area must meet the definition of *ombrogenous* tropical peatland. [Refer Figure 4[8]].

Figure 4 Formation of Ombrogenous Mire or Bog and the possible degradation scenario[9]



(a) Formation of a peat dome. A peat dome develops where large amounts of dead; incompletely decomposed plant material accumulates over thousands of years in waterlogged environments that lack oxygen.
(b) Full-grown peat domes mostly have a convex shaped surface which can be up to 20m thick and be more than 100km wide, covering entire water catchments between rivers.

(a) Beginning of the degradation process. Construction of a network of drainage channels to control and lower the groundwater level for plantations and/or agricultural development, to facilitate the access to the peat swamp forest, and to extract timber. This leads to emissions of mainly CO2, due to micro-biotical decomposition and peat fires.

b) If no restoration measures are undertaken (e.g. blocking the drainage channels) these emissions will continue until no peat is left.

2. The project area must exist at an elevation less than 100m above sea level.
3. Mean annual water level below the peat surface within the project area for the baseline and project scenarios cannot be greater than 1 meter in depth.
4. The watershed(s) of interest that includes the project area must comprise one or more complete watersheds.

[8] *Types of Peatland – International Peatland Society (More reads on: Craft, C., 2016. Creating and Restoring Wetlands: From Theory to Practice. Elsevier | Joosten, H. & Clarke, D. 2002: Wise Use of Mires and Peatlands: Background and principles including a framework for decision making. IMCG/IPS)*
[9] *Airborne and spaceborne LiDAR data as a measurement tool for peatland topography, peat fire burn depth, and forest above ground biomass in Central Kalimantan, Indonesia, Uwe Ballhorn, Munich 2012*

5. The watershed(s) of interest cannot include areas where N-based fertilizers have been, or are planned to be, applied.

6. The baseline scenario in the watershed(s) of interest must result in equal or lower aboveground tree biomass compared to the project scenario.

7. The watershed(s) of interest cannot be hydrologically connected to adjacent peatland and non-peatland areas outside the project area [Refer Figure 5 & Figure 6].

Figure 5 Hydrologically Connected Watersheds - Hydraulic Conductivity[10]

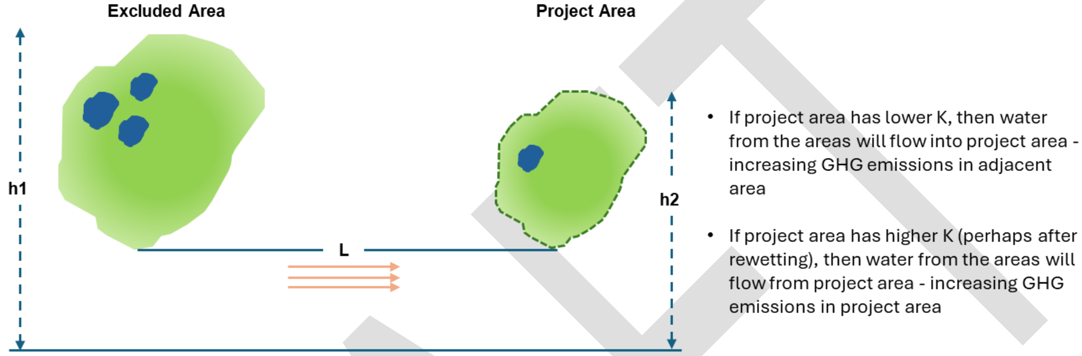
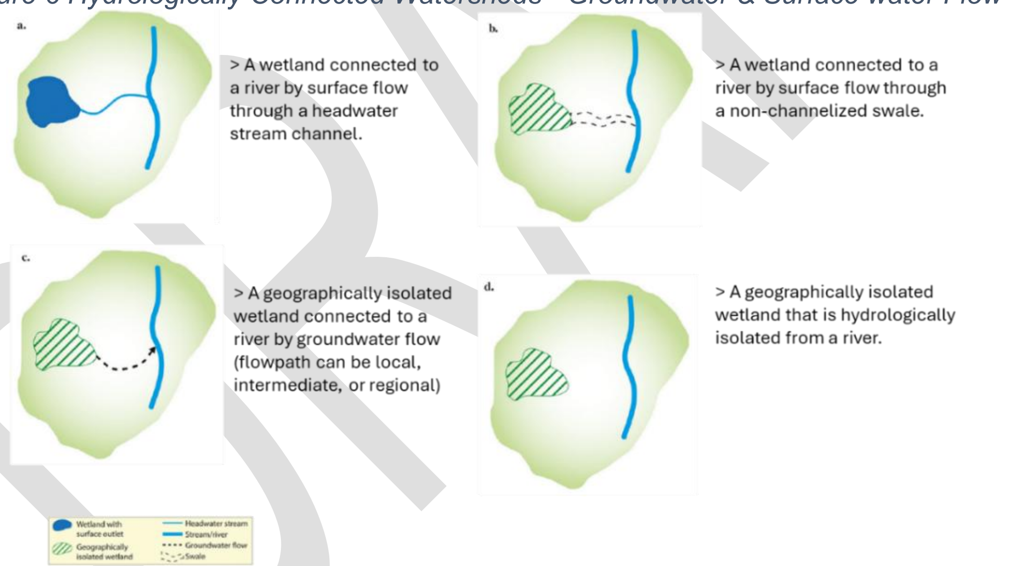


Figure 6 Hydrologically Connected Watersheds - Groundwater & Surface water Flow[11]



8. This methodology is only applicable where the most plausible baseline scenario is the scenario where the project area has been drained due to human-induced drainage activities and would remain drained in the absence of the project.

9. At the project start date, it must be demonstrated that no agents intend to implement further drainage activities within the project area.

[10] Connectivity of Streams and Wetlands to Downstream Waters: An Integrated Systems Framework, Article in JAWRA Journal of the American Water Resources Association – March 2018
[11] Ibid

10. At the project start date, land use activities in the project area cannot include deforestation, planned forest degradation, land use conversion, crop production or grazing of animals.

11. Current and/or potential future land use activities in the excluded area of watershed(s) must not have a significant negative hydrologic impact on the project area. Acceptable evidence includes land use plans, laws or resource concession rights. This applicability condition must be satisfied at validation and at each verification event. Failure to meet this applicability condition at verification will render the project ineligible for further crediting.

12. 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:

    The project proponent must demonstrate (a), (b), or (c) above using verifiable sources—such as legislation, bylaws, management plans, annual reports or accounts, market or government studies, or land use planning documents

    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 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/aquacultural sites within the country will not occur or is 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.

13. The project must demonstrate, through modeling and conservative assumptions, that the net GHG benefit between the baseline and project scenarios are sustained over a 100 year-period, in line with IPCC guidance on long-term ecosystem equilibrium..

2.2 Ineligibility

This methodology is not applicable under the following criteria:

1. The project activity including the creation of additional drainage waterways or other types of infrastructure that causes drainage.
2. The project activity including any agricultural activities.

3 Project Boundary

This section defines the spatial and temporal boundaries within which the WE: A/R 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 four 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 delineation of project area and stratification requirements.

2. **Temporal boundaries**
   These refer to the timeframes over which project activities occur and emissions are measured. This includes the start and end dates of the crediting period, monitoring intervals, and any time-based limitations (e.g., the number of years for which Soil Organic Carbon [SOC] claims can be made).

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

3.1 Geographical Boundaries

1. **<u>Project Area</u>**
   Peatland rewetting projects can cover one or more distinct land areas. The project area is defined as the specific peatland parcel(s) where the rewetting activities will have a hydrological effect.

   Compliance with this methodology also necessitates that the project proponent provide evidence that all land encompassed within the project area is comprised of *ombrogenous* tropical peat. Acceptable forms of evidence include remote sensing imageries etc [Refer Section 6.1].

2. **<u>Excluded Area(s) of Watershed</u>**
   The spatial extent of any excluded area(s) within the watershed(s) requires clear delineation [Refer Section 6.1].

   The following information is required for each individual physical area that is described.
   a. Name of the project area (e.g., compartment number, local name, watershed name)
   b. Map(s) of the area in digital format.
   c. Geographic coordinates of each polygon vertex along with the documentation of the respective accuracies.
   d. Total land area and the details of land ownership and land user rights.

3.2 Temporal Boundaries

The Project Proponent shall define the temporal boundaries as below.

1. **<u>Temporal Range for Historical Climate Data</u>**
   Baseline emissions are calculated by looking at drainage depth in relation to long-term climate factors such as precipitations, humidity levels (affecting the evapotranspiration rates), sea level rise, groundwater and surface water flow etc These long-term climate averages need to come from weather stations that accurately represent the project area and must include historical dataThe

historical data requirement, as well as the project crediting period shall be defined in accordance with the requirements set forth in the FCO Main Guidelines.

2. **Monitoring Period**
While not mandatory, this methodology suggests that each monitoring period should ideally last for a minimum of one year and a maximum of five years, based on its monitoring procedures. Also, annual baseline projections are required and must be accessible by each scheduled future verification date.

3. **Reassessment of Project Baseline**
Baseline emissions must be re-estimated before each verification using monitored climate data from the baseline period. Furthermore, if the baseline scenario is reassessed, the project proponent must also re-evaluate regulatory surplus and the behavior of agents impacting hydrology and/or land and water management.

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 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.

Table 2 List of Included and Excluded Carbon Pools

	Carbon Pool	Description
Included	Aboveground Biomass	Tree: Major carbon sink in forested wetlands.
	Soil Organic Matter	A key carbon pool in wetland ecosystems, major source of emissions if disturbed through deforestation
Excluded	Deadwood	May occur from project activities and can store carbon temporarily but may decompose over time, leading to emissions.
	Aboveground non-tree biomass	It is conservative to exclude this carbon pool - this pool can decompose and contribute to emissions; their impact is often less significant compared to the changes in soil emissions resulting from rewetting.
	Belowground biomass	It is conservative to exclude this carbon pool - While belowground biomass can influence CH4 emissions, especially in rice paddies, its role is often considered secondary to the water table level and the overall soil environment.
	Wood Products	Not relevant to wetland reforestation projects, as harvested wood is not a primary component.
	Litter	Comprises decomposing leaves and organic material with a fast turnover rate, contributing minimally to long-term carbon storage

3.4 GHG Emission Sources

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

Table 3 List of Emission Sources Included or Excluded from Project Boundary.

	Sources	Gas	Included	Description
Baseline	Peat Oxidation	CO_2	✓	Main source and gas to be addressed by project activities.
		CH_4	✗	Considered negligible in drained peatlands. CH_4 emissions from tropical peatlands are considered de minimis because they amount to less than 5% of the CO_2 emissions.
		N_2O	✗	For baseline, considered negligible in peatlands. N_2O emissions are conservatively not accounted for in the baseline scenario by this methodology.
	Fire Incidence	CO_2	✓	Main source and gas to be addressed by project activities.
		CH_4	✓	For fire prone project area, the CH_4 emissions are significant, hence not considered as de minimis
		N_2O	✗	Excluded or simplified in calculations due to data limitations, the complex nature of nitrogen cycling, and the relative simplicity of carbon-based emission factors.
	Peat Oxidation	CO_2	✓	Main source and gas to be addressed by project activities.
		CH_4	✓	Considered negligible in drained peatlands. CH_4 emissions from tropical peatlands are considered de minimis because they amount to less than 5% of the CO_2 emissions.
		N_2O	✗	Considered negligible in tropical Southeast Asia peatlands. Project activities increase the water table in comparison to the baseline and thus N_2O emissions will be equal or lower as a result of project activities
	Fire Incidence	Same as Baseline		

Research on greenhouse gas (GHG) emissions from land use changes in tropical peatlands shows that methane (CH_4) and nitrous oxide (N_2O) emissions are minor and can be considered insignificant compared to carbon dioxide (CO_2) emissions. Furthermore, a review of CH_4 emission changes after converting tropical peat swamp forests suggests that the CH_4 released from rewetting is minimal and doesn't negate the increased CO_2 emissions from draining peatlands.

Given the requirements of this methodology, the project's peatland rewetting activities will not lower water table levels compared to the baseline, thus nitrous oxide (N_2O) emissions are not considered. Although rewetting might increase methane (CH_4) emissions, their impact in tropical peatlands is very small compared to carbon dioxide (CO_2) emissions and are therefore considered negligible. Scientific literature confirms that CH_4 emissions are insignificantly low compared to CO_2 emissions in these ecosystems.

4 Baseline Scenario and Additionality

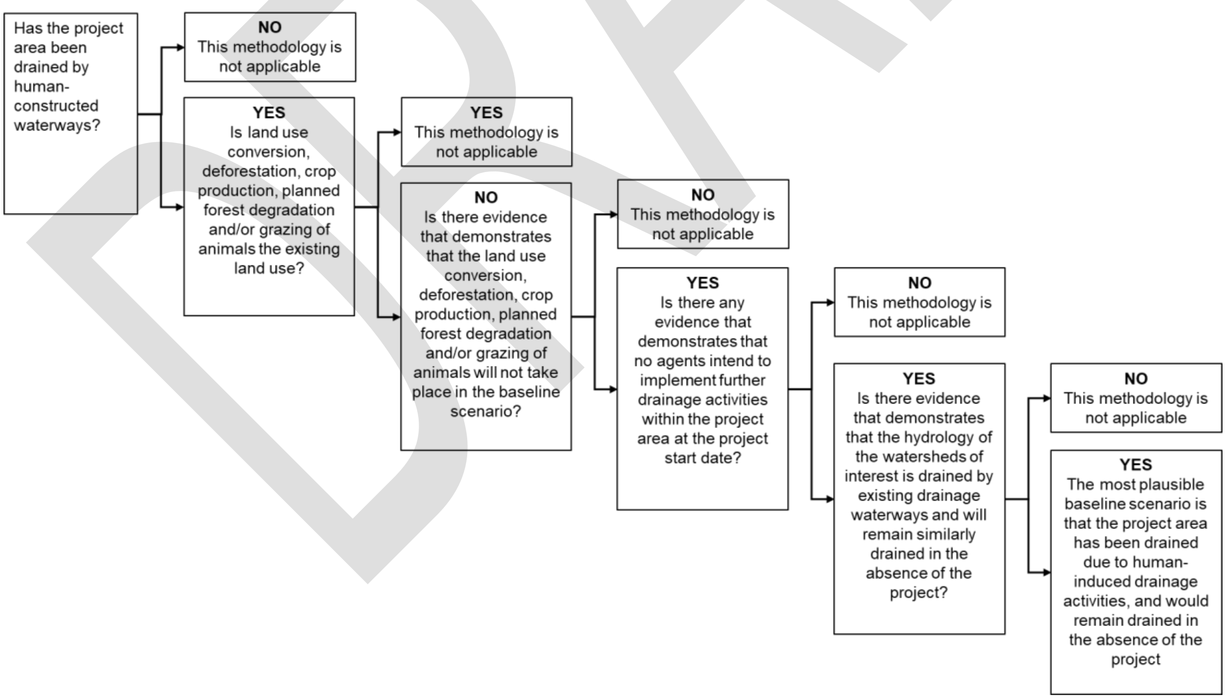
This section outlines the procedures for establishing and reassessing the baseline scenario and demonstrating additionality for WE projects under the FCO framework. A robust baseline scenario is essential to conservatively estimate GHG emissions or removals that would occur in the absence of project 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 is developed using the procedures outlined in the **FCO Tool: Baseline and Additionality Determination**. It enables a conservative estimation of net GHG emissions or removals that would occur without the WE intervention. Establishing this baseline is essential for demonstrating that the project delivers real, measurable and additional climate benefits.

4.2 Baseline Determination – Methodology specific

The chart presented below, reflecting the applicability conditions of this methodology, is required to identify the most plausible baseline scenario.



a. The project proponent is required to provide evidence demonstrating that the listed activities will not take place. This proof must include items such as legal restrictions, the suitability of the project area for specific land uses, and/or existing documented baseline management plans.

b. Permissible evidence includes documentation such as land use plans, appraisals, relevant legal documents & permissibility, resource concession rights, management or budgetary plans etc.

c. Evidence must be presented to confirm that no changes to waterway drainage are planned within the watersheds of interest. Furthermore, project proponents must use at least 20 years of long-term average climate data that influence water table depths, timing, and amount of water flow to demonstrate that water inputs will likely remain consistent with existing conditions without the project.

4.3 Reassessment of Baseline Scenario

The baseline scenario must be reassessed every 10 years OR earlier if significant changes are observed 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

5 Quantification of Estimated GHG Reductions and Removals

This section outlines the methodology for calculating the GHG emission reductions achieved through WE: Rewetting & Fire Management 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 WE: Rewetting & Fire Management interventions in place).

5.1 Project Area Stratification & Sampling Design

The following section outlines the methodology for establishing a robust spatial framework across the project area to facilitate targeted data collection. This involves the systematic development of spatially distinct Assessment Units, designed to reflect homogenous peatland condition categories[12].
Subsequently, this section details the sampling approaches to be implemented within these defined units, ensuring that data collection is statistically sound and provides the necessary information for accurate project baselining, emission calculations, and monitoring of rewetting outcomes.

5.1.1 Development of Spatial Assessment Units

The primary objective of this initial mapping phase, utilizing aerial photography and supplementary data sources, is to facilitate the preliminary identification of the various peatland condition categories present within a prospective project site.

This section comprehensively describes the sequential procedures that Project Proponents shall adhere to generate a spatially defined map of assessment or hereinafter referred to as Spatial Assessment Units (SAU)s, which will form the essential basis for the ensuing field investigation. The project name, scale, grid reference, and site access points must be clearly indicated on these maps.

[12] Field Protocol Version 2.1, Assessing Eligibility, Determining Baseline Condition Category and Monitoring Change – Peatland Code. IUCN | National Committee United Kingdom. October 2024

Various methods can be deployed when creating the map such as satellite imagery, drone imagery etc.

Each map must include the following key information:

a. Project Name
b. Scale
c. Grid Reference
d. Site Access Points

Various methods can be deployed when creating the map such as satellite imagery, drone imagery etc.

1. Utilizing Digital Aerial Imagery

Use a minimum mapping unit of 0.01 hectares (10x10 meter resolution) for the restoration site. While using Unmanned Aerial Vehicles (UAV) imagery such as drone, LiDAR, Thermal Cameras etc. can help with project design and more accurate cost estimates, it's not mandatory at this stage.

2. Define Project Areas

Delineate the entire project area as one or more precise polygons on the map. Subsequently, calculate the total gross area encompassed by these polygons, expressed in hectares, to accurately define the project's spatial extent.

3. Mapping the Non-peatland Features

Delineate all clearly identifiable non-peatland features such as rock, forest, water courses, and tracks as distinct polygons on the map. For all mapped watercourses, establish a 30-meter drainage exclusion zone extending from both banks, within which rewetted carbon units cannot be claimed, and peat depths from this zone shall be recorded. Water courses are specifically defined as any linear, permanently flowing water features that incise through the peat substrate, displaying bare peat sides, and will not be blocked as part of the project.

In order to find the Net Project Area in hectares, first calculate the area of all non-peatland features and the drainage exclusion zones, and then subtract this combined area from the total Gross Project Area.

4. Map the Peatland Features

Identify and map the uppermost edge of any detectable peat or peat bank. For any visible peat areas, map their boundaries, measure their length and width, and calculate their area. Only when the extent of the peat cannot be accurately determined from aerial imagery, such as when it is limited to steep, exposed cliffs, should remote sensing technologies be employed to obtain the precise acreage.

To validate the peatland features identified through remote sensing, photographic evidence from ground truthing across the site must be included, showing the actual features corresponding to those identified remotely.

5. Map the Eligible & Non-eligible Peatland Boundaries

Accurately map all areas within the project site designated for active restoration that also satisfy the defined eligibility requirements. Concurrently, ensure that all other areas within the project site, which do not meet these eligibility requirements, are mapped as distinct non-eligible areas, providing a complete spatial representation of the site's eligibility status.

6. Identify Spatial Assessment Units

Create a boundary map for each SAU, ensuring each unit represents only one condition category. Aim for the fewest possible assessment units by combining adjacent areas with the same condition category when it makes spatial sense. Calculate the area of each unit in hectares; the total area of all assessment units combined must equal the Net Project Area.

5.1.2 Sampling Designs

A comprehensive field survey of the project site is mandatory to verify that the existing peatland meets the specified depth eligibility criteria and to definitively confirm the baseline peatland condition categories. The SAU, as detailed in the preceding section, provides the essential structural framework that will guide the execution of this field survey.

This section outlines the sequential steps that Project Proponents are required to undertake to generate a comprehensive SAU as mentioned above, which will serve as the foundational spatial framework for the subsequent field survey activities.

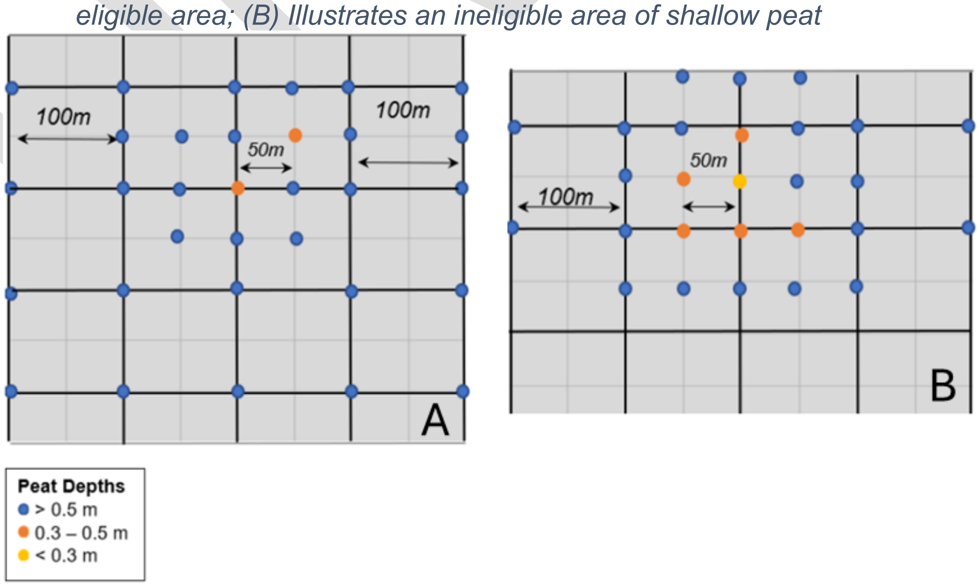
1. Determine Survey Point Location

Overlay a 100 x 100-meter grid on the SAUs, where each intersection defines a survey point. Conduct peat depth and condition category assessments at each of these points. Precisely record the GPS coordinates or grid reference of each survey point for future monitoring. If the exact point is unreachable, document the actual GPS coordinates or grid reference of the measurement location. Consider creating and overlaying a 50 x 50-meter grid as a precautionary measure for potential additional peat depth measurements.

2. Peat Depth Assessment

At each designated survey point, measure and record the peat depth with a rod, ensuring accuracy to the nearest centimeter, up to a maximum depth of 1 meter. Initiate depth measurements using the established 100 x 100-meter grid. Should a measurement at any point reveal a peat depth of less than 50 centimeters, immediately increase the measurement frequency by implementing a finer 50 x 50-meter grid centered around this shallow point. Continue measurements on this denser grid until all surrounding measurement points within the 50 x 50-meter grid exhibit a peat depth exceeding 50 centimeters. Once this threshold is met, revert to the original 100 x 100-meter grid spacing, as illustrated in Figure 7 below.
Furthermore, the validator may request supplementary depth measurements to accurately determine the depth of peat area and the calculation or to precisely delineate the boundary of the project site.

Figure 7 Example of the survey measurement frequency depending on peat depth. (A) Illustrates an eligible area; (B) Illustrates an ineligible area of shallow peat



Isolated shallow peat pockets (30-50 cm deep) classified as ‘Drained’ in the baseline are acceptable if no more than 2 interconnected peat depth points on a 50 x 50m grid are surrounded by deeper peat (>50 cm). However, any peat depth points between 30 cm - 50 cm within the ‘Actively Eroding’ baseline category are eligible, regardless of the extent of the area.

Superimpose the collected peat depth data onto the SAUs for visual representation. Furnish a clearly organized and cross-referenced spreadsheet that provides a complete record of all peat depth measurements, explicitly linked to their respective SAUs.

A minimum of 75% of the peat depth measurements recorded on the 100 x 100-meter grid within each SAUs must be equal to or exceed 30 centimeters. Project proponents retain the option to redefine SAU boundaries to exclude areas exhibiting shallower peat and thereby achieve the required 75% threshold. Should this boundary adjustment be necessary, the newly delineated SAU boundary must be positioned precisely halfway between two peat depth measurement points.
For projects lasting longer than 30 years, Project Proponent must demonstrate that at least 75% of the peat depth measurements on the 100 x 100 m grid within every Assessment Unit are greater than the minimum peat depth required for the project's period.

3. <u>Peatland Condition Assessment</u>
At every survey point, identify and record the existing condition category based on the baseline definitions. If the field-recorded conditions within an SAUs differ from what was initially mapped during the initial assessment, more field surveying is necessary to ascertain the underlying cause. The boundaries of SAUs must then be adjusted to accurately represent the actual conditions observed in the field.

4. <u>Water Table Assessment</u>
The approach to monitoring the average yearly water table will be tailored to each individual project. The specific locations and frequency of water table measurements will be determined by the unique characteristics of the site, its subsurface layers, and the likely ways water is supplied to the area.

Consequently, each project must develop a water table monitoring plan specifically suited to their project area and detail this plan in the Project Design Document (PDD). The PDD must also include evidence that an independent expert, such as a hydrologist has reviewed and deemed the proposed monitoring design to be sound and reliable.

5. <u>Photographs</u>
Capture clear photographic evidence or orthorectified images to document the condition of all peatland features intended for restoration. These photographs should be strategically distributed across the entire project area and encompass all designated SAUs. Furthermore, if multiple restoration techniques are planned, ensure that the photographs also illustrate the specific type of restoration being implemented. As a guideline for coverage, photographs should ideally be taken at a frequency of one in every four survey points established on the 100 x 100-meter grid.

Ensure that all photographs are repeatable fixed-point images, meticulously documenting key restoration features from consistent locations and angles. Each photographic location must be assigned a unique number, and these numbered locations should be clearly indicated on the corresponding SAU for accurate future reference.

6. <u>Confirm SAUs</u>
Re-delineate the boundary (or boundaries) of each SAU to ensure accuracy. Subsequently, calculate the precise area of each SAU in hectares, as this area will be crucial for the accurate computation of

emissions. Finally, accurately overlay the collected peat depth measurement points onto the SAUs for integrated spatial analysis.

5.2 Baseline Emissions

Baseline emissions are determined by summing the emissions resulting from net changes in carbon pools and any non-CO_2 emissions. The detailed calculation methods for each carbon stock and emission source for forest fire can be found in **FCO Tool: GHG Quantification Equations**. Consequently, the calculation for baseline net GHG emissions is as follows:

$$\Delta GHG_{BSL,t} = \left(\sum_{x=0}^{x} -\Delta C_{BSL,x,t} \times A_x\right) + GHG_{FF,t} \quad (1)$$

$$\Delta C_{BSL,t} = -\Delta \boldsymbol{C_{BSL,CO2,x,t}} + GHG_{BSL-nonCO2,x,t} \quad (2)$$

$$GHG_{BSL-nonCO2,x,t} = 0 \quad (3)$$

Where:

Variable	Description	Unit
$\Delta \boldsymbol{GHG_{BSL,t}}$	Net baseline GHG emissions, in year *t*	tCO_2e
$\Delta \boldsymbol{C_{BSL,x,t}}$	Net baseline GHG emissions in SAU *x*, in year *t*	$tCO_2e\ ha^{-1}$
$\Delta \boldsymbol{C_{BSL,CO2,x,t}}$	Net carbon stock change in all carbon pools in the baseline scenario in grid *x*, in year *t*	$tCO_2e\ ha^{-1}$
$\boldsymbol{GHG_{BSL-nonCO2,x,t}}$	Non-CO_2 emissions taking place in the baseline in SAU *x*, in year *t*	$tCO_2e\ ha^{-1}$
$\boldsymbol{GHG_{FF,t}}$	Refer to **FCO Tool: GHG Quantification Equations** for the complete substitutions	tCO_2e
$\boldsymbol{A_x}$	Area of SAU (each grid unit)	-
x	*1,2, 3…* *x* SAU in project area	-
$\boldsymbol{t}$	1, 2, 3, … t_{max} years elapsed since the project start date	-

For all ΔC 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 ΔC terms are preceded by a minus sign (-ΔC) to reflect their contribution to net GHG emissions.

For both the baseline and project scenarios, the only carbon pools that are accounted for are aboveground tree biomass and soil carbon. In the baseline scenario, the amount of carbon stored in aboveground trees is expected to decrease or remain the same because lower water table levels increase the likelihood of fires or tree mortality. Hence, it is conservative to assume that there is no net change in aboveground tree biomass in the baseline scenario. Similar conservative approaches were applied for any loss of sediment within the drainage canals which are not accounted for in the baseline scenario.

$$\Delta \boldsymbol{C_{BSL,CO2,x,t}} = -\Delta C_{AB\_tree,x,t} - \Delta \boldsymbol{C_{B-SOC,x,t}} \quad (4)$$

$$\Delta C_{AB\_tree,x,t} = 0 \quad (5)$$

Where:

Variable	Description	Unit
$\Delta C_{BSL,CO2,x,t}$	Net carbon stock change in all pools in the baseline in SAU *x*, in year *t*	$tCO_2e\ ha^{-1}$
$\Delta C_{AB\_tree,x,t}$	Net carbon stock change in the aboveground tree biomass pool in the baseline in SAU x, in year t	$tCO_2e\ ha^{-1}$
$\Delta C_{B-SOC,x,t}$	Net emissions from soil carbon pool in the baseline in SAU *x*, in year *t*	$tCO_2e\ ha^{-1}$
x	*1,2, 3… x* SAU in project area	-
t	1, 2, 3, … t_{max} years elapsed since the project start date	-

For all ΔC 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 ΔC terms are preceded by a minus sign ($-\Delta C$) to reflect their contribution to net GHG emissions.

Baseline CO_2 emissions from peat oxidation are estimated based on daily water levels in the project area relative to the peat surface, using a specific emission factor that correlates water levels with CO_2 release from oxidation. On days when the water table is at or above the peat surface (zero or a positive value, indicating flooding), CO_2 emissions from that location are assumed to be zero.

To calculate baseline CO_2 emissions from peat oxidation, for every SAU, emissions should only be estimated up until the point in time when the peat is projected to be fully depleted.

$$\Delta C_{B-SOC,x,t} = \sum_{d=1}^{D} h_{corr,BSL,x,d,t} \times 0.01 \times \frac{EF_{CO2}}{356} \quad (6)$$

Where:

Variable	Description	Unit
$\Delta C_{B-SOC,x,t}$	Net emissions from soil carbon pool in the baseline in SAU *x*, in year *t*	$tCO_2e\ ha^{-1}$
EF_{CO2}	Emission Factor; t CO_2 $ha^{-1}yr^{-1}m^{-1}$ of water level relative to peat surface[13]	98
$h_{corr,BSL,x,d,t}$	0, 1, 2, 3 …$h_{corr,d,t}$ Water table level relative to the peat surface, corrected for subsidence, in baseline, in SAU *x*, on day *d*, in year *t* (cm) (if $h_{corr,x,d,t}$ ≤0 then assume $h_{corr,x,d,t}$ =0 on day d)	-
x	*1,2, 3… x* SAU in project area	-
d	*1, 2, 3 … 365 days of year t*	
t	1, 2, 3, … t_{max} years elapsed since the project start date	-

The emission factor used above is derived from a study of greenhouse gas fluxes in tropical peatlands across Southeast Asia[14]. However, Project Proponents may utilize a different emission factor if they can provide evidence demonstrating that it is compatible to jurisdictional conditions.
It is assumed that as drainage causes the peat layer to subside, the vertical distance between the water level and the peat surface decreases. To reflect the lower CO_2 emission rates that occur because of this ongoing subsidence, the water table levels are adjusted annually based on an average rate at which the peat layer is sinking.

[13] Hooijer, A., S. Page, J. Jauhiainen, W. A. Lee, X. X. Lu, A. Idris, and G. Anshari. 2012. Subsidence and carbon loss in drained tropical peatlands. Biogeosciences, 9, 1053–1071.
[14] Ibid

$$h_{corr,BSL,x,d,t} = h_{x,d,t} - (t \times S_p) \quad (7)$$

Where:

Variable	Description	Unit
$h_{corr,BSL,x,d,t}$	0, 1, 2, 3…$h_{corr,t}$ Water table level relative to the peat surface, corrected for subsidence, in SAU *x*, on day *d*, in year *t* (cm) (maximum 100 cm) (if $h_{x,d,t}$ ≤0 then assume $h_{x,d,t}$ =0 on day *d*)	$tCO_2e\ ha^{-1}$
$h_{corr,BSL,x,d,t}$	*0, 1, 2, 3…h* water table level relative to the peat surface in SAU *x*, on day *d*, in year *t* (cm) (maximum 100 cm)	cm
S_p	Peat subsidence rate	-
x	*1,2, 3… x* SAU in project area	-
d	*1, 2, 3 … 365 days of year t*	
t	1, 2, 3, … t_{max} years elapsed since the project start date	-

To determine the peat subsidence rate, Project Proponents have the option to calculate it using time-series vertical deformation data[15], potentially derived from sources such as UAVs, or alternatively, they can utilize published subsidence rates specific to Malaysia. The PDD, under the Water Table Assessment section, must provide a comprehensive elaboration of the subsidence dynamics relevant to the project area.

5.3 Project Emissions

The project net GHG emissions are calculated as below. The detailed calculation methods for each carbon stock and emission source for forest fire can be found in **FCO Tool: GHG Quantification Equations**.

$$\Delta GHG_{FCO,t} = (\textstyle\sum_{x=0}^{x} -\Delta C_{FCO,x,t} \times A_x) + GHG_{FF,t} \quad (8)$$

$$\Delta C_{FCO,t} = \Delta C_{FCO,CO2,x,t} \quad (9)$$

Where:

Variable	Description	Unit
$\Delta GHG_{FCO,t}$	Net project GHG emissions, in year *t*	tCO_2e
$\Delta C_{FCO,x,t}$	Net project GHG emissions in grid *x*, in year *t*	$tCO_2e\ ha^{-1}$
$\Delta C_{FCO,CO2,x,t}$	Net carbon stock change in all carbon pools in the project scenario in SAU *x*, in year *t*	$tCO_2e\ ha^{-1}$
$GHG_{FF,t}$	Refer to **FCO Tool: GHG Quantification Equations** for the complete substitutions	tCO_2e
A_x	Area of SAU (each grid unit)	-
x	*1,2, 3… x* SAU in project area	-
t	1, 2, 3, … t_{max} years elapsed since the project start date	-

[15] Julzarika, A. (2023). Land Subsidence Dynamics in Malaysia Based on Time-Series Vertical Deformation Using Modified D-INSAR Sentinel-1. *PLANNING MALAYSIA*, *21*(29). https://doi.org/10.21837/pm.v21i29.1374

For all ΔC 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 ΔC terms are preceded by a minus sign ($-\Delta C$) to reflect their contribution to net GHG emissions.

While initial aboveground tree biomass might be zeroed out for the carbon accounting of rewetting benefits, the development of new, native peatland vegetation (including some shrubs and specialized trees adapted to wet conditions) will contribute to aboveground biomass carbon stocks over the long term in a healthy, rewetted peatland. However, the immediate and most significant carbon benefit of rewetting comes from the restoration of soil carbon sequestration. Hence the aboveground tree biomass for project is also assumed zero.

$$\Delta C_{FCO,CO2,x,t} = -\Delta C_{AB\_tree,x,t} - \Delta C_{FCO-SOC,x,t} \quad \textbf{(10)}$$

$$\Delta C_{AB\_tree,x,t} = 0 \quad \textbf{(11)}$$

Where:

Variable	Description	Unit
$\Delta C_{FCO,CO2,x,t}$	Net carbon stock change in all pools in the baseline in SAU *x*, in year *t*	$tCO_2e\ ha^{-1}$
$\Delta C_{AB\_tree,x,t}$	Net carbon stock change in the aboveground tree biomass pool in the baseline in SAU x, in year t	$tCO_2e\ ha^{-1}$
$\Delta C_{FCO-SOC,x,t}$	Net emissions from soil carbon pool in the project scenario in SAU *x*, in year *t*	$tCO_2e\ ha^{-1}$
x	*1,2, 3… x* SAU in project area	-
t	1, 2, 3, … t_{max} years elapsed since the project start date	-

For all ΔC 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 ΔC terms are preceded by a minus sign ($-\Delta C$) to reflect their contribution to net GHG emissions.

To calculate baseline CO_2 emissions from peat oxidation, for every SAU, emissions should only be estimated up until the point in time when the peat is projected to be fully depleted.

$$\Delta C_{FCO-SOC,x,t} = \sum_{d=1}^{D} h_{corr,FCO,x,d,t} \times 0.01 \times \frac{EF_{CO2}}{356} \quad \textbf{(12)}$$

Where:

Variable	Description	Unit
$\Delta C_{FCO-SOC,x,t}$	Net emissions from soil carbon pool in the project scenario in SAU *x*, in year *t*	$tCO_2e\ ha^{-1}$
EF_{CO2}	Emission Factor; t CO_2 $ha^{-1}yr^{-1}m^{-1}$ of water level relative to peat surface[16]	98
$h_{corr,FCO,x,d,t}$	0, 1, 2, 3 …$h_{corr,d,t}$ Water table level relative to the peat surface, corrected for subsidence, in project, in SAU *x*, on day *d*, in year *t* (cm) (if $h_{corr,x,d,t}$ ≤0 then assume $h_{corr,x,d,t}$ =0 on day d)	-

[16] *Hooijer, A., S. Page, J. Jauhiainen, W. A. Lee, X. X. Lu, A. Idris, and G. Anshari. 2012. Subsidence and carbon loss in drained tropical peatlands. Biogeosciences, 9, 1053–1071.*

Variable	Description	Unit
x	*1,2, 3…* x SAU in project area	-
d	*1, 2, 3 … 365 days of year t*	
t	1, 2, 3, … t_{max} years elapsed since the project start date	-

Similar to Baseline Emissions, the emission factor used above is derived from a study of greenhouse gas fluxes in tropical peatlands across Southeast Asia[17]. However, Project Proponents may utilize a different emission factor if they can provide evidence demonstrating that it is compatible to jurisdictional conditions.

As for the variable $h_{corr,FCO,x,d,t}$, kindly refer to the Equation 7 from Section 6.2. Similar condition applies for the project emissions as the Project Proponent shall either calculate it using time-series vertical deformation data[18], potentially derived from sources such as UAVs, or alternatively, they can utilize published subsidence rates specific to Malaysia. The PDD, under the Water Table Assessment section, must provide a comprehensive elaboration of the subsidence dynamics relevant to the project area.

[17] *Ibid*
[18] *Julzarika, A. (2023). Land Subsidence Dynamics in Malaysia Based on Time-Series Vertical Deformation Using Modified D-INSAR Sentinel-1. PLANNING MALAYSIA, 21(29). https://doi.org/10.21837/pm.v21i29.1374*

5.4 Leakage Emissions

Leakage is the rise in GHG emissions occurring outside the project area that can be directly linked and measured because of the project activity. The types of leakage to be considered include market leakage, activity-shifting leakage, and ecological leakage.

Regarding market and activity-shifting leakage, this methodology shall not account for them because baseline emissions do not include emissions from deforestation and degradation. Consequently, the project scenario shall not include reductions from preventing these activities, and importantly, no agents causing deforestation or drainage are present in the project area at the start (as per the applicability conditions).

Regarding ecological leakage, even though rewetting within the project might lead to increased methane (CH_4) emissions outside the project boundaries, these are considered minimal (de minimis) because they are less than 5% of the carbon dioxide (CO_2) emissions. Therefore, it's a conservative approach to not account for emissions from ecological leakage.

5.5 Net GHG Emission Reductions and Removals

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

$$NER = GHG_{BSL} - GHG_{FCO} \quad \textbf{(13)}$$

Where:

Variable	Description	Unit
$\boldsymbol{NER}$	Net CO_2 emissions reductions/removals from project activity	tCO_2e
$\boldsymbol{GHG_{FCO}}$	Net CO_2 emissions in the project scenario	tCO_2e
$\boldsymbol{GHG_{BSL}}$	Net CO_2 emissions in the baseline scenario	tCO_2e

A positive $\boldsymbol{NER}$ 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 $\boldsymbol{NER}$ implies that the FCO project results in higher emissions or lower removals than the baseline.

5.6 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**.

5.7 Calculation of Verified Forest Carbon Units

The calculation of FCO units issued must account for the buffer credits deposited in the FCO Buffer Account.

The number of FCO units is calculated as follows:

$$FCO_{t2} = (adj\_NER_{t2} - adj\_NER_{t1}) * (1 - Buffer\_Factor_{t2}) \quad \textbf{(14)}$$

Where:

Variable	Description	Unit
FCO_t	Number of FCO 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 pooled buffer account in year t2	%

The buffer contribution to address non-permanence risk shall be determined using the **FCO Tool: Buffer Risk Assessment**, which applies a risk-based calculation across defined risk categories. Where a local jurisdiction has established a recognized buffer or insurance mechanism that demonstrably addresses non-permanence, the project may follow the jurisdictional approach, subject to MFF's approval and alignment with the tool.

6 Monitoring

6.1 Monitoring Plan

This section outlines the monitoring framework required to ensure the integrity, transparency, and accuracy of WE: A/R 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. Key components include:

- **Data and Parameters at Validation:** Specifies the baseline variables that must be confirmed before project initiation, including forest area change and deforestation rates.
- **Ongoing Monitoring Requirements:** Details the spatial, temporal, and carbon stock data that must be collected at regular intervals (typically every 3–5 years), using remote sensing, field measurements, and geolocation tools.
- **Monitoring Plan Development:** Describes the structure of a comprehensive monitoring plan, including procedures for data collection, quality assurance, uncertainty management, and documentation.
- **Baseline Renewal Protocols:** Establishes the criteria and frequency for reassessing baseline scenarios to reflect evolving land-use dynamics and maintain conservative estimates.

6.1.1 Monitoring of Project Area

The project area will be monitored to verify its adherence to the boundaries defined in the project description and to confirm the project proponent's continued control over the entire designated area. Additionally, the geographic location of all constructed dams will be monitored to ensure they are situated within the project's boundaries.

The Table 4 Illustrative Monitoring Framework for Rewetting Project Implementation below serves as an illustrative example for Project Proponents to guide the development of their comprehensive monitoring plan. While it outlines key parameters, developers are encouraged to further refine and expand upon these elements to precisely align with the specific objectives, ecological context, and proposed methodologies detailed within their PDD.

Table 4 Illustrative Monitoring Framework for Rewetting Project Implementation

Monitoring Parameter	Monitoring Frequency	Monitoring Method & Unit	Responsible Party	Remark
Project Area Conformance	Quarterly	GPS surveys, remote sensing analysis (e.g., drone imagery) & Ha	Project Manager	Verify that the actual project area remains consistent with the boundaries outlined in the project description.
Project Proponent Control	Annually	Site inspections, land ownership/lease documentation review & (Yes/No)	Project Manager	Confirm that the project proponent maintains legal and operational control over the entire designated project area.
Dam/ Ditches etc. Geographic Location	Post Construction, Annually	GPS Surveys & GPS Coordinates	Engineering Team	Verify that all constructed dams / ditches etc. are located within the defined project boundaries. Record coordinates for each structure
Water Level relative to peat surface	Daily / Weekly	Water level loggers installed in monitoring wells & cm	Hydrology Team	Measure and record the water table depth relative to the peat surface at designated monitoring points. Frequency should be sufficient to capture seasonal variations and the impact of rainfall events.
Peat Subsidence Rate	Annually	Time-series vertical deformation data (e.g., leveling surveys, UAV analysis), or reference published rates & mm/year	Hydrology Team / Survey Team	Calculate or reference the annual rate of peat subsidence within the project area. Specify the methodology used. This should be elaborated upon in the PDD's Water Table Assessment section.
Fixed Point Photography	Quarterly/ Annually	Repeat photography from established, marked locations & Visual (Images)	All teams	Capture visual evidence of site conditions and restoration progress from fixed locations. Locations should be numbered and mapped.

This adaptable framework should be considered a starting point, allowing for the integration of additional relevant variables, adjustments to monitoring frequency and methods based on site-specific conditions and the advice of relevant experts, ultimately ensuring an effective monitoring program for the peatland rewetting projects.

6.1.2 Monitoring of Project Emissions

Project emissions are calculated using the same methodology applied to determine both baseline and estimated project emissions, with the added step of accounting for any potential increase in emissions due to peat fires occurring within the rewetted areas.

$$\Delta C_{FCO,x,t} = \Delta C_{FCO,CO2,x,t} + GHG_{FCO,x,t} + \Delta C_{FCO,Rev,x} \quad \textbf{(15)}$$

Where:

Variable	Description	Unit
$\Delta C_{FCO,x,t}$	Net project GHG emissions in SAU *x*, in year *t*	tCO_2e
$\Delta C_{FCO,CO2,x,t}$	Net carbon stock change in all carbon pools in the project scenario in SAU *x*, in year *t*	$tCO_2e\ ha^{-1}$
$GHG_{FCO,x,t}$	Non-CO2 emissions taking place in the project SAU *x* in year *t*	$tCO_2e\ ha^{-1}$
$\Delta C_{FCO,Rev,x}$	Project emissions reversal due to from fire in SAU *x*	$tCO_2e\ ha^{-1}$
x	*1,2, 3… x* SAU in project area	-
t	1, 2, 3, … t_{max} years elapsed since the project start date	-

While rewetting peatlands is expected to decrease the likelihood of fires, they can still happen. Any fires within the project area must be tracked, and their spatial extent mapped. If a fire occurs in a specific SAU where emission reductions were previously claimed, then all those past emission reductions within that SAU must be counted as project emissions in the year the fire occurs. The following equation accounts for fire emissions during project.

$$\Delta C_{WRC,x,t} = \Delta C_{BSL,x,t} - \Delta C_{FCO,x,t} \quad \textbf{(16)}$$

$$\Delta C_{WRC,x} = \sum_{t=1}^{t_{max}} \Delta C_{WRC,x,t} \quad \textbf{(17)}$$

If $\Delta C_{WRC,x}$ < 0 then $\Delta C_{FCO,Rev,x} = 0$ else: $\Delta C_{FCO,Rev,x}$ = $\Delta C_{WRC,x}$ **(18)**

Where:

Variable	Description	Unit
$\Delta C_{FCO,Rev,x}$	Project emissions reversal due to from fire in SAU *x*	$tCO_2e\ ha^{-1}$
$\Delta C_{WRC,x}$	Total net greenhouse emission reductions in SAU *x*, since project start date	$tCO_2e\ ha^{-1}$
$\Delta C_{WRC,x,t}$	Total net greenhouse emission reductions in SAU *x*, in year *t*	$tCO_2e\ ha^{-1}$
$\Delta C_{BSL,x,t}$	Net baseline GHG emissions in grid *x*, in year *t*	$tCO_2e\ ha^{-1}$
$\Delta C_{FCO,x,t}$	Net project GHG emissions in SAU *x*, in year *t*	tCO_2e

Variable	Description	Unit
x	*1,2, 3… x* SAU in project area	-
t	1, 2, 3, … t_{max} years elapsed since the project start date	-

6.2 Data and Parameters

6.2.1 Data and Parameters at Validation

Variables	Definition	Unit	Equation
EF_{co2}	Emission factor, based on a review of GHG fluxes from tropical peatlands in Southeast Asia	$tCO2\ ha^{-1}\ yr^{-1}\ m^{-1}$	6, 12
S_p	Peat subsidence rate	cm/year	7
h	water table level relative to the peat surface,	cm	6, 7, 12

6.2.2 Data and Parameters Monitored

Variables	Definition	Unit	Equation
EF_{co2}	Emission factor, based on a review of GHG fluxes from tropical peatlands in Southeast Asia	$tCO2\ ha^{-1}\ yr^{-1}\ m^{-1}$	6, 12
S_p	Peat subsidence rate	cm/year	7
h	water table level relative to the peat surface,	cm	6, 7, 12
Location and construction date of the dam, ditches etc. in the project area	Location and date of the constructions commencement and maintained.	Coordinates, Date	NA
Area burned	Area burned, and SAU *x* burned at time *t* in the project area.	Hectares	NA
Land use in excluded area	Land use activities in area of interest not included in the project area	NA	NA

7 General Reference

(EPA), E. P. (n.d.). *US EPA*. Retrieved from Healthy Watershed(s) Protection Programme: https://www.epa.gov/climate-change-water-sector/healthy-watersheds-program#:~:text=The%20Healthy%20Watersheds%20Program%20(HWP,water%2C%20productive%20fisheries%2C%20and%20outdoor

A. Hooijer, S. P. (2012). Subsidence and carbon loss in drained tropical peatlands. *European Geoscience Union*.

Atriyon Julzarika [Research Centre for Geospatial, N. R. (September 2023). *Land Subsidence Dynamics in Malaysia Based on Time-Series Vertical Deformation Using Modified D-INSAR Sentinel-1.* Malaysia : Planning Malaysia.

Ballhorn, U. (2012). *Airborne and spaceborne LiDAR data as a measurement tool for peatland topography, peat fire burn depth, and forest above ground biomass in Central Kalimantan, Indonesia.* München: Ludwig-Maximilian-Universität München.

Kingdom, I. |. (2024). *Field Protocol Version 2.1, Assessing Eligibility, Determining Baseline Condition Category and Monitoring Change - Peatland Code.* United Kingdom: IUCN | National Committee United Kingdom.

Ministry of Natural Resources and Environment Malaysia, U. (April 2008). *Peat Swamp Forests - Conservation and Sustainable Use.* Malaysia.

Nursugi, T. a. (2020). Peat Dome Conservation and Its Problems Based on Geomorphometry: Case Study in Tebing Tinggi Island. *IOP Conference Series on Earth & Environmental Science* | *IOP Conf. Ser.: Earth Environ. Sci. 412 012031*.

Scott G. Leibowitz, P. J. (2018). Connectivity of Streams and Wetlands to Downstream Waters: An Integrated Systems Framework. *JAWRA Journal of the American Water Resources Association*.

Sulaeman, D. (2023, October 5). *World Research Institute Indonesia*. Retrieved from “What is Peat Subsidence and How can Countries Prevent this Natural Disaster?”: https://wri-indonesia.org/en/insights/what-peat-subsidence-and-how-can-countries-prevent-environmental-disaster

Types of Peatlands – International Peatland Society. Craft, C., 2016. Creating and Restoring Wetlands: From Theory to Practice. Elsevier | Joosten, H. & Clarke, D. 2002: Wise Use of Mires and Peatlands. (n.d.).

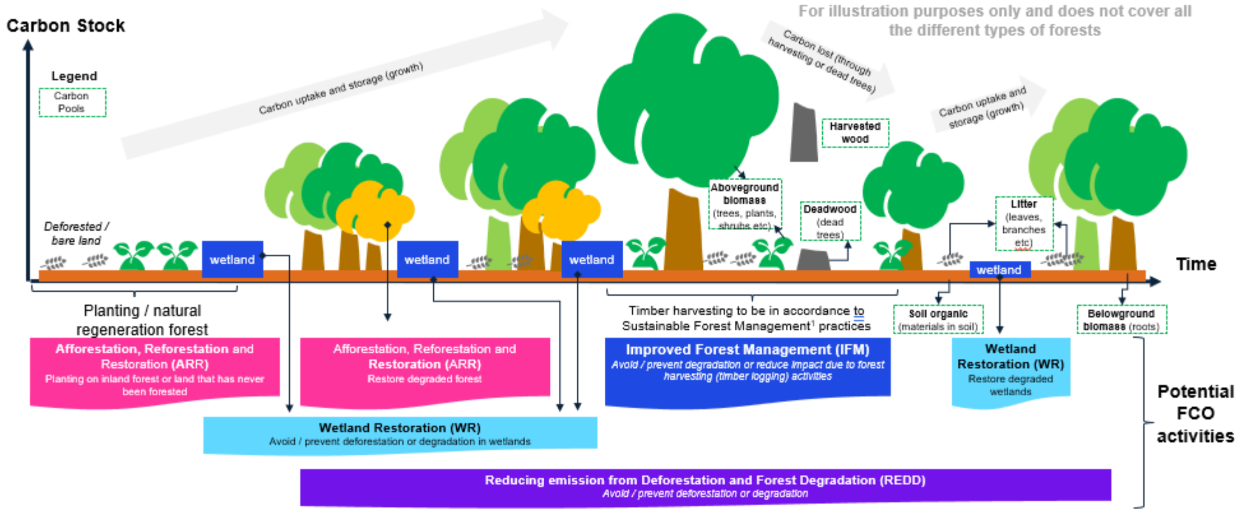
WWF Indonesia, W. G. (2014). *VM0027 Methodology for Rewetting Drained Tropical Peatlands, VErsion 1.0, Sectoral Scope 14.* Verified Varbon Standard (VCS).

IX. ANNEXES (PLACEHOLDER)

A1. Annex 1

General Principles: Forest lifecycle and proposed FCO activities

The amount and distribution of carbon stored in various forest pools change over time, influenced by factors such as forest age, tree species, disturbances from natural events or human activities, and soil characteristics like texture and drainage.



[1]Source Malaysia Policy on Forestry on Selective Management System (SMS) - Implement sustainable logging practices by harvesting mature, high-quality trees, promoting the growth of younger trees, and maintaining the forest ecosystem through detailed inventories, replanting activities, and adherence to minimum cutting limits, with typical cutting cycles ranging between 25 to 30 years and each state having an Annual Allowable Coupe (AAC).