KATINGAN PEATLAND RESTORATION AND CONSERVATION PROJECT

MONITORING & IMPLEMENTATION REPORT COVER PAGE

i. Project name:

The Katingan Peatland Restoration and Conservation Project (The Katingan Project)

ii. Project location (Country, Sub-national jurisdiction(s))

Mendawai, Kamipang, Seranau and Pulau Hanaut sub-districts of Katingan and Kotawaringin Timur districts, Central Kalimantan, Republic of Indonesia

iii. Project proponent (organization and contact name with the email address and telephone number)

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v. Project start date, GHG accounting period and lifetime

Project start date: November 1, 2010
GHG accounting period: November 1, 2010 to October 31, 2070 (60 years)
Project lifetime: November 1, 2010 to October 31, 2070 (60 years)

vi. The project implementation period covered by the PIR (Monitoring and Implementation Report)

November 1, 2010 to October 31, 2015

vii. History of CCB Status including issuance date(s) of earlier Validation/Verification Statements etc.
The Katingan Project is concurrently completing the CCB Validation. The project completed validation against the Verified Carbon Standard on May 11, 2016.

viii. The edition of the CCB Standards being used for this verification
CCB Standards Third Edition

ix. A brief summary of the climate, community and biodiversity benefits generated by the project since the project start date and during the current implementation period covered by the PIR
The Katingan Project's goal is to protect and restore 149,800 hectares of peatland ecosystems, to offer local people sustainable sources of income, and to tackle global climate change – all based on a solid business model. The project area stores vast amounts of CO2, and plays a vital role in stabilizing water flows, preventing devastating peat fires, enriching soil nutrients and providing clean water. It is rich in biodiversity, being home to large populations of many high conservation value species, including some of the world's most endangered; such as the Bornean Orangutan (*Pongo pygmaeus*) and Proboscis Monkey (*Nasalis larvatus*). It is surrounded by villages for which it supports traditional livelihoods including farming, fishing, and non-timber forest products harvesting.

The project's achievements during this Monitoring Period include:
A) Climate benefits

- Achieved emissions reductions of 12,748,612 tons of GHG through avoided deforestation and forest degradation, prevention of peat drainage, and minimizing fires and fire damage
- Ecological enhancement at the landscape scale through ecosystem restoration

B) Community benefits

- Conducted participatory planning to identify community boundaries and goals
- Provided training for community members hired by the project
- Supported initiation of community-led enterprises and ensured long-term success and self-sufficiency through microfinancing and training
- Enabled community sanitation and renewable power projects

C) Biodiversity benefits

- Reduced threat of drivers of deforestation and forest degradation to stabilize healthy populations of faunal and floral species in the project zone
- Enhanced natural habitats and ecological integrity through ecosystem restoration

x. Which optional Gold Level criteria are being used and a brief summary of the exceptional benefits generated by the project to meet the requirements of each relevant Gold Level
The Katingan Project seeks to achieve all climate, community and biodiversity Gold Level criteria.

A) Climate Gold Standard
The Katingan Project has provided significant support and benefits to the project-zone communities in coping with and adapting to the expected impacts of climate change in coming years. The project has strengthened community and biodiversity resilience through various project activities, including restoration of peat swamp ecosystems and reforestation, climate resilient infrastructural development, adjustment and diversification of agroforestry and agricultural practices, capacity building for forest management and non-timber forest product development, and the implementation of integrated natural disaster prevention and management systems.

B) Community Gold Standard
The project zone is qualified as a rural area of a high concentration of population living under the national poverty line, and the Katingan Project delivers significant well-being benefits to smallholders/community members. The project has benefited communities through a variety of socio-economic activities which also target the most vulnerable and marginalized community members. This includes the poor, women, elderly and the disabled. These programs are designed to lift the poorest out of poverty by engaging them in community-based business development such as microfinance, women's empowerment, sustainable agroforestry, renewable energy development, and NTFPs. All

community programs are designed and implemented through community participation, transparent decision-making processes based on mutual trust, and proper management of project activities.

C) Biodiversity Gold Standard
The Katingan Project is qualified as a Key Biodiversity Area (KBA), and conserves and protects the biodiversity of global significance. The project has generated exceptional biodiversity benefits based on multiple achievement of the criteria defined in the CCB Standards Third Edition. This includes five species considered critically endangered, eight considered endangered, and 31 species considered vulnerable. For two of these at least, Orangutan and Proboscis Monkey, the project zone is estimated to hold over 5% of the entire global population.

xi. Date of completion of this version of the PIR, and version number as appropriate.

July 29, 2016, Version 1.2

KATINGAN PEATLAND RESTORATION AND CONSERVATION PROJECT

MONITORING & IMPLEMENTATION REPORT

Document Prepared By PT. Rimba Makmur Utama

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LIST OF ACRONYMS

APD	Avoiding Planned Deforestation
AFOLU	Agriculture, Forestry, and Other Land Use
AGB	Above Ground Biomass
ANR	Assisted Natural Regeneration
APL	Non-Forest Estate
ARR	Afforestation, Reforestation, and Revegetation
BAU	Business-As-Usual
BIG	Geospatial Information Bureau of Indonesia
C	Carbon
CDM	Clean Development Mechanism
CH_4	Methane
Co	Alluvial sediment
CO_2	Carbon dioxide
COP	Conference of the Parties
CR	Critically endangered species
CUPP	Conservation of Undrained and Partially drained Peatland
CV	Coefficient of Variation
DBH	Diameter at breast height (1.3 meter)
DEL	Drainability Elevation Limit
DEM	Digital Elevation Model
DF	Deforestation
DG	Forest Degradation
DM	Dry Matter
DOC	Dissolve Organic Carbon
EF	Emission Factor
ER	Endangered species
ERC	Ecosystem Restoration Concession
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
FORDA	Indonesian Forest Research and Development Agency
FPIC	Free, Prior and Informed Consent
FS	Feasibility Study
GHG	Greenhouse Gas
GIS	Geographic Information System
GoI	Government of Indonesia
GPS	Global Positioning System
GWP	Global Warming Potential
Ha	Hectare
HCV	High Conservation Value
HCVF	High Conservation Value Forest
HPH	Commercial Logging Concession

HPK	Conversion Production Forest
HTI	Industrial Timber Plantation
IDR	Indonesian Rupiah
IEC	Information, Education and Communication
IEPB	Initial Estimate of Peatland Border
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IUPHHK-RE	Ecosystem Restoration Concession License
LCL	Lower Confidence Limit
LiDAR	Light detection and ranging (an optical remote sensing technology)
LULC	Land Use and Land Cover
LULUCF	Land Use, Land-Use Change and Forestry
MDD	Methodology Design Document
Mg	Mega gram = 1 metric tonne
MMU	Minimum Mapping Unit
MoF	Ministry of Forestry Indonesia
MRV	Monitoring, Reporting and Verification
MT	Metric Tonne
N_2O	Nitrous Oxide
NDVI	Normalized Difference Vegetation Index
NER	Net Greenhouse Gas Emission Reduction
NGO	Non-Government Organization
NTFP	Non-Timber Forest Products
PD	Project Document
PDT	Peat Depletion Time
PRA	Participatory Rural Appraisal
PT. RMU	PT. Rimba Makmur Utama
QA/QC	Quality Assurance / Quality Control
REDD	Reduced Emissions from Deforestation and forest Degradation
REDD+	Reducing Emissions from Deforestation and Degradation Plus carbon stock enhancement
RePProt	Regional Physical Planning Program for Transmigration
RDP	Rewetting of Drained Peatland
RKT	Annual Workplan
RSA	Firefighting Team
SOC	Soil Organic Carbon
SOP	Standard Operation Procedure
SRTM	Shuttle Radar Topography Mission
tCO_2e	Metric tonne of Carbon Dioxide equivalent
TM	Landsat Thematic Mapper
TOd	Dahor formation
UKL-UPL	Environmental Management and Monitoring Programme
UNFCCC	United Nations Framework Convention on Climate Change
UU	National Act/Law
VCS	Verified Carbon Standard
VCU	Verified Carbon Unit

WB	Water Bodies
WRC	Wetland Rewetting and Conservation

1 GENERAL

1.1 Summary Description of the Project

1.1.1 Project summary

Tropical peatlands support fundamental ecological functions and store massive amounts of carbon, with belowground stocks accounting for up to 20 times the amount stored in trees and vegetation. When cleared, drained and burned to make way for plantations and other developments, this carbon is released into the atmosphere as carbon dioxide (CO_2) along with other greenhouse gases (GHG). Indonesian Borneo, known as Kalimantan, encompasses approximately 5.7 million hectares (ha) of peatland [1]. By 2020, the expansion of industrial plantations on peatlands in Kalimantan alone is estimated to contribute to 18–22% of Indonesia's total GHG emissions [2].

The Katingan Peatland Restoration and Conservation Project ('The Katingan Project') seeks to protect and restore 149,800 hectares of peatland ecosystems, to offer local people sustainable sources of income, and to tackle global climate change – all based on a solid business model. The project lies within the districts of Katingan and Kotawaringin Timur in Central Kalimantan Province, and covers one of the largest remaining intact peat swamp forests in Indonesia. The area stores vast amounts of CO_2, and plays a vital role in stabilizing water flows, preventing devastating peat fires, enriching soil nutrients and providing clean water. It is rich in biodiversity, being home to large populations of many high conservation value species, including some of the world's most endangered; such as the Bornean Orangutan (*Pongo pygmaeus*) and Proboscis Monkey (*Nasalis larvatus*). It is surrounded by villages for which it supports traditional livelihoods including farming, fishing, and non-timber forest products harvesting.

The project area is located entirely within state-designated production forest. Without the project, the area would be converted to fast-growing industrial timber plantations, grown for pulpwood. The Katingan Project prevents this fate by having obtained full legal control of the production forest area through an Ecosystem Restoration Concession license (ERC; Minister of Forestry Decree SK 734/Menhut-II/2013) and Principle License (RATTUSIP) (Letter no 25/1/SK/S-IUPHHK-RE/P-MON/2016), blocking the applications of plantation companies from the entire project area.

The Katingan Project implemented a variety of activities through a holistic approach in order to achieve its objectives. All activities were implemented with full consideration of internationally credible science and standards, conservation priorities, Indonesian laws and regulations, land tenure, socio-economic needs, and community consultation based on free, prior and informed consent principles. The Katingan Project is performance-based and, at its core, is financed by its achieved GHG emission reductions and sequestrations against a baseline scenario during the initial crediting period of 60 years. Through the implemented activities described in this report, the project has achieved emissions reductions of 12,748,612 tons of GHG emissions during the first monitoring period. In addition, the project has achieved positive social and biodiversity outcomes as described later in this report.

The Katingan Project is managed by the Indonesian company PT. Rimba Makmur Utama and is designed to ensure that all benefits are real, long-lasting, and passed on to local communities, the region, and to the wider State of Indonesia in which it operates. The Katingan Project aims to continue to bring positive change over the next 60 years by conserving the integrity of remaining peat swamp forest, and by playing a crucial role for Indonesia as it sets out to fulfil its emissions reduction commitments in the years ahead.

1.1.2 Project objectives

The goal of the Katingan Project is to develop and implement a sustainable land use model through reducing deforestation and degradation, habitat and ecosystem restoration, biodiversity conservation, and increasing economic opportunities for the local people of Central Kalimantan. The Katingan Project is designed to achieve this through a series of objectives, considered in turn below:

A) Climate objectives

- To deliver credible GHG emissions reductions through avoided deforestation and forest degradation, prevention of peat drainage and fires
- To enhance ecological values at the landscape scale through ecosystem restoration
- To conduct research and development (R&D) activities as to implement the latest science, research and management practices

B) Community objectives

- To enhance the quality of life and reduce poverty of the project-zone communities by creating sustainable livelihood options and economic opportunities
- To strengthen community resilience by increasing capacity to cope with socio-ecological risks
- To maintain and enhance ecosystem services for the overall well-being of the project-zone communities through ecosystem restoration
- To conduct research and development (R&D) activities as to implement the latest science, research and management practices

C) Biodiversity objectives

- To eliminate drivers of deforestation and forest degradation and to stabilize and maintain healthy populations of faunal and floral species in the project zone through biodiversity conservation and protection
- To maintain natural habitats and ecological integrity through ecosystem restoration
- To conduct research and development (R&D) activities as to implement the latest science, research and management practices

1.2 Project Location

1.2.1 Project geographic boundaries

The project is located in the Mendawai, Kamipang, Seranau and Pulau Hanaut sub-districts of Katingan and Kotawaringin Timur districts, Central Kalimantan, Republic of Indonesia (see Map 1). The project lies within the following geographic boundaries: S2° 32’ 36.8" to S3° 01' 43.6" E113° 00' 29.7" to E113° 18' 57.4".

Map 1. Location of the Katingan Project in Kalimantan, Indonesia

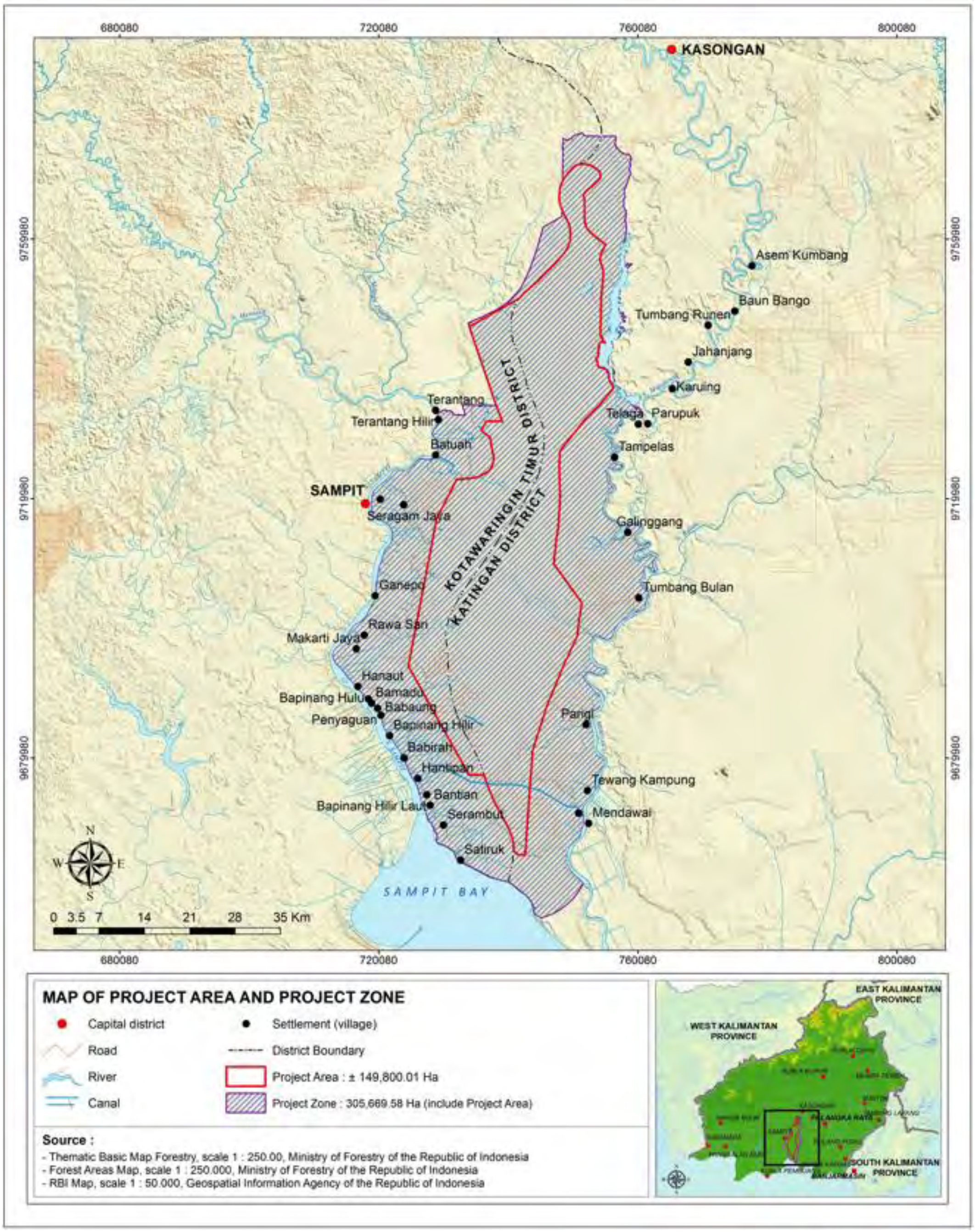
1.2.1.1 Project area

The project area encompasses 149,800 ha of land with a total perimeter of 254.12 km (see Map 2). The project area boundary delineates the area in which GHG emission reductions are quantified. The project area is described in more detail below.

1.2.1.2 Project zone

The wider project zone represents the extent of the area in which the project activities are implemented. It extends to the banks of the Mentaya River in the west and the Katingan River in the east, and encompasses bordering areas to the north and south of the project area, covering an area of 305,669 ha (see Map 2). The project zone was selected based on the dominant ecological, landscape and socio-economic features and in particular to include the main river catchments and to encompass the land of 34 villages likely to be affected by the project. No additional areas beyond the project zone are expected to be directly affected by the project.

Map 2. The location of the project area and project zone



1.2.2 Basic physical parameters

1.2.2.1 Geology and soils

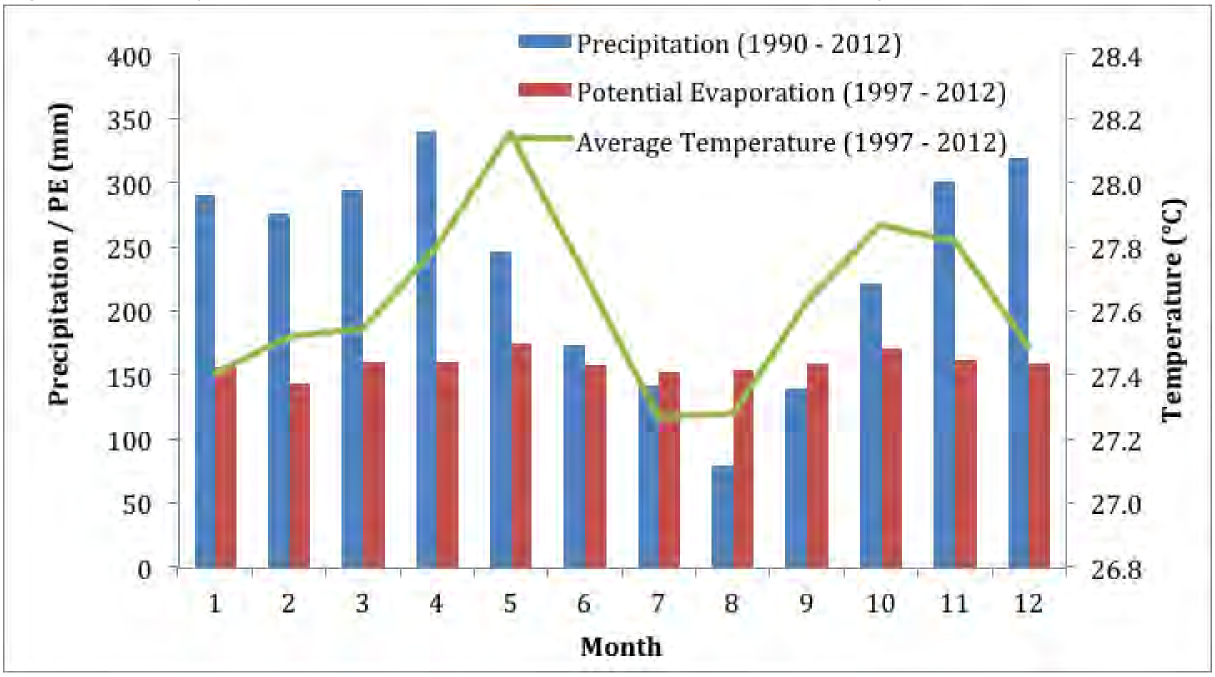
The project area is almost entirely based on peat soils (97%), with the remainder made up of exposed alluvial deposits of sand silt, kaolinite clay and gravel. Peat soils are defined as organic soils with at least 30% organic matter and a minimum thickness of 50 cm. They were formed by a process that began thousands of years ago and which continues to the present day. The formation of peat soil is a result of constant conditions of water logging above mineral soil and a lack of oxygen, in which a large amount of organic residues are accumulated at a higher rate than they can be decomposed [3]. Peat layers in the project area store an enormous amount of organic matter, and play an important role as an ecological reservoir for greenhouse gasses such as CO_2, nitrous oxide (N_2O), and methane (CH_4).

Underlying the peat, the project area has two distinct geologies. Stretching from north to south over the eastern part of the project, the underlying geology is made up of alluvial deposits, while in the north-western part of the project area the underlying geology is predominantly dahor formations consisting of quartz sandstone, lignite and limonite soft clay [4].

1.2.2.2 Climate

The project area has a wet tropical climate with an average annual precipitation of around 2,820 mm and approximately 196 rainy days per year (monthly record from Haji Assan Sampit Airport Station 1990 – 2012). Precipitation is highly seasonal with the highest average monthly rainfall typically occurring in November – April (wet season), while the lowest average monthly rainfall occurs in August (see Figure 1). Daytime temperatures are very stable year-round, averaging around 27.6°C (min 21°C, max 32°C), as is humidity, averaging 83%. Dry seasons usually last from June to September, when potential evaporations are close to or exceed precipitations. Additional detail about the climate of the area is given in Annex 1 of the Project Design Document (PD).

Figure 1. Monthly rainfall, potential evaporation and temperature in the project area



1.2.2.3 Hydrology

The project area is situated on top of the Katingan peat dome. Hydrology in the project area is characterized by the seasonal recharge in the wet season and recessive discharge in the dry season. Due to the raised nature of the inter-lying peat dome, the flood plains of the two major rivers – Katingan and Mentaya rivers – extend only a short distance from the riverbanks into the forest. The inter-lying peat dome therefore receives little nutrient influx from these river floodplains, and can be classified as an “ombrogenous” peat swamp [5]. In such peat swamps the source of nutrients is often limited to aerial precipitation (i.e., rain and dust), with small amounts of nutrient influx from microbial nitrogen fixation and animal faeces. While brackish backwater may contribute to the small portion of ground water recharge, it is limited to the southern part of the project area close to the sea.

The peat layer serves as the main aquifer in which precipitation input is stored and slowly released to blackwater streams during the dry season. Natural drainage shows a radial pattern, typical to the convex land form, with an enormous number of creeks along the footslope of the peat dome. The Mentaya and Katingan rivers serve as major tributaries to the drainage system in the project zone.
Inundation in the project area is a combined feature of seasonal excess precipitation and diurnal tidal rise. While tidal rise does not normally cause inundation, it may amplify the magnitude of recharge in the wet season. This happens when the sheer volume of blackwater discharge meets lowered head gradients downstream, leading to water level rise in tributaries due to the combined effects of the tidal and seasonal high river flows.

Output components of water balance are dominated by evapotranspiration, as indicated in Figure 1. The overland flow contributes the major portion of the annual river flow in wet season, while the ground water flow contributes to the minor portion.

For a detailed description of the hydrology of the area, please see Annex 1 of the PD.

1.3 Project Proponent

1.3.1 Contact information and roles of the project proponent

The Katingan Project is developed and managed by PT. Rimba Makmur Utama (RMU). By collaborating with the project-zone communities and partner organizations, PT. RMU takes full responsibility to manage, finance and implement project activities for the duration of the project. Table 1 shows the project proponent's information.

Table 1. Project proponent information

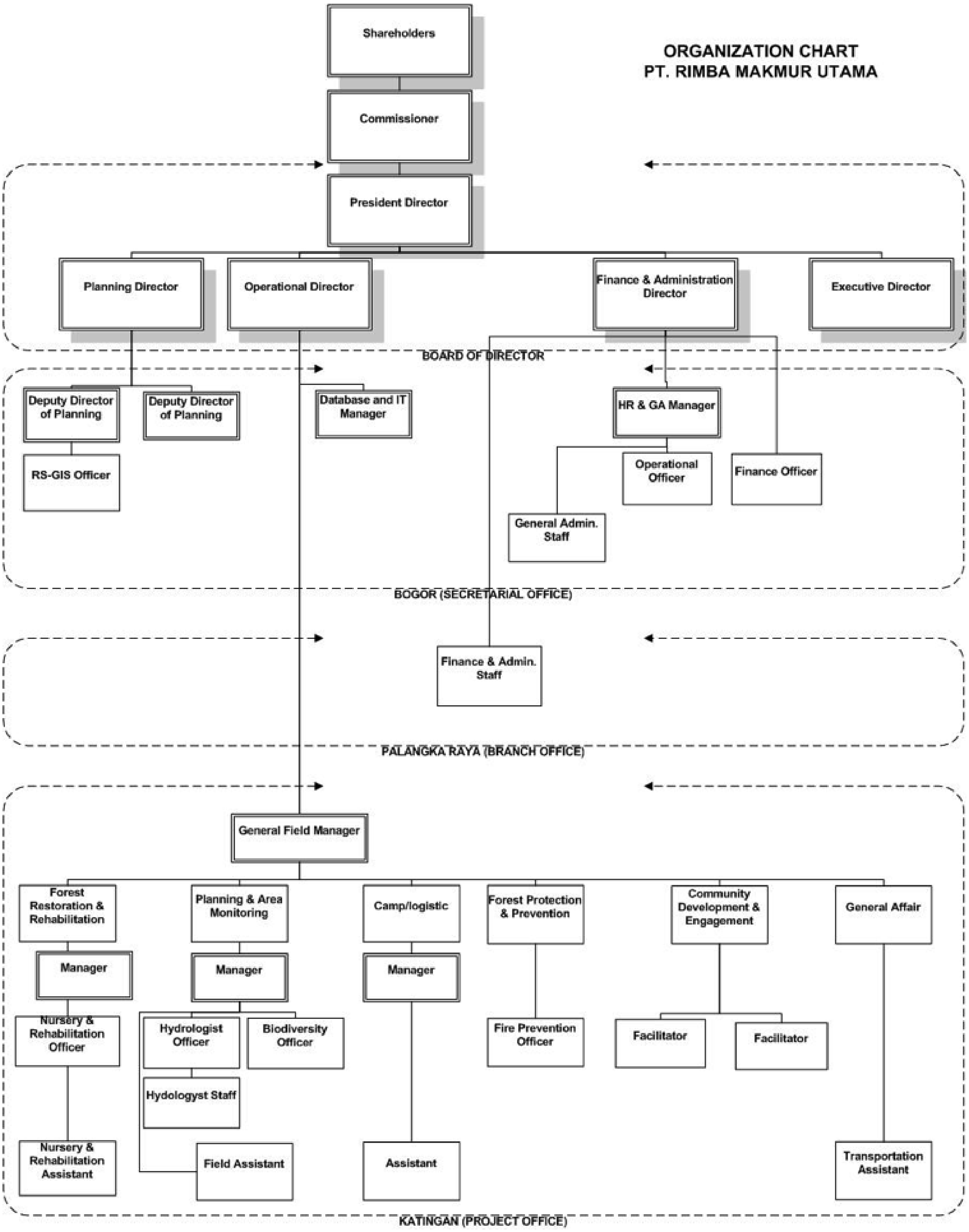
Organization	PT. Rimba Makmur Utama (PT. RMU)
Organizational category	Private company
Contact person	Dharsono Hartono, Director
Address	Menara BCA, Fl. 45, Jl. MH Thamrin No. 1, Jakarta, Indonesia Phone: +62 (0)21 2358 4777; Fax +62 (0)21 2358 4778; Mobile: +62 (0)816-976-294 dharsono@ptrmu.com
Organization's profile	PT. RMU was founded in 2007 with a mission to restore and conserve peatland in Central Kalimantan Province through a land-use permit, IUPHHK-RE, also known as ecosystem restoration concession (ERC). By using the ERC business model, PT. RMU seeks to reduce greenhouse gas emissions within the concession site and generate carbon offset credits under REDD+ mechanisms.
Project roles	PT. RMU is the project developer, ERC license holder and lead implementer. It is responsible for the overall management, financing and implementation of the Katingan Project. Proposed project activities are to be carried out in collaboration with communities in the project zone and project partners as described below.
Project management team	**Mr. Dharsono Hartono, Chief Executive Officer** Dharsono is the Chief Executive Officer (CEO) of PT Rimba Makmur Utama, an Indonesia-based company that is developing the Katingan Project. Since 1998, he has worked for multinational companies such as PricewaterhouseCoopers and JP Morgan in New York, handling merger acquisition, debt management and

	financing and raising capital. His role in PT Rimba Makmur Utama includes managing all the company's activities, especially marketing and financing in the carbon market. Dharsono obtained a bachelor's degree in Operation Research, and a Master of Engineering from Cornell University in Financial Engineering. **Mr. Rezal Kusumaatmadja, Chief Operating Officer** Rezal is the Chief Operating Officer (COO) of PT Rimba Makmur Utama. Before joining PT RMU, he was involved in the Katingan Project as co-founder of Starling Resources where he led the development of the project activities since 2008. He has more than 15 years of experience in natural resource management, community-based planning, forest conservation and sustainable forest management. Rezal is also actively involved in the international REDD+ initiatives serving as an advisory board member to the Climate and Land Use Alliance (CLUA) from 2010 until present, a member of the REDD+ Social Environmental Standards (REDD+ SES) international standards committee from 2009 to 2013, and a member of Advisory Committee VCS Jurisdictional and Nested REDD Initiative in 2012. Rezal holds a master's degree in urban and regional planning from the University of Hawaii and a bachelor's in City and Regional Planning from Cornell University.

1.3.2 Organizational structure

The organizational structure of PT RMU is shown below in Figure 2.

Figure 2. Organizational structure of PT. RMU as of June 2015



1.4 Other Entities Involved in the Project

1.4.1 Implementing and technical partners

Key implementing and technical partners are shown below.

Organization	Yayasan Puter Indonesia
Category	NGO
Contact Person	Yekti Wahyuni, Executive Director
Address	Jalan Ahmad Yani II, Nomor 11A, Bogor, 16151, Indonesia Tel/Fax: +62 (0)251-831-2836 Email: yektiwahyuni@gmail.com
Organization's profile	Yayasan Puter Indonesia is a not-for-profit organization based in Bogor with a core mission to develop and implement innovative approaches to people-based planning processes. Yayasan Puter is committed to assisting communities, CSOs, private companies as well as government agencies that share Puter's vision and mission.
Project roles	Community development activities, including: • Participatory land-use mapping • Community consultations and REDD+ awareness building • Livelihood programs

Organization	Wetlands International
Category	NGO
Contact Person	I Nyoman Suryadiputra, Director Indonesia Programme, Wetlands International
Address	Indonesia Programme office: Jl. Ahmad Yani No. 53 Bogor, 16161, Indonesia Tel: +62 251 8312189 Email: nyoman@wetlands.or.id Web: www.wetlands.org
Organization's profile	Wetlands International is an international NGO, dedicated to maintaining and restoring wetlands – for their environmental values as well as for the services they provide to people. The organization works through a network of offices (including a HQ based in the Netherlands and a Programme Office in Indonesia), with a global network of partners, specialist groups and associate experts. It receives funding from governments, private donors and a membership.
Project roles	Wetlands International leads technical aspects of MRV-related activities, including: • MRV methodology and platform development for monitoring above- and below-ground carbon emissions; • The provision of technical expertise including biodiversity management, fire management, land-use management and community development

Organization	Permian Global
Category	Company
Contact Person	Dr. Nick Brickle, Asia Director
Address	Savoy Hill House, 7-10 Savoy Hill London, WC2R 0BU, United Kingdom Tel: +44 20 3617 3310 Email: info@permianglobal.com Web: www.permianglobal.com

Organization's profile	Permian Global is an investment firm dedicated to the protection and recovery of natural forests to mitigate climate change. Permian Global comprises a team of experienced experts from the fields of science, forest conservation and asset management; committed to creating the best possible forest carbon projects.
Project roles	Technical advice and support, including: • MRV methodology design and technical support • Remote sensing • Carbon commercialization and marketing • Technical management advice including protection and restoration methods

1.4.2 Key technical skills required for project implementation

The project activities described in the PD and in this Monitoring Report have been and will continue to be implemented primarily by the project proponent, PT. RMU. The company employs a large, highly-qualified and professionally-experienced staff drawn from various backgrounds and with expertise including forest management, peatland biochemistry, conservation biology, silviculture, aquaculture, community development, financial management, business management, legal and technical regulation and policy. This team is based in headquarters in Bogor and Jakarta, within regional offices in Palangkarya and Sampit, and throughout the project zone.

In addition to in-house experts, PT. RMU collaborates with a wide-range of institutions both as implementing partners and as sources of technical advice. These institutions include those partners listed above and a range of other partners that assist the project on an issue-based or ad hoc basis, both pro bono and as contracted consultants. Amongst these partners are a range of nationally and internationally recognized scientific and technical experts, providing advice on issues such as climate science, community development, practical site management and biodiversity conservation. Furthermore, local communities are also considered to be one of the key collaborating experts since they are the source of a wealth of local and traditional knowledge.

Table 2 below summarizes some of the main project activity themes and the range of skills required for their implementation. The project's human and financial resources have been adequate to implement the project as discussed in Section 2.2 Project Activities.

Table 2. Key skills required to implement the project, by activity

Project activity	Sub-project activity	Key skills required
Ecosystem Restoration	Hydrology management; reforestation; enrichment planting; MRV	Hydrology; Carbon MRV, GIS/remote sensing; silviculture; peatland biogeochemistry
Forest Resources Conservation	Protection and enforcement; Forest fire prevention and control; Habitat conservation and management	HCV mapping, forest conservation; Peat forest fire management; biodiversity conservation, biodiversity MRV
Research and Development	Knowledge management; MRV methods; restoration methods; biodiversity conservation methods	Carbon MRV, hydrology, silviculture, peatland biogeochemistry, forest conservation, biodiversity conservation
Livelihood Development	Non-timber forest products; Agroforestry; Ecotourism; Salvaged wood production; Aquaculture and sustainable fisheries	Community organizing, conflict resolution, participatory land-use mapping, business management;

Project activity	Sub-project activity	Key skills required
		Agroforestry, peatland biogeochemistry
Community Resilience	Microfinance institutions and enterprises; Energy efficiency and production; Mother and child health care; Clean water and sanitation; Basic education support	Microfinance, community organizing, conflict resolution; Renewable energy, community organizing

1.5 Project Start Date

Following the VCS definition of start date (the date on which activities that lead to the generation of GHG emission reductions or removals are implemented), the project start date is November 1, 2010.

PT. RMU submitted a technical proposal to the Ministry of Forestry in 2008. The application was acknowledged and PT. RMU was instructed to proceed with a partial environmental impact assessment of the project area (the status known as SP-1) in 2009, hence blocking any further applications. November 1, 2010 is the date when the Katingan Project commenced field survey activities inside the project area, and it also coincides with the time when baseline emissions would have started, had the project not blocked any further applications. Therefore, this date will be used as the calculation base for the historical reference period required for setting a baseline scenario, and for the project crediting period as required by the methodological standards of the VCS guidelines.

1.6 Project Crediting Period

The duration of the VCS project crediting period is 60 years, beginning on the project start date of November 1, 2010 and ending on October 31, 2070, which is in line with the lifetime of the Katingan Project based on the term of the ecosystem restoration concession (IUPHHK-RE) held by PT RMU.

The project implementation schedule and major project milestones are listed in the tables below.

Table 3. Implementation Schedule

Activity	Activity start year
APD+CUPP	2010
Reforestation (ARR)	2016
Peatland rewetting and conservation (RDP)	2016
Fire prevention and suppression	2014
Protection and law enforcement	2014
Species conservation and habitat management	2014
Participatory planning	2010
Community-based business development	2010
Microfinance development	2010
Sustainable energy development	2010
Improved public health and sanitation services	2017
Basic education support	2014

Table 4. Major Project Milestones

Year	Event
2010	Project Begins
2010-2017	Participatory planning process
2015	Data collection, methodology revision, project documentation
2015 - 2016	VCS/CCB monitoring events and reports generated
2016	Project VCS/CCB Validation and Verification, dissemination of Verified Monitoring Reports
2014 - 2018	Nursery established
2016 - 2017	Canals blocked
2020	VCS /CCB monitoring events and reports generated
2015 - 2017	Boundary demarcation
2021	Project VCS/CCB Verification dissemination of Verified Monitoring Reports
2025	VCS/CCB monitoring events and reports generated
2026	Project VCS/CCB Verification dissemination of Verified Monitoring Reports
2030	VCS/CCB monitoring events and reports generated
2031	Project VCS/CCB Verification dissemination of Verified Monitoring Reports
2035	VCS/CCB monitoring events and reports generated
2036	Project VCS/CCB Verification dissemination of Verified Monitoring Reports
2040	VCS/CCB monitoring events and reports generated
2041	Project VCS/CCB Verification dissemination of Verified Monitoring Reports
2045	VCS/CCB monitoring events and reports generated
2046	Project VCS/CCB Verification dissemination of Verified Monitoring Reports
2050	VCS/CCB monitoring events and reports generated
2051	Project VCS/CCB Verification dissemination of Verified Monitoring Reports
2055	VCS/CCB monitoring events and reports generated
2056	Project VCS/CCB Verification dissemination of Verified Monitoring Reports
2060	VCS/CCB monitoring events and reports generated
2061	Project VCS/CCB Verification dissemination of Verified Monitoring Reports
2065	VCS/CCB monitoring events and reports generated
2066	Project VCS/CCB Verification dissemination of Verified Monitoring Reports
2070	VCS/CCB monitoring events and reports generated
2071	Project VCS/CCB Verification dissemination of Verified Monitoring Reports

2 IMPLEMENTATION OF DESIGN

The project has successfully implemented a wide variety of project activities supporting its objectives for climate, community and biodiversity. These are detailed in Section 2.2.

2.1 Sectoral Scope and Project Type

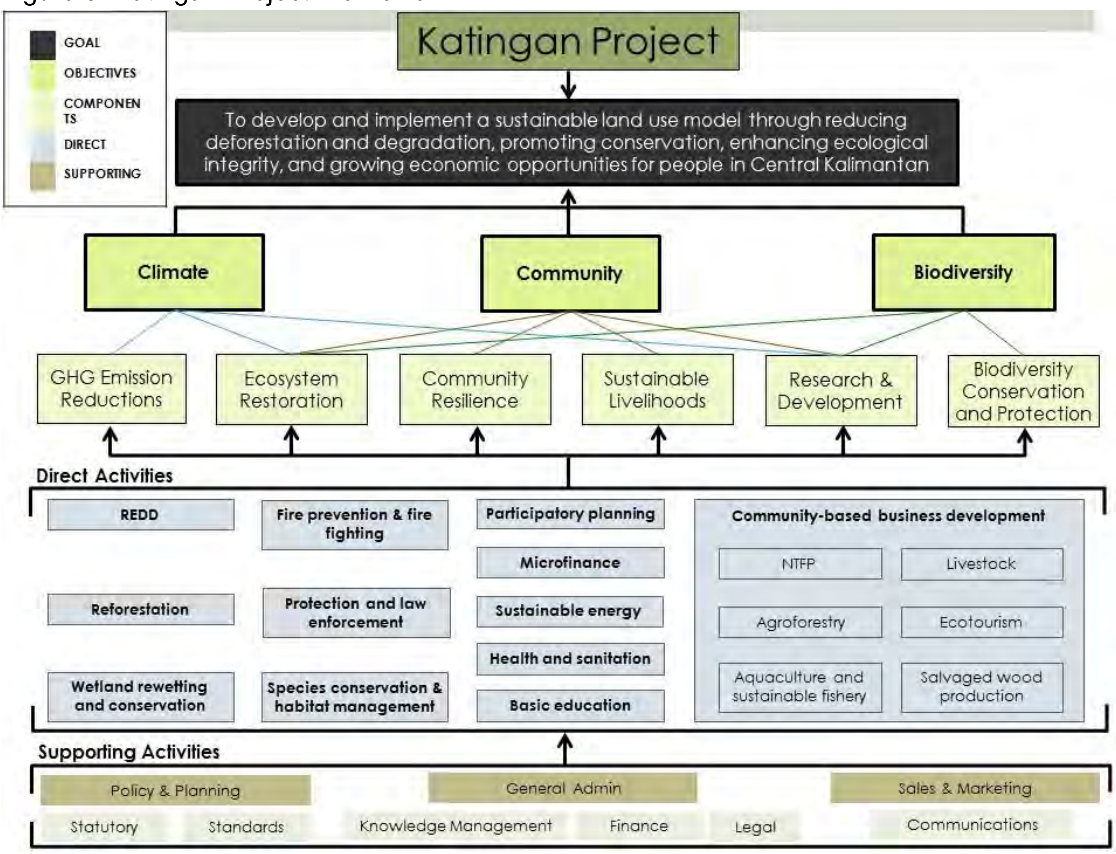
The Katingan Project is categorized as an Agriculture, Forestry and Other Land Use (AFOLU) project under the Reduced Emissions from Deforestation and Degradation (REDD) project category. The project activities are categorized under the VCS as a combination of REDD+WRC and ARR+WRC; specifically as Avoiding Planned Deforestation (APD) and Reforestation (ARR), in combination with Conservation of Undrained and Partially drained Peatland (CUPP) and Rewetting of Drained Peatland (RDP) activities. This is not a grouped project.

2.2 Description of the Project Activity

The Katingan Project's activities have successfully conserved a vast ecosystem of mostly intact peat swamp forest which would have otherwise been converted to industrial acacia plantations in the absence of the project. The project has thereby achieved net greenhouse gas emissions reductions as demonstrated in the climate monitoring section. A number of fire incidents, the worst of which occurred in 2015, did however have some impact on the GHG emissions reductions. These events, and the methods used to quantify their impact, are discussed in greater detail in the climate monitoring section.

Based on the project framework presented in Figure 3, project activities have been implemented with a full consideration of science, research, field surveys and community consultation, and have reflected the condition of surrounding ecosystems, local land tenure, conservation priorities and livelihood options. A summary of the planned activities together with a summary of progress to date is provided in the remainder of this section. A description of the impact these activities have had on biodiversity and communities is presented in the appropriate monitoring sections. No unexpected biodiversity or community impacts occurred as a result of the project's activities.

Figure 3. Katingan Project Framework



2.2.1 Avoided Deforestation and peat drainage (REDD + WRC)

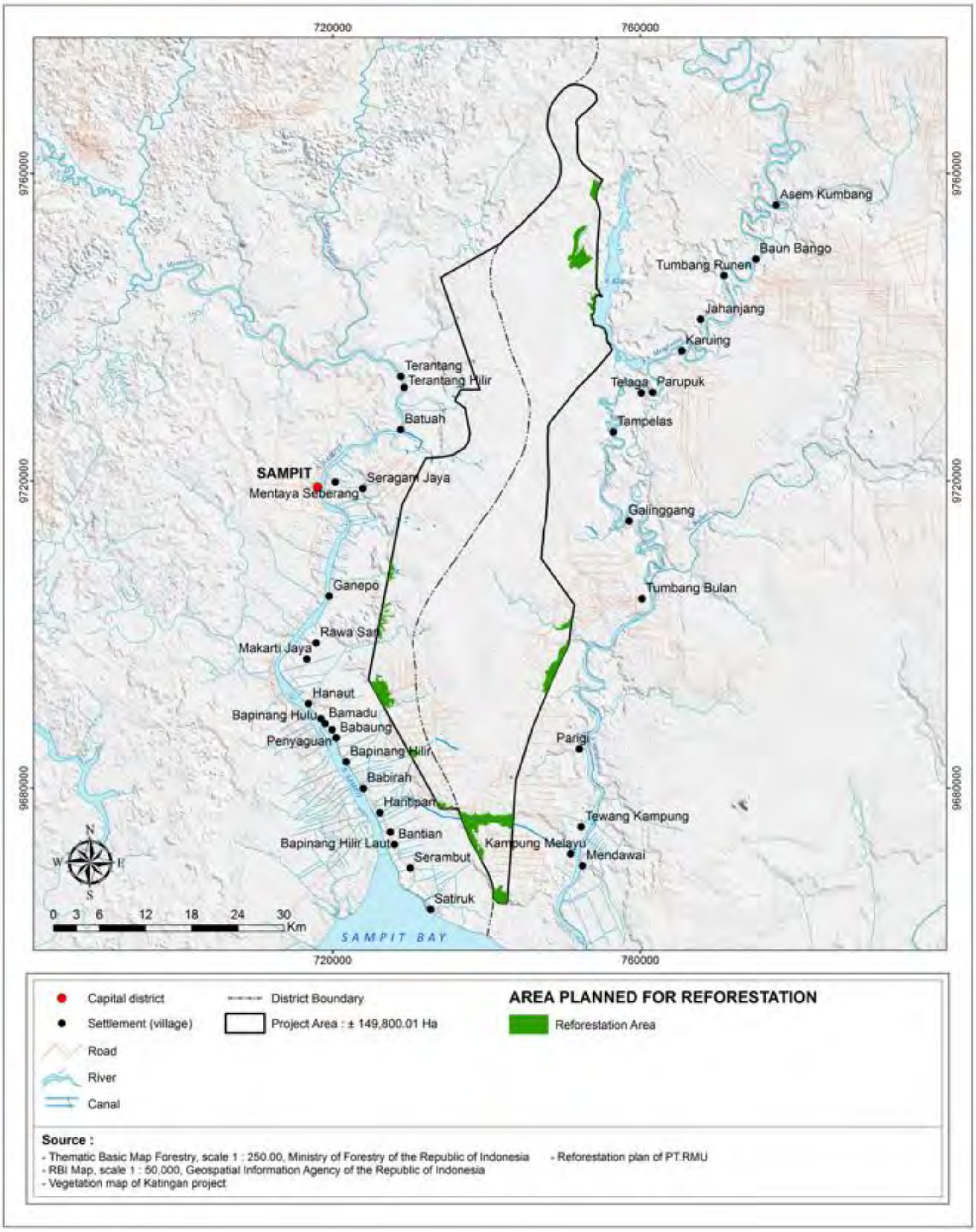
The project has avoided the deforestation, degradation and drainage of a vast area of peat swamp forest. The deforestation projected in the baseline scenario, and the emissions avoided as a result of project activities under the project scenario are described in more detail in the following sections of this Monitoring Report. Each section first explains the planned activities and how they will avoid emissions as presented in the PDD. The last portion of each section describes the activities conducted during this monitoring period which avoided emissions as discussed in the plan.

2.2.2 Reforestation (ARR)

At the outset of the project only a relatively small percentage of the project area was non-forest, totalling 4,433 ha. It is the project's intention to reforest this area using three different approaches: community-led agroforestry, fire break plantation and intensive reforestation. In all cases, saplings will be grown in on-site nurseries and regular maintenance will be conducted to improve the rate of tree survival and to control fire risk.

Map 3 indicates the locations of planned reforestation activities inside the project area.

Map 3. Locations of reforestation plan



The community-led agroforestry approach will focus on a small area alongside the transport canal in the south of the project area in areas claimed by local communities. Through the project's community-based business development program, two economically-valuable local species will be planted; Rubber trees (*Havea brasiliensis*) as demanded by the project-zone communities and Jelutong trees (*Dyera lowii*). When mature, these agroforests will generate incomes for local communities and also to lower the risk of fire incidents by providing the otherwise open areas with biomass cover.

Small fire-break plantations will be established along the east and west boundaries of the Hantipan canal areas. These areas will be planted with two local fire-resistant species; Galam (*Melaleuca spp*) and Tumih (*Combretocarpus rotundatus*), and are intended to prevent the spread of outside fires into the project area while it is being rehabilitated.

Intensive reforestation will be carried out in all remaining non-forest areas inside the project area. In these areas, three primary species will be planted; Jelutong (*Dyera lowii*), Belangiraan (*Shorea belangeran*), Pulai (*Alstonia spp.*), as well as other native peat swamp forest species (See Appendix 1).

In 2014 through 2015, 65 men and women from 5 villages were involved in reforestation activities including providing seedlings, maintaining the community-based nurseries, planting the seedlings in firebreak areas, watering the seedlings and weed control. Towards the end of this monitoring period the first phase of replanting had begun, and by its close 1.23 ha had been replanted. This activity now continues to be underway. A map showing the location of the reforestation work done during this monitoring period is provided in the Climate Section.

2.2.3 Peatland rewetting and conservation (RDP)

Peatland rewetting and conservation activities are crucial to maintain the integrity of the peatland ecosystem. Rewetting of the drained peatland (RDP) will be conducted in areas where drainage canals already exist (see Map 4 and Figure 4), while the conservation of undrained and partially drained peatlands (CUPP) will take place in the rest of the project area.

Figure 4. Hantipan canal used for the main transportation route in the southern part of the project zone

There are two types of drainage canals in the project area – 1) small logging canals (narrower than 2 meters and shallower than 1 meter) typically made by loggers to access forest and transport logs; and 2) navigation or irrigation canals (wider than 2 meters) made by the local government for the purpose of transportation and irrigation for the nearby communities. Rewetting efforts will be achieved by reducing the water table head-gradient towards canals as well as by reducing and preventing water outflow. Combinations of different rewetting approaches are feasible, and the final technical design will be determined in 2016 through a consideration of field conditions, technical assessments, stakeholder involvement and expert judgments. Options include:

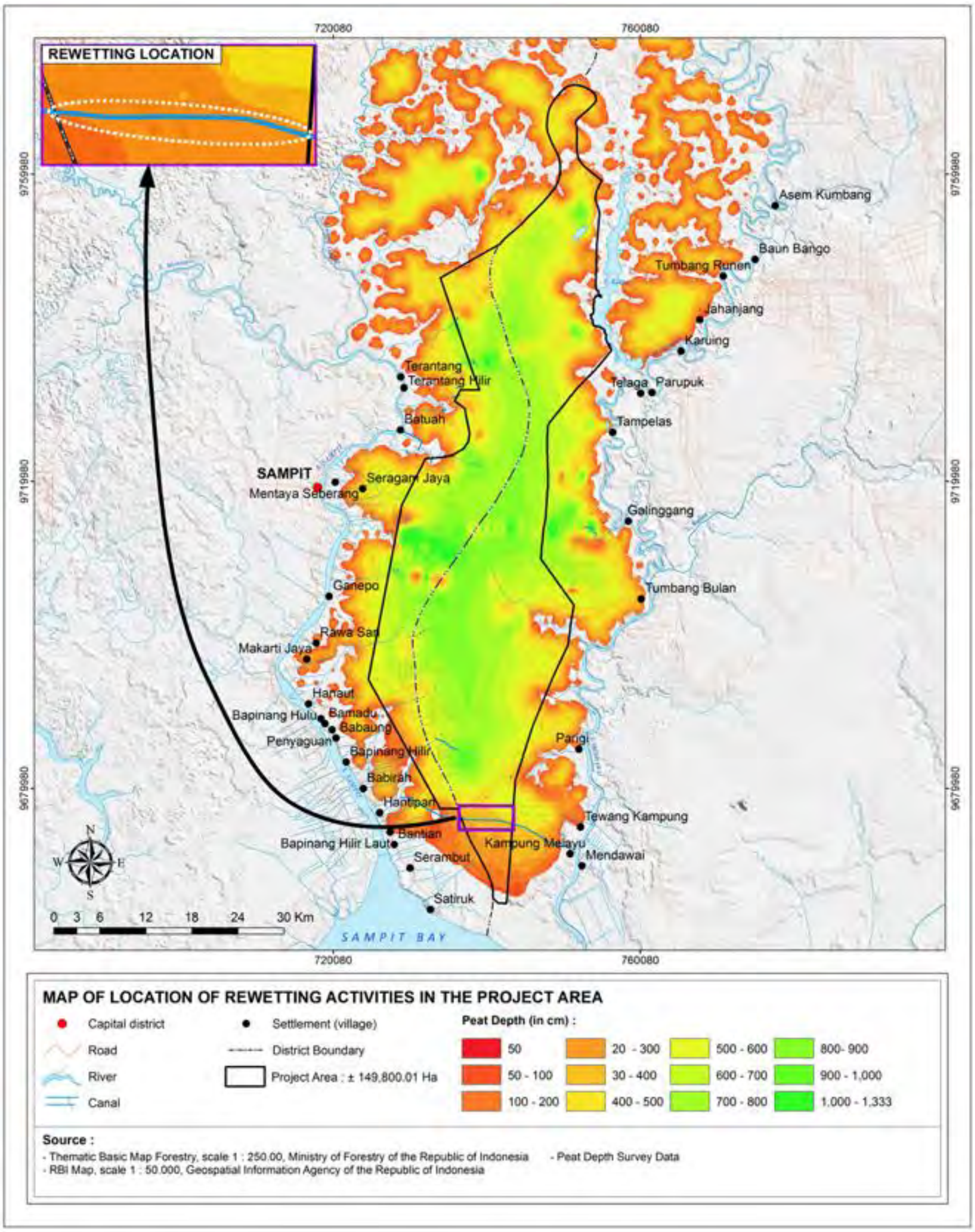
- Construction of a series of cascade sluices and/or dams in the main canals;
- Construction of membrane barriers along smaller canals and ditches for the prevention of water loss from the area;
- Blocking of ditches and small canals with local materials (e.g. peat, wood), and allow them to naturally fill and overgrow with sediments and vegetation.

Together with 2.2.1 REDD and 2.2.2 reforestation (ARR) activities described above, RDP and CUPP activities will be implemented over four phases and were not started during this monitoring period:

- Preparation phase (2016): Collection of hydrological information, feasibility study, development of the technical design, relevant stakeholder consultations, and financing
- Construction phase (2017): Procurement and mobilization of construction materials and workforce, and construction
- Post-construction evaluation phase (2017): Monitoring and evaluation of construction, and making improvements
- Maintenance phase (2017 – 2070): Regular monitoring of the structures and day-to-day maintenance of the blocks, if necessary

Protection and conservation measures will include protection against fire (see below 2.2.4, protection against the creation of any new drainage, and protection against the loss of peat soil (erosion and oxidation) by maintaining and replanting tree vegetation in non-forest areas. This leads to the creation of a mild microclimate on the forest floor which in turn decreases wind speed on the forest floor, increases shading, lowers soil temperatures, and hence reduces microbial decomposition and fire risk.

Map 4. Location of planned rewetting activities in the project area



2.2.4 Fire prevention and suppression

Forest and peatland fires occur almost every year during the dry season on non-forest and drained peatland areas in the project zone. They can spread quickly and travel long distances, and pose immediate threats to all climate, community and biodiversity benefits of the project. They are typically caused by the extreme weather (drought) combined with unsustainable land-use practices, primarily land clearing using fire. As a result, most fires spread from near settlements and adjacent agricultural land. Prior to the start of the project, the most heavily affected region was the area adjacent to the transport canal in the south. This is the area now targeted for reforestation (see above).

Given the highly damaging nature of fires, the Katingan Project takes fire prevention and response very seriously. Key activities throughout the project zone include:

- Participatory fire mapping to identify locations with potential risks to communities and the project zone;
- Development of early warning systems through continuous weather forecasting, water level monitoring, patrolling and community radio systems;
- Establishment of monitoring posts and watch towers in fire prone areas;
- Development of firefighting teams (Regu Siaga Api or RSA) staffed by local communities members and provision of fire extinguishing equipment and training; and
- Awareness building programs for communities in the project zone.

All of these activities were conducted during this monitoring period. Community members assisted in implementing these activities: 168 local villagers helped establish fire prevention and fighting teams, identify and minimize surface fuel in high-risk areas, build water ponds and a deep well for firefighting, conduct patrols and conduct fire suppression activities. Early warning systems have been developed and are currently in use.

2.2.5 Protection and law enforcement

Protection and law enforcement activities will seek to prevent illegal exploitation of the project area, including illegal logging, poaching, encroachment, illegal gold mining, peat drainage and forest clearance with fire. This will be achieved through a combination of activities, including:

- Physical demarcation of the project boundary (based on community maps, see below project activity 2.2.7);
- Identification of specific locations, agents, targeted species, methods, frequency and the typical season of improper activities to be monitored and refrained;
- Mobilization of forest rangers and patrol teams consisting of local community members;
- Development of community-led monitoring and reporting systems to enforce laws and village regulations;
- Community radio systems for effective monitoring, reporting and information sharing;
- Establishment of monitoring posts at main entry-exit points to the forest;
- Provision of necessary equipment and training to participating community members
- Awareness building programs for communities in the project zone to enhance their understanding on potential socio-ecological impacts of illegal resource extraction and unsustainable land-use practices.

All of these activities were conducted during the monitoring period. Monitoring posts continue to be built and additional ones are planned. Community member training and community awareness programs are ongoing.

2.2.6 Species conservation and habitat management

The vast majority of the biodiversity within the project zone requires no active management beyond the protection of their habitat and prevention of unsustainable exploitation or hunting. These objectives will be delivered through the activities described above and below. A comprehensive program of biodiversity monitoring will provide feedback on population status of key species as is described later in this report.

In a few cases more specific management may be required, such as if the incidence of crop-raiding by orangutan requires approaches to mitigate the potential conflict with local communities. See Chapter 8 for a summary of main project activities by key species. During this monitoring period no incidence of crop raiding by orangutan, or conflict with local communities was recorded, so no additional mitigation measures were required.

Through collaboration with other partners, it is also likely that the project area will be used to support the orangutan rehabilitation efforts of these partners. In such cases careful assessment will be made of suitable location for the potential release of rehabilitated animals and any releases will be made in full compliance with Indonesian law and adhering to IUCN guidelines for reintroductions and translocations [6].

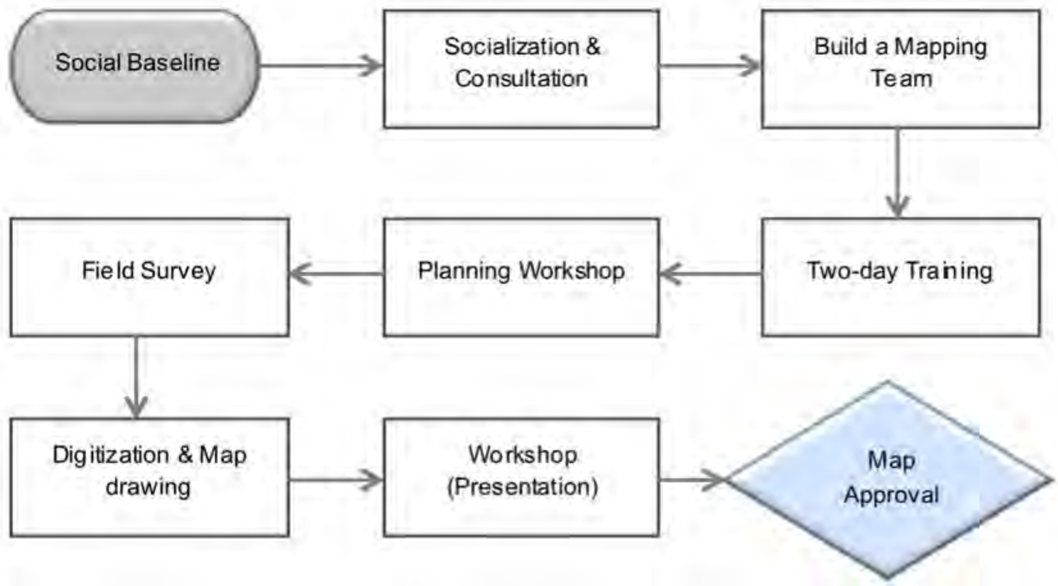
During this monitoring period The Bornean Orangutan Survival Foundation (BOSF) requested assistance in releasing five fully-grown adult orangutan within the project area. These were recently brought into captivity within Central Kalimantan following the destruction of their habitat. Following health screening, and following all IUCN guidelines, the animals were released into the project area in the Bakumin River area in August 2014. All released animals were micro-chipped prior to their release to allow future identification if required. Subsequent field monitoring by BOSF has indicated that the released animals have successfully integrated with existing wild populations.

2.2.7 Participatory planning

Participatory planning is a cornerstone of the Katingan Project's approach to activities designed to support local communities. It consists of two tenure-based methods: participatory community mapping and village planning.

Participatory community mapping transparently draws together important spatial information regarding the project-zone villages. This includes information such as village boundaries, the extent of cultivated land owned by community members, the extent of other land-uses, and other thematic information as relevant. All data points are ground-truthed together with the community and recorded by GPS to create a spatial map that is presented back to the community for approval. Figure 5 shows general steps in the community mapping process.

Figure 5. Participatory community mapping process



Participatory village planning is the second integral part of participatory planning processes. The Katingan Projects' community-based activities are designed to address needs which the project-zone communities have identified through the participatory village planning process. A variety of methodologies are used, including focus-group discussions, interviews, household surveys and others.

The maps developed through the community mapping process are used as a basis for dialogue. Through the village planning process, local communities are to discuss and determine short- to medium-term development goals and plan specific activities that can be implemented between them and the Katingan Project. As such, participatory planning is an integral part of and leads to all project activities.

During the first monitoring period, 30 villages completing the participatory mapping process with the remaining four villages scheduled for completion in 2016. Thirteen villages have completed the subsequent planning process as evidenced by completed MOUs. The remaining villages are scheduled to complete the planning process in 2016 or 2017. Finally, 15 villages have completed boundary mapping and have reached agreement with all neighboring villages. Nine additional villages have reached agreement with all but one or two neighboring villages. The remaining villages are either in progress or will soon begin.

2.2.8 Community-based business development

Community livelihood development is a core priority of the Katingan Project. The goal is to bring substantial benefits to the project-zone communities through sustainable economic development and land use, through support for activities identified during the participatory planning process. Activities already identified include the development of non-timber forest products, agroforestry, ecotourism, livestock, salvaged wood production, and aquaculture and sustainable fisheries, each described in more detail below (also see Figure 6).

Figure 6. Community livelihoods in the project zone

Non-timber forest products: The Katingan Project works with local communities to develop the sustainable use of non-timber forest products, such as rattan, honey, coconut and jelutong. This includes helping to consolidate individual efforts to facilitate collaborative management and marketing of NTFPs, creating access to financing for businesses through microfinance, helping to develop small processing facilities, assisting to add value to produce and assisting access to value-added market access.

In the first monitoring period, the project assisted 15 different rattan enterprises through activities summarized in Table 5, involving 145 different community members.

Table 5. Activities supporting rattan enterprises

No	Activity	Timeframe
1	Workshop on rattan community group institution/enterprises	October 2012
2	Training on rattan production	December 2012 - February 2013

3	Rattan basket production - Batch 1	February - April 2013
4	Shipping to United Kingdom - Batch 1	August 2013
5	Training on rattan production in 6 villages, Seranau Sub District	May - July 2014
6	Rattan basket production - Batch 2	October 2014-January 2015
7	Shipping to United Kingdom - Batch 2	September-2015

Agroforestry: The Katingan Project supports the development of village-owned agroforestry that provides revenues to local communities while being sympathetic to emission and fire-risk reduction and biodiversity conservation. Efforts are targeted on degraded lands mostly outside of the project area but including one small area within the project where fire risk is currently very high as described in 2.2.2 Reforestation above. A variety of crop plants may be considered, including rubber, jelutong, rattan, pineapples, meranti and blangeran. In each case the project's support will be linked to the use of sustainable management systems that avoid peat drainage and support fire-risk reduction measures. As for non-timber products, the project will also support the development of local processing facilities where appropriate and assist communities to access value-added markets.

In the first monitoring period, the project assisted four villages with technical advice and monitoring of rubber agroforestry efforts that pre-dated the project's implementation, involving 154 community members.

Ecotourism: The project area holds a great potential for tourism due to its aesthetic beauty, abundant forests, wildlife, clean rivers, and unique local culture. While accessibility is often one of the most challenging and crucial factors for the success of ecotourism, a network of roads and rivers within the project area provides fairly easy transportation from nearby cities (i.e., Palangkaraya, Sampit and Kasongan) to remote villages and forests. The Katingan Project seeks to develop ecotourism in the project zone in collaboration with experienced tour operators. This will help market the project to both national and international investors, and also to increase employment and livelihood opportunities to the project-zone communities in ways which do not compromise surrounding ecosystems and cultural heritage.

This area of development has not yet occurred as the project has initially focused on existing efforts in the area and community priorities.

Livestock: Livestock production is still rare in the project zone, but has economic potential for local communities. The Katingan Project provides technical assistance and access to microfinance to purchase livestock such as cows, goats, chickens and ducks. Livestock can be raised within villages themselves or small pastures with agricultural land. As with other community-based business development activities, this program will focus on small community groups, with each group receiving support and capacity building ranging from animal husbandry to fund management to the production of organic fertilizers and biogas from animal manure.

Eighty-seven people in two villages received management support and training for livestock management during the first monitoring period.

Salvaged wood: As a consequence of the history of commercial forest exploitation in the wider project region, high-value salvageable wood is still common and can sell to export markets for high prices either as a raw or processed product, both with full certification of the origin. Much of the capacity needed already exists locally as a result of the area's past, while knowledge of and access to markets and of regulatory requirements now restrict development. These are issues the Katingan project seeks to address while ensuring sufficient safeguards are in place to ensure the supply chain is based only on salvaged timber.

Ten individuals benefited from salvaged wood production development during the first monitoring period.

Aquaculture and sustainable fisheries: Similar to the agroforestry program, the Katingan Project supports and works with local fisherman groups to establish aquaculture platforms and promote sustainable fisheries. As many local communities depend on fisheries for their livelihoods and nutrient intake, this program aims to improve the efficiency and effectiveness of local fishing practices using traditional methods as well as fish pens. It also seeks to increase livelihood options and generate alternative income sources for a greater number of the project-zone communities. Specifically the Katingan Project will provide technical and financial support to create traditional fish traps (locally known as karamba) in the river and to develop aquaculture platforms (i.e., fish ponds) in villages; help develop networks for market access; help establish small processing facilities and facilitate training to fishermen's groups, and; conduct research to improve the productivity of fisheries and share lessons learned among fishing communities in the project zone.

The project has supported the development of 42 fish ponds in seven villages, affecting 360 individuals during the first monitoring period.

2.2.9 Microfinance development

The Katingan Project seeks to assist sustainable local development by supporting the development of small to medium sized businesses, particularly those listed above. A variety of mechanisms will be used, including the direct provision of microfinance to facilitating access to government-backed financing schemes and grants. When implemented directly by the project, microfinance will typically be channelled through local community groups known as Kelompok Swadaya Masyarakat (KSMs), often entirely made up of women.

In the first monitoring period, the project established eight microfinance institutions in villages in addition to providing the training needed to build capacity to independently operate them. An additional 13 trainings were provided to interested individuals wishing to learn more about financial planning and management. The trainings were coordinated with the microfinance approvals to enable recipients to attend the appropriate training prior to obtaining the loans, thereby increasing their chance for long-term success. A total of 882 women and 516 men received microfinancing during the first five years of the Project.

2.2.10 Sustainable energy development

The Katingan Project promotes the use of sustainable and renewable energy sources using locally available resources. Through the community-based planning process, the project will seek to increase energy efficiency and the number of communities who have access to cleaner, renewable energy. Initially the work has focused on a number of pilot villages, to learn and develop methods, and then will be expanded more widely. Sustainable energy sources that will be considered include biomass cook stoves, bio-gas, and solar lamps.

The project conducted energy assessments in two pilot villages and provided information to both regarding the benefits of sustainable and renewable energy. Low-cost solar lighting was purchased by 421 households significantly altering the energy profiles of the two villages.

2.2.11 Improved public health and sanitation services

Currently, the project-zone communities only have close access to very basic health care. The Katingan Project will seek to improve this by working closely with local government to improve access to public services and to assist local government in providing health education at the village level, The Katingan Project will also seek to improve local sanitation practices, including the common practice of discharge of all waste into local rivers, which are in turn used for cooking, drinking and bathing. The Katingan Project will work with the villages together with local government agencies to bring awareness about and improve sanitation in each village, increase access to clean drinking water, and develop waste treatment facilities in each village.

In the first monitoring period, 40 households in the Baunbango Village, Kamipang sub-district were allocated to receive supplemental grants from the project to build latrines to prevent the discharge of waste into the local rivers. The effort was led by the village government after the need was identified during the village participatory planning process. Sufficient funds were not available at the local level so the project will provide the required additional funds.

2.2.12 Basic education support

Project-zone communities all have the right of access to basic education, however the accessibility and the quality of schools and teaching remains a challenge. Students in villages with no middle school often need to travel at their own cost to other villages to attend classes. The Katingan Project aims to support the local government's efforts to improve the quality of basic education and the number of enrollment, and encourage the youth to pursue higher education. The project will implement an open competitive scholarship programs to provide funding to selected students, and will assist to develop facilities at local schools. Capacity building and educational workshops for teachers will be conducted as well through various training programs.

No scholarships were awarded during the first monitoring period as communities did not identify this as an immediate priority when developing their community plans. As additional activities are completed, this will occur in the future.

2.3 Management of Risks to Project Benefits

The project manages risks to project benefits during the project lifetime in a variety of ways. These have been implemented as planned in the PD and are summarized in the non-permanence risk assessment conducted by the project. This assessment was designed to address the risk to climate benefits but is equally applicable to the risks associated with community and biodiversity benefits. No additional risks to project benefits were identified.

The Katingan Project is based on a 60-year concession license, extendable to 100 years. Project benefits are expected to extend beyond this time scale. The effective protection status of the forest and peatlands is anticipated to be maintained and extended, either through a further concession license or directly under state ownership as the global importance of the stored carbon stocks and biodiversity are fully recognised as a result of the project. The project's close working relationship with the government established before the project began and strengthened during this monitoring period will support this outcome. In parallel, the future actions of the project to restore both hydrology and degraded areas will result in the project area being more resilient to the threat of fire. Similarly, activities targeting community benefits have been and will continue to be designed to be managed in the future by the local communities themselves, without the need for further external interventions. The community work completed during this monitoring period and outlined in other portions of this report demonstrates this commitment. Ensuring the communities are able to undertake and manage the activities themselves is the most secure means of ensuring the activities will continue even after project's lifetime. Finally, the project itself is anticipated to set an example of sustainable land use management in the region, leading to wider adoption of the practices it is pioneering. The project has and will continue to offer tours to government agencies, other non-profits and any other groups interested in learning about its activities in order to spread best practices and lessons learned throughout the region. In this way the Katingan Project is and will continue to contribute to a wider region managed more sustainably with respect to carbon emissions, biodiversity conservation and equitable development of local communities.

2.3.1 Non-permanence risk assessment

A non-permanence risk assessment was carried out in accordance with the most recent AFOLU Non-Permanence Risk Tool v.3.2. The resulting risk rating and non-permanence risk buffer is 10%. The summary of non-permanence risk assessment is provided in Table 6, and the full assessment is provided in Appendix 2.

Table 6. Summary of non-permanence risk assessment

VCS AFOLU non-permanence risk category	Score
Internal Risk	
Project Management (PM) Risk Value	-4
Financial Viability (FV) Risk Value	0
Opportunity Cost (OC) Risk Value	0
Project Longevity (PL) Risk Value	0
	0
Total External Risk	
Total Land Tenure (LT) Risk Value	2
Total Community Engagement (CE) Risk Value	-5
Total Political (PC) Risk Value	2
	0
Natural Risk	
Fire (F)	1
Pest and Disease Outbreaks (PD)	0
Extreme Weather (W)	0
Geological Risk (G)	0
Other natural risk (ON)	0
	1
Total Overall Risk Rating	**1%**
Non-Permanence Buffer	**10%**

2.4 Measures to Maintain High Conservation Values

Project activities have been designed and implemented to protect and enhance the High Conservation values (HCVs) identified earlier in this report and in the PD. These activities as described in the proceeding section, work together to preserve the intact peat swamp forest, rewet and replant portions of the project area to improve the ecosystem and lessen the threat and impact of fires, engage the surrounding communities and provide for development of sustainable infrastructure, energy sources and economic activities in the communities based on the outcomes of community-led planning initiatives. All of these approaches implemented together have and will continue to maintain the HCVs in the project zone.

2.5 Project Financing

The financial management plan and supporting evidence presented during the project validation remains the valid and functional financial management plan for the project. Project financing remains in place and secure, as demonstrated at the time of validation. Project expenses and financing during this monitoring period have remained as predicted and future projections of expense and revenue provide at the time of validation remain unchanged.

Financial control within the project is taken very seriously. Written financial management practices, including full segregation of responsibilities, are enshrined in the deeds of enactment of the company and in supporting documentation agreed on behalf of the shareholders by the Board of Directors. PT RMU conducts routine internal audits and undergoes annual independent external audit. Full external audit reports for the years ending 2014 and 2015 are available to the validators on request.
PT RMU has a strict non-corruption policy. This is reflected in both the company's deeds of enactment and in the Staff Manual governing acceptable staff behavior (see Section below) and extends to practices that include bribery, embezzlement, fraud, favoritism, cronyism, nepotism, extortion and collusion. Measures taken to ensure these policies are complied with include strict contractual arrangements with project partners, routine field inspections (including of implementing partners), strict documentation of all expenses (including documented authorization), centralized procurement and documented procurement procedures, full segregation of financial management practices (i.e. segregated responsibility for activity/purchase authorization, expense authorization, payment and bookkeeping), staff training, and internal and independent external audit.

2.6 Employment Opportunities and Worker Safety

The Katingan Project and PT. RMU operate in full compliance with Indonesia's labour laws and continues to strive to set an example of best practice with respect to employment terms, conditions and practices.

Indonesian labour law is principally governed by the Labour Law 13 of 2003. This represents the highest and most comprehensive set of regulations governing employment, including such issues as employment agreements, working hours, wages, paid leave, termination of employment, discrimination and grievance procedures. Below this is a raft of implementing legislation in the form of government regulations, presidential and ministerial decrees.

As per this body of regulation, PT RMU has collated and defined all employment terms into a Staff Handbook. This handbook has, in turn, been submitted to the Ministry of Manpower for approval of its compliance with the law. Every page and article of the manual is inspected and stamped and PT RMU has received a certificate of compliance from the Ministry (available on request). Once approved the Staff Manual was provided to all staff, together with a detailed explanation of the articles contained within and opportunity to raise any questions or concerns. All staff members were then asked to sign to indicate that they have received the manual and that they fully understand its contents (itself a requirement of manpower regulations). Certification of the Staff Manual is valid for two years, at which point the process must be repeated (next due December 2016). PT RMU is also required to report its employment statistics to the Ministry of Manpower on an annual basis, under terms of the law regarding Compulsory Company Manpower Reporting (UU 7/1981). PT RMU is up-to-date and fully compliant with this requirement.

Amongst many other things, the Staff Manual describes in detail the grievance process that any employees can take if they are unhappy with any term of their employment. If the issue cannot be resolved internally any employees can report their complaint directly to the local Manpower Office which can then address the complaint directly to the company, seek to assist a bipartite resolution, or enlist the assistance of an independent mediator to seek a tripartite resolution. To date no staff have initiated such grievance procedures, but the opportunity always remains open.

In addition to requirements under the body of employment law, PT RMU is also fully compliant with Social Security Law (Laws 3/1992, 40/2004 and 4/2011). These laws require PT RMU to register all employees for Social Security (known as BPJS Ketenagakerjaan and BPJS Kesehatan) and to make payments on their behalf. All staff are issued membership cards to the scheme.

Three aspects of employment practice are discussed in more details below.

2.6.1 Equal employment opportunities

The Katingan Project seeks to invest in people; in particular those who are living within the project zone, the wider region, and Indonesia as a whole. It provides employment opportunities irrespective of gender, age, social class or ethnicity and other factors, although the priority goes to the project-zone communities. Staff or contractors, whether employed on a long-term of short-term basis, are all entitled to employment terms based on similar types of work and working conditions in the area of employment.

Open positions have been advertised in a variety of ways to reach a broad array of potential applicants. This includes online posting on job boards, announcements and postings in villages and Palangkaraya University, and through social media. Local facilitators and/or field staff visit all villages to announce job vacancy opportunities, so that the village government has an opportunity to discuss the position's requirements and qualifications. After this consultation process, villagers who fit the job description and meet the minimum requirements are recommended to the project team. This recruiting effort has resulted in over 80% of project field staff being hired from project zone communities representing 66% of the total project personnel. All other staff are from Indonesia.

2.6.2 Training and capacity building

The Katingan Project remains committed to investment in training and capacity building, and this commitment extends from project staff to project-zone communities to local collaborators (both NGO and government). Such training has taken many forms, from work shadowing, internships, ad hoc training, to formal classroom style teaching. Table 7 below summarizes some of the main aspects of the project's training and capacity building program, focusing on those aspects that incorporate local communities.

All of the types of training listed below took place during the monitoring period except for rewetting and canal blocking training. These will take place in conjunction with the start of these activities. Training for staff was developed based on identified needs and planning for specific activities. Training provided to communities has been based on needs identified during the participatory planning process. For example, if a village proposed an aquaculture program, the project team and the village identified all of the training required for successful design and sustainable implementation of the program. The training became part of the work plan and the project team then ensured that the appropriate community members received the necessary training. In total some form of training was delivered to over 1,000 recipients. A detailed list of all training provided during the monitoring period is available upon request.

Table 7. Capacity building and training

Topic	Target	Description	Outcomes
Carbon MRV	Project-zone communities, employees	Field and classroom based Provide training and equipment for the monitoring	MRV team formed and necessary equipment and facilities provided

Topic	Target	Description	Outcomes
		of peat depth, biomass and water level.	
Fire prevention and suppression	Project-zone communities, local governments, employees	Field and classroom based training on organizational management, strategy, equipment use, resource mobilization, risk assessment and communication.	Firefighting team formed, monitoring facility and firefighting equipment in place with proper resources and communication network
Silviculture / reforestation	Project-zone communities, employees	Field based training on nursery establishment and operation, planting and maintenance	Nursery facilities developed and operational, tree planting underway
Peat hydrology / rewetting	Project-zone communities, local government, employees	Field and classroom based training to share and transfer skills regarding managing water levels, canal blocking and peat rewetting	Major canals blocked, and monitoring team (i.e., water level) formed
Participatory planning	Project-zone communities, local/village governments, employees	Training on participatory land-use mapping and village planning	Community maps digitalized and village plans endorsed by the local governments and communities
Basic skills	Project-zone communities, employees	Classroom and on-the-job training on administration, finance, project management, leadership and foreign languages	Management team established, and project activities properly and effectively managed
Conflict mediation	Project-zone communities, local governments, employees	Classroom and on-the-job training provide training on formal conflict mitigation and resolution processes	Conflict resolution mechanism in place and understood by community stakeholders
Biodiversity survey methods	Employees and project-zone communities	Field based training on flora and fauna survey, phenology, identification and data recording.	Biodiversity survey team established and activities run effectively
Data and information management	Employees	Provide training on data collection, storage and analysis	Data and information properly managed and easily accessed

2.6.3 Worker safety

Worker safety remains a priority of the Katingan Project which conforms with the requirements of the labour law, UU No. 13/2003. Occupational safety and health are stipulated in the company safety regulation (available to verifiers upon request) and include:

- Providing workers with a first aid kit including anti-venom cream and insect repellent;
- Providing navigation and communication equipment such as GPS, compass and handheld transceivers;
- Enforcing a buddy system (minimum two persons in a group) for all field activities;

- Providing standard safety equipment such as microfiber mask, rubber boots, heavy-duty gloves, uniform, hat, harness, survival kit, portable water bottles/bags, and life jacket;
- Providing additional logistics such as fuel, propeller for a boat, and water and meals enough for three extra days; and
- Providing proper training on safety procedures, evacuation, communication, equipment use, and shelter making in order to ensure worker safety and mitigate potential risks inherent to certain field activities such as fire suppression and surveys.

PT. RMU has and will continue to provide safety training and equipment as described above. Training is provided prior to the start of any activity so that it can be specific to the risks associated with that activity. In addition, a safety SOP is in effect and maintained and employee safety is an important priority in all planning. A formal risk assessment and management process is being developed.

During the monitoring period, only two minor injuries to employees were recorded, one in 2014 and one in 2015. Both were cuts to an individual's foot from a machete. Both individuals received first aid in the field and were taken to the nearest medical facility for follow-up care and made full recoveries.

2.7 Stakeholder Engagement

2.7.1 Stakeholder consultations and community involvement

2.7.1.1 Stakeholder consultations

Since 2007, the Katingan Project has conducted a series of stakeholder consultations at different levels – national, provincial, district, sub-district and village. Through this process, the project has disseminated information on the ecosystem restoration concession concept, planned activities, expected impacts from the project, management plans and project boundary setting processes, and has adapted feedback from the stakeholders into agreed plans and legal approval. Table 8 provides a list of formal stakeholder consultations which were conducted by PT. RMU. Furthermore, a number of community meetings have also been conducted as part of stakeholder consultations on a variety of topics including dissemination of the PDD and this Monitoring Report. They are omitted from this list, but meeting minutes and attendance sheets are available upon request.

During all consultations with communities, strenuous efforts have been made to ensure that adequate, understandable, honest and accurate information is provided as a basis for any decisions, including information on costs, risks and benefits. This process has been ensured by a number of means, including:

- A written Standard Operating Procedure that all project staff must follow when working with local communities. This document describes the need to ensure any information is presented in a form that can be fully understood and in a timely manner to allow due consideration, together with guidelines as to how that should be achieved. A copy of the SoP is available on the project database.

- During the development of all written agreements (including MoUs and SPK agreements) a period of 1-2 months was allocated to allow each village time to discuss internally, raise questions, seek clarification and amend the draft agreement. This iterative process is evidenced by a comparison of early drafts of each agreement, written notes of feedback from each community, and the revised final agreements.

- The project has offered, and accepted requests from prospective villages to visit other project zone villages where activities have already been conducted in order to more clearly understand the nature of collaboration. This has allowed villages to directly raise questions to members of those villages about the project.

Table 8. Summary of formal stakeholder consultations

Consultation type	Stakeholder	Jurisdiction	Date
Ecosystem restoration socialization and consultation	Village government and community members (Kampung Melayu, Tewang Kampung and Seranau); Forest Agency at the district level; district government	District (Kota Waringin Timur and Katingan)	January 15 – April 15, 2009
Ecosystem restoration socialization and consultation	Village government and community members (Seranau, Bapinang hulu, Bapinang hilir, Kampung Melayu, tewang kampung)	District (Kota Waringin Timur and Katingan)	18, 19, 23, 27 October, 2009
UKL–UPL socialization and public consultation	Community members, sub-district government, district government	District (Kotawaringin timur)	27 January 2010
UKL–UPL socialization and public consultation	Sub-district government, village government	Sub-district (Tasik Payawan, Kamipang, mendawai)	19 – 21 December 2011
Ecosystem restoration socialization and consultation	Sub-district government, village government, and community members	Sub district (Mendawai)	1 – 3 May 2012
Ecosystem restoration socialization and consultation	Sub-district government, village government, and community members	Sub district (Kamipang)	3 – 7 May 2012
Ecosystem restoration socialization and consultation	Sub district and village government	Sub district, village (Seranau sub-district)	13 – 15 March 2013
Ecosystem restoration socialization and consultation	Sub-district government, village government and community members	District (Kotawaringin timur)	25 – 26 February 2014
Ecosystem restoration concession (IUPHHK-RE SK.734/Menhut-II/2013) socialization and consultation	District, sub-district government, village government and community members	Sub-district (Kamipang, Mendawai), district (Katingan)	5-6 February 2014 at the sub-district level; 23 February – 3 March 2014 at the village level; and 4 March at the provincial level
IUPHHK-RE SK.734/Menhut-II/2013 socialization	Provincial government, District government, university, national and local NGOs	Province (Palangka Raya)	March 4th 2014

2.7.1.2 Community involvement during project design and implementation

As described above, the vast majority of the Katingan Project's activities have been both designed and implemented in close consultation and collaboration with local communities. This is key to achieving the long-term sustainability of the initiatives, without need for further external interventions. The consultation processes are ongoing with regular meetings organized to evaluate the progress of each initiative and adapt initiatives to changing needs and conditions. The Katingan Project conforms to all relevant Indonesian laws and regulations throughout its lifetime, and thus will not be involved in or complicit in any form of discrimination or sexual harassment during the process of project design and implementation.

2.7.2 Public comment period

The Katingan Project will publicize a variety of project documentation and monitoring plans in both Indonesian and English languages through appropriate means by which local communities and stakeholders can have the opportunity to provide comments. They include a combination of media such as newsletters, workshops, meetings, and the project website.

PT. RMU will also take measures to communicate the project's verification process to the project-zone communities and other stakeholders. In addition to posting this project design document (PDD) on the VCS-CCB website for a 30-day public comment period, a summary of the Monitoring Report has been prepared in the Indonesian language and will be disseminated to the local stakeholders for their comments. PT. RMU will conduct stakeholder meetings to collect their feedback following the dissemination.

2.7.3 Implementation of feedback and grievance redress procedure

The Katingan Project has adopted a formal grievance and redress procedure to prevent and handle any conflicts with and among communities and other stakeholders which may arise during the implementation of project activities.

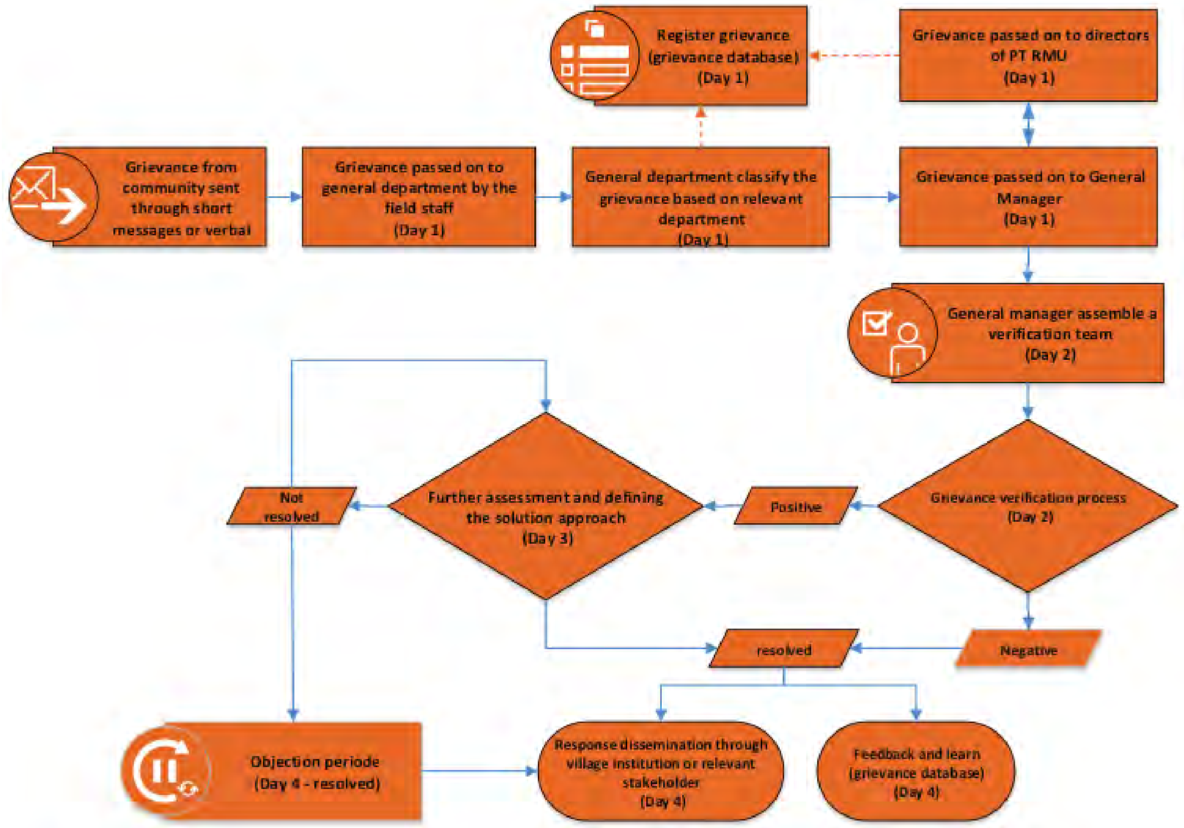
One of the most important elements of the grievance redress procedure is to prevent potential conflicts before they arise. Such precautionary approaches include the implementation of FPIC-based community consultations, participatory planning and regular communication. This helps to identify underlying grievances well in advance and allow them to be addressed. The formal village level planning processes also help to strengthen the bargaining position of project-zone communities when dealing with other stakeholders.

If any grievances occur and are reported from the project-zone communities and/or other relevant stakeholders in the form of letters, short messages or verbal communication, PT. RMU will quickly respond to them by following the formal handling process as shown in Figure 7. All reported cases will be assessed to identify and verify the cause, actors and scale of grievances, and PT. RMU's verification team will recommend resolution options based on the feedback from the stakeholders. The degree of intervention and process will depend on the nature of disputes, and PT. RMU will continue to monitor the cases.

In case where a grievance is not amicably resolved after this process, it will be submitted to an unbiased third party for a formal mediation and arbitration process, and subject to a hearing at which both disputing parties have the opportunity to testify. All cases will be referred and examined to the extent allowed by Indonesian laws and regulations of the relevant jurisdiction before decisions are made, and both parties are bound to satisfy the result of arbitration.

Local facilitators, community organizers and PT. RMU staff have all been contacted with questions or comments directly. Almost all of these questions have been addressed successfully without the formal grievance process. The formal process has been used successfully resolve issues six times during the monitoring period demonstrating stakeholder awareness of and engagement with the process. The issues and resolutions have been logged and disseminated to the affected individuals and communities.

Figure 7. Grievance handling process



3 LEGAL STATUS

3.1 Compliance with Laws, Statues, Property Rights and Other Regulatory Frameworks

3.1.1 Compliance with laws and regulations

The following sections outline the national and local laws and regulations as well as international treaties the Project ensures its compliance with. The SOPs have been developed to ensure operating practices conform to the requirements. Regular visits, inquires and oversight by multiple layers of government provide routine checks that all operations are within the legal requirements. In addition, the project's first concession license was granted in 2013. The second license application process uncovered no concerns about the project's compliance with applicable laws and regulations, serving as further evidence of compliance.

3.1.1.1 National and local laws and regulations

The Katingan Project is designed and has been implemented in full compliance with both national and regional laws of the Republic of Indonesia. This includes laws and regulations governing aspects of carbon emissions offsets, REDD+ and ecosystem restoration concession (ERC). In addition the project falls into line with the REDD+ National Strategy developed by the Government of Indonesia.

Relevant laws and regulations on land use, forestry, REDD+ and climate include:

- Law No. 6/1994 concerning the Ratification of United Nations Framework Convention on Climate Change
- Law No. 41/1999 concerning Forestry
- Law No. 5/1997 concerning Biodiversity
- Law No. 17/2003 concerning State Finances
- Law No. 17/2004 concerning the Ratification of Kyoto Protocol on the UN Framework Convention on Climate Change
- Law No. 25/2004 concerning National Development Planning System
- Law No. 17/2005 concerning Medium and Long Term National Development Plan (RPJP) 2005-2025
- Law No. 31/2009 concerning Meteorology, Climatology and Geophysics
- Law No. 32/ 2009 concerning Environmental Protection and Management
- Law No. 41/2009 concerning Sustainable Food Land Protection
- Government Regulation No. 6/2007 and its amendment No. 3/2008 concerning Forest Arrangement and Formulation of Forest Management Plan as well as Forest Exploitation
- Government Regulation No. 26/2008 concerning National Spatial Plan
- Government Regulation No. 10/2010 concerning Method of Change of Forest Area Allocation and Function
- Government Regulation No. 15/2010 concerning Implementation of Spatial Structuring
- Government Regulation No. 24/2010 concerning the Use of Forest Area
- Presidential Decree No. 5/2010 concerning National Medium Term Development Plan (RPJMN) of 2010-2014
- Ministry of Forestry Regulation P.68/2009 concerning Organization of Demonstration Activities for Reducing Emissions from Deforestation and Degradation
- Ministry of Forestry Regulation P.30/2009 concerning Mechanisms for Reducing Emissions from Deforestation and Degradation
- Presidential Decree No. 61/2011 regarding the National Action Plan for Reducing Green House Gas Emission
- Ministry of Environment Regulation No. 13/2010 regarding Environmental Management and Monitoring Effort
- Ministry of Environment Regulation No. 16/2012 regarding the Guidelines on the Development of Environmental Document

Relevant laws and regulations on Ecosystem Restoration Concession management include:

- Ministry of Forestry Regulation No. P.20/Menhut-II/2007 regarding Provision and Expansion of Business Licenses for Forest Timber Utilization in Natural Forest, Business Licenses for Ecosystem Restoration and Business License for Forest Plantation in Production Forest, revised by No. P.61/2008, No. P.50/2010, No. P.26/2012, and No P.31/Menhut-II/2014
- Ministry of Forestry Regulation No. P.56/Menhut-II/2009 regarding Business Planning for Ecosystem Restoration Licence, updated by No. P.24/Menhut-II/2011
- Ministry of Forestry Regulation No. P.8/Menhut-II/2014 regarding Limitation for the Allocation of the Concession Area for Business Licenses for Forest Timber Utilization in Natural Forest, Business Licenses for Ecosystem Restoration and Business License for Forest Plantation in Production Forest
- Ministry of Forestry Regulation No. P.64/Menhut-II/2014 regarding Application of Silviculture Techniques within the Ecosystem Restoration Concession License in Production Forest

- Ministry of Forestry Regulation No. P.66/Menhut-II/2014 regarding the Procedures for Periodical Forest Inventory and Work Plan in Ecosystem Restoration Concession License
- Ministry of Forestry Regulation no 39/Menhut-II/2008 on The Guidelines for applying administrative sanction towards forest concession holders
- Ministry of Forestry Regulation no 44/Menhut-II/2012 on the ratification and issuance of forest area
- Ministry of Forestry Regulation no 39/Menhut-II/2013 on community development program through forestry partnership
- Ministry of Forestry Regulation no 43/Menhut-II/2013 on the arrangement of forest working area boundary within forest utilization license, principle license of forest utilization, principle license of forest lease and Forest and Management of Forest Area under Forest Management Unit and Forest area for special designation.
- Ministry of Forestry Regulation no 32/Menhut-II/2014 on guidelines for Financial reporting in Production Forest Utilisation
- Ministry of Environment and Forestry Regulation No. P1/Menhut-II/2015 on the revision of Ministry of Environment and Forestry regulation no P.97/MENHUT-II/2014 on delegation of authority for the issuance of environmental and forestry license and non-license as implementation on one door integrated service to the investment coordinating board
- Ministry of Environment and Forestry Letter No. SE.1/Menlhk-II/2015 on The Processing legal Enviornmental and Forestry cases

As the majority of the project area is forested and situated on peatland, the Katingan Project must also comply with various regulations on the management of forest and peatland, including:

- Presidential Instruction INPRES No. 10/2011 regarding Suspension on the Issuance of New Licenses and Improved Management of Primary Forest and Peatlands", renewed by INPRES No. 6/2013 and No. 8/2015
- Government Regulation PP No. 71/2014 regarding Protection and Management of Peatland Ecosystem

While there are no laws specifically requiring FPIC in Indonesia, the Katingan Project has adopted the Free, Prior and Informed Consent (FPIC) standard Prinsip Persetujuan atas Dasar Informasi Awal tanpa Paksaan (PADIATAPA) and the social safeguard standard called Prinsip Kriteria dan Indikator Safeguards Indonesia (PRISAI), which were developed by the Indonesian REDD+ Agency. The Katingan Project is among the first REDD+ projects in Indonesia which adopted these standards in the process of project design and implementation. Indeed, PT. RMU and its project implementation partner, Yayasan Puter Indonesia contributed substantially to the development of PRISAI standards since 2010; providing input to their design and conducting a series of public consultations to test the standards at the Katingan Project site. This helped the Government of Indonesia integrate important safeguard standards in its national REDD+ policy framework development.

3.1.1.2 International treaties

In addition to complying with national and local laws, the Katingan Project has also complied with the requirements of international treaties and agreements. Treaties that are or may become relevant to the project include the following:

- Ramsar Convention on Wetlands of International Importance, 1971
- Convention on International Trade in Endangered Species (CITES) 1973
- Rio Declaration on Environment and Development 1992
- United Nations Framework Convention on Climate Change (UNFCCC) 1992
- Convention on Biological Diversity in 1992 and enactment 1993
- United Nations Convention against Corruption (UNCAC) 2003

- Kyoto Protocol in 1997 and enactment 2005
- Cartagena Protocol on Biosafety to the Convention on Biological Diversity 2004
- Bali Action Plan (COP 13) 2007
- Nagoya Protocol on Genetic Resources Access and Equal and Fair Benefit Sharing from the Utilization of the Biodiversity Convention 2013

3.1.2 Documentation of legal approval

3.1.2.1 Legal approval from the national, provincial and district authorities

The Katingan Project has secured approval from the appropriate authorities to develop and implement project activities in the entire project area with final concession letter no SK.734/Menhut-II/2013 covering 108,225 ha and Principle License (RATTUSIP) Letter no 25/1/SK/S-IUPHHK-RE/P-MON/2016 covering 49.500 ha. Table 9 is the list of legal approval and consensus documentation in relation to the project to date. Copies of each document are available to verifiers on request. Copies of the ERC and Principle License letters are provided in Appendix 3.

Table 9. List of decrees and legal approvals

Decree / Approval No.	Description	Approval from	Date of issuance
08/RMU/XI/2008	Application letter from PT. RMU for IUPHHK-RE	N/A	November 10, 2008
S.442/Menhut-VI/2009	First order letter to do UKL-UPL (SP-1)	Minister of Forestry	June 12, 2009
522/185/Ek.	Legal support from The Governor of Central Kalimantan for PT RMU IUPHHK-RE	Governor of Central Kalimantan	February 17, 2010
660/89/II/BLH/2012	Approval of UKL-UPL and recommendation to proceed with the IUPHHK-RE licensing process	Environmental Agency, Central Kalimantan Province	February 13, 2012
S. 104/Menhut-VI/BRPUK/2012	Instruction to produce a working area map (SP-2)	Ministry of Forestry Directorate General of Forest Production Development	February 17, 2012
S. 320/VII-WP3H/2012	Issuance of working area map for PT. RMU's IUPHHK-RE concession	Ministry of Forestry, Forestry Planning Agency	March 15, 2012
S.295/VI-BRPUK/2012	Draft Concept Concession Decree for PT. RMU's IUPHHK-RE	Ministry of Forestry, Directorate General of Forest Production Development	April 27, 2012
SK.734/Menhut-II/2013	**Issuance of IUPHHK-RE License to PT RMU for an area of 108,225 ha in District of Katingan, Central Kalimantan Province**	**Ministry of Forestry**	**October 25, 2013**
522.1.200/2156/Dishut	Technical Consideration for IUPHHK-RE for PT RMU	Forestry Provincial Office of Central	October 16, 2014

Decree / Approval No.	Description	Approval from	Date of issuance
		Kalimantan Province	
No. 522/0212/PTSP	Letter of Recommendation for PT RMU for IUPHHK-RE for an area of 49,497,9 ha	Governor of Central Kalimantan	March 2, 2015
Letter no 25/1/SK/S-IUPHHK-RE/P-MON/2016	Principle License (RATTUSIP) for PT RMU for an area of 49,500 ha in Katingan Regency, West Kalimantan as an official approval of the Technical Proposal and instruction to process further steps	Investment Coordinating Board of the Republic of Indonesia (BKPM)	April 26, 2016
Environmental & social Impact Study (UKL-UPL)	Conducted by certified 3rd party consultant	P9/MenLHK/2015	May 21, 2016

In May 2016 PT RMU was successfully granted the Provisional Licence (RATTUSIP) to an additional area of 49,500 ha by The Investment Coordinating Board (BKPM) of the Indonesian Government. This Provisional License, together with the original ERC licence, gives PT RMU the right of use to the entire project area sufficient to undertake all of the described project activities and to formally prevent any other commercial plantation company applying for rights of use in the area. The regulatory process now continues with a further series of steps primarily intended to provide additional environmental and social safeguards, and described in Table 9a below.

Table 9a. List of administrative steps required to finalize second ERC license

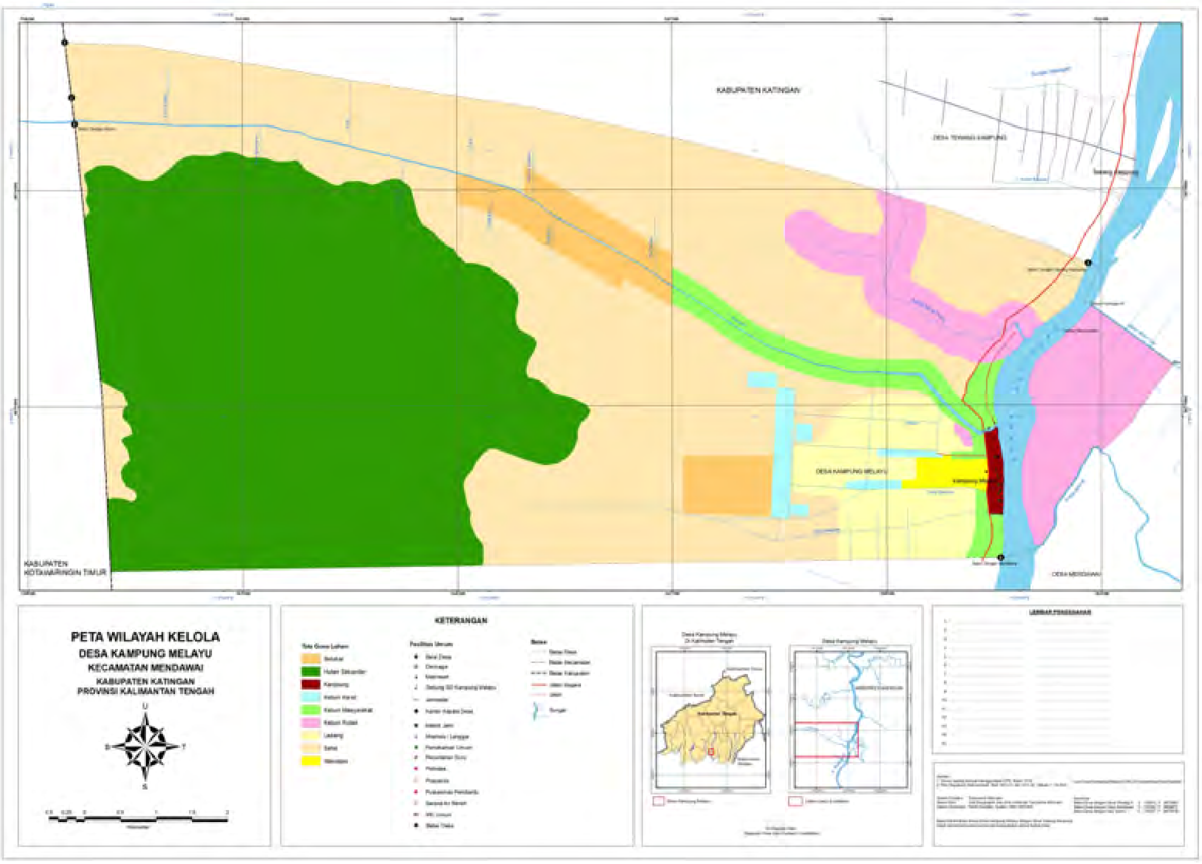
Steps	Description	Regulation	Processing time
Approval of UKL-UPL	Environmental Agency of Provincial Government of Central Kalimantan will approve completed and agreed upon UKL UPL	P9/MenLHK/2015	150 calendar days maximum
Issuance of Environmental License	Governor of Central Kalimantan, through the Provincial Environmental Agency will issue Environmental License to PT RMU as sealed approval in terms of environmental and social impact	P9/MenLHK/2015	
Obtaining official geographical coordinate from BPKH	Based on the RATTUSIP Letter from BPKM, the Provincial BPKH (Balai Pemantapan Kawasan Hutan) office of the Ministry of Environment and Forestry will provide the official geographical coordinates for working area map	P9/MenLHK/2015	14 working days
Meeting to finalize Working Area map	Directorate General of Management of Sustainable Production Forest will formalize	P9/MenLHK/2015	7 working days

	the working area map as the final map for concession license		
Concession License Fee	Upon completion of the Working Area Map, Ministry Of Environment and Forestry will issue a letter to concession holder to pay for the license fee for IUPHHK-RE to the state	P9/MenLHK/2015	Needs to be paid within 30 working days after receipt
Draft concept of Concession License	Directorate General PHPL and General Secretary of the Ministry will provide draft of Concession License for final internal discussion	P9/MenLHK/2015	4 working days
The issuance of Concession License	Ministry of Environment and Forestry will officially issue the final concession license of IUPHHK-RE	P9/MenLHK/2015	5 working days

3.1.2.2 Respect for rights to lands, territories and resources

The Katingan Project designed and implemented all project activities in participation with project-zone communities and based on full consultation and FPIC principles. This includes the creation of agreed upon spatially accurate maps that define the agreed extent of village land and the agreed boundary of the project area, as well as recognition of other spatially explicit landscape features, which is the final step in the participatory planning process. These maps also allow the project-zone communities to understand their spatial positions in relation to the project area, and to be able to plan their future land use within their village boundaries without disputing other village territories or the project area. This tenure-based approach ensures that rights of the project-zone communities to lands, territories and natural resources are respected and protected. An example of community maps is provided in Map 5, and community maps of other villages are available to the verifiers on request. Currently over half of the communities have completed the maps. Additional village maps will be created until all project zone communities have agreed upon maps.

Map 5. Example of the community map of Kampung Melayu village



3.1.2.3 Consensus and approval from village authorities

Mutual understanding of the goals and objectives of the Katingan Project between PT. RMU and the project-zone communities is crucial for long-term success. To this end, and as part of the company's commitment to FPIC and outreach activities having been conducted since 2010, PT. RMU has agreed, and now signed a memorandum of understanding (MoU) with each of 13 village authorities in the project zone (See Table 10; copy of each MoU is available to verifiers upon request). The remaining villages are expected to have MoUs in 2016 and 2017 following completion of the initial participatory mapping process. Each MoU is initially for a three-year period with opportunity for extension after review and evaluation by the village.

Table 10. List of community agreement and approval with the Katingan Project

Village	MoU No.	Partnership agreement No.	Date of agreement
Mendawai	081/RMU-I/V/2015	082/RMU-I/V/2015	May 22, 2015
Kampung Melayu	079/RMU-I/V/2015	080/RMU-I/V/2015	May 22, 2015
Tewang Kampung	077/RMU-I/V/2015	078/RMU-I/V/2015	June 4, 2015
Galinggang	073/RMU-I/V/2015	074/RMU-I/V/2015	May 21, 2015
Tumbang Bulan	075/RMU-I/V/2015	076/RMU-I/V/2015	May 21, 2015
Tampelas	071/RMU-I/V/2015	072/RMU-I/V/2015	May 20, 2015
Telaga	069/RMU-I/V/2015	070/RMU-I/V/2015	May 20, 2015
Perupuk	067/RMU-I/V/2015	068/RMU-I/V/2015	May 20, 2015
Tumbang Runen	061/RMU-I/V/2015	062/RMU-I/V/2015	May 19, 2015
Karuing	065/RMU-I/V/2015	066/RMU-I/V/2015	May 19, 2015
Jahanjang	063/RMU-I/V/2015	064/RMU-I/V/2015	May 19, 2015

Village	MoU No.	Partnership agreement No.	Date of agreement
Bahun Bango	059/RMU-I/V/2015	060/RMU-I/V/2015	May 18, 2015
Asem Kumbang	057/RMU-!/V/2015	058/RMU-I/V/2015	May 18, 2015

In addition to the MoUs, PT. RMU and the project-zone communities have developed cooperation arrangements through a partnership agreement (Kesepakatan Kerjasama). This agreement describes specific support which PT. RMU seeks to provide to the communities, and the communities propose priority activities to reach the objectives. The agreement is valid for one year, and will be evaluated and revised every year thereafter. The partnership agreements are a binding document which explains PT. RMU's commitment to ensuring net positive impacts and benefit sharing for the project-zone communities.

3.2 Evidence of Right of Use

PT RMU is the sole concession holder of the project area under Ecosystem Restoration Concession license (ERC; Minister of Forestry Decree SK 734/Menhut-II/2013) and Principle License (RATTUSIP) (Letter no 25/1/SK/S-IUPHHK-RE/P-MON/2016). These licenses grant a range of rights and responsibilities, of which is included the right to generate and sell carbon offset credits derived from forest and peatland protection and restoration, and prevent any other organization from applying for concessions in the project area. Copies of the licenses are provided in Appendix 3.

3.3 Emissions Trading Programs and Other Binding Limits

Activities carried out by the project are not covered by any emission trading programs or other binding limits in relation to GHG emissions. Presidential Decree No. 61/2011 regarding the National Action Plan for Reducing Green House Gas Emissions requires government agencies to set reduction targets for specific sectors and identify plans for achieving these goals. The project is not currently subject to these targets nor will its reductions be used to demonstrate achievement of the agency goals.

3.4 Participation under Other GHG Programs

The Katingan Project has not been registered under any emissions trading programs, but may seek to do so in the future. In this case applicable requirements in the VCS Standard, AFOLU Requirements, and the Registration and Issuance process will be followed. The project will not claim credit for the same GHG emission reduction or removal under the VCS Program and another GHG program.

3.5 Other Forms of Environmental Credit

The Katingan Project currently only seeks carbon credits under the VCS program, and has not received other forms of environmental credits from its activities.

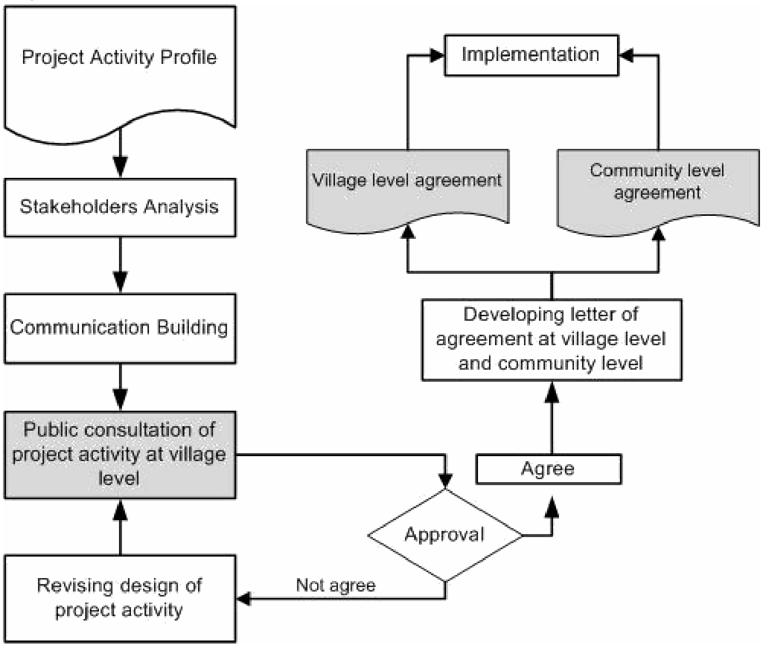
3.6 Projects Rejected by Other GHG Programs

The Katingan Project has not applied for or been rejected by any other GHG programs.

3.7 Respect for Rights and No Involuntary Relocation

The Katingan Project adopts FPIC principles in all community consultation processes (see Figure 8). This approach has been and will be maintained throughout the life of the project. It allows local people to critically consider potential impacts of the project and to negotiate based on mutual consensus without being forced or manipulated. The FPIC approach is also used for stakeholder consultations and communications which were discussed earlier in this report.

Figure 8. FPIC process



The Katingan Project has not and will not undertake any involuntary relocations. The current project area contains no permanent human settlements.

3.8 Illegal Activities and Project Benefits

Illegal activities, including logging or mining within protected forests, hunting of protected species, or making use of fire for land clearing have been historically practiced in parts of the project zone. The Katingan Project aims to reduce and put an end to these activities by a combination of protection and enforcement, education and incentive, including strengthening tenure rights and providing sustainable livelihood options and employment opportunities.

The Katingan Project will not and has not derived benefits from illegal activities.

4 APPLICATION OF METHODOLOGY

4.1 Title and Reference of Methodology

The Katingan Project applies the latest version of approved VCS methodology VM0007 (version 1.5) [7], including all applicable modules as detailed in this report.

4.2 Deviations from the Monitoring Plan

One methodology deviation and three project description deviations were made during this monitoring period and are discussed in further detail below.

Methodology deviation:

- More accurate analysis of Landsat imagery was conducted than outlined in the PD monitoring plan. In addition to unsupervised classification to detect deforestation, a more complex SMA Monte Carlo algorithm was used in order to detect subtle forest disturbances such as small scale degradation. This analysis is a more accurate and conservative method than that described in the PD and is discussed in more detail in section 5.1.3.1. This deviation is in accordance with the requirements of VCS Standard Section 3.5.1 as it is allowed by the methodology, applies only to data and parameters monitored, does not negatively affect the conservativeness of the emission reduction quantification, and improves the accuracy of the quantification.

Project Description deviations:

The following deviations are deviations from the validated PD that occurred during the monitoring period. All changes occurred during the monitoring report preparation unless otherwise noted. The Project reviewed the process outlined in the CDM “Guidelines on assessment of different types of changes from the project activity as described in the registered PDD”. All three deviations relate to the collection of or analysis of monitored data parameters and therefore, it was determined that the deviations do not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario. The project also remains in compliance with the applied methodology. Using the results of this analysis and the requirements outlined in VCS Standard Section 3.6.1, the project concluded that the deviations could be described and justified in the Monitoring Report rather than requiring a change to the PD. In further support of this conclusion, the deviations fall under the category of “changes in the procedures for measurement and monitoring” which is listed as a possible example of deviations that can be included in the Monitoring Report. Further information is provided below for each deviation requested.

The following deviations were made:

- A Participatory Rural Appraisal was not conducted in 2012 or 2014 as outlined in the monitoring plan in order to determine if illegal logging had occurred. To ensure any illegal logging during the monitoring period was appropriately captured, the project elected to conservatively assume that illegal logging had occurred during the entire period and conducted a PRA and full field survey in 2015 focused on quantifying the logging’s impact on the project’s emission reductions over the entire period. The approach used is discussed in more detail in Section 5.
- The PD monitoring plan describes the use of MODIS FIRMS to detect fires in the project and the use of Landsat data to detect any forest disturbances. The 2015 fires did not uniformly affect the fire-affected areas and these variations were too fine scaled to detect using Landsat imagery. The team therefore used very high resolution drone data to quantify the unplanned fire emissions. This monitoring plan deviation provides more accurate data for the GHG emission reduction quantification, and meets the requirements of the M-MON module since the overlap of drone-based remote sensing and Landsat technology exceeds 1 year.
- The Global Forest Watch data used for a portion of the leakage assessment was not yet available for the 2015 calendar year. In order to complete the assessment, the project used the most conservative value from the previous four years. Additional detail is provided in Section 6.3.

4.3 Project Boundary

4.3.1 Spatial boundary of the project area

The project area was stratified into discrete units of land that have relatively homogeneous emission and/or carbon stock characteristics (per VCS methodology VM0007 Module X-STR). This includes stratification by:

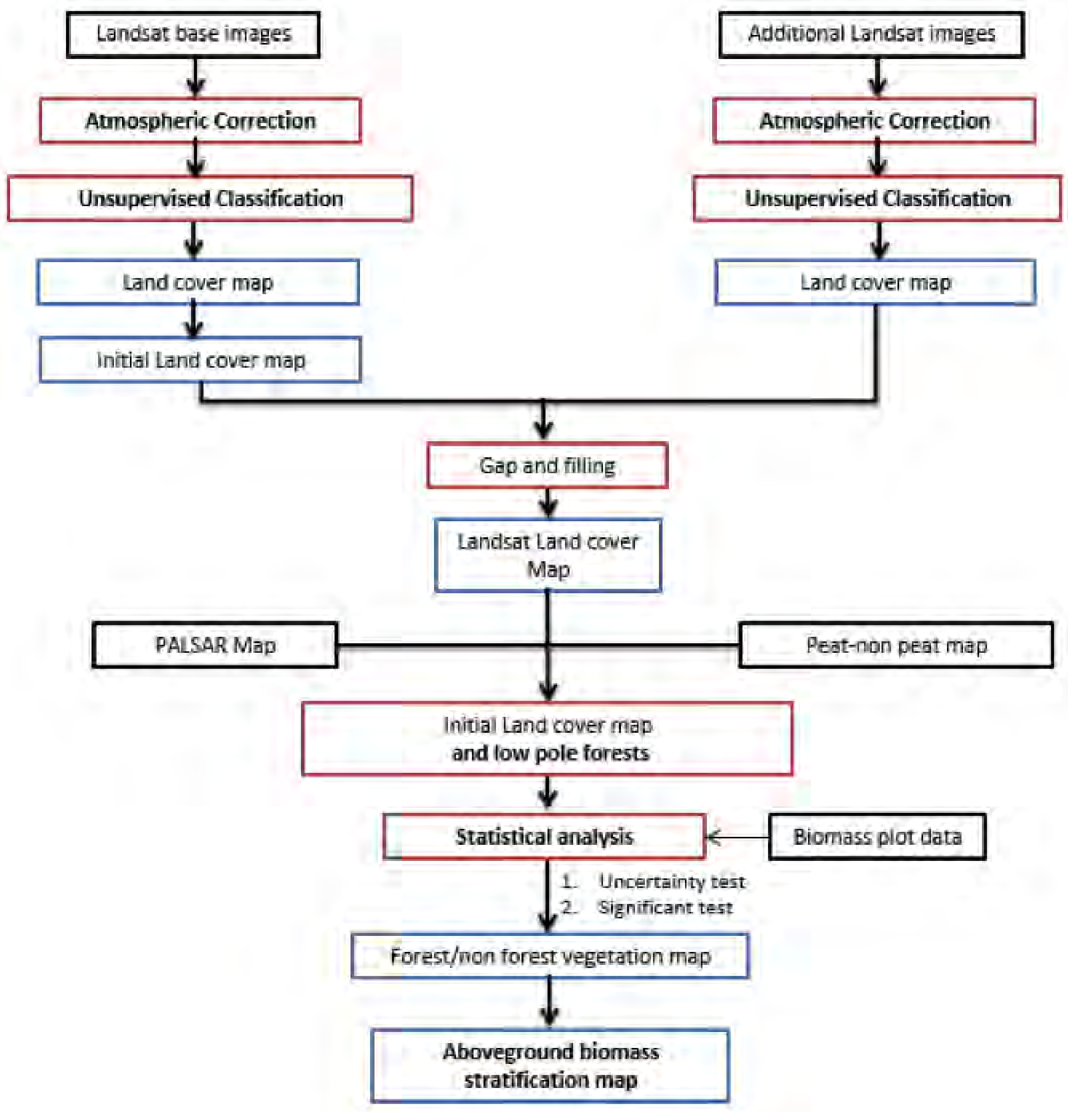
- Aboveground biomass (AGB) & vegetation types
- Soil types (peat or non-peat soils)
- Peat thickness and peat depletion time (PDT)
- Carbon stock
- Eligible area for crediting

Sub-subsections 4.3.1.1 through 4.3.1.6 describe the spatial boundary of the project area in more detail.

4.3.1.1 Aboveground biomass (AGB) stratification

The project area was stratified into homogeneus classes based on their aboveground carbon stock. Satellite imagery was used to delineate the project area based on vegetation types and structures as well as land cover features. Field data was used to quantify aboveground biomass (AGB) and carbon (C) in each stratum. The remote sensing and field data were subsequently cross-checked and calibrated where necessary. Figure 9 shows the process of AGB stratification.

Figure 9. Aboveground stratification process



Spectral data from 2010 Landsat imagery, downloaded from the USGS online database[1], was used to map the land cover classes. Due to significant data gaps caused by the Landsat 7 ETM+'s Scan Line Corrector's failure and cloud cover, additional 2010 imagery was used to fill the gaps. Additional remaining gaps were subsequently filled using imagery from 2009. The data acquisition, pre-processing, classification and accuracy assessment methods followed the steps outlined in Sub-section 6.1.2.

In addition to the Landsat imagery, the project also acquired two fully polarimetric ALOS PALSAR datasets from 28/04/2010 and15/05/2010. These have a 25m spatial resolution as well as a Fine Beam Double (FBD) Polarization dataset from 05/07/2010 with a 12.5m spatial resolution (all processed to level 4.1 products).The microwaves emitted by the ALOS PALSAR system interact differently with the earth's surface depending on their polarization [8] which makes them ideal for mapping forest characteristics such as vegetation structure. Both PALSAR datasets were classified using the entropy, representing the randomness of the signal's scattering, and the alpha angle, which is indicative for the dominant scattering mechanism. Given the FBD's limited polarimetric data, the fully polarimetric dataset

[1] http://earthexplorer.usgs.gov

produced more accurate classification results and was used to map the vegetation structure characteristics of the forest. This analysis identified a significant area of low pole forest in the center of the project area, which was subsequently added to the Landsat based AGB stratification. This analysis also identified small areas of freshwater swamp forest inside the project area.

Satellite images used for the stratification analyses are provided in Table 11. The result of the stratification based on the Landsat and PALSAR analyses is provided in Map 6 and Table 12.

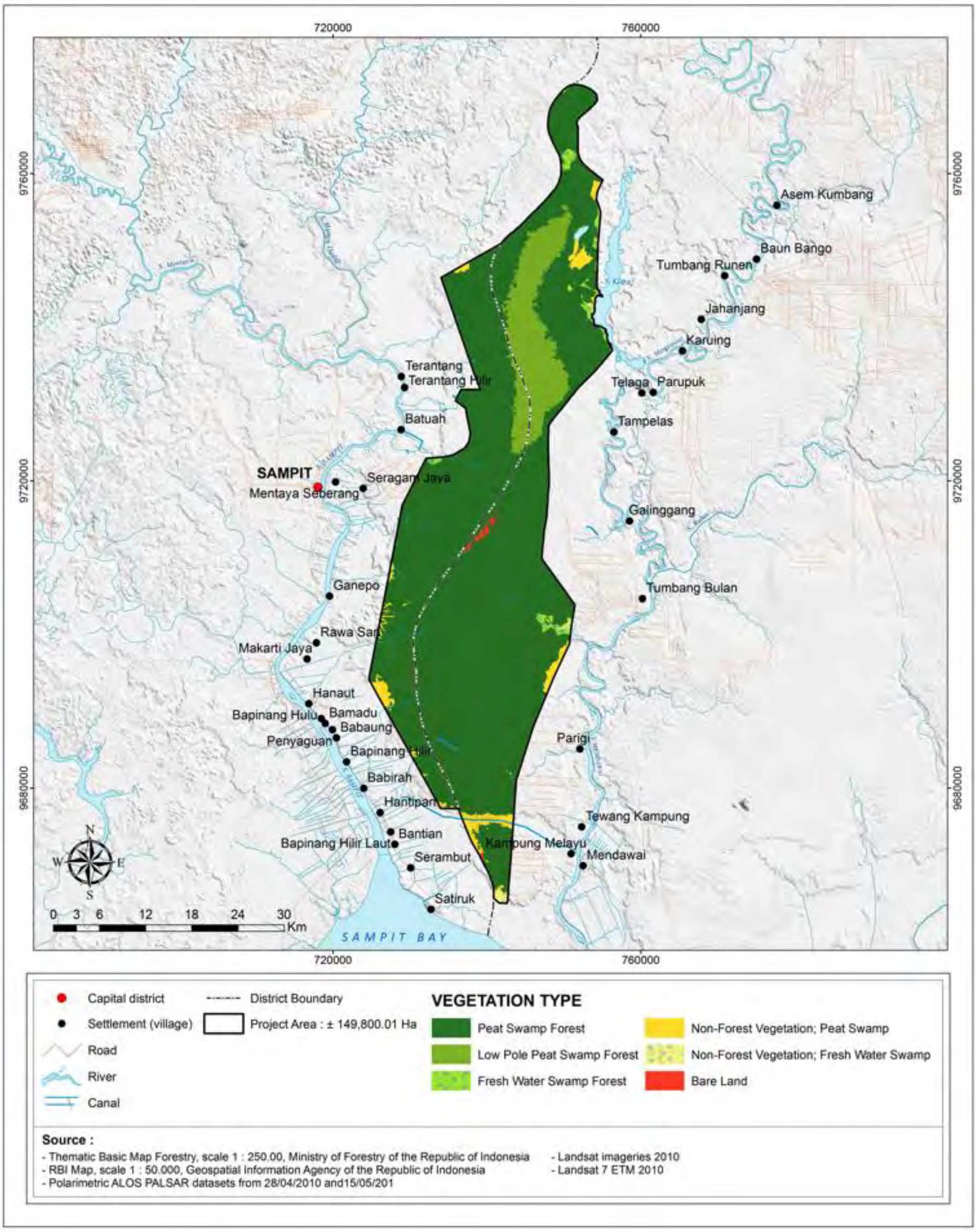
Table 11. Satellite images used for stratification

No	Satellite sensor	ID	Dated
A	Main images		
1	Landsat 5 TM	LT51180622010041BKT00	10-02-2010
2	Landsat 5 TM	LT51190612010016BKT00	16-01-2010
3	Landsat 5 TM	LT51190622010016BKT00	16-01-2010
B	Images for gap filling		
1	Landsat 7 ETM +	LE71190622008019EDC00	10-02-2010
2	Landsat 7 ETM +	LE71190622009213EDC01	16-01-2010
3	Landsat7 ETM +	LE71190612010040EDC01	16-01-2010
4	Landsat 7 ETM +	LE71190612010152EDC01	01-06-2010
C	ALOS PALSAR Images		
1	ALOS PALSAR	Full Polarimetry Mode dataset	28/04/2010
2	ALOS PALSAR	Full Polarimetry Mode dataset	15/05/2010
3	ALOS PALSAR	Fine Beam Double Polarization dataset	05/07/2010

Table 12. Land cover of the project area based on the Landsat and PALSAR analyses

No	Vegetation type	Hectares	%
1	Peat swamp forest	128,584	85.84
2	Low pole peat swamp forest	14,510	9.69
3	Freshwater swamp forest	1,683	1.12
4	Non-forest vegetation: freshwater swamp	469	0.31
5	Non-forest vegetation: peat swamp	4,189	2.80
6	Bare land	362	0.24
TOTAL		149,800	100.00

Map 6. Stratification of the project area based on the Landsat and PALSAR analyses

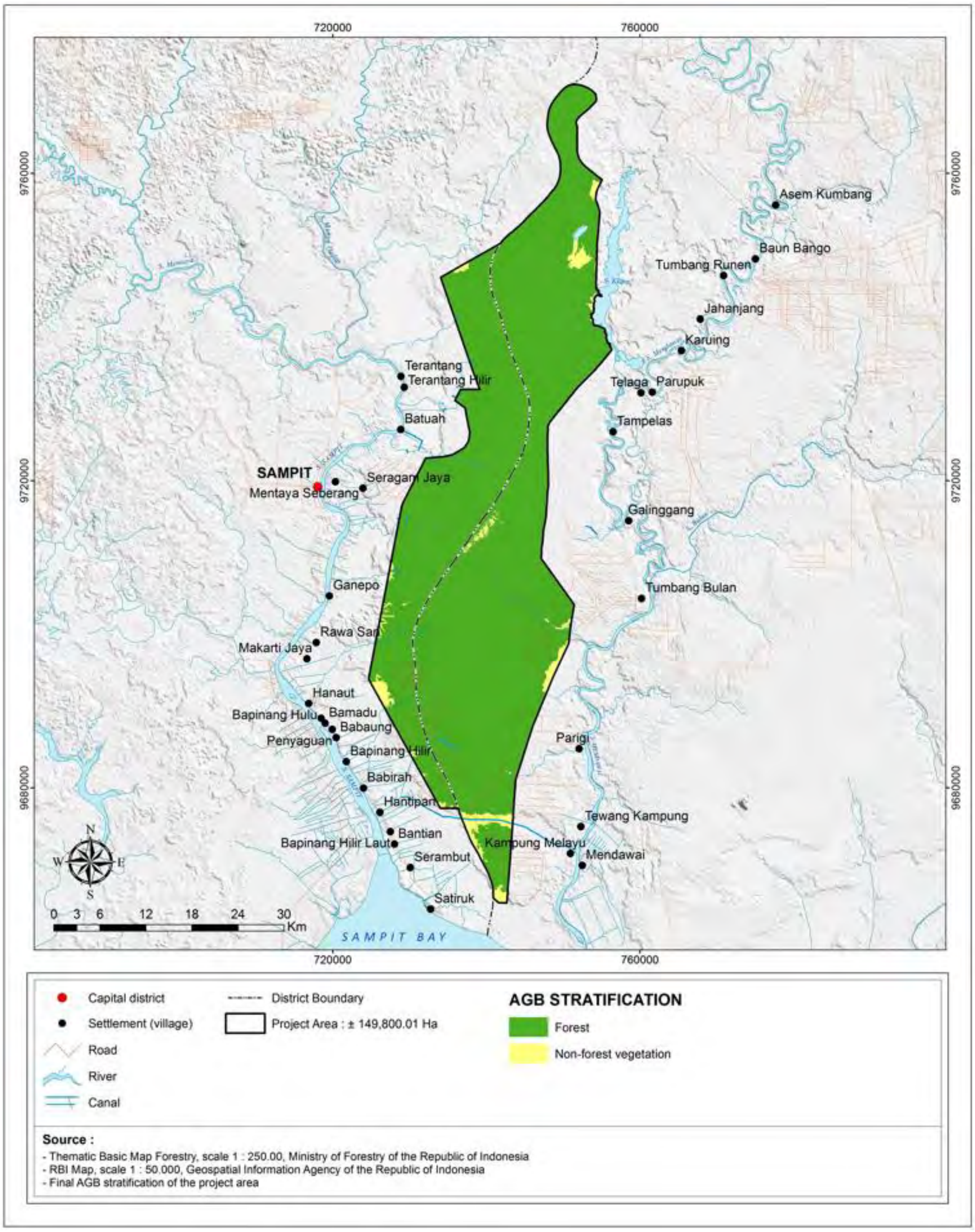


Above ground biomass was sampled using 91 sampling plots distributed across the project area (both randomly and systematically along two transects crossing the project area). The plot data were used to calculate the mean AGB for each stratum. Per VCS methodology VM0007 Module X-STR, all strata with means within 20% of each other were merged into single strata, resulting in the peat swamp forest and low-pole peat swamp forest strata being combined. Since the Landsat and PALSAR data did not identify any difference in land cover and forest structures between the freshwater swamp forest and the surrounding peat swamp forest areas, these two classes were also combined. Furthermore, the non-forest vegetation strata was conservatively combined with the bare land strata, resulting in a final AGB stratification map consisting of forest and non-forest vegetation strata (see Map 7 and Table 13).

Table 13. Final AGB stratification summary of the project area

	Vegetation type	Hectares	%
1	Forest	144,778.26	96.65
2	Non-forest vegetation	5,021.75	3.35
TOTAL		149,800.01	100

Map 7. Final AGB stratification of the project area



As mandated in VCS methodology VM0007 module M-MON, the classification accuracy must be at least 90%. By applying a basic binary confusion matrix, the stratification map was estimated to have an accuracy level of 98.5%. This level of accuracy is also acceptable under the IPCC Good Practice Guidance 2003 [9]. An uncertainty analysis was carried out by using the VCS methodology VM0007 module X-UNC 'estimation of uncertainty for REDD project activities'. The uncertainty level was found to be 10.61%, which meets requirements of VSC methodology VM0007 module X-UNC.

4.3.1.2 Stratification of peatland and non-peatland

Mapping the peatland area and the peat thickness within the project area followed three general steps. The first step was to identify the general area of the peat dome in order to determine the 'Initial Estimate of Peatland Borders' (IEPB). This step uses several indicators as listed in Table 14. Once the IEPB was identified, the second step sought to delineate more refined borders following geomorphological and geostatistical analyses, including steps presented in Figure 10 and Annex 1. The third step was to subset (clip) the peatland area within the landscape with reference to the project boundary.

Table 14. Indicators for the differentiation of peatland from non-peatland

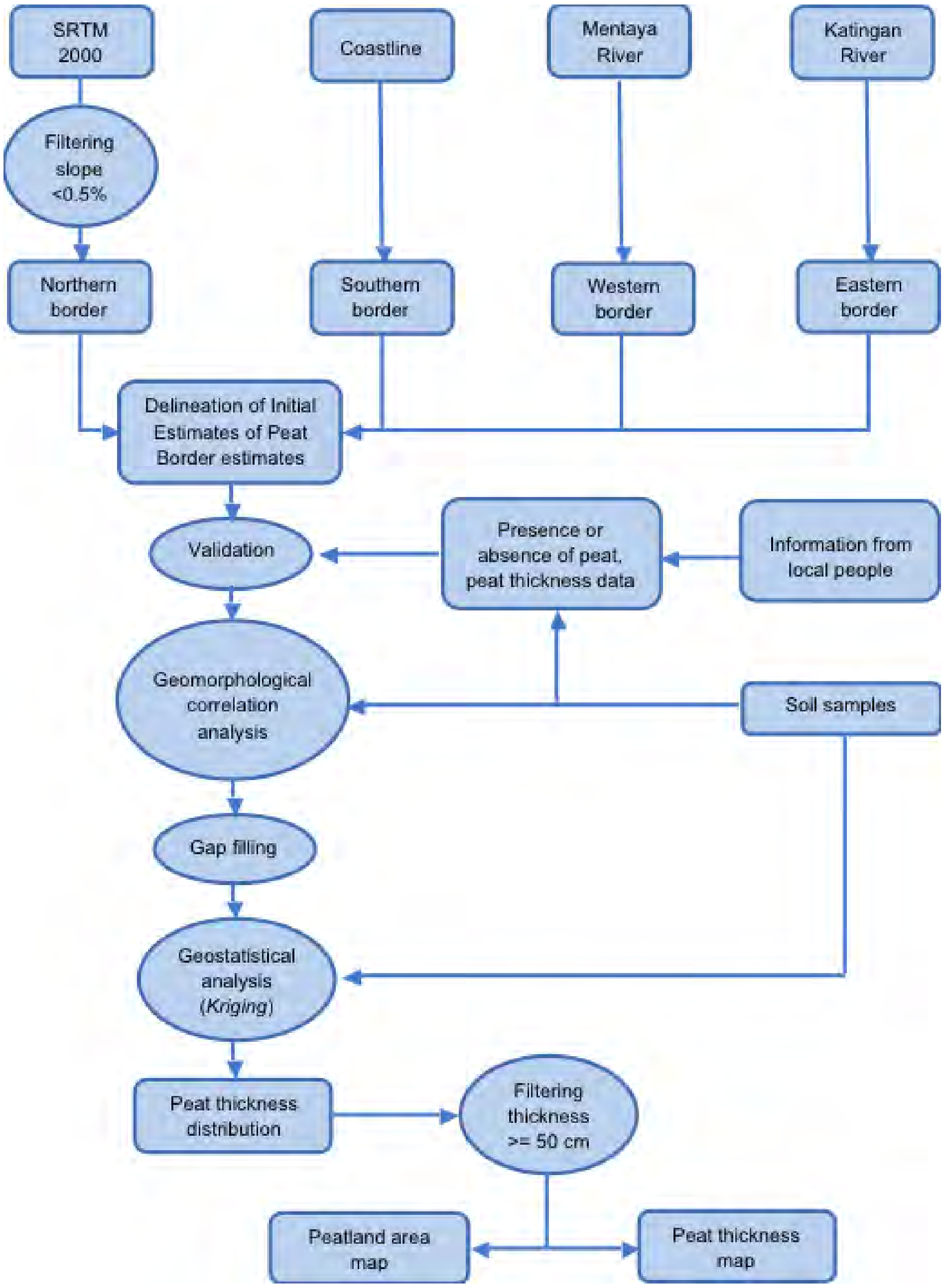
Indicators	Purpose	Source
Major rivers with mineral levees	Indicator for the absence of peat	Official BIG[2] river map[3] (2008)
Coastline	Indicator for the absence of peat	Official BIG river map (2008)
Heathland areas	Indicator for the absence of peat	SRTM 2000 (NASA)
Soil samplings	Indicator for the presence or absence of peat	Field data
Information from local people	Indicator for the presence or absence of peat	Local people

River networks, coastline and heathland were used as indicators to determine the peatland borders. Katingan and Mentaya rivers, which clearly show the presence of mineral levees, border the peat dome on the east- and western side of the project area respectively. The coastline to the south was used as the southern border.

To identify the northern heathland border, a surface slope map of the landscape was generated by using a NASA SRTM 2000 digital elevation dataset[4]. Since tropical coastal peatlands of Indonesia usually show flat surface pattern with less than 0.5 percent slope, filtering the dataset with slope values less than 0.5 percent provides an indication of the heathland boundary. The SRTM 2000 dataset also shows that the heathland features a more undulating surface, a feature which peatlands lack, and which therefore provided a visual confirmation of the northern heathland boundary.

[2] Badan Informasi Geospasial (Geospatial Information Bureau of Indonesia)
[3] This map also includes canal networks. The year of publication is still relevant, as main canals within project area were constructed before 2000, and no new canals have been constructed post 2008.
[4] Available at: http://srtm.csi.cgiar.org/SELECTION/inputCoord.asp

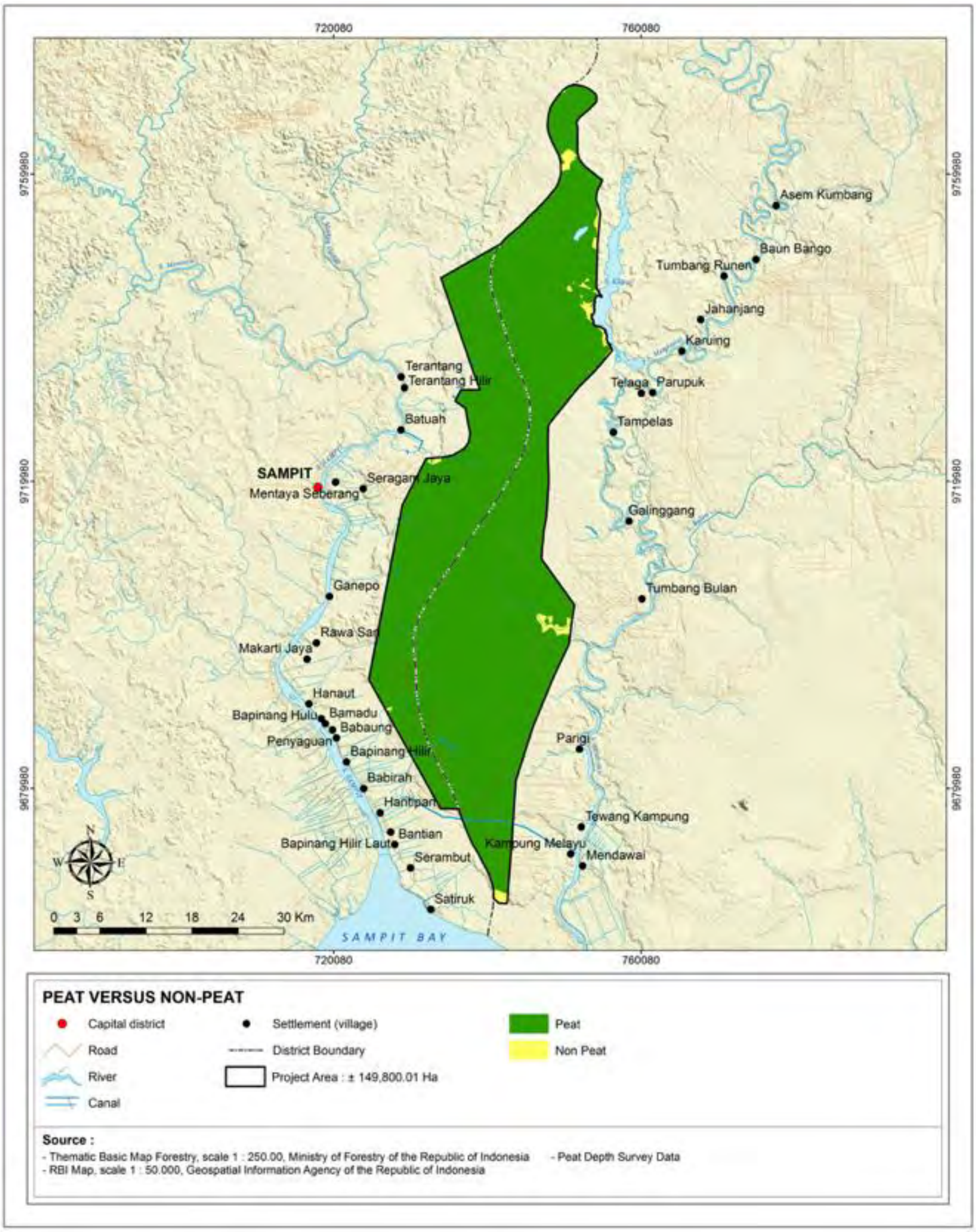
Figure 10. Process of peatland and peat thickness mapping



Additional data was collected in the field for validation of the IEPB including information on river networks with mineral levees other than Mentaya and Katingan rivers, the presence or absence of peat, peat thickness in the visited locations as shown from soil samplings, and information from local people on the presence or absence of peat near their villages. The validated IEPB was stored in ESRI[5] polyline shapefile format, and was used for further processing as described in Sub-subsection 4.3.1.3 (see also Figure 10) to produce a peat thickness distribution map. This map was further processed by filtering peat thickness ≥50 cm, and was used as the final peatland area map. The resulting peat and non-peat map is shown in Map 8.

[5] A geographic information system company. More information is available online at: http://www.esri.com.

Map 8. Peat versus non-peat areas within the project area boundary



4.3.1.3 Stratification of peat thickness and PDT

Because drained peat soils are subject to microbial decomposition and (uncontrolled) burning, in the baseline scenario, all peat at some locations in the project area may be depleted before the end of the crediting/project period. The time at which the peat in the project area would have been depleted (peat depletion time; PDT) in the most likely baseline scenario in the project area was calculated based on the following, which are then each considered in more detail below:

- Peat thickness;
- Drainability elevation limit;
- Surface elevation; and
- Subsidence related to microbial decomposition and burning.

A) Peat thickness

To determine peat thickness, over 390 peat core samples were taken using peat augers according to the method detailed in Annex 1. Sample locations were selected using a systematic design that included transects perpendicular to water bodies, the peat-non-peat perimeter, and contour lines. This sampling design fulfils the requirements described in the VCS methodology VM0007 modules M-PEAT and X-STR. Peat thickness was then modelled based on spatial interpolation (Kriging) of inputs from peat thickness points.

Peat thickness measurement points were plotted in the ArcGIS 10.1 platform[6]. The distances of each point to the nearest IEPB were calculated by using the built-in Euclidean Distance Tool. The IEPB was generated by process as previously described in Sub-subsection 4.3.1.2. Peat thickness data was then paired against distance to IEPB, and the best fit equation was analyzed:

$$P=aX^{c} \tag{1}$$

Where:
P : Thickness of peat (cm)
X : Distance to the nearest IEPB (m)
a, c : Constants

An array of approximate points were created manually to fill gaps (i.e. areas where peat thickness measurements were absent due to accessibility constraints). The distances of the approximate points to IEPB were also calculated using the same method as used for those of the actual measurement points. Estimated peat thickness at locations of the approximate points were calculated by using the above equation (1).

Actual measurement points and the approximate points were pooled together by using the Merge Tool in ArcGIS 10.1. The resulting points were then used in spatial interpolation (Kriging) to produce a peat thickness raster with 1 hectare spatial resolution. The raster was further processed by filtering peat thicknesses ≥50 cm and the resulting map was used as the final peat thickness map and as the source for peat thickness stratification. The area covered was used as the peatland area map, as outlined in Figure 10. The result shows that peatland with peat thickness ≥50 cm occupies 146,639 hectares (97.9%) of the project area.

Per VCS module X-STR, our initial analysis indicated that the entire peatland in the project area must be stratified, although stratification by peat thickness at a 50 cm resolution was not necessary (see Table 15). Therefore, a wider range of peat thickness was used, and the project area was stratified into 5 classes as presented in Table 16 and Map 9.

Table 15. Decision matrix for peat stratification requirements

No	Requirements per VM0007 module X-STR	Findings	Conclusion
1	When in more than 5% of the project area peat is absent or the thickness of the peat is below a threshold value (e.g., 50 cm); the map only needs to distinguish where peat thickness exceeds this threshold. It is conservative to treat shallow peat strata as mineral soil strata.	Peat ≥50 cm occupies more than 95% of the project area.	The entire peatland in the project area must be stratified.
2	When, using a conservative (high) value for subsidence rates, in more than 5% of the	In 12.56% of the project area, peat that remains	The peat thickness map

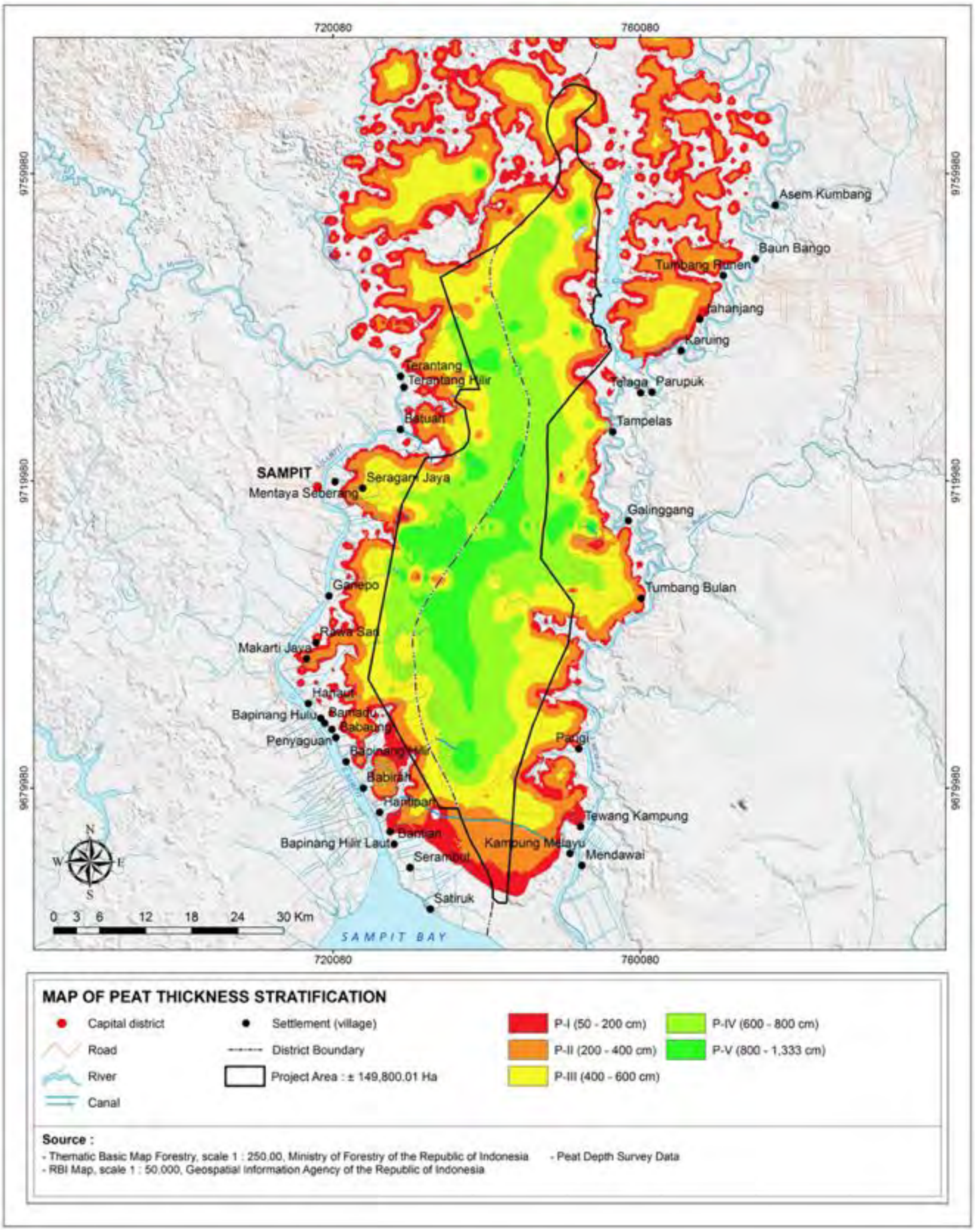
[6] ArcGIS is an integrated geographic information system developed by ESRI.

No	Requirements per VM0007 module X-STR	Findings	Conclusion
	project area less or equal peat is available at t=100 years in the project scenario than in the same strata in the baseline scenario, the peat thickness map only needs to distinguish these strata	in the project scenario equals that of the baseline scenario at t =100 years	only needs to distinguish these strata.
3	When, using a conservative (high) value for subsidence rates, in the baseline scenario in more than 5% of the project area the project crediting period exceeds the peat depletion time (PDT); the peat thickness map must distinguish with a resolution of 50 cm strata where peat will be depleted within the project crediting period. Peat strata that will be depleted can be further stratified according to their peat depletion time. Areas where peat will not be depleted need not be further stratified.	Less than 5% of the project area where project crediting period (60 years) exceeds PDT (see Table 17).	The peat thickness map does not need to be distinguished with a resolution of 50 cm strata, where peat will be depleted within the project crediting period.

Table 16. Peat thickness stratification of the project area

Thickness Range (centimetres)	Class Symbol	Area (hectares)	% of the project area
50 – 200	PI	5,365	3.6
200 – 400	PII	16,113	10.8
400 – 600	PIII	41,508	27.7
600 – 800	PIV	61,849	41.3
800 – 1,333	PV	21,803	14.6
Total		146,638	97.9

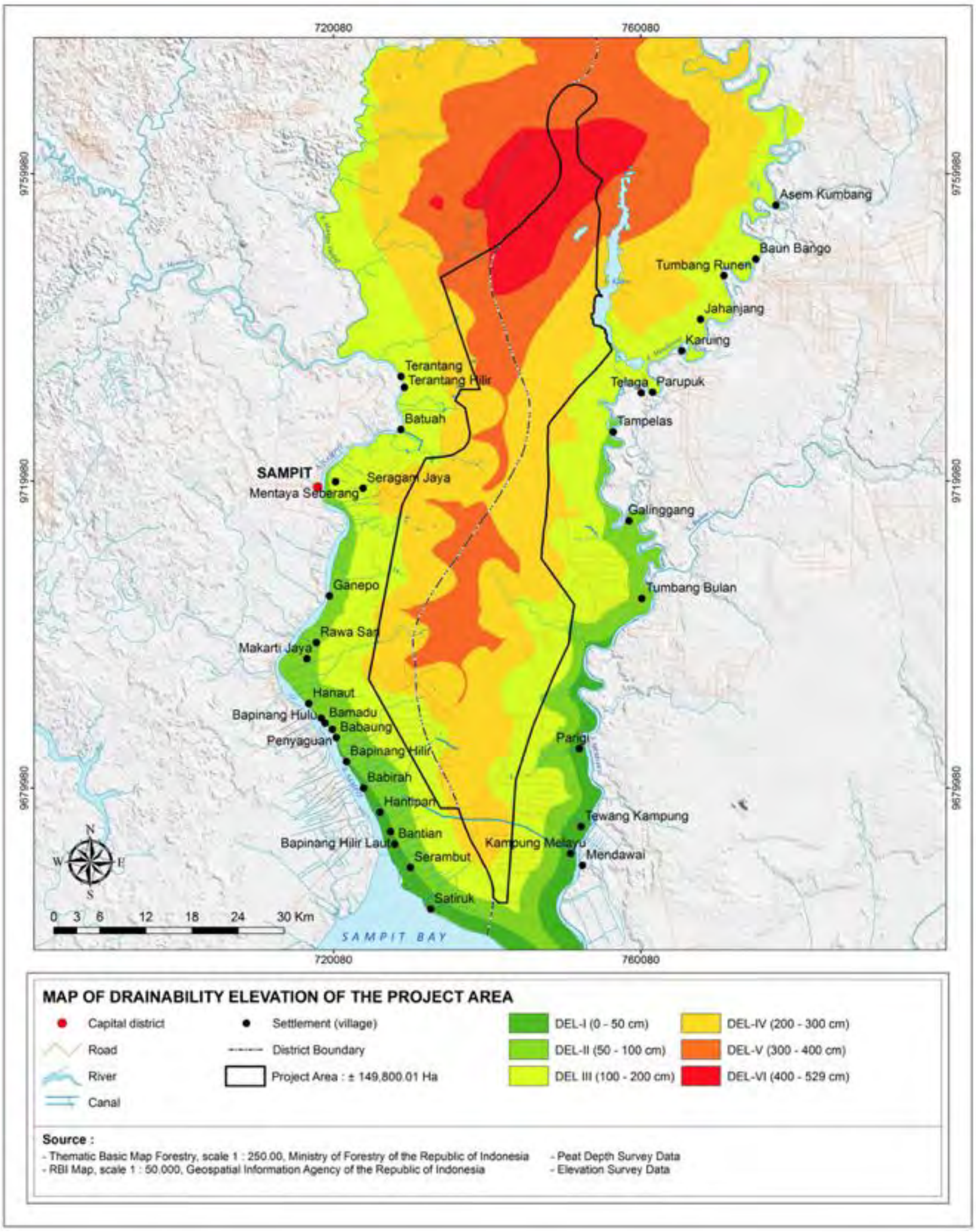
Map 9. Peat thickness stratification of the project area



B) Digital elevation model and drainability elevation limit

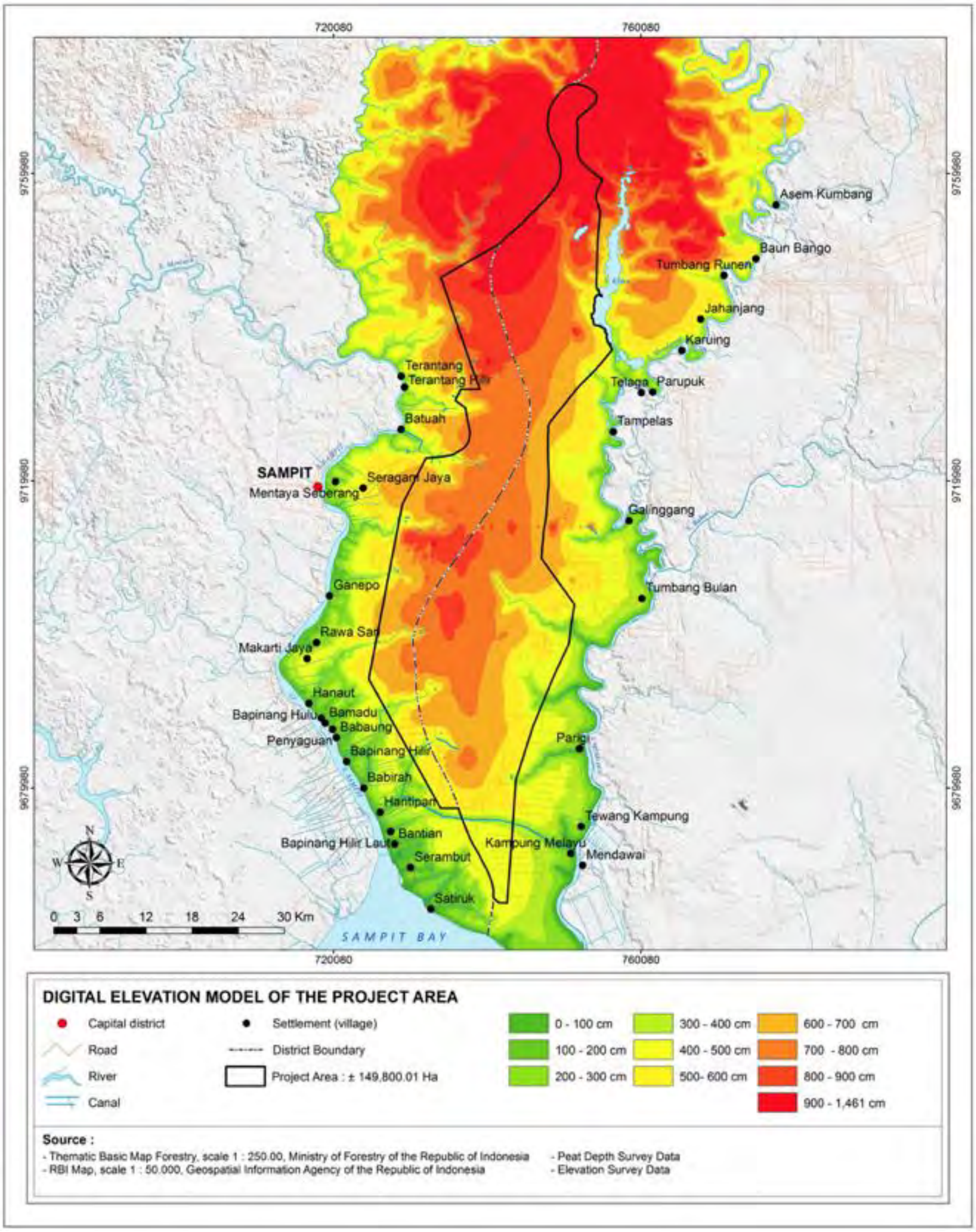
It was conservatively assumed that, in the baseline scenario, the deforestation agents will not practice mechanical pumping. Therefore the thickness of peat that may be lost is restricted by the Drainability Elevation Limit (DEL) – the elevation at which the peat cannot be drained any further without mechanical pumping, defined by the water level in the closest water body. Where, during the course of subsidence, land surfaces reach DEL, further drainage is prevented as the remaining peat layer stays waterlogged. A DEL map (see Map 10) was created by using estimated water levels in rivers and other water bodies in the Katingan landscape. Detailed methods are given in Annex 2.

Map 10. Drainability elevation limit of the project area



To create a surface elevation map (Digital Elevation Model, DEM), data was collected through a levelling survey and river bed slope data (see Map 11). This was combined with the application of geomorphological correlation analysis and geostatistical interpolation methods (Kriging), as described in Annex 3.

Map 11. Digital elevation model of the project area



Combining these three maps (see Map 9, Map 10 and Map 11) resulted in a map of peatland subject to microbial decomposition and burning (as shown in Map 12), based on the following rules:

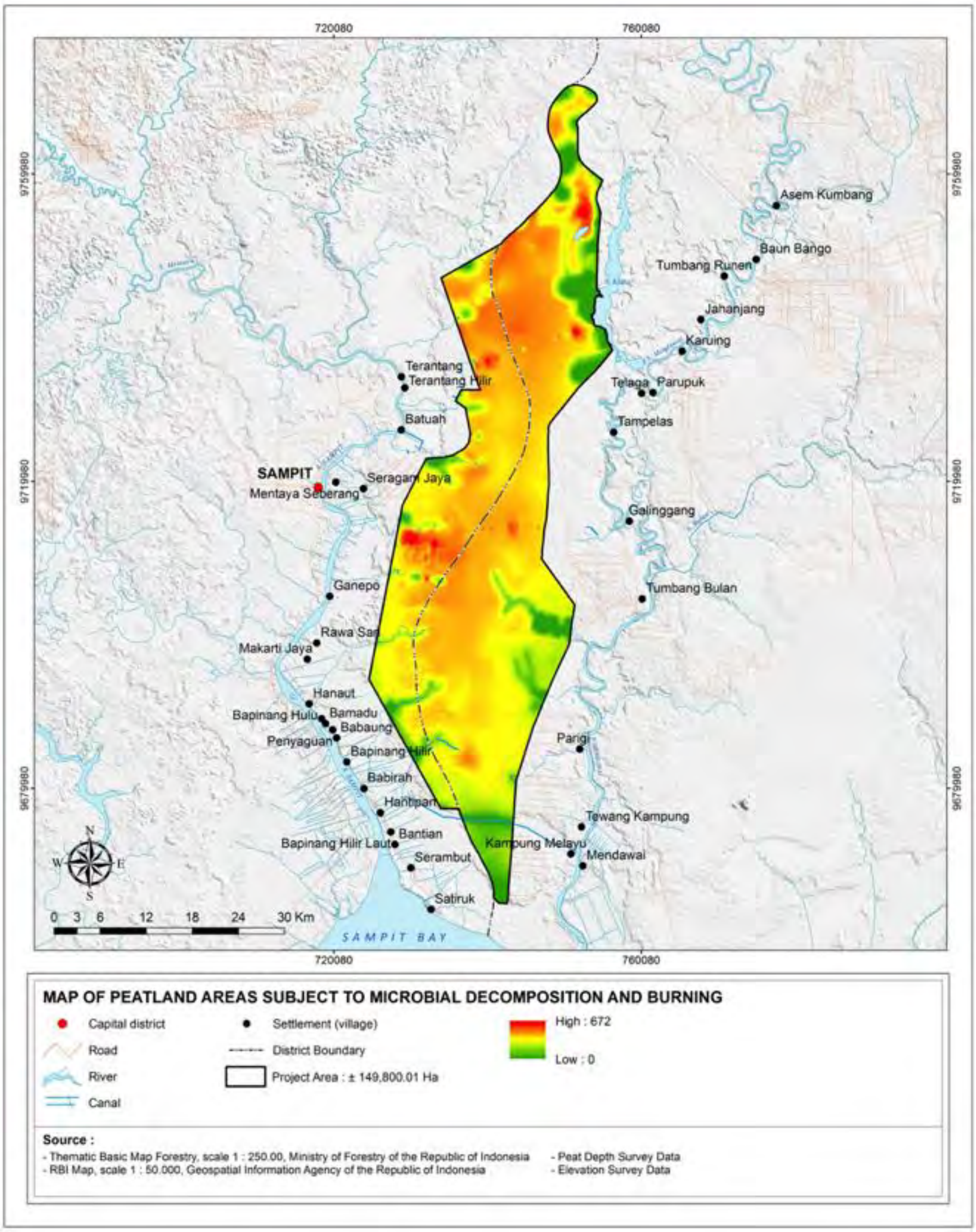
Peat available for microbial decomposition and burning = DEM – DEL (2)

Where:
DEM – DEL ≤ Peat Thickness

Peat Available for Microbial Decomposition and Burning = Peat Thickness (3)

Where:
DEM – DEL > Peat Thickness

Map 12. Peatland area subject to microbial decomposition and burning



C) Peat depletion time (PDT)

Based on the resulting maps of peat thickness, the DEM and DEL, and the calculated peat subsidence in the baseline scenario (see Section 6.1), a map based on the peat depletion time (PDT) was created (see Map 13) by using the following equation. Table 17 presents the calculation of PDT stratification of the project area.

$$t_{PDT\text{-}BSL,i} = Depth_{peat\text{-}BSL,i} / Rate_{peatloss\text{-}BSL,i} \quad (4)$$

Where:

$t_{PDT\text{-}BSL,i}$	Peat depletion time in the baseline scenario in stratum i in years elapsed since the project start (yr)
$Depth_{peat\text{-}BSL,i}$	Average peat depth in the baseline scenario in stratum i at project start (m). In this case = peat thickness available for microbial decomposition
$Rate_{peatloss\text{-}BSL,i}$	Rate of peat loss due to subsidence and peat burning in the baseline scenario in stratum i; (m yr^{-1})

Map 13. PDT of the project area

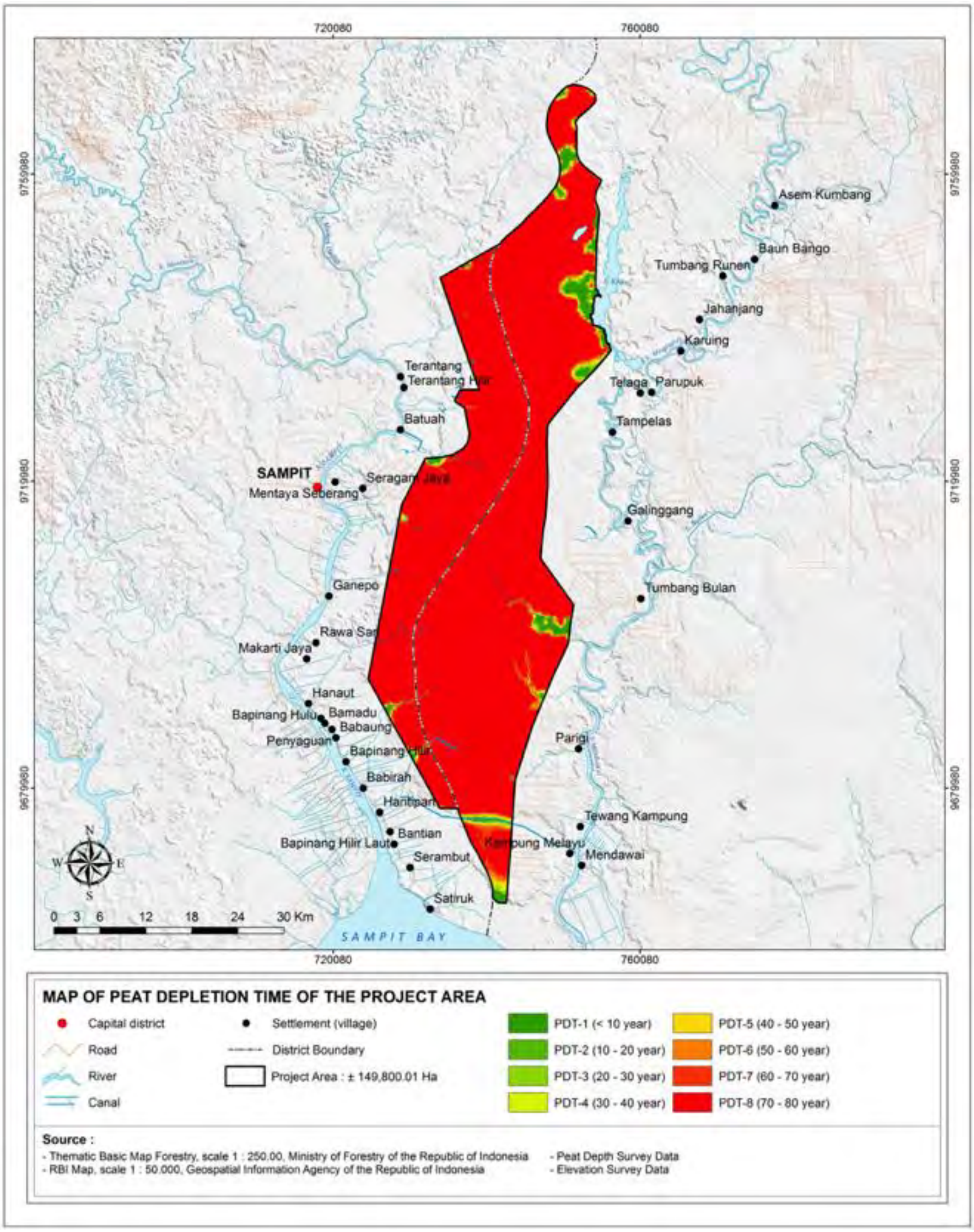


Table 17. Summary of the PDT stratification of the project area

Class Symbol	PDT Range (years)	Area (ha)	% of the peat area	% of the project area
PDT-1	<10	121	0.1	0.1
PDT-2	10 – 20	562	0.4	0.4
PDT-3	20 – 30	1,159	0.8	0.8
PDT-4	30 – 40	1,281	0.9	0.9
PDT-5	40 – 50	1,305	0.9	0.9
PDT-6	50 – 60	1,986	1.4	1.3
PDT-7	60 – 70	2,490	1.7	1.7
PDT-8	70 – 80	3,349	2.3	2.2
PDT-9	80 – 90	3,746	2.6	2.5
PDT-10	90 – 100	5,146	3.5	3.4
PDT-11	>100	125,494	85.6	83.8
Total		146,638	100.0	97.9

Less than 5% of the peatland in the project area are expected to deplete before reaching the 60-year crediting period, while more than 85% are likely to exceed the peat depletion time of 100 years.

4.3.1.4 Stratification based on carbon stock

A) AGB carbon stock

Based on the AGB map of the project area (see Map 7), carbon stock were quantified for each stratum by using the following equations.

$$C_{AB} = A_{AB,i} * C_{AB,i} \quad (2)$$

Where:

C_{AB} = Total aboveground biomass carbon stock; tC

$A_{AB,i}$ = Area of stratum i; Ha

$C_{AB,i}$ = Mean aboveground biomass carbon stock in stratum i; $tC.ha^{-1}$

This ultimately resulted in the AGB density of 98.38 Mg C ha^{-1} for the forest stratum and 2.16 Mg C ha^{-1} for the non-forest stratum. The final calculation estimated the total AGB carbon stock in project area to be **14,254,599 MgC**, in which 14,243,741 MgC (99.92%) was stored in forest areas and 10,858 MgC (0.08%) in non-forest vegetation. The stratification of AGB carbon stock in the project area at the project start is provided in Map 14, and the calculation based on each stratum is summarized in Table 18.

Map 14. Stratification of AGB carbon stock

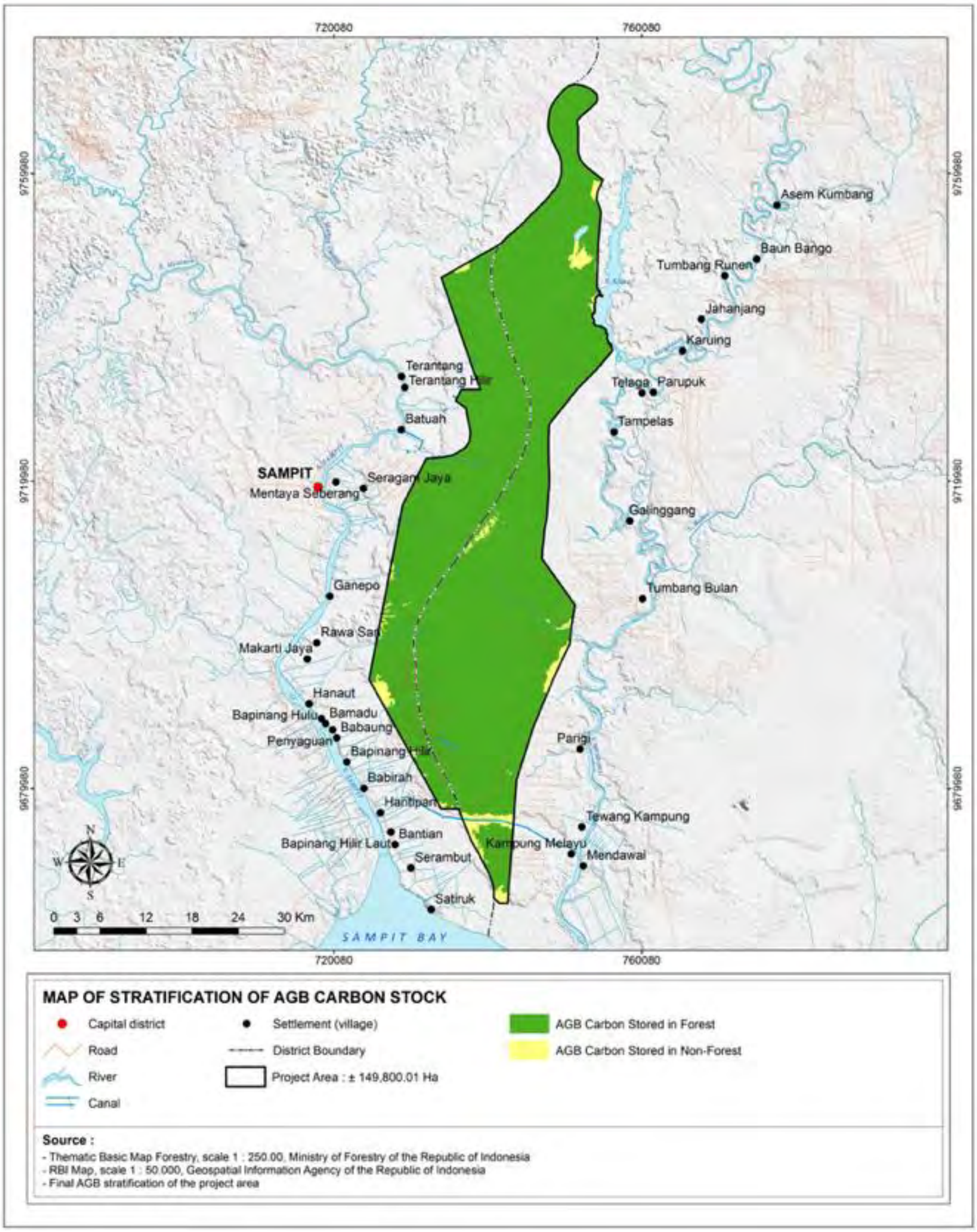


Table 18. Volume of AGB carbon stock in the project area at the project start

Strata	Strata	Area (ha)	Average AGB C stock (tC.ha^{-1})	Total AGB C Stock (tC)
F0	Forest	144,778	98.38	14,243,741
NF0	Non Forest	5,021	2.16	10,858
Total		149,800	-	14,254,599

B) Peat carbon stock

Based on the peat thickness map (see Map 9), the volume of initial peat carbon stock at the project start date has been quantified by using peat bulk density of the project area and conservative carbon content value of 48 $kgC.kg^{-1}$ dry mass of peat [10]. The bulk density measured by the project showed no significant variation either across horizontal or vertical directions (μ=127 $kg.m^{-3}$, SE=3.1 $kg.m^{-3}$, n=197, p=0.05). Details on the measurement methods and analyses are provided in Annex 4. The volume of peat carbon stock across strata in the project area were quantified by using the following formula:

$$C_{stock\text{-}i,t0} = \frac{48}{100} \times Depth_{peat\text{-}i,t0} \times BD_{i,t0} \times 10 \qquad (3)$$

Where:

$C_{stock\text{-}i,t0}$ Initial carbon stock of stratum i (at t=0) (t C ha^{-1})

$Depth_{peat\text{-}i,t0}$ Initial peat thickness of stratum i (at t=0) (m)

$BD_{i,t0}$ Initial bulk density of peat of stratum i (at t=0) ($kg.m^{-3}$)

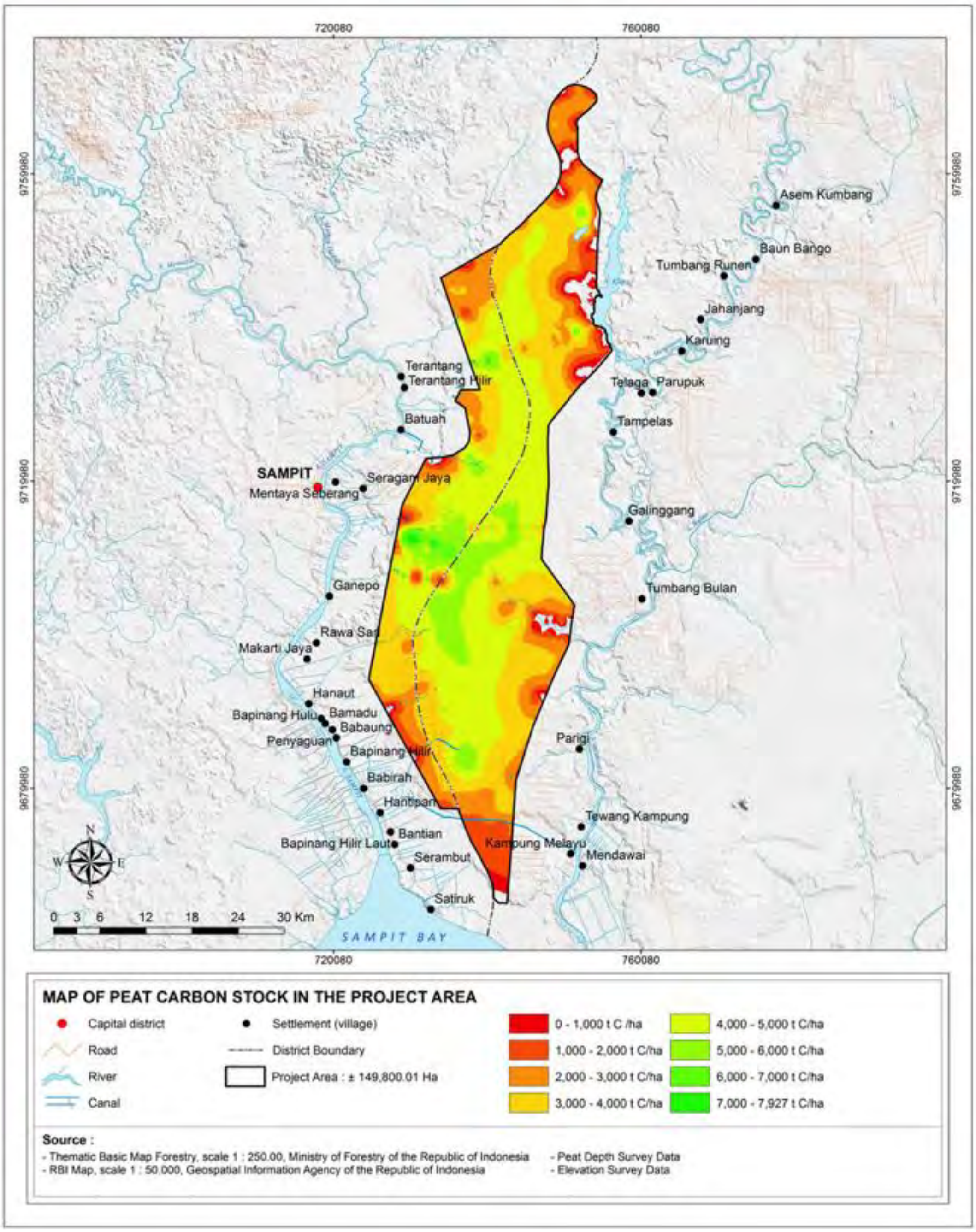
The final calculation estimated the total peat carbon stock in project area to be **546,767,493 MgC.** The stratification of peat carbon stock in the project area at the project start is provided in Map 15, and the calculation based on each stratum is summarized in Table 19.

Table 19. Volume of peat carbon stock in the project area at the project start

Strata	Area (ha)	Average peat carbon stock ($tC.ha^{-1}$)	Total peat carbon stock (tC)
P1L0D0	3,172	2,597	8,043,633
P1L0D1	987	2,124	2,078,712
P1L1D0	141,910	3,738	535,294,904
P1L1D1	354	2,162	764,132
WB	216	2,685	586,113
NP[7]	3,162	-	-
Total	149,800	2,218	546,767,493

[7] Non peat-related strata

Map 15. Stratification of peat carbon stock at the project start



4.3.1.5 Stratification based on emission characteristics

Emission characteristics are highly dependent on the present and future land use and the drainage status of the project area under the baseline and project scenarios. Expected significant differences in emissions and carbon stock changes between different types of aboveground biomass and between different drainage statuses determine which strata are separated from others. The baseline and project scenarios as well as associated emissions are further described in Sections 6.1 and 6.2, which serve as a basis for calculating the area eligible for crediting.

4.3.1.6 Eligible area for crediting

The determination of the area eligible for crediting followed VCS rules as set out in VM0007 module X-STR section 5.4, by using Total Stock Approach.

A) REDD and ARR project activities

The eligible area for REDD projects is the area of forest designated to be deforested. With acacia plantations as most likely baseline scenario, the eligible area refers to all area that is available for the developments of acacia plantations (69%), infrastructure area (2.2%), and community crops (5.3%). While for ARR projects, the area eligible for crediting is all non forest areas where the project would carry out reforestation within the project area (2.8 %). Based on the spatial analysis, the area eligible for crediting from REDD and ARR activities is 114,689.64 ha and 4,227.72 ha respectively. Map 16 indicates the REDD and ARR eligible area within the project area, and Table 20 is the summary of the area.

Map 16. Eligible areas for crediting from REDD-ARR project activities

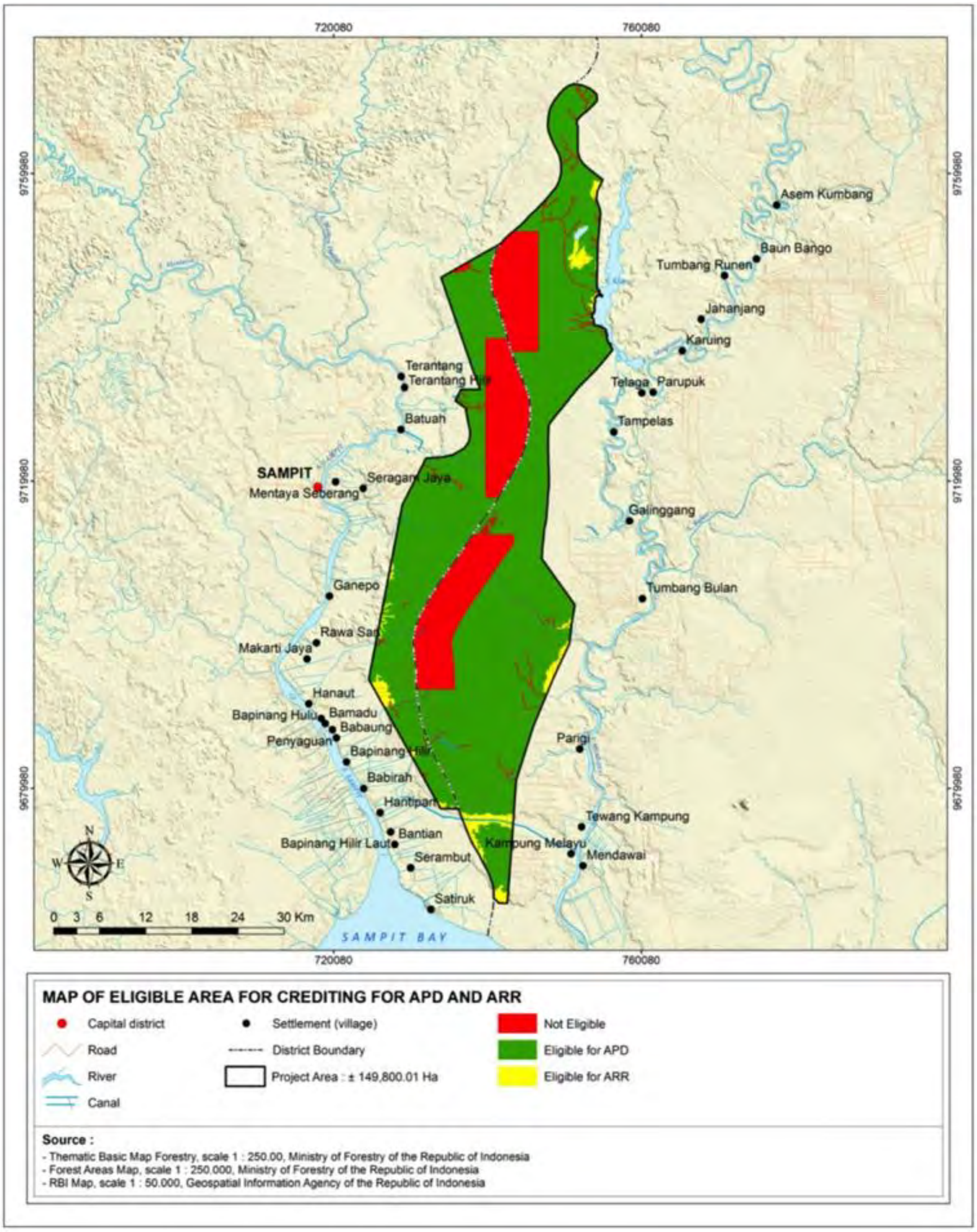


Table 20. Summary of the area eligible for crediting from REDD and ARR activities

Description	Area (hectares)	Area (percent)
Project area	149,800.01	100
Eligible area for crediting for REDD	114,689.64	76.56
Eligible area for crediting for ARR	4,227.72	2.82
Area not eligible for crediting	30,882.65	20.62

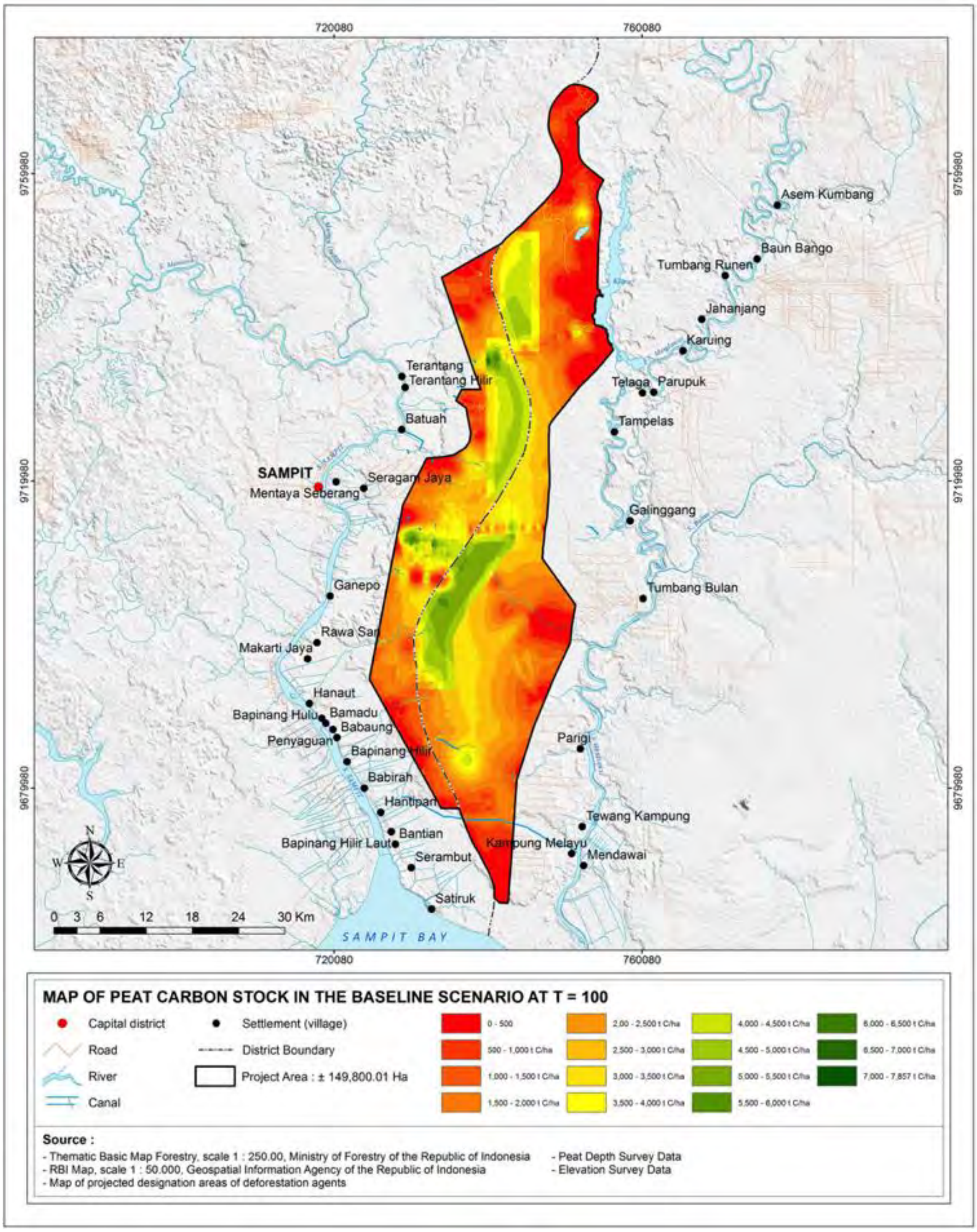
B) WRC project activities

For WRC activities on peatlands, the area eligible for crediting is based on the PDT assessment for the baseline and based on the assessment of 'not successful' conservation of the peat layer (and thus peat depletion) in the project scenario. The eligible area for crediting is in close relation with the eligible project crediting period (the time for which GHG emission reductions or removals generated by the project are eligible for crediting with the VCS program).

Delineation of eligible area for crediting involved three steps as follows (also defined in more detail in VCS methodology VM0007 module X-STR, Section 5.4).

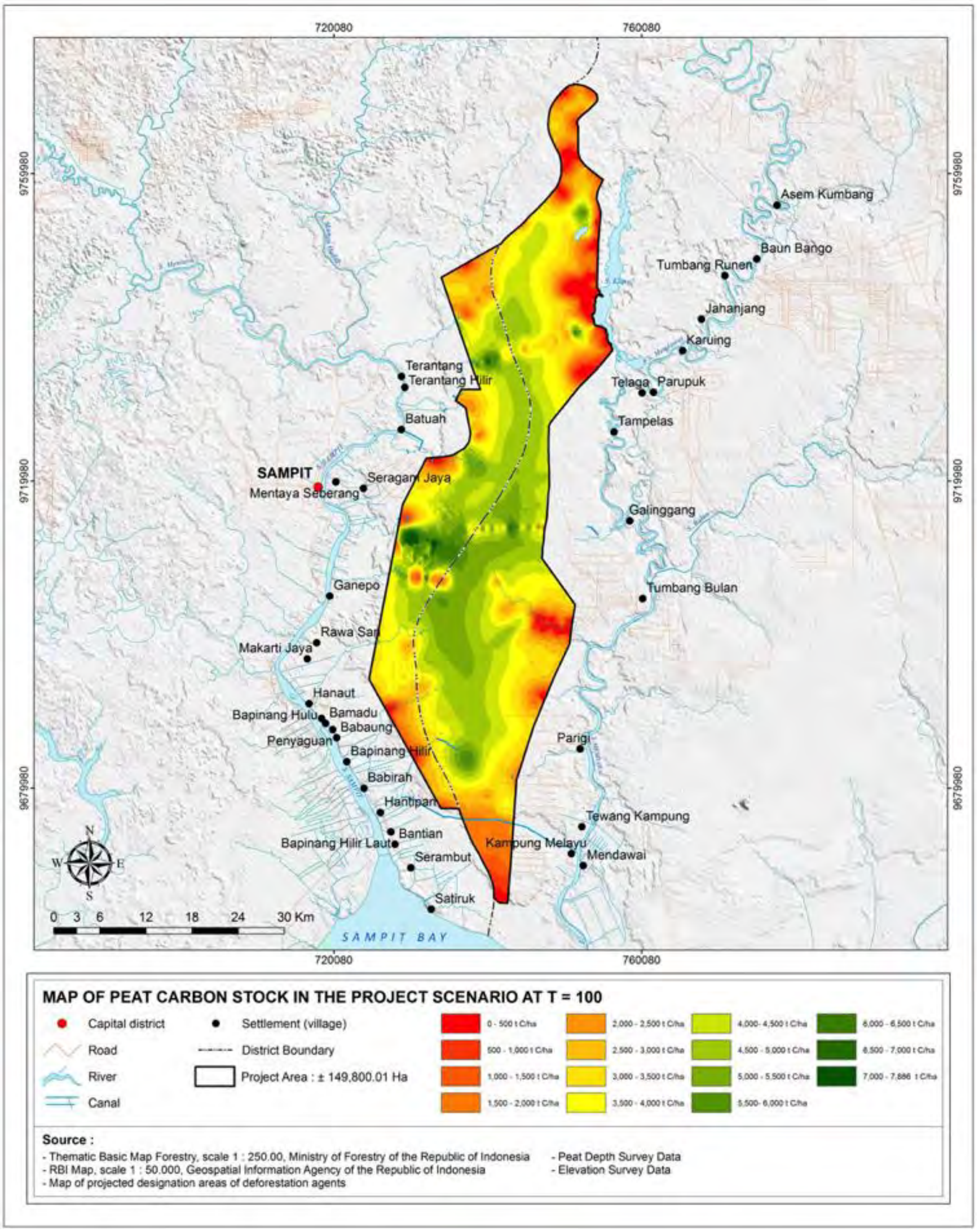
Step 1. Under the baseline scenario, successive changes of peat carbon stock within each stratum were calculated over 100 years. The remaining carbon stocks at t=100 were then mapped (see Map 17). The method for calculating dynamics of carbon stock over time under the baseline scenario is given in Section 6.1.

Map 17. Peat carbon stock in the baseline scenario at t = 100



Step 2. Under the project scenario, successive changes of peat carbon stock within each stratum were calculated over 100 years. The remaining carbon stocks at t=100 were then mapped (see Map 18). The method for calculating dynamics of carbon stock over time under the project scenario is given in Section 6.2.

Map 18. Peat carbon stock in the project scenario at t = 100



Step 3. All areas that show a positive peat carbon stock difference between the baseline and project scenarios at t=100 were delineated as the area eligible for crediting (see Map 19). Such differences were estimated using the following equations:

$$C_{WPS-BSL,t100} = \sum_{i=0}^{M_{WPS}} \left(C_{WPS,i,t100} \times A_{WPS,i}\right) - \sum_{i=0}^{M_{BSL}} \left(C_{BSL,i,t100} \times A_{BSL,i}\right) \quad (4)$$

$$C_{WPS,i,t100} = Depth_{peat\text{-}WPS,i,\ t100} \times C_{vol\_lower,WPS} \times 10 \quad (5)$$

$$C_{BSL,i,t100} = Depth_{peat\text{-}BSL,i,\ t100} \times C_{vol\_lower,BSL} \times 10 \quad (6)$$

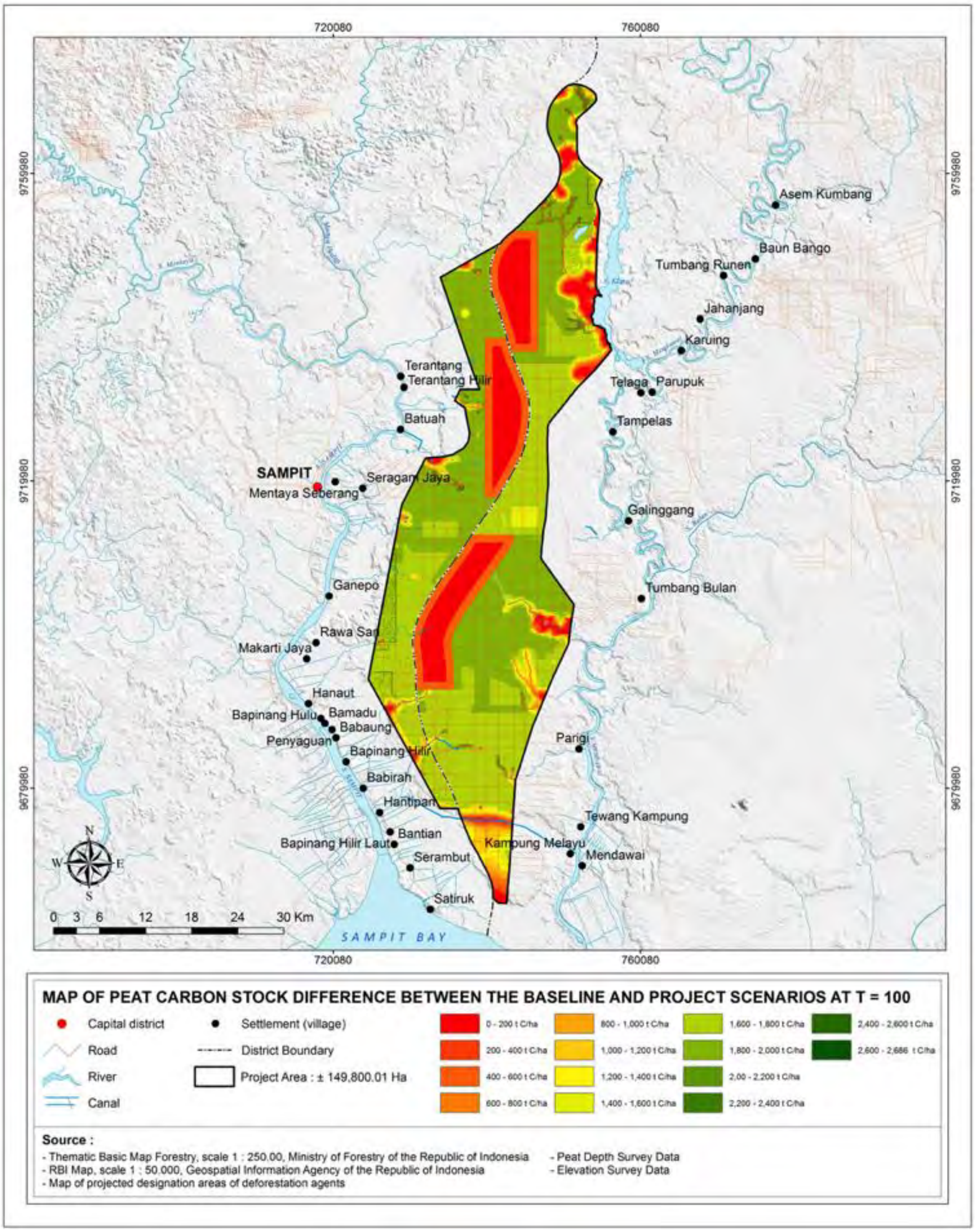
$$Depth_{peat-BSL,i,t100} = Depth_{peat-BSL,1,t0} - Sub_{initial-BSL,i} - \sum_{t=1}^{t=100} Rate_{peatloss-BSL,i,t} \quad (7)$$

$$Depth_{peat-WPS,i,t100} = Depth_{peat-WPS,1,t0} - \sum_{t=1}^{t=100} Rate_{peatloss-WPS,i,t} \quad (8)$$

Where:

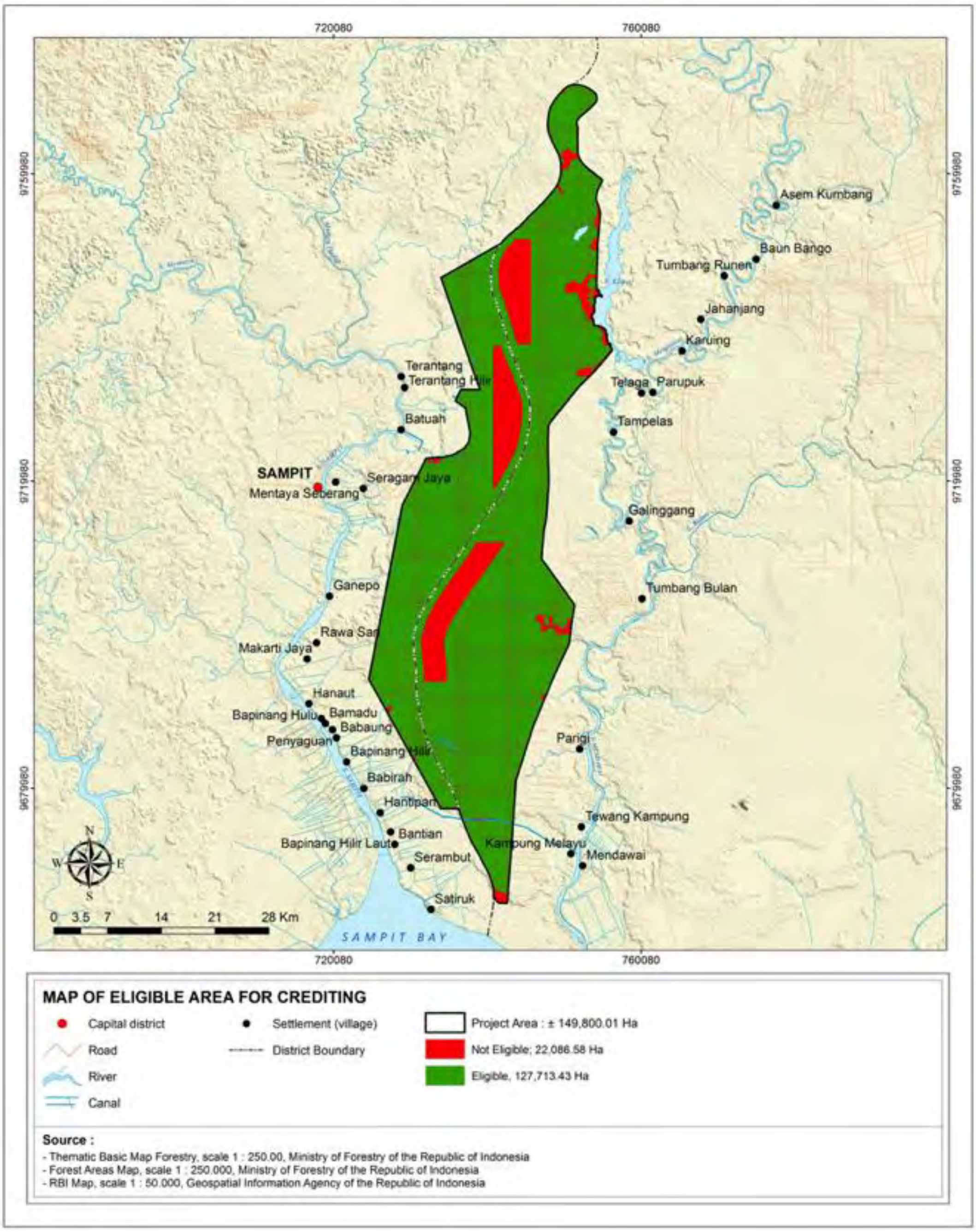
$C_{WPS-BSL,i,t100}$	Difference between peat carbon stock in the project scenario and baseline scenario in peat depth stratum i at t=100 (t C ha^{-1})
$C_{WPS,i,t100}$	Peat carbon stock in the project scenario in peat depth stratum i at t=100 (t C ha^{-1})
$C_{BSL,i,t100}$	Peat carbon stock in the baseline scenario in peat depth stratum i at t=100 (t C ha^{-1})
$A_{WPS,i}$	Area of project stratum i (ha)
$A_{BSL,i}$	Area of baseline stratum i (ha)
$Depth_{peat-BSL,i,t100}$	Average peat depth in the baseline scenario in stratum i at t=100 (m)
$Depth_{peat-WPS,i,t100}$	Average peat depth in the project scenario in stratum i at t=100 (m)
$Depth_{peat-BSL,i,t0}$	Average peat depth in the baseline scenario in stratum i at project start (m)
$Depth_{peat-WPS,i,t0}$	Average peat depth in the project scenario in stratum i at project start (m)
$Sub_{initial-BSL,\,i}$	Subsidence in the initial years after drainage in stratum i, deemed 0 for RDP projects (m)
$Rate_{peatloss-BSL,i,t}$	Rate of peat loss due to subsidence and fire in the baseline scenario in stratum i in year t; a conservative (high) value may be applied that remains constant over time; Subsidence in the initial years after drainage is not included in this rate (m yr^{-1})
$Rate_{peatloss-WPS,i,t}$	Rate of peat loss due to subsidence and fire in the project scenario in stratum i in year t; alternatively, a conservative (low) value may be applied that remains constant over time (m yr^{-1})
$C_{vol\_lower,WPS}$	Volumetric carbon content of the peat below the water table in the project scenario; in case of RDP projects, this is the same as $C_{vol\_lower,BSL}$ (kg C m^{-3})
$C_{vol\_lower,BSL}$	Volumetric carbon content of the peat below the water table in the baseline scenario (kg C m^{-3})
t_{100}	100 years since project start
10	Conversion from kg m^{-2} to t ha^{-1}

Map 19. Carbon stock difference between the baseline and project scenarios at t = 100



Based on the spatial analysis, **the area eligible for crediting from WRC activities is 127,713 ha or 85.3%.** Furthermore, as Sub-subsection 4.3.1.3 describes, the PDT over 125,951 ha (84%) of the project area is expected to exceed the maximum project crediting period of 60 years. For the rest of the project area, the approximate years in which the peat layers would be depleted (i.e., eligible period for crediting) were determined (see Table 17 and Map 13), and beyond these years, no accounting will be carried out. Map 20 indicates the WRC eligible area within the project area, and Table 21 is the summary of the area.

Map 20. Area eligible for crediting for WRC project activities



For the project scenario, few parts the project area will be affected by the drainage located outside the project area. Buffer zone agreements with the surrounding stakeholders have been established to ensure that drainage outside the project area would not cause significant hydrological impacts inside the project area or the area eligible for crediting. The effectiveness of these agreements will be monitored by the project.

Table 21. Summary of the area eligible for crediting from WRC activities

Description	Area (hectares)	Area (percent)
Project area	149,800	100
Peatland area within the project boundary	146,638	97.9
Area eligible for crediting	127,713	85.3
Area not eligible for crediting	22,087	14.7

4.3.2 Temporal boundary

The temporal boundaries of the Katingan Project are as follows.

- Historical reference period: August 22, 2000 to October 31, 2010
- Project crediting period: November 1, 2010 to October 31, 2070 (60 years)
- Baseline update period: Every 10 years

4.3.3 Carbon pools

4.3.3.1 Carbon pools included in the project

Table 22 describes carbon pools included in the Katingan Project.

Table 22. Summary of carbon pools

Carbon pool	In/excluded	Justification
Aboveground tree biomass	Included	Mandatory pool in ARR and REDD project activities
Aboveground non-tree biomass	Excluded	Non-tree biomass carbon pool is expected to increase in the project scenario compared to the baseline, and therefore can be conservatively omitted.
Belowground biomass	Excluded (as accounted for in the peat component below)	Belowground biomass is not distinguished from the soil pool in WRC procedures.
Litter on mineral soil	Excluded	It is conservatively excluded. However, litter carbon pools and their stock changes may be monitored in the future.
Litter on peatland	Excluded	This pool is not mandatory for peatland. As the litter carbon pool is expected to increase in the project scenario compared to the baseline, it is therefore conservatively omitted.
Dead wood	Excluded	This pool is not mandatory for either mineral soil or peatland. As the dead wood carbon pool is expected to increase in the project scenario compared to the baseline, it is therefore conservatively omitted.
Mineral soil carbon pool	Excluded	Carbon stock in this pool is expected to increase more or decrease less due to the implementation of project activities relative to the baseline, and thus conservatively omitted.
Peat carbon pool	Included	Carbon stock in this pool is expected to increase in the project scenario compared to the baseline.

Carbon pool	In/excluded	Justification
Wood products	Excluded	This pool is mandatory only where the process of deforestation involves timber harvesting for commercial markets.

4.3.3.2 Carbon pool significance

No significance tests were necessary since, as described in the above Sub-subsection 4.3.3.1, all carbon pools not included in the baseline and project scenario have been shown either to increase more or decrease less in the project relative to the baseline scenario, or been conservatively excluded. All mandatory pools have been included and all sources of GHG emissions have either been included or conservatively excluded.

4.3.4 Sources of GHG emissions

Table 23, Table 24 and Table 25 describe sources of GHG emissions included in the Katingan Project.

Table 23. GHG sources included in the REDD project boundary

Source		Gas	Included?	Justification/explanation
Baseline scenario	Deforestation	CO_2	Yes	Aboveground biomass losses as a result of deforestation are included
	Biomass burning	CO_2	No	Aboveground biomass losses as a result of fire are conservatively assumed zero
		CH_4	No	Aboveground biomass losses as a result of fire are conservatively assumed zero
		N_2O	No	Above ground biomass losses as a result of fire are conservatively assumed zero
	Combustion of fossil fuels	CO_2	No	Conservatively omitted.
		CH_4	No	Conservatively omitted.
		N_2O	No	Conservatively omitted.
	Use of fertilisers	CO_2	No	Fertiliser application is higher in the baseline scenario compared to the project scenario. Therefore, it is conservatively omitted.
		CH_4	No	Fertiliser application is higher in the baseline scenario compared to the project scenario. Therefore, conservatively omitted.
		N_2O	No	Fertiliser application is higher in the baseline scenario compared to the project scenario. Therefore, it is conservatively omitted.
Project scenario	Biomass burning	CO_2	No	Per VM0007 REDD-MF, CO_2 emissions are excluded but carbon stock decreases due to biomass burning are accounted for as carbon stock changes.
		CH_4	Yes	If burning occurs in the project scenario it will be accounted for. IPCC combustion factors for CH4 will be used.
		N_2O	Yes	If burning occurs in the project scenario it will be accounted for. IPCC combustion factors for N2O will be used.
	Deforestation	CO_2	Yes	If deforestation occurs in the project scenario, it will be accounted for. Values will be calculated using deforestation emission factors.

Source		Gas	Included?	Justification/explanation
	Forest degradation	CO_2	Yes	If forest degradation occurs in the project scenario, it will be accounted for. Values will be calculated using forest degradation emission factors.
	Combustion of fossil fuels	CO_2	No	Can be neglected if excluded from baseline accounting.
		CH4	No	Can be neglected if excluded from baseline accounting.
		N_2O	No	Can be neglected if excluded from baseline accounting.
	Use of fertilisers	CO_2	No	Fertiliser application is higher in the baseline scenario compared to the project scenario. Therefore it is conservatively being omitted.
		CH_4	No	Fertiliser application is higher in the baseline scenario compared to the project scenario. Therefore it is conservatively being omitted.
		N_2O	No	Fertiliser application is higher in the baseline scenario compared to the project scenario. Therefore it is conservatively being omitted.

Table 24. GHG sources included in the ARR project boundary

Source		Gas	Included?	Justification/explanation
Baseline scenario	Burning of woody biomass	CO_2	No	Above ground biomass losses as a result of fire are assumed zero.
		CH_4	No	Above ground biomass losses as a result of fire are assumed zero.
		N_2O	No	Above ground biomass losses as a result of fire are assumed zero.
Project scenario	Burning of woody biomass	CO_2	No	Per REDD-MF, CO_2 emissions are excluded but carbon stock decreases due to burning are accounted as a carbon stock change.
		CH_4	Yes	If burning occurs in the project scenario it will be accounted for. IPCC combustion factors for CH4 will be used.
		N_2O	Yes	If burning occurs in the project scenario, it will be accounted for. IPCC combustion factors for N2O will be used.

Table 25. GHG sources included in the WRC project boundary

Source		Gas	Included?	Justification/explanation
Baseline / Project scenario	Microbial decomposition	CO_2	Yes	Initially TIER 1 methods (IPCC defaults) will be used for the baseline and project to estimate emissions, later in the project measurements will be performed to develop site-specific emission models, and if needed, in the reference regions for the baseline.

Source		Gas	Included?	Justification/explanation
		CH_4	Yes	Required unless de minimis or conservatively omitted. In this project TIER 1 (IPCC defaults) will be used to estimate CH4 emissions in the baseline and project.
		N_2O	No	Excluded as per applicability condition in module BL-PEAT
	Water bodies	CO_2	Yes	Water bodies comprise about 5% of the drained peatland landscape. DOC values for 'drained' and 'undrained' peatlands (IPCC) are used to calculate the differences in carbon losses between baseline and project. These carbon losses will be expressed in CO2-equivalents, and conservatively assumed that all dissolved organic carbon (DOC) will be lost as CO2.
		CH_4	No	It will be conservatively assumed that all dissolved organic carbon (DOC) will be lost as CO2 and that no CH4 is being released. Over the long-term, the project will develop a site-specific model to quantify emissions from water bodies based on site specific measurements performed.
		N_2O	No	Conservatively omitted.
	Peat combustion	CO_2	Yes	Procedures provided in module E-BPB using IPCC combustion factors for both baseline and project scenario. If peat combustion occurs in the project scenario it will be accounted for.
		CH_4	Yes	Procedures provided in module E-BPB, using IPCC combustion factors for both baseline and project scenario. If peat combustion occurs in the project scenario it will be accounted for.
		N_2O	Yes	Procedures provided in module E-BPB, using IPCC combustion factors for both baseline and project scenario. If peat combustion occurs in the project scenario it will be accounted for.
	Combustion of fossil fuels	CO_2	No	Can be neglected if excluded from baseline accounting.
		CH_4	No	Potential emissions are negligible.
		N_2O	No	Potential emissions are negligible.
	Fertiliser application	CO_2	No	Fertiliser application is higher in the baseline scenario compared to the project scenario. Therefore, it is cconservatively omitted.
		CH_4	No	Fertiliser application is higher in the baseline scenario compared to the project scenario. Therefore, it is cconservatively omitted.
		N_2O	No	Fertiliser application is higher in the baseline scenario compared to the project scenario. Therefore, it is cconservatively omitted.

4.4 Baseline Scenario and Additionality

This section identifies the project's baseline and demonstrates the project's additionality using the "combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities: Version 1" [11]. Following this, the project passes preliminary screening ('Step 0').

4.4.1 Justification of baseline scenario and additionality

4.4.1.1 Alternative land use scenarios to the proposed project activity
Sub-step 1a. Identify credible alternative land use scenarios to the proposed project activity

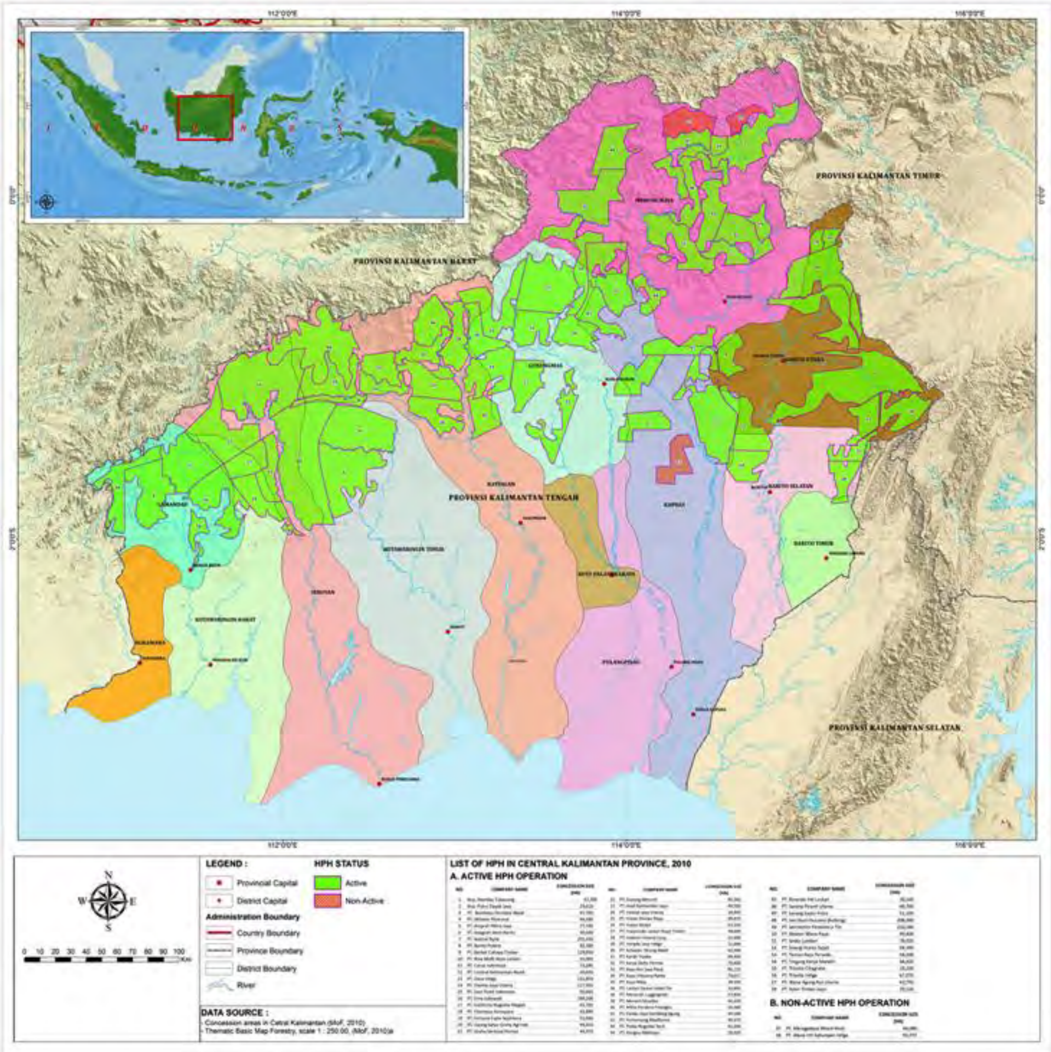
The range of realistic and credible alternative land use scenarios that would have occurred on the land within the project boundary in the absence of the project are shown in Table 26. These seven scenarios were derived from the analysis of current land use across the lowlands peatlands of Central Kalimantan together with an analysis of land use trends within other similar regions of Indonesia; in particular the lowland peatlands of Sumatra which along with southern Borneo represents the two largest tracts of lowland peatland in Indonesia.

Table 26. Description of the major alternative land use scenarios for the project area

Land use scenario	Description
Industrial acacia plantation	Fast growing *Acacia crassicarpa* is among the most common industrial land uses of lowland peatlands in Indonesia [12]. Grown in 5-6 year fast rotations, the harvested wood is used for paper and pulp wood products. Commercial growing requires continuous drainage of the peat to below 70cm depth [13]. The area of industrial acacia plantation has grown rapidly in Indonesia over the past decade and further development is targeted in Ministry of Forestry development plans: from 10 million ha in 2010, to 13 million ha in 2014 [14]. Acacia plantations have already been established in peat forest areas of Central Kalimantan to the east of the project site in Pulang Pisau and Gunung Mas districts and to the West in Kubu Raya district of West Kalimantan, while applications for establishment have been lodged in many other nearby areas, including the project area itself (see below). The rapid expansion of industrial acacia plantations across Indonesia has already led to drainage and conversion of vast areas of peatland forest, providing a vision of the future for the project region.
Industrial oil palm plantation	Oil palm is also one of the most common non-forest commodity industrial land uses of lowland peatlands in Indonesia [15], despite the fact that peat soils are not ideal for its cultivation [13]. Grown in 25-35 year rotations, and commercially harvestable after 4-5 years, oil palm's fruit is processed to produce oil. Commercial growing requires continuous drainage of the peat to below 70cm depth [13]. The area of oil palm plantations in Indonesia has increased dramatically over the past decade [16], including in Central Kalimantan, although almost exclusively in areas legally outside of the forest estate (designated as APL or Other Land Utilization) or within the forest estate in areas ear-marked for conversion (designated HPK or Conversion Forest), these legal land use distinctions are expanded upon in the next section. Currently there are two pending oil palm plantation applications adjacent to the east of project area, including areas of forested peatland.

Land use scenario	Description
Forest with commercial logging	Much of the forested peatlands of Central Kalimantan were commercially logged in the 70's, 80's and 90's using selective cutting approach, including the majority of the project area (see below). However, none of the production forest on peatland in Central Kalimantan is subject to active commercial logging today. Historically activities were generally conducted on a large scale utilizing rail haulage systems to remove timber, rather than canals. At that time concession holding companies were not required to implement long-term management of the areas, and so following the initial harvest of the most commercially valuable trees, the operations were all closed. A resumption of commercial logging within production forest areas remains a legal possibility, albeit it an unlikely practice now, due to the low remaining timber potential within allowable diameter size. Most commercial logging operations in Central Kalimantan have now moved to the non-peat areas in the north of the province where primary forests still exist (see Map 21), while in the south the commercial focus has switched to conversion to plantations.
Unprotected Forest (status quo)	Unexploited and unprotected forests exist in Indonesia, but generally only as a transitional state; existing only between phases of commercial or local exploitation (see above and below). Neglected, unprotected forest areas tend to become rapidly degraded, which in turn reinforces the neglect. They rapidly lose all commercial value from standing timber and so become targeted for conversion. This progression can clearly be seen in the adjacent district of Pulang Pisau.
Protected Forest	Forest can be deliberately retained through the creation of a protected area. Over the past 10-20 years in Central Kalimantan, a number of former logging concession areas have been converted to protection forest, including Sebangau National Park and a number of areas of Watershed Protection forest (Hutan Lindung). The possibility of protection without exploitation is considered in more detail below.
Smallholder agriculture	Smallholder-managed agricultural land only occupies around 10% of the peatland area of Central Kalimantan, and only 3% of the districts in which the project lies [17] [18]. This figure is low relative to other parts of Indonesia due to the generally low population density and the unsuitability of peat soils for agriculture without drainage. Currently none of the project area is subject to smallholder agriculture, although it does exist within the wider project zone. It typically exists closer to the rivers and villages where sand ridges allow more productive agriculture, including a variety of tree and non-tree crops, including rubber, cassava, pineapple, rice and oil palm (see Annex 5). Smallholder agriculture is not considered a likely land use for the project area, however it is considered here due to its prevalence in Indonesia generally.
Mining	To the north of the project area, open-cast and strip mining is a common land use. Such mining targets both gold and zircon. It is considered here due to its existence in the wider landscape, however it is not considered a likely land use for the project area as it exists almost entirely on non-peat areas and mostly operates illegally (see below).

Map 21. Active commercial logging concessions (HPH) in Central Kalimantan as of 2010



In addition to these seven major land use scenarios, a number or smaller or minority land use were also considered, including, infrastructure development and industrial aquaculture. However all were considered to either lack sufficient credibility or precedence to be included in this analysis.

Sub-step 1b. Consistency of credible alternative land use scenarios with enforced mandatory applicable laws and regulations

The seven major land use scenarios identified under Sub-step 1a were next considered in the context of mandatory laws and regulations in Indonesia. The key consideration in this analysis is the legal designation of the project area as 100% ‘Production Forest’ or ‘Hutan Produksi’. The results of this analysis are shown in Table 27.

Table 27. Consistency of alternative land use scenarios with laws and regulations

Land use scenario	Legality
Industrial acacia plantation	This land use scenario is legally permissible, as regulated principally by the Forestry Laws No. 41/1999, 19/2004 and later by Ministry of Forestry decree No. 31/2014 and supporting regulations.

Land use scenario	Legality
Industrial oil palm plantation	This land use is not legally permissible. Oil palm cannot legally be established on land designated as production forest. It can only be established legally by first excising the area from the forest estate as regulated under Government Decree PP No. 60/2012. However, this is only possible in forest areas designated as Conversion Production Forest (Hutan Produksi Konversi or HPK). As can be seen from the map of the project area (see Map 2), the area does not include any forest areas designated as HPK, as a result the scenario of commercial conversion to oil palm is not considered a legally viable scenario.
Forest with commercial logging	This form of land use is legally permissible, as regulated principally by the Forestry Laws No. 41/1999 and No. 19/2004, and later by Ministry of Forestry decree No. 31/2014 and supporting regulations.
Unprotected Forest	Legally, a number of routes exist by which the site could remain to be unexploited forest. The first is simply neglect: the area could remain designated as production forest but not be subject to any license application for logging or conversion. Secondly, the site could be subject to an application for management as an ecosystem restoration concession, a form of logging concession permissible on production forest land as regulated and later by Ministry of Forestry decree No. 31/2014.
Protected Forest	Forest land could be legally converted to some form of protection or conservation forest. This is a complex process, governed and regulated by a range of laws (see below).
Smallholder agriculture	As production forest, the project area is not legally permissible for conversion to smallholder agriculture (based on the same legal regulations referenced above). Despite this, however, neglected forest land (which is not subject to an active concession licence or commercial exploitation) is often targeted by smallholders. If no commercial licence is issued, such smallholders can attempt to claim a title to the occupied land via a number of legal routes. These are considered in more detail below.
Mining	Mining is not legally permissible within the project area without an appropriate licence. Such licences are governed by a complex set of laws that restrict the area that can be mined and which outline the compensation arrangements which must be paid to the concession holder (if there is one) and the state. Such licences are only granted to legally registered mining companies. The bulk of the mining activity to the north of the project area is small-scale, unregistered and probably illegal. As with smallholder agriculture, this may be tacitly permitted within neglected forest areas, and so is retained here for further consideration.

In conclusion, we reject industrial oil palm plantation as a credible alternative land use scenario as it is not legally permissible. Of those scenarios retained, smallholder agriculture and mining are retained despite their illegality, as both remain commonplace across much of Indonesia and so merit further consideration.

4.4.1.2 Barrier analysis

Sub-step 2a. Identification of barriers that would prevent the implementation of at least one alternative land use scenarios

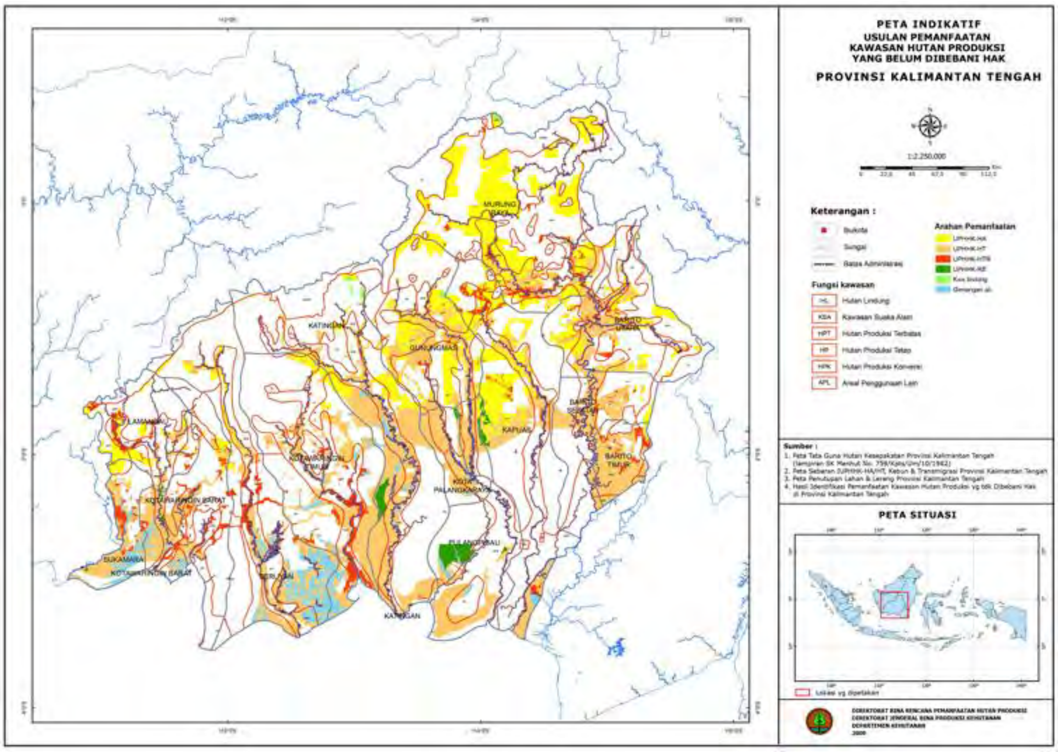
In this section, we consider each of the six remaining scenarios in turn with respect to barriers that would prevent realization of that scenario (following the listed barriers in A/R CDM project activities: Version 1" [11]. The results of this analysis are shown in Table 28.

Table 28. Identification of barriers that would prevent the implementation of each scenario

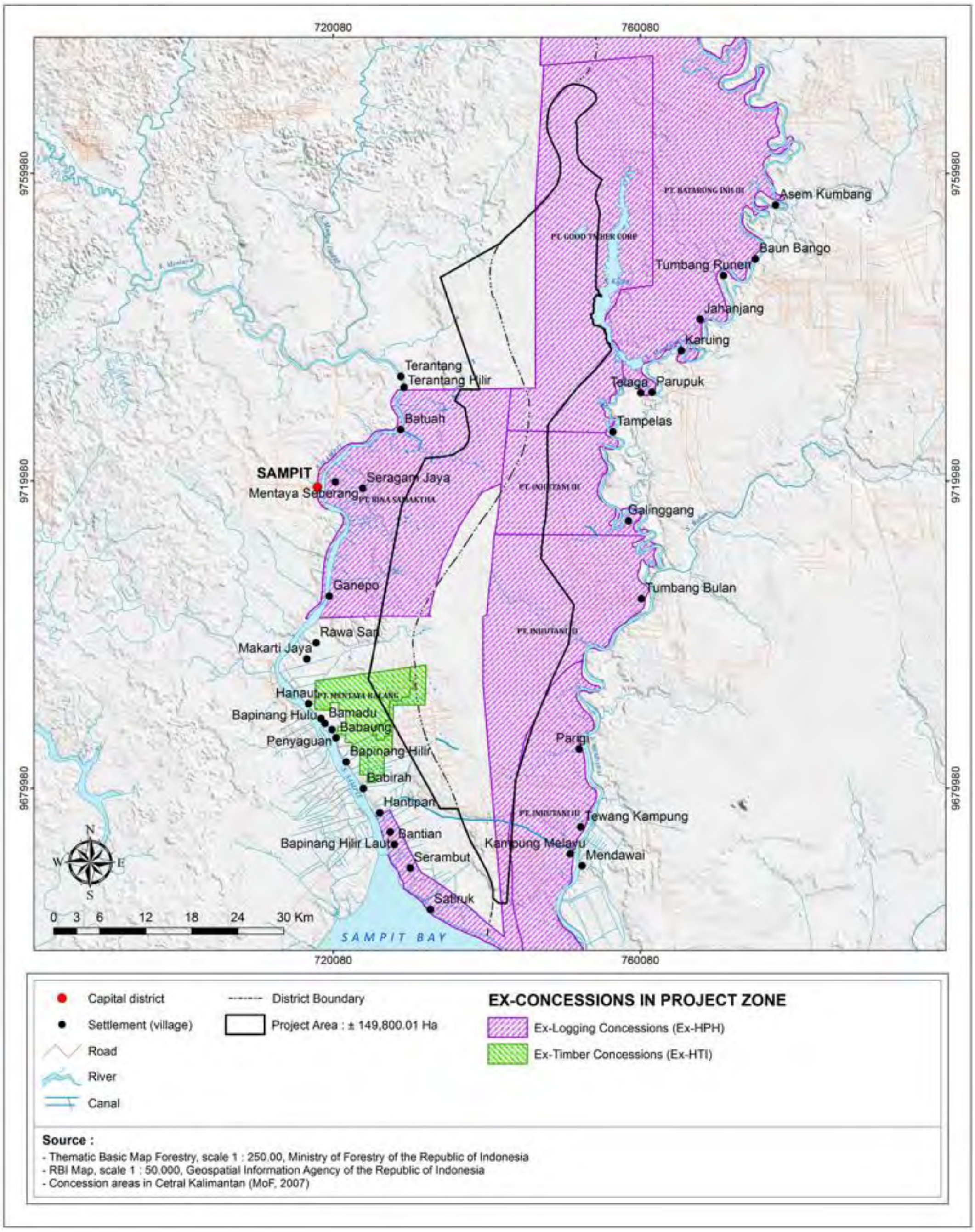
Land use scenario	Barriers
Industrial acacia plantation	There are no barriers for this land use. At the time of the project's initiation, the area was both legally eligible for plantation establishment, and designated as such in the Ministry of Forestry's indicative maps (which indicate areas targeted for different uses, akin to development plans; see Map 22). Furthermore, in 2008, an application for the establishment of a 50,000-ha acacia plantation within the project area was filed by PT. Natural Wood Kencana with the Ministry of Forestry (i.e., Letter No. 04/TOR/CEO/X/2008 dated October 23, 2008).
Forest with commercial logging	The principal barriers are both ecological and economic, and result from the paucity of commercial-sized timber due to the majority of the site having been logged between 1970-2002 based on licences issued in the 70's. At this time, most of the peatlands in southern Central Kalimantan were also logged, and subsequent to that period there has been no resumption of commercial logging in any of these peatland areas. In addition to the lack of high value commercial timber, the economics of commercial logging have changed. When first logged, tax collecting regimes were far more lax, allowing companies to operate more marginal sites profitably, labour was cheaper (and labour laws were more lax). Timber prices were high and markets very open. High value export markets are now difficult to access without accreditation, and this would be very difficult to obtain on a site-based on peat soils.
Unprotected Forest	Without the prospect of revenue from carbon offset sales, there exist numerous barriers to the forest remaining intact, principally economic and institutional, but also related to prevailing practice and local traditions of exploitation. The land is politically as well as legally designated for production. De facto protection through neglect (or through deliberately refusing to issue any licences) is not tenable as the area would generate no revenues, either to state coffers or to local communities. The experience across Kalimantan, and indeed across Indonesia, is that unprotected forest does not often remain intact for long.
Protected Forest	As described above, legal conversion of the land status to become fully protected would not generate political support locally, as this would place an additional financial management burden and obligation on the local government while adding no additional state revenue.
Smallholder Agriculture	Barriers exist to prevent the expansion of smallholder agriculture in the project area. These include physical barriers such as the general unsuitability of peat soils for growing crops (which accounts for the very low levels of smallholder agriculture within peat areas of Central Kalimantan

Land use scenario	Barriers
	generally), but principally the fact that the expansion of smallholder agriculture with areas designated as production forest relies almost entirely on legal neglect of such areas. As no barriers exist to prevent the establishment of commercial plantations on the project area the possibility of an expansion of smallholder agriculture is negated.
Mining	The main barrier to the expansion of mining within the project area is the lack of suitable mineral deposits and the peat overburden. These combine to render the vast majority of the site, with the small exception of some marginal areas in the north, unsuitable for mining. This is confirmed by absence of any commercial mining exploitation permits for the area. In addition, as above, any expansion of small-scale mining relies on legal neglect of the project area, which is not considered a likely scenario.

Map 22. Ministry of Forestry indicative map 2009



Map 23. Logging concessions previously existing in the project zone



In conclusion, significant barriers prevent the realization of all but a single credible land use scenario: industrial acacia plantation.

4.4.1.3 Investment analysis

Because a single credible land use scenario was identified through the analytical steps above, a detailed investment analysis is not required by the A/R CDM additionality tool [11]. However, as part of the analytical preparation for the project, such an analysis was independently commissioned and is available to download [19]. This study supported the identification of Industrial acacia plantation as being the most profitable and likely land use on areas legally classified as production forest, while conversion to oil palm would be the most profitable land use within areas designated as conversion forest within the wider project zone.

4.4.1.4 Common practice analysis

Maintenance of intact forest on land designated for production is not common practice in Indonesia. Outside of legally designated protected areas, and without the prospect of revenues from carbon finance, few examples exist. Those that do tend to be small projects backed by stable philanthropic donors, and even in these cases, the projects often lead to conflict with local government or communities as the areas are perceived as making no financial contribution to local coffers, despite being designated for production. Other examples include offset projects whereby large corporates are paying management costs of the site as reparations for areas damaged as part of their operations elsewhere. These are rare and typically very small in extent.

4.4.1.5 Conclusion

The project is considered additional, with the most likely and plausible business-as-usual scenario being conversion to **industrial acacia plantation**.

4.4.2 Description of acacia plantations as the baseline scenario

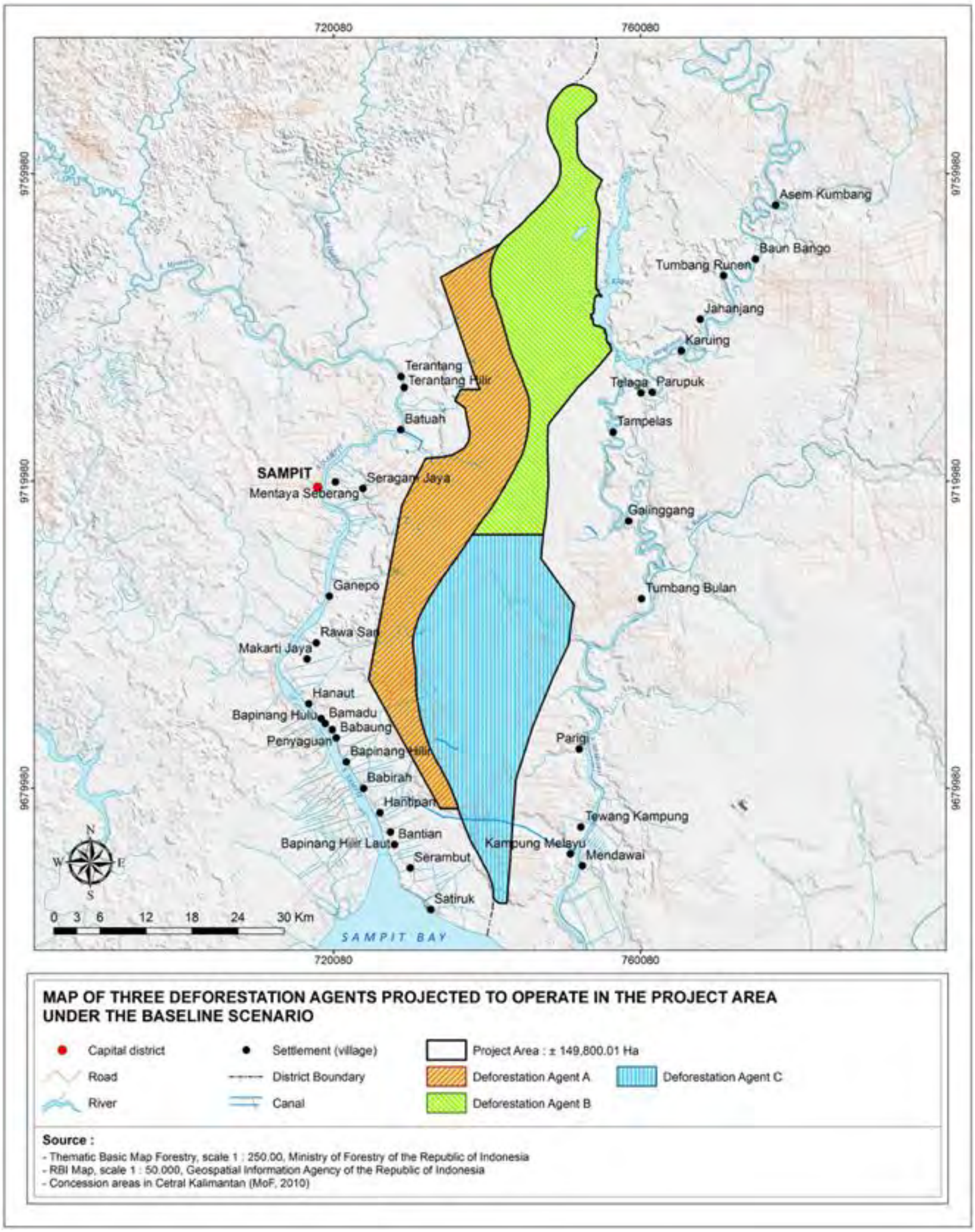
Historical data on industrial acacia plantation concessions [20] exhibit a pattern in the period of 2000 to 2010 of vast areas of peatlands (peatdomes) being split up and licensed to a range of companies producing similar commodities and each managing an area on average <70,000 ha. This pattern can be clearly observed in Kampar Peninsula in Riau Province and Merang in South Sumatra where three or more plantation companies have been operating on the same peat dome. Given this pattern, and the size of the project area, it is reasonable to suggest that in the absence of the project the project area would have been granted to and managed as industrial acacia plantations by a total of three companies (designated here as deforestation agents A, B and C).

In 2008, PT. Natural Wood Kencana (deforestation agent A) applied for an industrial acacia plantation concession in the project area covering 50,000ha. Without the Katingan Project, this company would have successfully obtained the concession in 2010. Given the fact that the area was zoned for plantation establishment and that pulp and paper industry was on the rise, additional operators would have applied for concessions in the adjacent areas within the project area. Two additional agents (B and C) were therefore projected to apply for concessions in 2010, receive reservation letters in 2011 and eventually obtain the concessions in 2012. A spatial analysis based on the administrative territory and the location of previous logging concessions in the project area, these three companies were assumed to have received licenses for 47,309 ha, 44,837 ha and 57,654 ha within the project area, respectively (see Map 24and Table 29).

Table 29. Summary of the concessions granted to the projected deforestation agents

Deforestation agent	Area (Ha)	District	License year
Agent A	47,308.62	Kotawaringin Timur	2010
Agent B	44,837.19	Katingan	2012
Agent C	57,654.20	Katingan	2012
TOTAL	149,800.01		

Map 24. Three deforestation agents projected to operate in the project area under the baseline scenario



According to the national regulation, Minister's decree No. 70/1999, deforestation agents are mandated to set aside certain areas of concession sites into the following five different land use purposes: 1) Plantation area, 2) Protected area, 3) Native tree area, 4) Community buffer area, and 5) Infrastructural development area. In line with the regulations, these designations should be based on the existance of communities, previous concession boundary in the same area, and natural and administrative borders, and are projected in Map 25 and Table 30 below. Regulations state that land designated as protected areas must prioritize intact forest situated far away from the community land. In the Sections 6.1 and 6.2, 'community buffer area' is further referred to as 'community crop area', 'protected forest' is referred to as 'conservation forest', 'native tree species area' is included in the 'forest' and 'river buffer' categories, and infrastructure is referred to as 'canals and ground facilities such as yards, stations, nursery, roads and other 'bare' land' or 'non-vegetated land' used for infrastructure.

Map 25. The projected land use within the concession areas of the deforestation agents

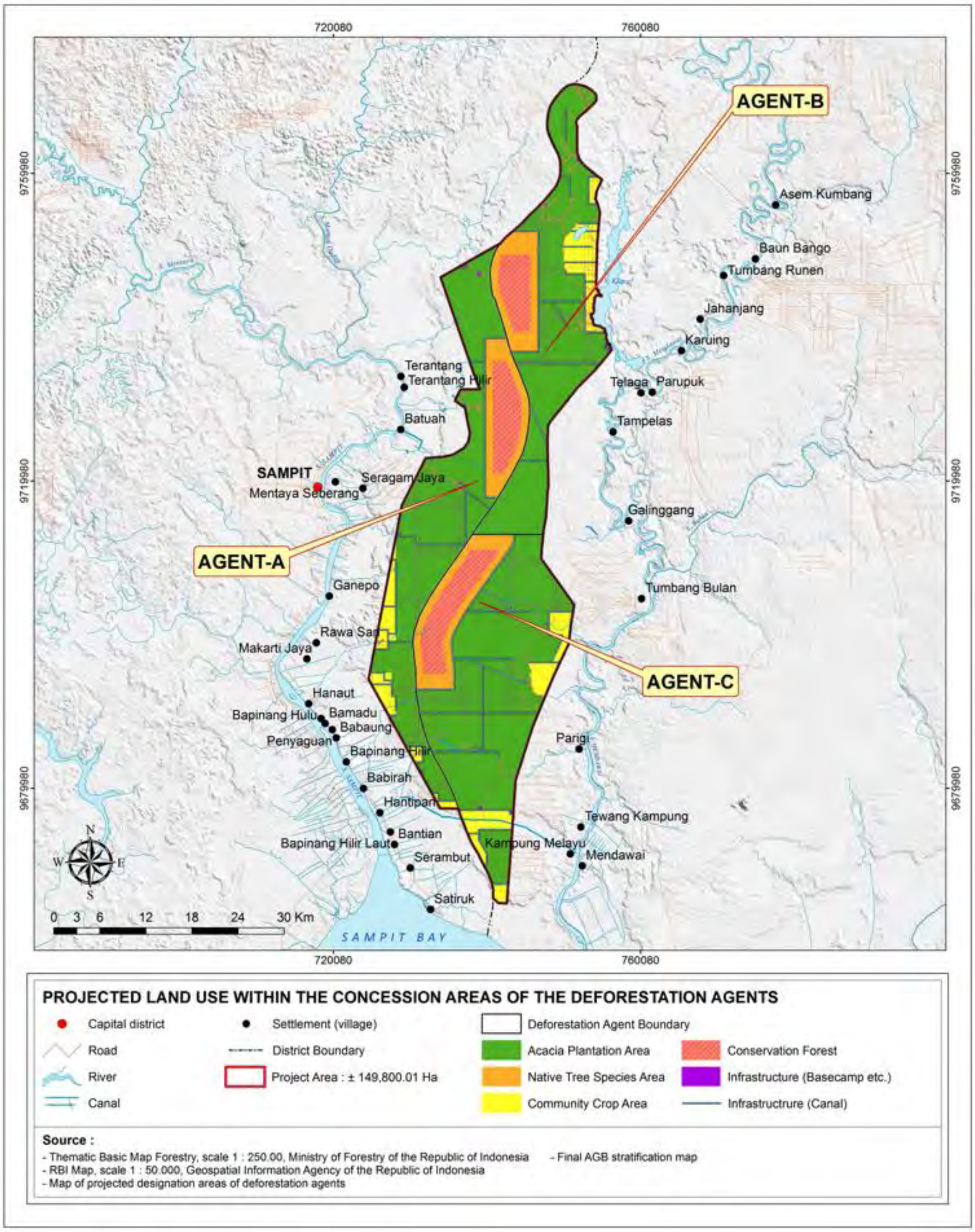


Table 30. Projected land use within the concession areas of the deforestation agents

Land use	Agent A (ha)	Agent B (ha)	Agent C (ha)	Total (ha)	%
Acacia plantation area	32,950.58	30,965.14	39,799.82	103,715.55	69.24%
Native tree species area	4,789.20	4,505.47	5,803.52	15,098.19	10.08%
Community crop area	3,566.79	3,799.06	4,842.25	12,208.10	8.15%
Conservation forest	4,787.91	4,529.49	5,928.45	15,245.85	10.18%
Infrastructure	1,214.13	1,038.03	1,280.16	3,532.32	2.36%
TOTAL	47,308.62	44,837.19	57,654.20	149,800.01	100%

4.4.3 Estimated impacts of the baseline scenario on communities and biodiversity and additionality justification

Under the baseline scenario, both communities and biodiversity would suffer from the large-scale transition from intact peat swamp forest to plantation. The loss of forest for habitat and livelihood would be devastating for both, resulting in extinction, forced migration or at a minimum, a severely degraded quality of life with no recourse for support. Additional details regarding the impact on communities and biodiversity can be found in Sections 7 and 8 of this report.

None of the positive impacts resulting from the project activities would take place in the baseline scenario. Because the project is additional, the community and biodiversity benefits occurring as a result are also additional.

5 MONITORING DATA AND PARAMETERS

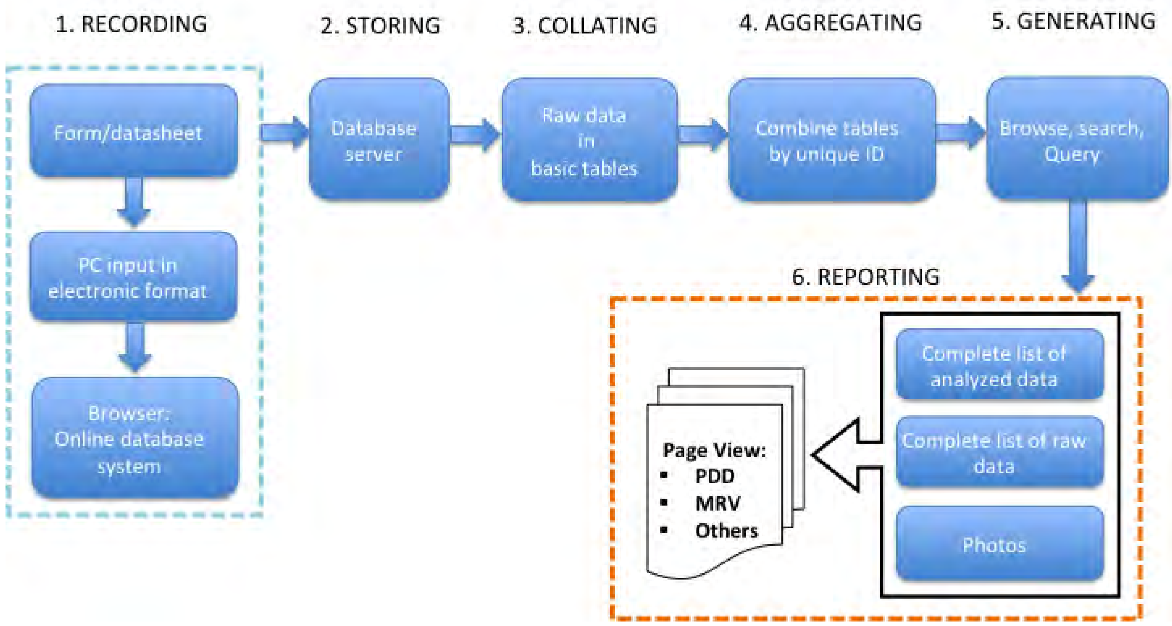
5.1 Description of the Implementation of the Monitoring Plan

5.1.1 Data management methods and structure

All data generated by the Katingan Project is centrally managed in an online-based database. Hard copies of all data sheets are archived in field offices, with duplicate copies stored centrally in PT. RMU's headquarter in Bogor. Field data is uploaded directly into the online database system from the field office, allowing simultaneous multi-user input through a local server network. After the data is collated by the database server, it can be adapted to fulfil all monitoring and reporting needs using standard and custom-made report formats.

All climate, community and biodiversity monitoring parameters, including both raw and processed data, together with their frequency, are detailed in Appendix 4, Appendix 5, and Appendix 6(MRV Trackers).

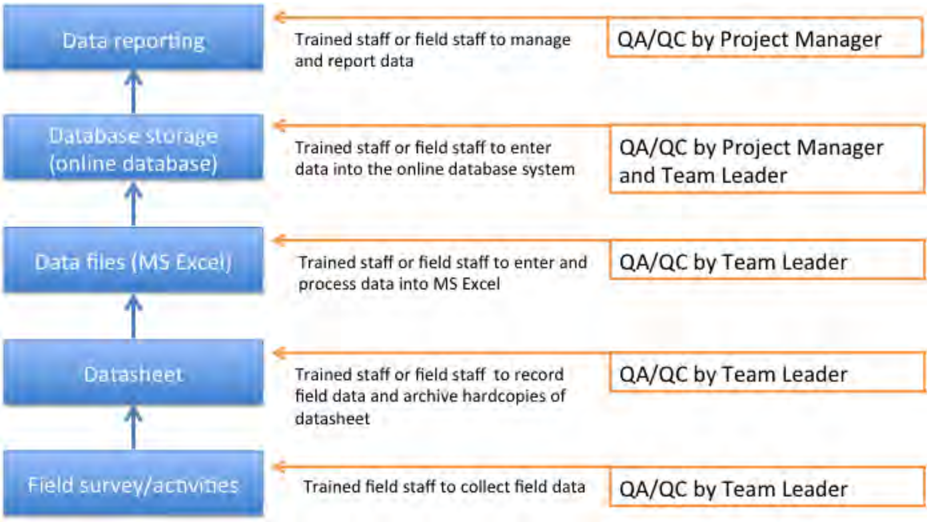
Figure 11. Simple schematic of data management structure



5.1.2 Procedures for handling internal auditing and non-conformities

Internal auditing and non-conformities are addressed through standard operation procedures (SOPs) that incorporate multiple quality assurance and quality control (QA/QC) measures. All data collected, recorded, stored and reported are subject to review and approval by team leaders and/or project managers with reference to written SOPs covering each level of data management. In order to ensure the security and traceability of data entry and QA/QC procedures, all users are allocated unique user IDs and passwords in order to access the database, and in turn their access and roles can be restricted as appropriate.

Figure 12. Data management QA/QC procedures



5.1.3 Climate impact monitoring plan and methodological approach

Climate impacts have been monitored, reported and evaluated according to the Climate MRV Tracker (Appendix 4). This includes monitoring changes in land cover, land use, peat thickness and water table depth, as per the VCS VM0007 methodological requirements and GHG emissions associated with relevant land uses in the project area. A summary of the main monitoring methods followed during this reporting period is given below. For further details consult the PDD and relevant Annex.

The formal monitoring period reported in this report extends from 1st November 2010 to 31st October 2015. However in the presentation of results monitoring years are simplified to the year ending, such that “2011” represents the 12 month period from 1st Nov 2010 to 31st October 2011, and so on. In general, all reported data refers to these exact periods. However, in some cases where data was only available on a calendar year basis, the annual numbers as presented are either derived by pro-rating and combining two months of data from the preceding year and 10 months of data from the ‘current’ year, or, in cases where the nature of the data prevents such an approach, by using the annual calendar year data to apply in respect of the monitoring period year in which the majority of months fall (i.e. 2012 calendar year data would be used to apply to the monitoring year 1st Nov 2011 through 31st Oct 2012). This approach is considered pragmatic, and unlikely to introduce any consistent bias as it is applied consistently without a priori assumptions.

5.1.3.1 Remote sensing

As the original project description only included ‘forest’ and ‘non-forest’ classes, monitoring during this reporting period focused on the integrity of these two strata (i.e. deforestation/afforestation), and on the identification of visible degradation.

In order to monitor deforestation in the project area Landsat imagery was processed annually. See Table 31 for a list of the imagery processed. Each image was atmospherically corrected and cloud masked prior to running the Monte Carlo spectral mixture analysis (SMA) algorithm. This algorithm allows for sub-pixel data to be extracted from coarse resolution datasets, drawing upon the assumption that each pixel in a forest has a spectral signature that combines the reflectance of photosynthetic vegetation (PV), non-photosynthetic vegetation (NPV) and bare substrate (BS). By analysing the pixels’ actual spectral signature, the proportion of the aforementioned land covers can be determined, hence allowing for small-scale land cover changes, such as degradation, to be identified in addition to deforestation. After running the SMA algorithm, the ISOCLASS unsupervised classification algorithm was run on the imagery using 50 classes. The classes were visually inspected and then assigned to a deforested, degraded or forest class.

Table 31. Landsat imagery used to monitor deforestation

Sensor	Image Code	Image Date
Landsat 5	LT51190612010016BKT00	16-01-2010
Landsat 5	LT51190622010224BKT00	12-08-2010
Landsat 7	LE71190622011171EDC00	20-06-2011
Landsat 7	LE71190622012126EDC00	05-05-2012
Landsat 7	LE71190622012174EDC00	22-06-2012
Landsat 7	LE71190622012222EDC00	09-08-2012
Landsat 7	LE71190622013224EDC00	12-08-2013
Landsat 8	LC81190622013280LGN00	07-10-2013
Landsat 8	LC81190622013328LGN00	24-11-2013
Landsat 8	LC81190622014267LGN00	24-09-2014
Landsat 8	LC81190622015334LGN00	30-11-2015
Landsat 8	LC81180622016074LGN00	14-03-2016
Landsat 8	LC81190622016113LGN00	22-04-2016
Landsat 7	LE71190622016153EDC00	17-06-2016
Landsat 8	LC81190622016161LGN00	09-06-2016

In cases where forest changes were detected, the procedures outlined in VCS methodology VM0007 module M-MON were used to quantify the relevant parameters. See Section 6.2 for full results.

In addition to monitoring forest change using remote sensing analysis, a Participatory Rural Appraisal (PRA) was conducted in 2015 in order to investigate illegal logging activity undetectable using remote sensing methods (as per VM0007 Module M-MON). Rather than using this PRA to determine if a set threshold of respondent believed illegal logging had taken place, the project conservatively assumed that illegal logging had taken place in every year, and focused the PRA on determining key characteristics of that activity. The survey was able to deliberately target over 100 known loggers in 2015, and so obtain robust information on the characteristic of logging within the project area over the preceding 5 years. During the subsequent field surveys the field team used machete tests to accurately determine how recently trees were felled, and to allocated each tree to the year it was logged (ranging from pre-2010 onwards) For further details, including the delineation of affected areas ($A_{DegW,i,t}$) and the quantification of emissions (ΔCP,DegW,i,t) see Section 6.

5.1.3.2 Monitoring GHG Emissions from microbial decomposition of peat

GHG emissions from microbial decompositions of peat were quantified by monitoring land use change (as described above) in combination with IPCC default emission factors and the procedures provided in the VSC methodology VM0007, module M-PEAT (see Section 6.2 for results). In addition, direct monitoring of water table depth was initiated in 2015 using dip-wells (point-based monitoring) installed along transects designed to be representative of each stratum. In the future this data can be used as an additional proxy for future analysis, but was not used for any emission calculations in this monitoring report.

5.1.3.3 Monitoring GHG Emissions from water bodies

GHG emissions from water bodies were estimated based on IPCC default values applied to the estimated area of water bodies in the project area, as described in the PD Section 5.4. During this monitoring period the annual area of water bodies was assessed through a combination of remote sensing analysis and field measurements by inspecting segment lengths of each water body and by estimating average width for each segment. Results are given in Section 6.

5.1.3.4 Monitoring GHG Emissions from peat and biomass burning

MODIS FIRMS hotspot data were initially used to identify all areas that experienced fires in each year. To ensure the process was conservative, all hotspots (with fire incident confidence percentages ranging from 0 to 100) were first plotted on a map. Next, a combination of Landsat 5, 7 and 8 imagery (depending on availability) was used to manually digitize the boundary of affected areas (see Table 32 for list of imagery used). These layers were then overlaid with the 2010 stratification to identify which areas experienced forest and non-forest burns. All forest fires detected within forest areas in the period 2010-2015 were automatically marked as “first burns” for peat emission calculating purposes (see section 6.2). For the non-forest areas, additional data was needed to determine the number of previous fires in the area and therefore the required peat burn scar depth value. This was done by examining additional MODIS FIRMS hotspot data for the period 2000-2010. Any hotspots that appeared in this period were then investigated by analysing Landsat data from shortly after the hotspot timestamp to confirm there was a fire and in order to digitize and quantify the area burnt. Afterwards Landsat data from before the fire event was analysed in order to determine the land cover type prior to the fire. For any such area that was forest prior to this fire event, this historic event was classed as its first fire, and any fire post-2010 was classed as its second. Likewise, for any area that was already bare soil before the historic fire, any fire post-2010 was classed as at least its third burn. Additional fire iterations were not inspected since the peat burn scar depth values per the IPCC are constant at 4cm starting with the third burn.

Table 32. Satellite imagery used to identify and delineate burnt areas

Sensor	Code	Date
Landsat 7	LE71190622001239EDC00	27/08/2001
Landsat 7	LE71180622001232EDC00	20/08/2001
Landsat 5	LT51180622001256BKT00	13/09/2001
Landsat 7	LE71190622002306SGS00	02/11/2002
Landsat 7	LE71190622003053SGS00	22/02/2003
Landsat 7	LE71180622003046SGS00	15/02/2003
Landsat 7	LE71180622003014EDC00	10/01/2003
Landsat 7	LE71180622003238EDC01	26/08/2003
Landsat 7	LE71190622003101ASN00	11/04/2003
Landsat 5	LT51190622004288BKT00	14/10/2004
Landsat 5	LT51180622004329BKT00	24/09/2004
Landsat 7	LE71190622004344EDC00	09/12/2004
Landsat 5	LT51190622005274BKT00	01/10/2005
Landsat 7	LE71180622005275EDC00	02/10/2005
Landsat 5	LT51180622006350BKT00	16/12/2006
Landsat 5	LT51190622007040BKT00	09/02/2007
Landsat 5	LT51180622007017BKT00	17/01/2007
Landsat 5	LT51190622009301BKT00	28/10/2009
Landsat 7	LE71180622009270EDC00	27/09/2009
Landsat 5	LT51190622010016BKT00	16/01/2010
Landsat 5	LT51180622011156BKT00	05/06/2011
Landsat 7	LE71180622011132EDC00	12/05/2011
Landsat 7	LE71190622011139EDC00	19/05/2011
Landsat 7	LE71190622011155EDC01	04/06/2011
Landsat 7	LE71180622011164EDC00	13/06/2011
Landsat 7	LE71190622011171EDC00	20/06/2011
Landsat 7	LE71180622011180EDC00	29/06/2011
Landsat 5	LT51180622011268BKT00	25/09/2011
Landsat 7	LE71180622011276EDC00	03/10/2011
Landsat 7	LE71190622011283EDC00	10/10/2011
Landsat 7	LE71180622011292EDC00	19/10/2011
Landsat 7	LE71180622011308EDC00	04/11/2011
Landsat 7	LE71180622011324EDC00	20/11/2011
Landsat 7	LE71190622011331EDC00	27/11/2011
Landsat 7	LE71190622012254EDC00	10/09/2012
Landsat 7	LE71190622012190PFS00	08/07/2012
Landsat 7	LE71180622012263EDC00	19/09/2012
Landsat 7	LE71180622012247EDC00	03/09/2012
Landsat 7	LE71190622012174EDC00	22/06/2012
Landsat 7	LE71190622012158EDC00	06/06/2012
Landsat 7	LE71190622012126EDC00	05/05/2012
Landsat 7	LE71180622012167EDC01	15/06/2012
Landsat 7	LE71190622012286EDC00	12/10/2012
Landsat 7	LE71180622012295EDC00	21/10/2012
Landsat 7	LE71180622012279EDC00	05/10/2012
Landsat 7	LE71180622012327DKI00	22/11/2012

Landsat 7	LE71180622012359DKI00	24/12/2012
Landsat 8	LC81190622014235LGN00	23/08/2014
Landsat 8	LC81190622014267LGN00	24/09/2014
Landsat 8	LC81180622014212LGN00	31/07/2014
Landsat 7	LE71190622014163EDC01	12/06/2014
Landsat 7	LE71180622014204EDC00	23/07/2014
Landsat 7	LE71180622014188EDC00	07/07/2014
Landsat 7	LE71190622014307EDC00	03/11/2014
Landsat 7	LE71180622014316EDC00	12/11/2014
Landsat 7	LE71180622014348EDC00	14/12/2014
Landsat 8	LC81180622014324LGN00	20/11/2014
Landsat 8	LC81190622014347LGN00	13/12/2014
Landsat 8	LC81180622014356LGN00	22/12/2014
Landsat 8	LC81190622015046LGN00	15/02/2015
Landsat 8	LC81190622015334LGN00	30/11/2015
Landsat 8	LC81190622015190LGN00	09/07/2015
Landsat 8	LC81190622015126LGN00	06/05/2015
Landsat 8	LC81190622015094LGN00	04/04/2015
Landsat 8	LC81190622015078LGN00	19/03/2015
Landsat 8	LC81190622015046LGN00	15/02/2015
Landsat 7	LE71190622016153EDC00	17-06-2016
Landsat 8	LC81190622016161LGN00	09-06-2016

After the 2015 fires, ground staff inspecting the affected areas observed that fire damage within the forest was not uniform, and that a significant amount of both peat and aboveground biomass had not been affected by the fires. Closer inspection on the ground showed that although the non-tree vegetation had typically burned, a considerable amount of the trees were still standing with a portion of them intact and alive, while fallen trees were typically un-burned and simply fell due to the peat supporting its roots being burnt. The burn scar ground visits also suggested that a significant proportion of the peat had not burnt, leading the team to hypothesise there was a correlation between the condition of the vegetation (fallen/standing, alive/dead) and the extent of burnt peat.

Due to the heterogeneity of the fire affected areas, Landsat and other multispectral datasets could not be used to accurately quantify the fire damage. Therefore, an Unmanned Aerial Vehicle (UAV) survey was used to evaluate the fire damage in more detail. In the initial phase of the survey, an ebee UAV platform with a S110 RGB camera was used to map 3319.35 ha of the burnt area in eastern Katingan. The survey was then continued using a Long Range Long Endurance QuestUAV Q-200 Surveyor fitted with a DSC-WX500 RGB camera (see Table 33 for more details).

Table 33. UAV survey specifications

Parameter	UAV Survey I	UAV Survey II
Date	04/12/2015 - 10/12/2015	14/02/2016 – 28/02/2016
UAV	eBee UAV from sensefly	Long Range Long Endurance Q-200 Surveyor from QuestUAV
Area Covered	3319.35 ha	4520.15 ha
Camera	CANON S110 RGB camera	RGB - SONY DSC-WX500 18.2 Megapixels
Ground Sampling Distance	17.44 cm	4.78 cm

A significant percentage (84%) of the burnt forest from 2015 was surveyed but since blanket coverage wasn't achieved, a processing workflow that allowed the results to be extrapolated out to the un-surveyed area was needed. Therefore, a randomly allocated sampling grid consisting of 40 points was overlaid with the surveyed area. At each point the matching UAV image was identified and separated into 9 equal area sections. The middle section of each image was then extracted and classified using the ISOCLASS unsupervised classification algorithm. Although the imagery only contained the Red, Green and Blue bands and didn't include the frequently used for vegetation studies Near Infrared band, the unsupervised classification was able to utilise the significant difference in the reflectance of the red, green and blue bands to stratify the live vegetation from the dead vegetation with high accuracy. To further stratify the area, the standing dead and fallen dead trees were stratified given their apparent relationship to the presence of burnt peat. Since both spectral- and object-based analysis were not feasible methods for extracting this data, the very high spatial resolution of the data was utilised to manually delineate these strata. After processing all 40 randomly selected and evenly distributed points, the imagery showed the burnt forest contained 11.4% of live standing trees, 33.0% dead standing trees and 55.6% fallen trees (Table 34 below).

Next, in order to further investigate and quantify the relationship between peat burn and the condition of remaining vegetation, a field survey was conducted within areas affected by fire in 2015. This survey sampled at 366 sampling points situated at distances no less than 50m along a number of transects located in each of the three main fire affected areas. At each point every tree of >5cm in diameter, either fallen or standing, with 5m of the centre point was measured and its status recorded (Dead/Alive, Fallen/Standing). Live trees were identified by observing the presence of live leaves and by machete technique, i.e. by peeling the tree bark using machete and identifying the presence or absence of live cambium. Next, for **each tree**, the status of the peat surrounding the base of the tree to a distance of 1m was assessed on a four point scale representing percentage peat burned (0%, 25%, 50%, 75%,100%). 52 Plots that lay within 200m of the former forest edge were removed from the data set to account for inadvertent edge effects, leaving a total of 314 plots representing 2,648 trees.

Analysis of the data indicated that the percentage of peat burnt around the trees was strongly related to their status (fallen-standing/alive-dead), with no significant effect of location, or significant interaction (GLM. n=2648; Tree Status: F3,2636=250.23, P<0.000; Area: $F_{2,2636}$=0.983, P=0.374; Interaction: $F_{6,2636}$=1.225; P=0.290). Results are summarised in Table 34 below.

Table 34. Percentage of burnt peat area in the first-incident burnt areas in the project area

Burning strata	Percentage of burnt area (%)	Average % peat burned
Fallen trees	55.6%	85.0%
Live-Standing trees	11.4%	9.5%
Dead-Standing trees	33.0%	56.6%

IPCC default emission factors were then used to estimate emissions in each area, in each year after correcting for the percentage areas and burn impact shown above in Table 34. Full results are provided in Section 6.

Methods used to determine biomass loss from burning are described in detail in Section 6.

5.1.4 Community impact monitoring plan and methodological approach

5.1.4.1 Community impact monitoring plan

Impacts of the Katingan Project on the project-zone communities have been and will continue to be closely monitored, reported and evaluated according to the Community MRV tracker (Appendix 5).

Monitoring results were used to evaluate the progress of community-based activities, lessons learned and community inputs, and to implement adaptive management. Methods adopted for community impact monitoring include:

Step 1: Village-based survey teams, consisting of a community facilitator and organizers;
Step 2: Random sampling amongst representative village groups within each village;
Step 3: Standardized questionnaires that are adaptable to fit target groups;
Step 4: Standardized measures to manage and analyze sample data;
Step 5: Quantitative and qualitative data analysis to evaluate community impacts;
Step 6: Dissemination of results to all stakeholders to maintain transparency and participation.

In addition to on-the-ground surveys, data was also collected through secondary sources (e.g., village and local government census data, third-party studies). See the Community MRV Tracker for more details.

5.1.4.2 High conservation value plan

HCV 4, 5 and 6 areas have significant impacts on community well-being. The Katingan Project monitored and evaluated the effectiveness of measures taken to maintain or enhance HCV attributes through the community impact monitoring program. Ground truthing of information and maps was also conducted on a regular basis in order to assess the accuracy of spatial impacts on communities.

5.1.5 Biodiversity impact monitoring plan and methodological approach

5.1.5.1 Biodiversity monitoring plan

Biodiversity impacts in the project zone were monitored based on the Biodiversity MRV Tracker (Appendix 6). Biodiversity monitoring was focused on the project zone's HCV areas and key species (see Section 8). Monitoring was carried out using a variety of field survey techniques, including local community interview surveys to assess hunting level and threats.

5.1.5.2 High conservation value monitoring plan

It was anticipated that project activities would lead to positive enhancement of HCV areas, particularly HCV 1, 2 and 3 areas which include a particular focus on those areas critical for the survival of Critically Endangered and Endangered species. For more details see the Biodiversity MRV Tracker (Appendix 6). The planned HCV monitoring program allowed the project to demonstrate that the Katingan Project has achieved the stated HCV objectives for maintaining and enhancing these HCV species' populations (see Section 8).

5.2 Data and Parameters Available at Validation

Data and parameters available at validation per VCS methodology VM0007 MF are provided in the tables below. A full list of all relevant data and parameters are further provided in the Climate MRV Tracker (Appendix 4).

Data / Parameter	$\Delta C_{BSL,planned}$
Data unit	t CO_2-e
Description	Net greenhouse gas emissions in the baseline from planned deforestation
Equations	3
Source of data	Module BL-PL

Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	See Module BL-PL
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	$\Delta C_{BSL-ARR}$
Data unit	t CO_2-e
Description	Net GHG removals in the ARR baseline scenario up to year t*
Equations	5
Source of data	Module BL-ARR
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	See Module BL-ARR
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	$GHG_{BSL-WRC}$
Data unit	t CO_2-e
Description	Net GHG emissions in the WRC baseline scenario up to year t*
Equations	6
Source of data	Module BL-PEAT
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	See Module BL-PEAT
Purpose of Data	Calculation of baseline emissions
Comments	N/A

5.3 Data and Parameters Monitored

5.3.1 Climate impact monitoring parameters and relevant data

Data and parameters monitored per VCS methodology VM0007 MF are provided in the tables below. A full list of all relevant data and parameters are further provided in the Climate MRV Tracker (Appendix 4).

Data / Parameter:	$\Delta C_{WPS-REDD}$
Data unit:	t CO_2-e
Description:	Net GHG emissions in the REDD project scenario up to year t*
Equations	2
Source of data:	Module M-MON
Description of measurement methods and procedures to be applied:	See Module M-MON

Frequency of monitoring/recording:	See Module M-MON
QA/QC procedures to be applied:	See Module M-MON
Purpose of data:	Calculation of project emissions
Calculation method:	See Module M-MON
Comments:	

Data / Parameter	$\Delta C_{LK-AS,planned}$
Data unit	t CO_2-e
Description	Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation
Equations	4
Source of data	Module LK-ASP
Value applied	n/a
Justification of choice of data or description of measurement methods and procedures applied	See Module LK-ASP
Purpose of Data	Calculation of leakage
Comments	

Data / Parameter	ΔC_{LK-ME}
Data unit	t CO_2-e
Description	Net greenhouse gas emissions due to market-effects leakage
Equations	4
Source of data	Module LK-ME
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	See Module LK-ME
Purpose of Data	Calculation of leakage
Comments	

Data / Parameter:	$\Delta C_{WPS-ARR}$
Data unit:	t CO_2-e
Description:	Net GHG emissions in the ARR project scenario up to year t*
Equations	5
Source of data:	Module M-ARR
Description of measurement methods and procedures to be applied:	See Module M-ARR
Frequency of monitoring/recording:	See Module M-ARR
QA/QC procedures to be applied:	See Module M-ARR
Purpose of data:	Calculation of project emissions
Calculation method:	See Module M-ARR
Comments:	

Data / Parameter:	$\Delta C_{LK\text{-}ARR}$
Data unit:	t CO_2-e
Description:	Net GHG emissions due to leakage from the ARR project activity up to year t*
Equations	5
Source of data:	Module LK-ARR
Description of measurement methods and procedures to be applied:	See Module LK-ARR
Frequency of monitoring/recording:	See Module LK-ARR
QA/QC procedures to be applied:	See Module LK-ARR
Purpose of data:	Calculation of leakage
Calculation method:	See Module LK-ARR
Comments:	

Data / Parameter:	$GHG_{WPS\text{-}WRC}$
Data unit:	t CO_2-e
Description:	Net GHG emissions in the WRC project scenario up to year t*
Equations	6
Source of data:	Module M-PEAT
Description of measurement methods and procedures to be applied:	See Module M-PEAT
Frequency of monitoring/recording:	See Module M-PEAT
QA/QC procedures to be applied:	See Module M-PEAT
Purpose of data:	Calculation of project emissions
Calculation method:	See Module M-PEAT
Comments:	See Module M-PEAT

Data / Parameter	$GHG_{LK\text{-}ECO}$
Data unit	t CO_2-e
Description	Net GHG emissions due to ecological leakage from the WRC project activity up to year t
Equations	6
Source of data	Module LK-ECO
Value applied	n/a
Justification of choice of data or description of measurement methods and procedures applied	See Module LK-ECO
Purpose of Data	Calculation of leakage
Comments	

5.3.2 Community impact monitoring parameters and relevant data

See the Community MRV tracker (Appendix 5) for parameters and relevant data to be monitored through the life of the community-based project activities.

5.3.3 Biodiversity impact monitoring parameters and relevant data

See the Biodiversity MRV Tracker (Appendix 6) for parameters and relevant data to be monitored through the life of the biodiversity-related project activities.

5.3.4 Reporting frequency and dissemination plan

A Project Implementation and Monitoring Report will be issued at least every five years and as often as every year. When the PIMR is completed, summaries will be prepared in English and Indonesian and disseminated to the relevant stakeholders in accordance with the process described previously in in Section 2.7. In addition, each PIMR will undergo third party verification and as a result, will be publicly posted on the CCB website for public review and comment.

6 QUANTIFICATON OF GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Baseline Emissions

This section describes baseline emissions based on the VCS methodology VM0007 REDD+ MF and its modules BL-PL, BL-ARR, AR ACM 003, and BL-PEAT.

6.1.1 General procedures and assumptions

Baseline emissions and changes in baseline emissions and carbon stocks were determined based on analyses of the most likely baseline scenario as described in Section 4.

Emissions that are accounted result from:

- Above ground biomass stock changes due to conversion to plantations
- Peat microbial decompositions
- Peat burning
- Dissolved Organic Carbon from Water bodies

It is assumed that no non-human induced rewetting (e.g. collapse of dikes or canals that would have naturally closed over time, progressive subsidence leading to raising relative water table depths, increasingly thinner aerobic layers and reduced CO_2 emission rates) will occur in the baseline scenario. For peatland areas that were abandoned before the project started, this assumption was based on expert judgment taking account of verifiable local experience and/or studies and/or scientific literature in a conservative way.

It is assumed that the baseline agents perform regular maintenance of canals for drainage and transportation purposes. Due to limitations of available information on volume and frequency of dredging of the baseline agents, emissions from dredging (emissions from peat exposed to aerobic decomposition by spreading or piling following the establishment or maintenance of canals) is conservatively omitted in the baseline calculations. Note that the omission of this source of GHG emissions is very conservative, resulting in lower emission estimates in the baseline water body stratum compared to strata at the same location in the project scenario, since emissions from water bodies are lower than emissions resulting from peat microbial decomposition.

CO_2 and CH_4 are accounted for in the baseline, while N_2O emissions were conservatively omitted. It was assumed that uncontrolled burning of peat occurs only in part of the deforested project area. These emissions are accounted for since the loss is significant. GHG emissions from biomass burning in the baseline were conservatively omitted.

Baseline changes in land cover classes and drainage status during the project life-time determines (changes in) emissions of CO_2 and CH_4. Baseline emissions therefore have been calculated on an annual basis. (See Map 29, Table 37 and Appendix 7).

6.1.2 Proxy area analysis

6.1.2.1 Proxy area selection

Since the project area does not have a verifiable plan for the rate of deforestation, per module BL-PL, a minimum of 6 proxy areas are required to determine the baseline rate of deforestation, as well as 5 proxy areas to demonstrate the risk of abandonment. According to the methodology, all proxy areas must meet the following criteria:

- Land conversion practices shall be the same as those used by the baseline agent or class of agent;
- The post-deforestation land use shall be the same in the reference regions as expected in the project area under business as usual;
- The reference regions shall have the same management and land use rights type as the proposed project area under business as usual;
- If suitable sites exist they shall be in the immediate area of the project; if an insufficient number of sites exists in the immediate area of the project, sites shall be identified elsewhere in the same country as the project; if an insufficient number of sites exists in the country, sites shall be identified in neighbouring countries;
- Agents of deforestation in reference regions must have deforested their land under the same criteria that the project lands must follow (legally permissible and suitable for conversion);
- Deforestation in the reference region shall have occurred within the 10 years prior to the baseline period; and
- The three following conditions shall be met:
    - The forest types surrounding the reference region or in the reference region prior to deforestation shall be in the same proportion as in the project area (±20%).
    - Soil types that are suitable for the land-use practice used by the agent of deforestation in the project area must be present in the reference region in the same proportion as the project area (±20%). The ratio of slope classes “gentle” (slope<15%) to “steep” (slope≥15%) in the reference regions shall be (±20%) the same of the ratio in the project area.
    - Elevation classes (500m classes) in the reference region shall be in the same proportion as in the project area (±20%).

Suitable reference regions were identified using a database, provided by the Indonesian Ministry of Forestry[8], of pulp and paper concessions in Indonesia whose licenses were granted between 2000 and 2010. Using peat distribution geospatial data for Indonesia, obtained from Wetlands International Indonesia [21], the pulp and paper concessions with similar peat proportions as the project area were identified. Next, NASA Shuttle Radar Topography Mission’s (SRTM) 90m Digital Elevation Model (DEM) data, downloaded via the Consultative Group on International Agricultural Research’s online database[9], was analysed to identify the concessions that met the slope and elevation requirements. To determine which of the remaining concessions met the forest type and forest cover percentage criteria, medium-resolution satellite imagery was used. Table 35 shows proxy area requirements based on the project area’s land cover.

[8] Ministry of Forestry (2010), downloaded from Global Forest Watch Commodities (http://commodities.globalforestwatch.org/#v=home)
[9] Available at http://srtm.csi.cgiar.org/SELECTION/inputCoord.asp

Table 35. Reference region selection criteria

Project area	Reference region Requirement
96.65% forest cover	At least 77.32% forest cover
97.44% peat	At least 77.95% peat
100% of area in the 0-500m class	At least 80% of the area must fall in the 0-500m class
100% of area has "gentle" (slope<15%) slopes	At least 80% of the area must have "gentle" slopes

6.1.2.2 Satellite imagery analysis

A) Data acquisition

For each concession, Landsat 5 Thematic Mapper (TM), Landsat 7 Enhanced Thematic Mapper Plus (ETM+) or Landsat 8 Operational Land Imager (OLI) data was downloaded from the United States Geological Survey's online database[10]. All Landsat Level 1 data provided by USGS is geometrically corrected, using precision ground control points and SRTM DEM data, orthorectified and meets all standards laid out by the GOFC-GOLD 2013 handbook. For the first time-step, imagery from the concession grant date was downloaded. Due to Landsat's long revisit time and the high level of cloud cover in Indonesia, a compromise had to be made between cloud cover and the imagery acquisition date's proximity to the concession grant date.

B) Landsat pre-processing

All Landsat data was atmospherically corrected using the ATCOR2 for IMAGINE software. For optimal results, the radiometric rescaling values from each Landsat scene's metadata were used to create the scene's calibration file. Landsat 7 imagery acquired after 31/05/2003, when the sensor's Scan Line Corrector (SLC) failed, were also masked using the Landsat 7 gap-mask layer to remove all pixels affected by the scan line error.

C) Landsat classification

To increase the classification's accuracy, the concession shapefile data was used to subset the Landsat scene in order to remove all spectral data outside of the area of interest. The Unsupervised Classification ISODATA algorithm, with the standard clustering parameters, was then used to classify all concessions into forest and non-forest classes. The clouds, cloud shadows and scan line error gaps were masked out for all images and cross-applied to both time-steps to ensure only data available in both time-steps was used to calculate deforestation rates. When necessary, additional imagery from the same calendar year was processed and used to fill in cloud gaps to reduce overall cloud cover below 10%. All images were further processed with a 3*3 majority filter to remove noise and improve the classification accuracy. Lastly, an accuracy assessment was run on each map to ensure the overall classification accuracy was at least 90%. 100 points, with a 50-meter buffer between points, were randomly created for both forest and non-forest classes and compared with the unprocessed Landsat data and high-resolution imagery from Google Earth (when available). The accuracy was then calculated using the equation (12).

$$\text{Overall Classification Accuracy} = \frac{\text{Number of Pixels Classified Correctly}}{\text{Total Number of Classified Pixels}} \tag{12}$$

All maps had a satisfactory overall accuracy with the lowest accuracy being 91%.

6.1.2.3 Area of deforestation

Using the module BL-PL, a total of 7 suitable proxy areas were identified (see Table 36 and Map 26).

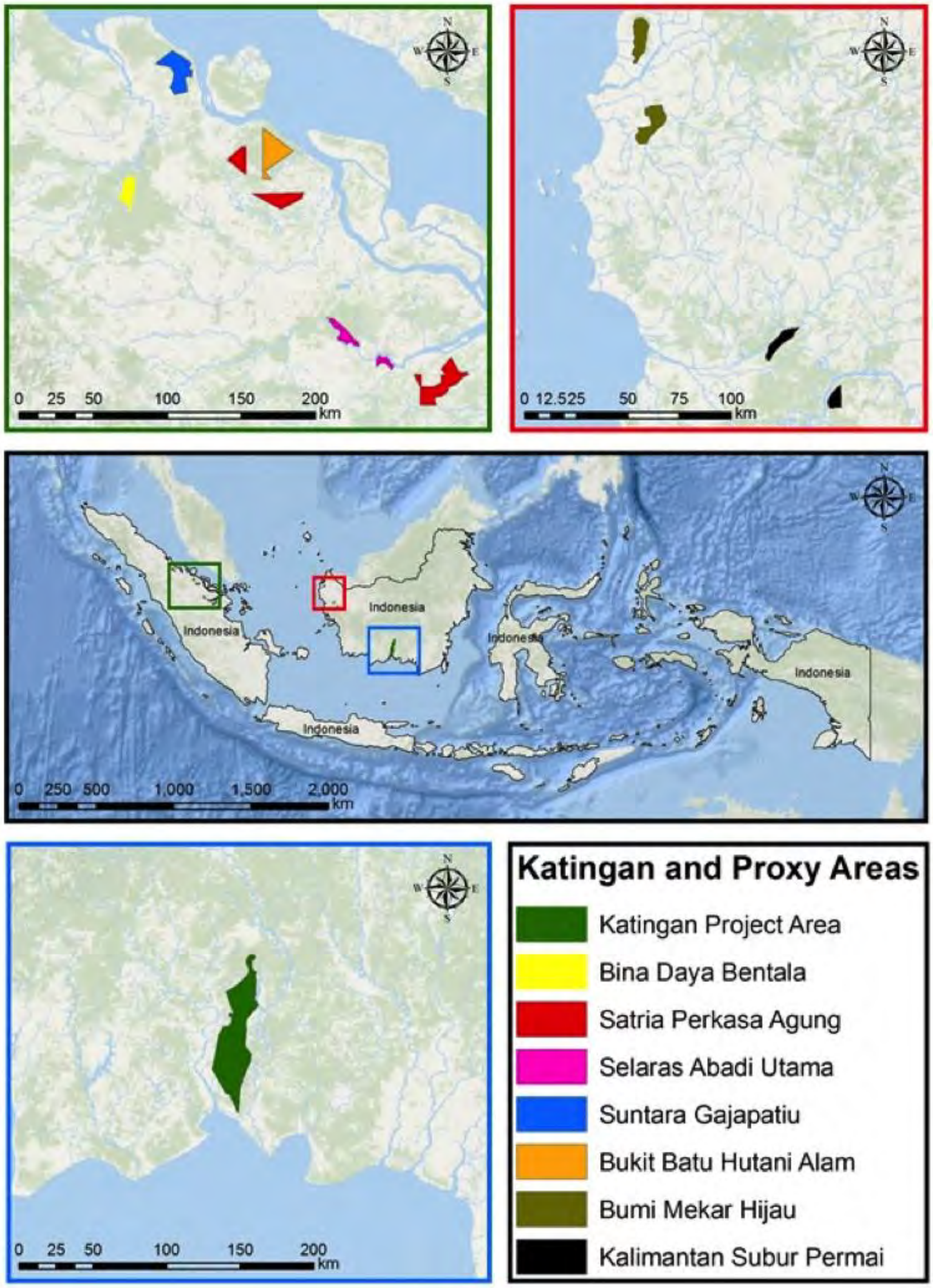
[10] Available at http://earthexplorer.usgs.gov

Table 36. Summary of suitable reference regions

Reference region	Deforestation Rate	Area in Ha	Province	Concession Grant Date	Peat %	Timestep 1 date	Forest % at Timestep 1	Timestep 2 date	Forest % at Timestep 2	Cloud Gap
Satria Perkasa Agung full concession	7.31%	97533.25	Riau	22/08/2000	88.31%	26/04/2000[a] 21/05/2000[b] 23/02/2000[c] 06/12/2000[d] 01/09/2000[d]	84.50%	09/10/2005[a] 15/02/2009[b] 01/05/2007[c] 19/06/2005[d]	42.55%	3.04%
Suntara Gajapatiu	6.42%	34258.30	Riau	15/03/2001	100%	20/09/2001	92.26%	28/08/2010	34.48%	8.30%
Bukit Batu Hutani Alam	14.31%	33030.50	Riau	30/10/2003	100%	21/05/2000	88.07%	09/10/2005	16.55%	7.85%
Selaras Abadi Utama	8.13%	17434.80	Riau	30/12/2002	100%	02/10/2002	92.40%	15/02/2009	35.52%	1.47%
Kalimantan Subur Permai	**3.91%**	13246.02	West Kalimantan	04/04/2006	92.11%	12/08/2005	93.42%	11/05/2009 30/07/2009 18/10/2009	77.79%	1.42%
Bumi Mekar Hijau	4.40%	25118.70	West Kalimantan	01/05/2007	85.93%	05/07/2006 13/07/2006	83.88%	12/10/2010 15/12/2010	66.27%	7.38%
Bina Daya Bentala	10.63%	14124.76	Riau	22/12/2006	100%	03/08/2004	77.55%	15/10/2010 13/09/2010	13.76%	1.86%

a. Plot 1 of the Satria Perkasa Agung concession; b. Plot 2 of the Satria Perkasa Agung concession; c. Plot 3 of the Satria Perkasa Agung concession
d. Plot 4 of the Satria Perkasa Agung concession

Map 26. Geographic location of the Katingan Project and reference regions for the baseline deforestation rate calculation



The baseline deforestation rate was calculated using the following equation.

$$D\%_{planned,i,t} = \left(\sum_{pn=1}^{n}\left(\frac{D\%_{pn}}{Yrs_{pn}}\right)\right)\Big/ n \quad (13)$$

Where:

$D\%_{planned,i,t}$	Projected annual proportion of land that will be deforested in stratum I during year t. If actual annual proportion is known and documented (e.g. 25% per year for 4 years), set to proportion; %
$D\%_{pn}$	Percent of deforestation in land parcel pn etc of a reference region as a result of planned deforestation as defined in this module; %
Yrs_{pn}	Number of years over which deforestation occurred in land parcel pn in reference region; years
n	Total number of land parcels examined
pn	1, 2, 3, …n land parcels examined in reference region
i	1, 2, 3, …M strata

The average projected annual deforestation rate for these proxy areas was estimated to be 7.82%. However, in order to guarantee that a conservative approach was used, the deforestation rate applied in the baseline emission calculation (subsection 6.1.5) was the lowest rate of the 7 proxy areas, **3.91%** (see Table 36). Since this approach is unquestionable conservative, the baseline rate of deforestation uncertainty was set to zero.

6.1.2.4 Likelihood of Deforestation

Since all pulpwood plantation concessions are zoned for deforestation, and are not under government control for the duration of the concession license, the likelihood of deforestation ($L\text{-}D_i$) is assumed to be equal to 100%.

6.1.2.5 Risk of Abandonment

To assess the risk of abandonment, 5 proxy areas with concession grant dates of at least ten years before the project start date were selected using the criteria outlined in Sub-subsection 6.1.2.1. After confirming the elevation, slope and soil criteria were met, Landsat 5 TM, Landsat 7 ETM+ and Landsat 8 OLI imagery was downloaded for three time-steps and visually analysed to determine if any areas were abandoned for forest regrowth. All 5 proxy areas showed clear signs of continued deforestation and plantation activities for all three time-steps, therefore the BL-PL module is applicable to this project.

6.1.2.6 Area of Deforestation

The annual area of deforestation in the baseline is calculated using equation 14.

$$AA_{planned,i,t} = (A_{planned,i} * D\%_{planned,i,t}) * L\text{-}D_i \quad (14)$$

Where:

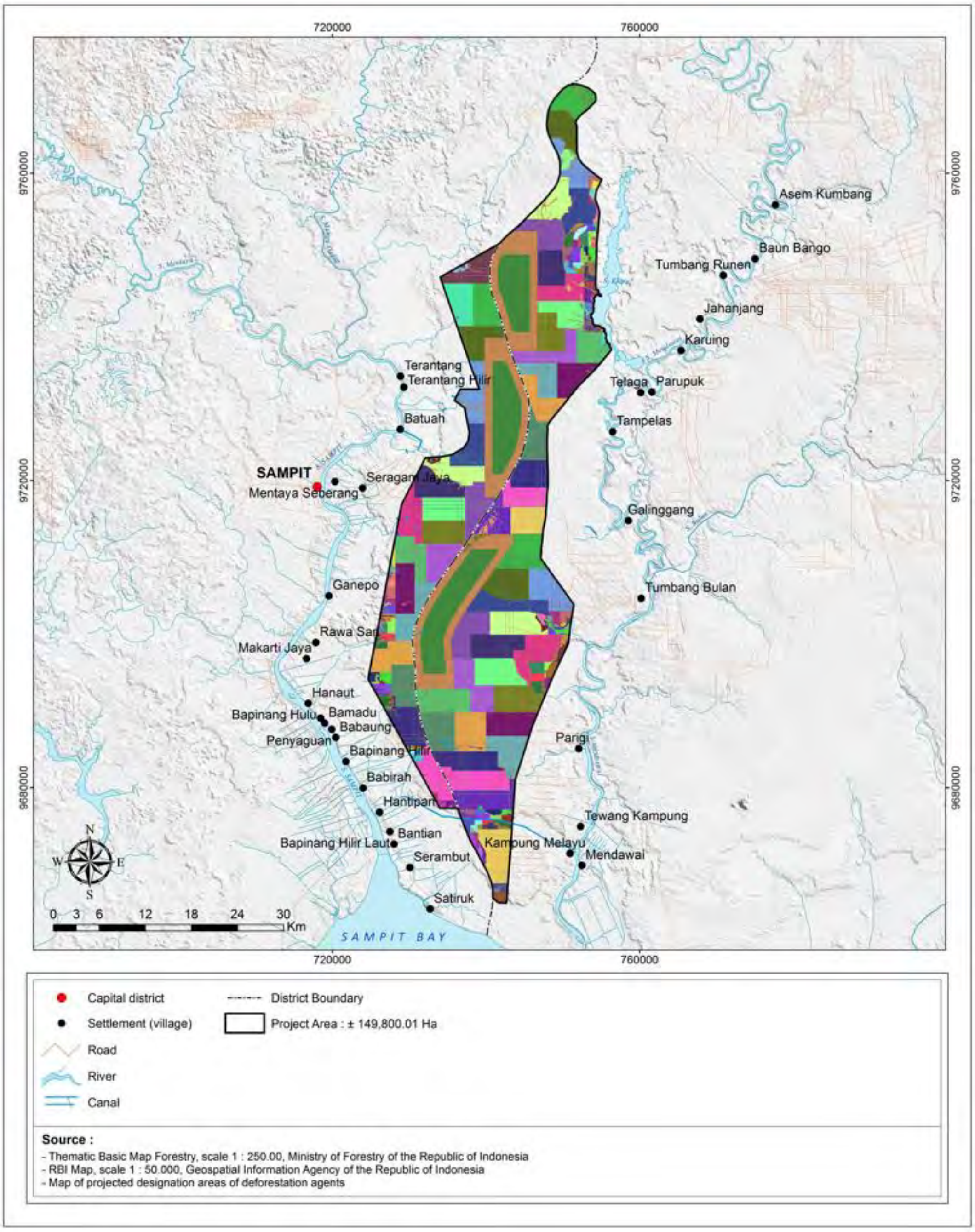
$AA_{planned,I,t}$	Annual area of baseline planned deforestation for stratum I at time t; ha
$D\%_{planned,I,t}$	Projected annual proportion of land that will be deforested in stratum I during year t. If actual annual proportion is known and documented, set to proportion; %
$A_{planned,I}$	Total area of planned deforestation over the baseline period for stratum I; ha
$L\text{-}D_i$	Likelihood of deforestation for stratum I; %

6.1.3 Projection of deforestation under the baseline scenario

Following the determination of the total annual area deforested in the baseline ($AA_{planned,i,t}$), the area was allocated spatially to produce a spatial map of the baseline scenario. The project area was stratified into six strata (Table 37) based on five land use classes, two drainage statuses and one water body class through a Combination-Elimination process as described in Annex 14 of the PD. A baseline scenario map is provided in Map 27. The mapping process involved the following steps:

- Delineation of forest and non-forest area at the project start date. This process is described in Sub-subsection 4.3.1.1.
- Delineation of water bodies present at the project start date (rivers and canals)
- Division of the project area into three assumed concession areas, corresponding to different baseline agents. The division is in compliance with historical records that timber plantation license being given is decreasing with size range from 30,000 to 70,000 ha. Strengthened in 2014 by Ministry of Forestry Decree no P.8/Menhut-II/2014 that limits concession sizes in Indonesia to a maximum of 50,000 hectares.
- Division of each concession area into five zones (acacia plantations, conservation areas, indigenous species area, infrastructure, and areas for community crops) in line with specific regulation (see Table 30).
- Delineation of 50 meters width river buffers (25 meters from both sides of natural rivers). Forest cover inside the buffers are prohibited to log or convert under regulation.
- Drainage canals were laid out in a step wise approach complying with applicable regulations, common practice and hydrotopography of the project area. Primary canals that enclose the concession areas (mandatory by regulation) were delineated first; then secondary canals that act as main outlets for tertiary canals and discharging channels into main canals or natural streams. Considering the hydrotopograhy of the area, baseline agents were assumed to construct secondary canals perpendicular to elevation contour-lines. Tertiary canals are not necessarily perpendicular to elevation contour-line and act as planting block borders, therefore the delineation was carried out in step 8. All the canals were placed in *Acacia* plantations and community crop zones only.
- Division of the *Acacia* plantation area of each assumed agent's concession into 4 Major Blocks (termed Blok RKT, Rencana Kerja Tahunan), resulting in 12 Major blocks in the project area.
- Division of each Major Blocks into smaller planting blocks (termed Blok Tanam) of 500 by 500 meter square parcels
- Division of all Major Blocks into deforestation/planting zones based on deforestation rate (D%) resulting in analysis of Reference Region. Each planting zone consists of several planting blocks.
- Division of all community crop zones into agriculture planting zones based on deforestation rate (D%) resulting in form the analysis of the proxy area analysis
- Assigning canals' construction years, starting from the closest area to access points, in this case rivers
- Assigning deforestation/planting years to deforestation/planting zones, starting from the closest area to access points, in this case rivers
- Assigning planting years to community crop zones
- Choosing and delineating locations for camps and log yards
- Assigning camps and log yards construction years, starting from the closest area to access points, in this case rivers

Map 27. Baseline scenario map[11]



[11] Legend of this map is continued to the box below the map. Numbers preceding alphabet symobols denote year of drainge/deforestation in reference to project start date. Abbreviations: AC=Acacia, CA= Community crops, IF=Ground fascility, IS=Indigineous species area, CF=Conservation area.

6.1.4 Emission characteristics in the baseline scenario

6.1.4.1 Stratification of emission characteristics for CUPP activities under the baseline scenario

Baseline strata of relative homogeneous emission characteristics were mapped on the basis of the Master Baseline Scenario Map (see Map 27) by taking into account (1) Coverage of land use / cover / drainage status; (2) Timing of land use change / drainage status under the assumed baseline; and (3) the delineation of peat. The stratification map of emission characteristics presents the following information:

- Land use (vegetation cover, water bodies, etc.) and the related emission factors: different land uses translate into different emission factors.
- Timing of deforestation or conversion (*Acacia* plantings) other agriculture plantings and canal constructions. Temporal variability of these activities and the different drainage status translate into different emissions. For example, if a peatland parcel belongs to the acacia stratum (forest

planned to be drained in year 3 and to be deforested and converted to acacia in year 6) and was initially undrained and forested, then the Emission Factor (EF) of undrained peatland forest will be used for year 1 – 2, the EF for drained peatland forest for year 3 – 5, and finally the EF for acacia for year 6 onwards.

- Area of peatland, outside which peat-related emissions are absent

In the baseline scenario, the six strata that significantly differ in peat GHG emission characteristics are summarized in Table 37 and Map 28. A summary of dynamics of these strata is presented in Map 29 and Appendix 7.

Map 28. Baseline stratification of the project area for CUPP activities

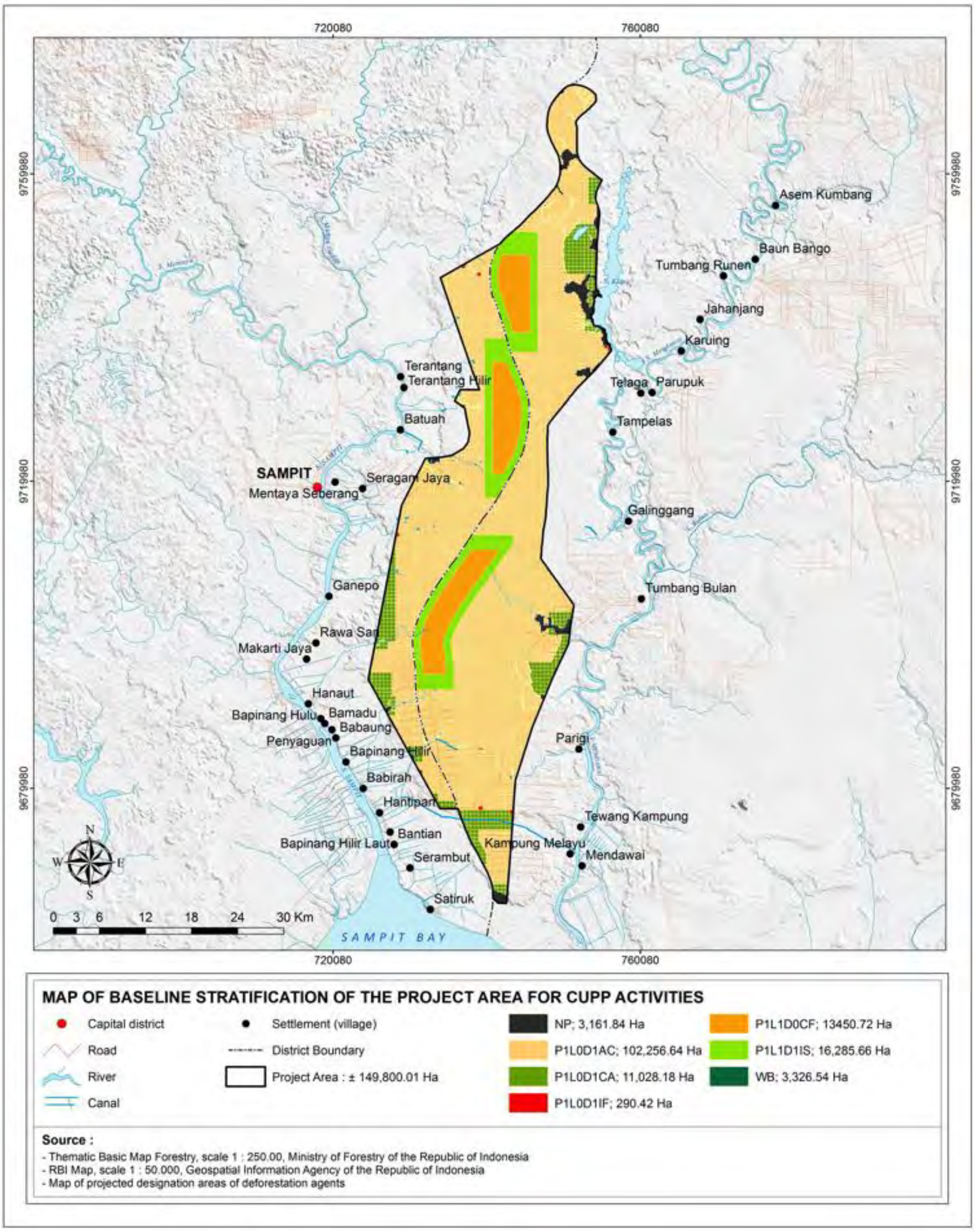
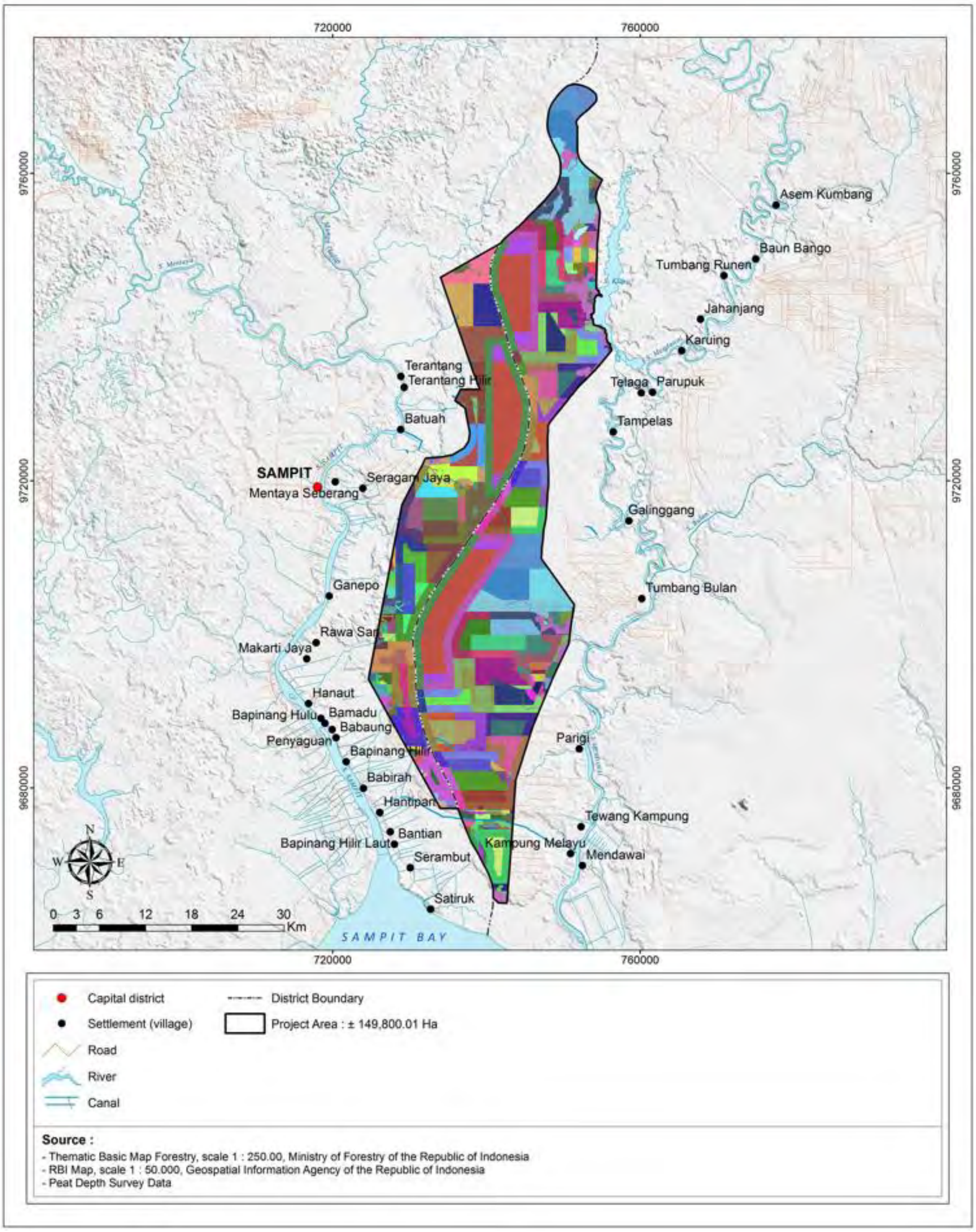


Table 37. Baseline stratification of peatlands and water bodies based on relative homogeneous emission characteristics

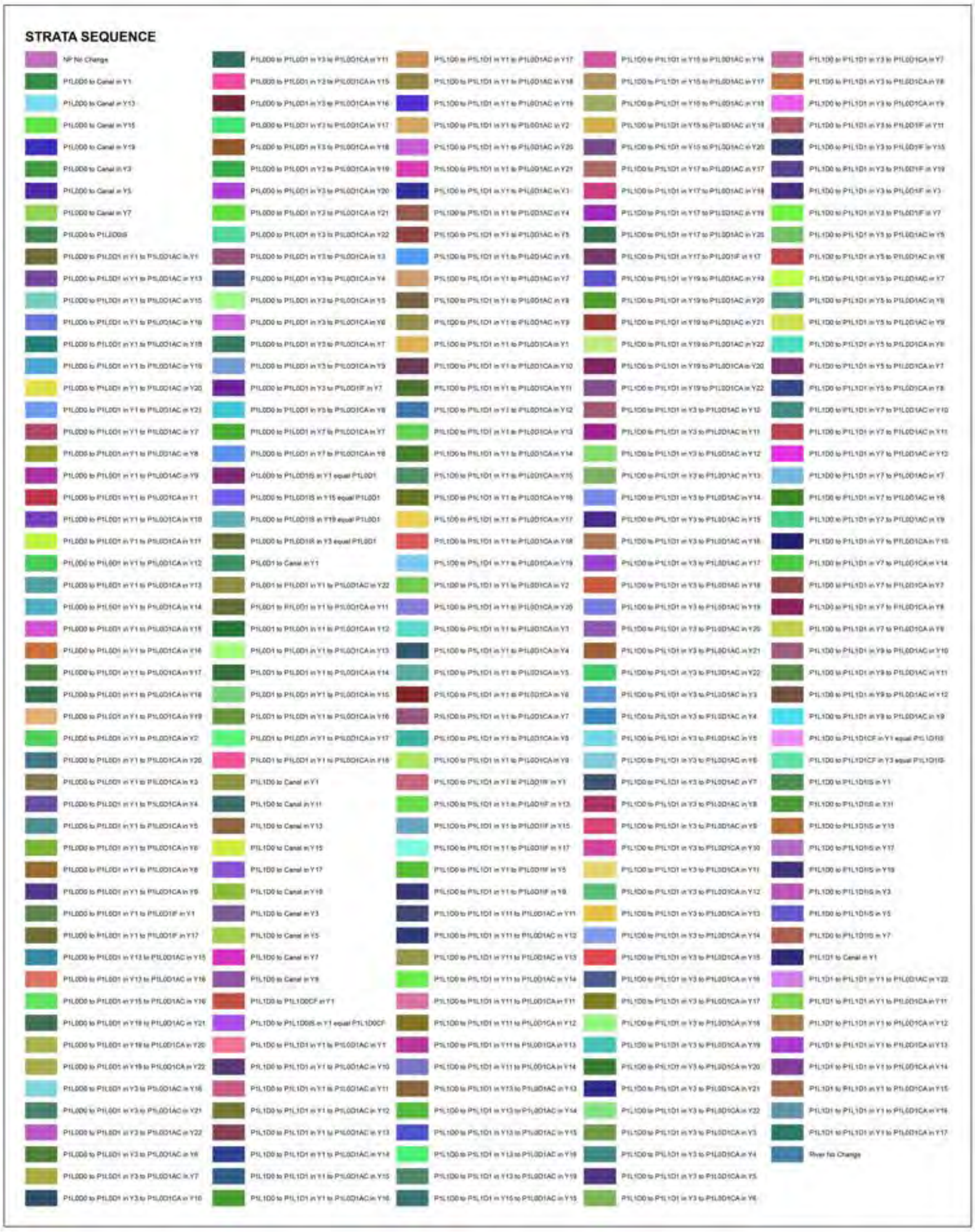
Strata	Description	Area (ha)	Percentage of Project Area	Assumed water table depth (cm-ss)
P1L0D1AC	Acacia Plantation on drained peatland. This stratum represents typical acacia plantations on peatland in Indonesia. For this stratum, drainage is required and forest covers are removed if present. Acacia planting starts in the same year as deforestation. The development of drainage constructions is assumed to happen just before- or at the same year as the deforestation/planting (details are provided in Map 29 and Appendix 7).	102,257	68.3	80
P1L1D0CF	Conservation Forest (undrained peatland forest). This stratum represents peatlands where forest covers are not removed and drainage is absent. This stratum remains unchanged since the project start date. The locations of these strata have been selected and positioned in areas where forest cover and peat were present at the project start date	13,451	9.0	20
P1L0D1CA	Community crops on drained peatland. This stratum represents areas nearby community villages that are or will be utilized for agriculture crops. The locations of these strata have been selected in or near deforested areas and with sufficient transportation access, in this project, rivers.	11,028	7.4	80
P1L0D1IF	Infrastructures on drained peatland. This stratum represents lands within acacia plantations planting that would be used for company operation supports, such as base camps, station camps and log yards. Infrastructure areas are usually drained (when on peatland) and barren. The locations have been selected as close as possible to transportation access (rivers).	290	0.2	80
P1L1D1IS	Native Tree species area and river buffer (drained peatland forest). This stratum consists of 2 types of drained forested peatlands in the project area. The indigenous species areas were positioned as c.a. 1 km buffer zone around each conservation area (stratum P1L1D0CF). Peatlands in this stratum are assumed to experience drainage	16,286	10.9	50

Strata	Description	Area (ha)	Percentage of Project Area	Assumed water table depth (cm-ss)
	impacts from the surrounding drained areas, but the forest cover remains unchanged during the project duration. Boundary canals are also constructed along the periphery of the indigenous species area. River buffers were positioned as a 50 m belt extending from both sides of rivers in the project area			
WB	Water bodies. This stratum represents rivers and drainage canals on peatlands. Rivers remain unchanged during the project period, while drainage canals coverage gradually expands following the assumed yearly operation of the baseline agents.	3,327	2.2	NA
Total		146,638	97.9	

Map 29. Stratification changes in the baseline scenario for CUPP activities[12]



12 Legend of this map is extended to the box below.



6.1.4.2 Stratification based on the emission characteristics for REDD under the baseline scenario

Carbon stock changes and emissions regarding aboveground biomass under the baseline scenario are driven by land cover changes before, during and after the occurances of deforestation. In the project area, GHG emissions as a result of deforestation occurred over 114,694 ha of forest land designated as acacia plantations, community crops, and infrastructure. Ministry of Forestry regulation [22] mandates that 30,348 ha of forest land must be set aside, of which 15,123 ha designated as conservation forest and 14,966 ha designated as native tree species area. These areas were therefore excluded from emission calculations. Given that no land cover change would occur in these areas, they are referred as non relevant strata and therefore excluded from emission calculations.

A total 114,778 ha of the forest in the project area is planned to be deforested in the baseline scenario, of which 103,364 ha will be transformed into areas designated as acacia plantation areas. In areas designated as 'community crops', 7,980 ha of forested area will be deforested and replaced by rubber tree plantations. While in areas designated as 'infrastructure area', 3,346 ha of forest area will be deforested and converted into canals, drainage ditches and other infrastructures. Given relatively small impacts (compared to peat/belowground), the carbon loss of AGB due to uncontrolled burning under the baseline scenario is excluded in the calculation.

In the baseline scenario, the stratification of AGB and land cover changes which significantly differ in GHG emission characteristics were estimated and summarized as summarized in Map 30 and Table 38. The dynamics of strata changes are provided in more detail in Appendix 8.

Map 30. Stratification of aboveground biomass in the baseline scenario for REDD

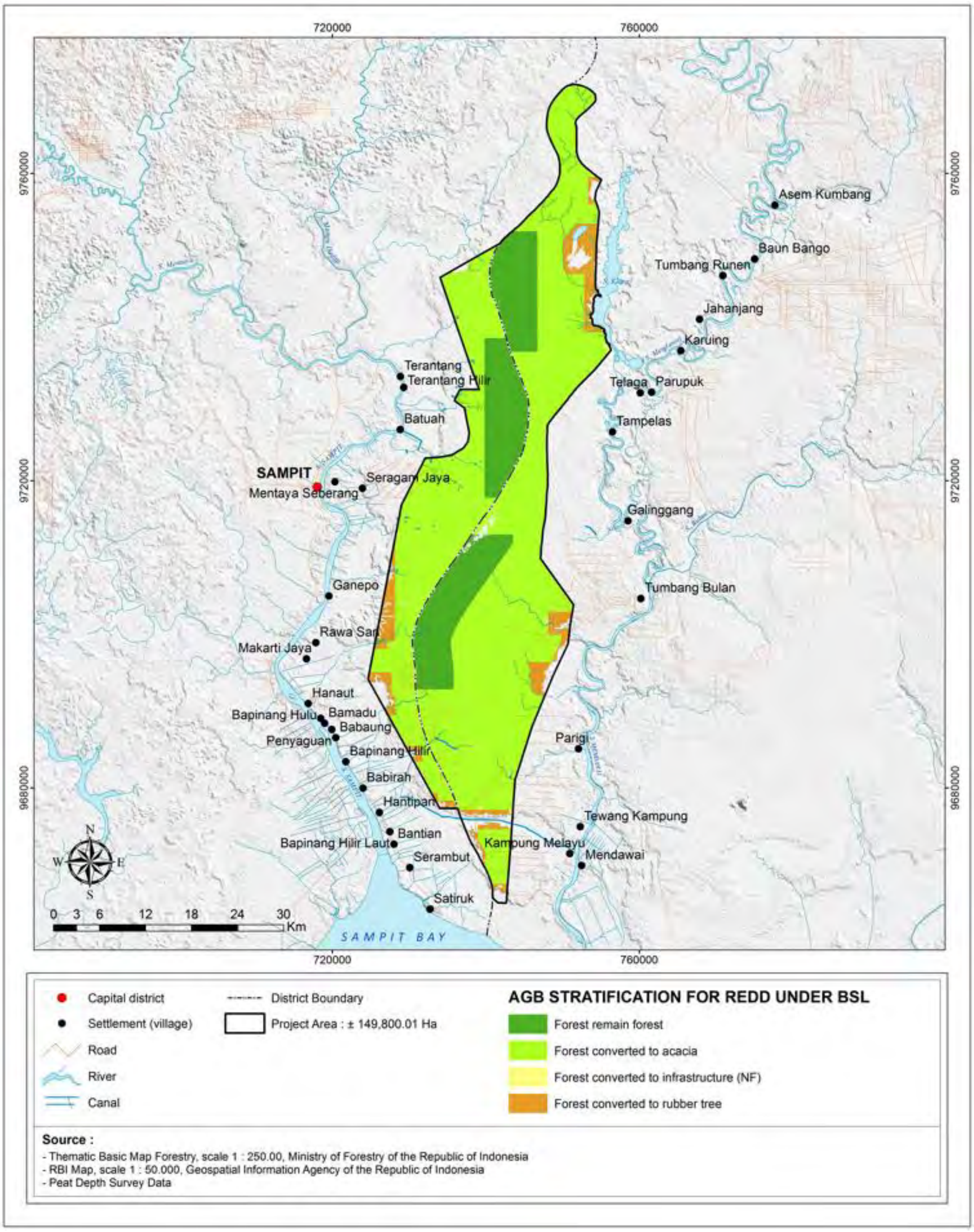


Table 38. Land cover changes strata in the baseline scenario for REDD

Strata	Description	Land use	Area (ha)	Proportion
F0F1*	Forest to forest	Protected area	15,122.82	10.45%
F0F1*	Forest to forest	Native tree area	14,965.81	10.34%
F0Ac1	Forest to *Acacia* plantation	Acacia plantation area	103,363.53	71.39%
F0Rbr1	Forest to rubber tree plantation	Community crops	7,980.38	5.51%
F0NF1	Forest to Non-forest	Infrastructure	3,345.73	2.31%
Total			144,778.26	100.00%

*Non relevant strata as there is no land cover change in baseline scanario

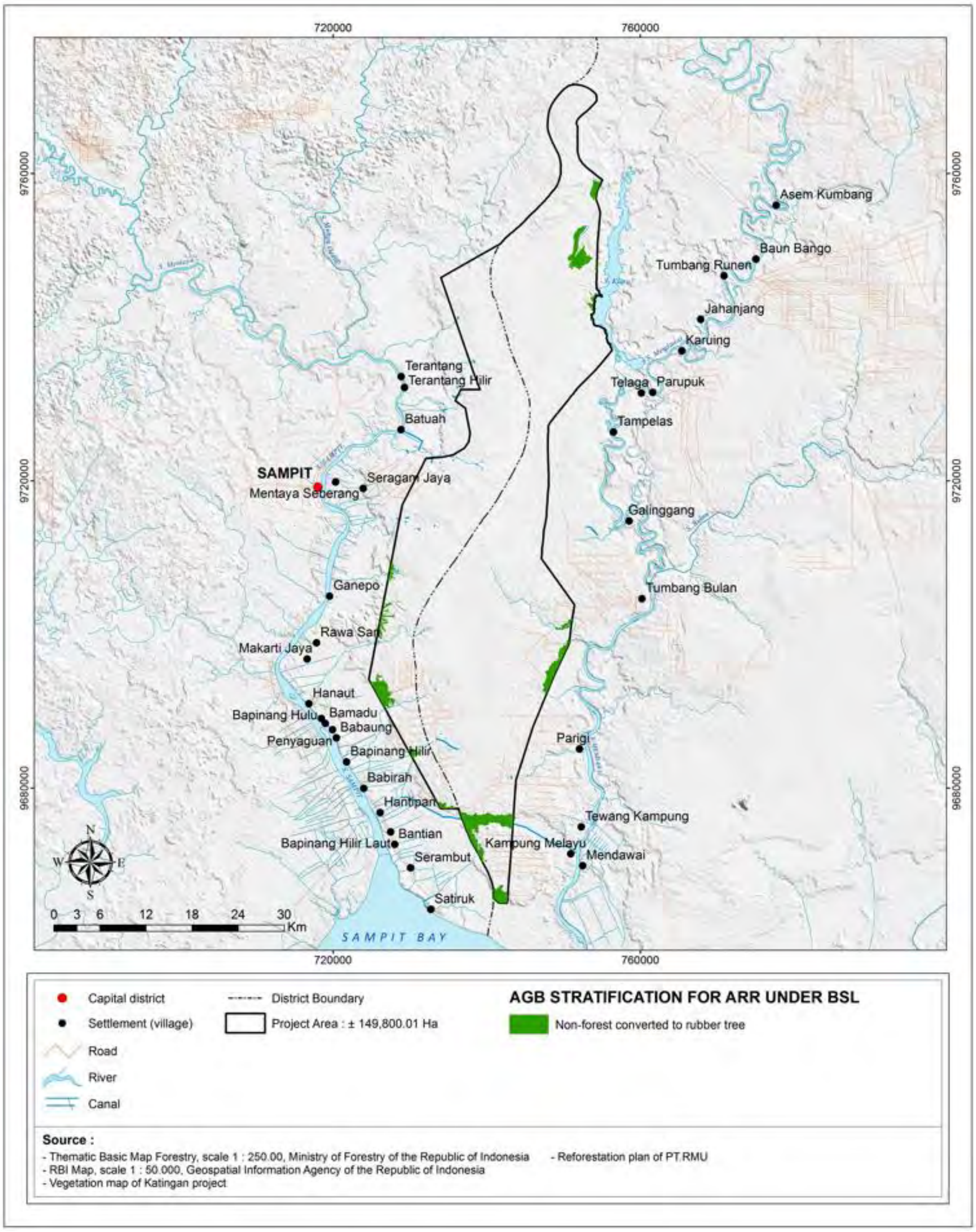
6.1.4.3 Stratification of emission characteristics for ARR activities under the baseline scenario

Replanting under the ARR activities in the areas designated for 'community crops' in the baseline will increase carbon stocks and will therefore be subtracted from the emissions resulting from other baseline activities such as deforestation and forest degradation. Spatial analysis showed that 4,227.72 ha of non-forest area would be transformed to rubber tree plantation (as an ARR activity). A rubber plantation is harvested and renewed every 25 year. Map 31 shows the stratification map of ARR activities under the baseline scenario. The dynamics of changes in the rubber plantation strata are presented in Table 39.

Table 39. Land cover changes strata in the baseline scenario for ARR

Strata	Planting Agent	Land use	Area (Ha)	Planting Start year
NF0Rbr1	Agent A	Community crops	1,004.37	2010
	Agent B	Community crops	1,018.52	2012
	Agent C	Community crops	2,204.82	2012
Total			4,227.72	

Map 31. Stratification of aboveground biomass in the baseline scenario for ARR



6.1.5 Baseline emissions from deforestation

Annual emissions from deforestation are estimated based on the carbon stock losses as a result of conversion of the original forest to acacia plantation area (103,715.55 ha), infrastructure (3,528.26 ha), and rubber tree plantation area (12,208.10 ha) by the three deforestation agents as described in Sub-section 4.4.2. The rate of conversion applied for acacia and rubber plantations is conservatively estimated as the lowest rate of deforestation found in proxy area (3.91%) to determine $AA_{planned,l,t}$. GHG dynamics in the acacia baseline are determined based on the changes in land cover, the soil emissions related to these land cover changes, the emissions from drainage canals and emissions resulting from uncontrolled burnings. The changes in carbon stock in AGB are a result of the conversion of forest to acacia or other land uses, the plantings schemes (rotational and year-by-year) that are applied for the establishment of the acacia plantations and forest degradation as a result of various illegal threads such as illegal logging in undeveloped or conservation areas.

The predicted drainage layout and drainage density of each proportion of the converted land is estimated based on the predicted annual deforestation rate, local hydrotopographic conditions, common practice among acacia plantations and existing regulations. Existing regulations require acacia plantation operators to construct main canals along the concession borders. These canals must be constructed at an early stage of the plantation development, collect water from all other canals in the concession area, and discharge it to nearby rivers. Local topographic conditions play a role in the baseline agents' decisions in designing secondary canals which would act as the main outlets for tertiary canals. The canals need to be constructed with minimal flow resistance, hence positioning them perpendicular to general contour line is optimal. Common practice shows that acacia plantation operators do not necessarily layout tertiary canals perpendicular to the contour line, as long as all of them connect to secondary canals.

As a result of the spatial layout of the baseline deforestation activity, the remaining forest in the project area would have been converted as shown in Table 40 below.

Table 40. Projection of annual forest convertion in project area under the baseline scenario

Year	Forest (ha) deforested and converted to									TOTAL
	Acacia plantation			Infrastructure			Rubber tree plantation			
	Agent A	Agent B	Agent C	Agent A	Agent B	Agent C	Agent A	Agent B	Agent C	
2010	-	-	-	-	-	-	-	-	-	-
2011	1,589	-	-	423	-	-	133	-	-	2,146
2012	1,640	-	-	-	-	-	155	-	-	1,795
2013	1,646	1,527	2,052	-	374	406	181	130	213	6,529
2014	1,636	1,527	2,041	-	-	-	155	88	259	5,705
2015	1,655	1,517	2,022	189	-	-	150	173	255	5,961
2016	1,646	1,619	1,930	-	-	-	125	77	196	5,593
2017	1,656	1,575	2,017	-	158	207	175	207	82	6,076
2018	1,683	1,630	1,945	-	-	-	127	191	282	5,857
2019	1,719	1,518	1,949	189	-	-	179	75	181	5,811
2020	1,695	1,550	1,986	-	-	-	174	180	235	5,819
2021	1,650	1,519	1,996	-	145	190	195	170	66	5,930
2022	1,649	1,550	1,942	-	-	-	141	58	117	5,456
2023	1,629	1,666	2,097	161	-	-	57	34	83	5,727
2024	1,624	1,517	2,043	-	-	-	10	173	92	5,459
2025	1,608	1,540	1,819	-	168	192	24	155	81	5,585

Year	Forest (ha) deforested and converted to									TOTAL
	Acacia plantation			Infrastructure			Rubber tree plantation			
	Agent A	Agent B	Agent C	Agent A	Agent B	Agent C	Agent A	Agent B	Agent C	
2026	1,595	1,515	1,844	-	-	-	156	178	127	5,415
2027	1,658	1,544	1,955	182	-	-	92	106	60	5,598
2028	1,616	1,566	1,916	-	-	-	133	135	-	5,367
2029	1,655	1,578	1,935	-	157	204	85	158	64	5,837
2030	1,550	1,484	2,041	-	-	-	117	161	104	5,455
2031	-	1,323	1,962	-	-	-	-	146	136	3,567
2032	-	1,527	2,282	-	-	-	-	186	5	4,000
2033	-	-	-	-	-	-	-	-	-	-
2070	-	-	-	-	-	-	-	-	-	-
TOTAL	32,798	30,792	39,773	1,145	1,002	1,199	2,562	2,781	2,637	**114,690**
	103,364			**3,346**			**7,980**			

Per BL-PL, net carbon stock changes in the baseline are equal to pre-deforestation stocks minus the long-term average carbon stock in the post-deforestation land-use (acacia and rubber plantation),), as defined in the following equation 15.

$$\Delta C_{AB_{tree},i} = C_{AB_{tree_{bsl}},i} - C_{AB_{tree_{post}},i} \quad (15)$$

Where :
$\Delta C_{AB\ tree,i}$ = Baseline carbon stock change in aboveground tree biomass in stratum i; t CO2-e ha-1
$C_{AB\ treeBSL,i}$ = Forest carbon stock in aboveground tree biomass in stratum i; t CO2-e ha-1
$\Delta C_{AB\ treepost,i}$ = Post-deforestation carbon stock in aboveground tree biomass in stratum i; t CO2-e ha-1

Pre-deforestation stock is equal to the average carbon density estimated from biomass plots in the project area (98.38 tC/ha). Referring to the baseline stratification (sub section 5.4.3), long-term average carbon stock is dependent on the post deforestation land-use of acacia plantations and rubber tree plantations. For *Acacia crassicapa*, the long-term average carbon stock is calculated from the biomass dynamics of *Acacia crassicarpa* in plantations with the rotation of 5 year. For rubber tree (*Hevea brasiliensis*) plantations the long-term average carbon stockis estimated from the biomass dynamic of rubber tree plantation with a 25 year rotation cycle based on RSPO default value. Applying the VCS AFOLU guidance[13], calculation of the long-term average carbon stockof *Acacia crassicarpa* and *Hevea brasiliensis* was calculated as 17.66 tC/ha and 21.09 tC/ha, respectively. Carbon stock change ($\Delta AB_{tree,i}$

[13] AFOLU Guidance: example for calculationg Long Term Average Carbon Stock for ARR project with harvesting

or EF) of forest convertion to *Acacia* plantation, rubber tree plantation, and infrastructure is 296.00 tCO_2-e ha^{-1}, 283.41 tCO_2-e ha^{-1}, and 352.81 tCO_2-e ha^{-1}, respectively. Table 41 provides an overview of the carbon stock changes and emissions within the project life time.

It is assumed that 100% of the deforested areas will be converted to plantations in the year of conversion. GHG emissions from fertilizer application and aboveground biomass loss due to fires are conservativelly excluded in the baseline.
Stock changes in aboveground biomass is accounted for at the time of deforestation, and is estimated using the following equation 16:

$$\Delta C_{BSL,i,t} = AA_{planned,i,t} * \Delta C_{ABtree,i} \quad (16)$$

Where :
$\Delta C_{BSL,i,t}$ = Sum of the baseline carbon stock change in all pools in stratum i at time t, t CO2-e
$AA_{planned,i,t}$= Annual area of baseline planned deforestation for stratum i at time t; ha
$\Delta AB_{tree,i}$ = Baseline carbon stock change in aboveground tree biomass in stratum i; t CO2-e ha-1

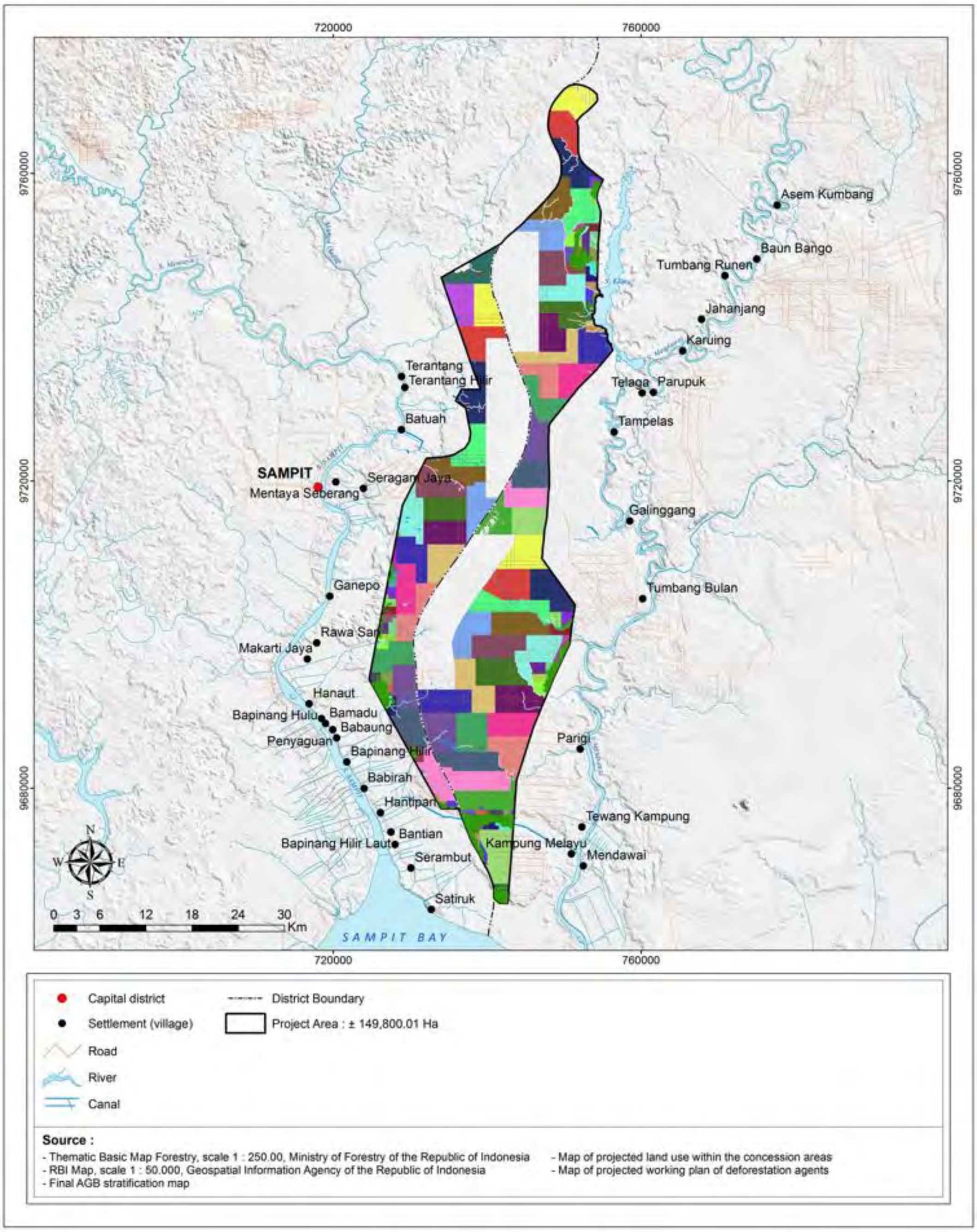
Total emissions from deforestation in the project crediting period are estimated as 34,037,000 tCO2 which is released from forest conversion from 2011 to 2031 (see Table 41 and Map 32 below).

Table 41. Carbon stock changes and emissions from deforestation in project area within project life time.

Year	Emission (x1000 tCO2-e) resulted from the conversion from forest to									TOTAL
	Acacia plantation			Infrastructure			Rubber tree plantation			
	Agent A	Agent B	Agent C	Agent A	Agent B	Agent C	Agent A	Agent B	Agent C	
2011	470	-	-	149	-	-	38	-	-	657
2012	485	-	-	-	-	-	44	-	-	529
2013	487	452	607	-	132	143	51	37	60	1,970
2014	484	452	604	-	-	-	44	25	73	1,682
2015	490	449	598	67	-	-	43	49	72	1,768
2016	487	479	571	-	-	-	35	22	56	1,651
2017	490	466	597	-	56	73	50	59	23	1,813
2018	498	482	576	-	-	-	36	54	80	1,726
2019	509	449	577	67	-	-	51	21	51	1,725
2020	502	459	588	-	-	-	49	51	67	1,715
2021	488	450	591	-	51	67	55	48	19	1,769
2022	488	459	575	-	-	-	40	16	33	1,611
2023	482	493	621	57	-	-	16	10	24	1,702

Year	Emission (x1000 tCO2-e) resulted from the conversion from forest to									TOTAL
	Acacia plantation			Infrastructure			Rubber tree plantation			
	Agent A	Agent B	Agent C	Agent A	Agent B	Agent C	Agent A	Agent B	Agent C	
2024	481	449	605	-	-	-	3	49	26	1,612
2025	476	456	538	-	59	68	7	44	23	1,670
2026	472	448	546	-	-	-	44	51	36	1,597
2027	491	457	579	64	-	-	26	30	17	1,664
2028	478	464	567	-	-	-	38	38	-	1,585
2029	490	467	573	-	55	72	24	45	18	1,744
2030	459	439	604	-	-	-	33	46	29	1,610
2031	-	392	581	-	-	-	-	41	39	1,052
2032	-	452	676	-	-	-	-	53	1	1,181
2033	-	-	-	-	-	-	-	-	-	-
2070	-	-	-	-	-	-	-	-	-	-
TOTAL	9,708	9,114	11,773	404	353	423	726	788	747	34,037
			30,595			1,180			2,262	

Map 32. Projected emissions from deforestation in the project area



6.1.6 Baseline emissions from ARR activities

Under the baseline scenario, ARR activities are carried out in the non-forest community buffer areas of the three deforestation agents (timber plantation companies). Based on spatial analysis, in total 4,227.72 ha will be planted with rubber tree (*Hevea brasiliensis*); 1,004.37 ha by agent A, 1,018.52 ha by agent B, and 2,204.82 ha by agent C.

The annual planting rate is set equal to the deforestation rate that resulted from analyses in the reference region. For rubber, the plantation was assumed to operate on a 25 year rotation (i.e. harvested and replanted every 25 years). We assumed 3 planting times and 2 harvesting times within the project period. Activities and sequences associated with the establishment of rubber tree plantation under baseline scenario are summarized in Table 42 below.

Table 42. The assumed annual planting and harvesting under ARR activities within the project periode

	Planting									Harvesting					
Agent	Agent A			Agent B			Agent C			Agent A		Agent B		Agent C	
Year/Rotation	1	2	3	1	2	3	1	2	3	1	2	1	2	1	2
2010	-														
2011	44														
2012	49			-			-								
2013	-			91			66								
2014	27			98			14								
2015	29			3			12								
2016	47			53			171								
2017	-			1			214								
2018	58			9			0								
2019	15			125			103								
2020	3			0			42								
2021	30			25			135								
2022	66			142			100								
2023	119			166			139								
2024	158			61			130								

	Planting									Harvesting					
Agent	Agent A			Agent B			Agent C			Agent A		Agent B		Agent C	
Year/Rotation	1	2	3	1	2	3	1	2	3	1	2	1	2	1	2
2025	152			29			134								
2026	30			-			83								
2027	65			93			141								
2028	18			36			187								
2029	75			12			152								
2030	22			33			88								
2031	-			37			70								
2032	-			3			223								
2033	-			-			-								
2034	-			-			-								
2035	-	-		-			-			-					
2036	-	44		-			-			44					
2037	-	49		-	-		-	-		49		-		-	
2038	-	-		-	91		-	66		-		91		66	
2039	-	27		-	98		-	14		27		98		14	
2040	-	29		-	3		-	12		29		3		12	

	Planting									Harvesting					
Agent	Agent A			Agent B			Agent C			Agent A		Agent B		Agent C	
Year/Rotation	1	2	3	1	2	3	1	2	3	1	2	1	2	1	2
2041	-	47		-	53		-	171		47		53		171	
2042	-	-		-	1		-	214		-		1		214	
2043	-	58		-	9		-	0		58		9		0	
2044	-	15		-	125		-	103		15		125		103	
2045	-	3		-	0		-	42		3		0		42	
2046	-	30		-	25		-	135		30		25		135	
2047	-	66		-	142		-	100		66		142		100	
2048	-	119		-	166		-	139		119		166		139	
2049	-	158		-	61		-	130		158		61		130	
2050	-	152		-	29		-	134		152		29		134	
2051	-	30		-	-		-	83		30		-		83	
2052	-	65		-	93		-	141		65		93		141	
2053	-	18		-	36		-	187		18		36		187	
2054	-	75		-	12		-	152		75		12		152	
2055	-	22		-	33		-	88		22		33		88	
2056	-	-		-	37		-	70		-		37		70	

	Planting									Harvesting					
Agent	Agent A			Agent B			Agent C			Agent A		Agent B		Agent C	
Year/Rotation	1	2	3	1	2	3	1	2	3	1	2	1	2	1	2
2057	-	-		-	3		-	223		-		3		223	
2058	-	-		-	-		-	-		-		-		-	
2059	-	-		-	-		-	-		-		-		-	
2060	-	-	-	-	-		-	-		-	-	-		-	
2061	-	-	44	-	-		-	-		-	44	-		-	
2062	-	-	49	-	-	-	-	-	-	-	49	-	-	-	-
2063	-	-	-	-	-	91	-	-	66	-	-	-	91	-	66
2064	-	-	27	-	-	98	-	-	14	-	27	-	98	-	14
2065	-	-	29	-	-	3	-	-	12	-	29	-	3	-	12
2066	-	-	47	-	-	53	-	-	171	-	47	-	53	-	171
2067	-	-	-	-	-	1	-	-	214	-	-	-	1	-	214
2068	-	-	58	-	-	9	-	-	0	-	58	-	9	-	0
2069	-	-	15	-	-	125	-	-	103	-	15	-	125	-	103
2070	-	-	3	-	-	0	-	-	42	-	3	-	0	-	42
	1,004	1,004	268	1,019	1,019	380	2,205	2,205	580	1,004	268	1,019	380	2,205	580

According to module BL-ARR, GHG emissions and removal are estimated using the procedure provided in AR-ACM0003 Afforestation and reforestation lands except wetlands and associated pool. Net GHG removals under the ARR baseline scenario up to time t*; t CO2-e ($\Delta C_{BSL-ARR}$) is equal to the summation from t=1 to t* of the baseline net GHG removals by sinks in year t;(ΔC) in AR-ACM0003, as describe in equation 17:

$$\Delta C_{BSL-ARR} = \sum_{t=1}^{t^*} (\Delta C_{BSL,t\ ACM0003}) \tag{17}$$

Where:

$\Delta C_{BSL-ARR}$ Net GHG removals under the ARR baseline scenario up to time t; t CO2-e
$\Delta C_{BSL,t\ ACM0003}$ Baseline net GHG removal by sinks in year t (from AR-ACM0003) (t CO2-e)
t = 1,2,3,... t time since project start
$C_{TREE,BSL,t}$ Change in carbon stock in tree biomass under baseline scenario, in year t: tCO2-e
t = 1,2,3,... t time since planting start

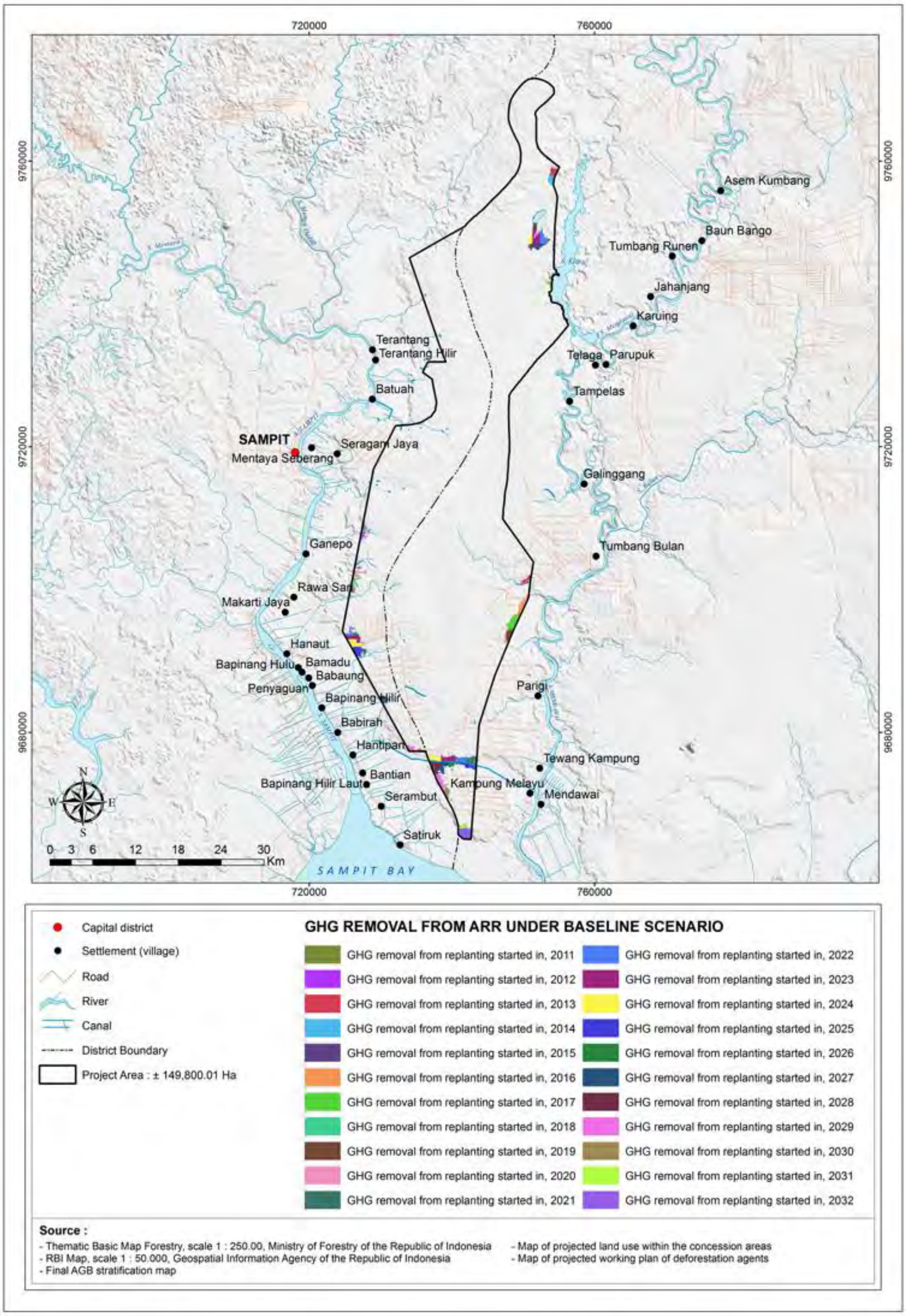
Net GHG removals under the ARR baseline scenario within the project period are estimated at 445,017.19 tCO2-e. Annual GHG removals and emissions (carbon losses because of harvesting are subtracted) under ARR are presented in Table 43 below.

Table 43. Baseline net GHG removal from ARR activities in project area within project periode

Year	NET GHG removal from ARR (tCO2-e)			
	Agent A	Agent B	Agent C	Total
2010	-	-	-	-
2011	295.26	-	-	295.26
2012	627.61	-	-	627.61
2013	627.61	614.85	443.25	1,685.71
2014	812.35	1,279.02	540.50	2,631.87
2015	1,005.45	1,297.58	620.71	2,923.75
2016	1,323.53	1,653.95	1,779.78	4,757.26
2017	1,323.53	1,663.70	3,226.08	6,213.31
2018	1,713.96	1,724.03	3,226.09	6,664.08
2019	1,813.52	2,567.54	3,924.44	8,305.51
2020	1,833.52	2,569.33	4,205.61	8,608.45
2021	2,033.10	2,739.54	5,119.77	9,892.42
2022	2,477.39	3,701.74	5,793.70	11,972.83
2023	3,278.98	4,823.03	6,736.93	14,838.95
2024	4,347.82	5,235.67	7,617.13	17,200.62
2025	5,375.53	5,432.88	8,522.22	19,330.64
2026	5,577.71	5,432.88	9,085.99	20,096.59
2027	6,017.45	6,064.77	10,041.17	22,123.40
2028	6,139.46	6,306.49	11,306.38	23,752.33
2029	6,646.71	6,389.04	12,332.16	25,367.91
2030	6,793.19	6,613.50	12,929.09	26,335.77
2031	6,793.19	6,865.32	13,403.43	27,061.94
2032	6,793.19	6,888.91	14,912.58	28,594.68
2033	6,793.19	6,888.91	14,912.58	28,594.68
2034	6,793.19	6,888.91	14,912.58	28,594.68

Year	NET GHG removal from ARR (tCO2-e)			
	Agent A	Agent B	Agent C	Total
2035	6,793.19	6,888.91	14,912.58	28,594.68
2036	(588.25)	6,888.91	14,912.58	21,213.24
2037	(1,515.60)	6,888.91	14,912.58	20,285.89
2038	6,793.19	(8,482.22)	3,831.28	2,142.25
2039	2,174.59	(9,715.45)	12,481.34	4,940.47
2040	1,965.67	6,424.92	12,907.27	21,297.86
2041	(1,158.68)	(2,020.40)	(14,064.16)	(17,243.23)
2042	6,793.19	6,635.45	(21,244.78)	(7,816.14)
2043	(2,967.52)	5,371.00	14,912.17	17,315.64
2044	4,304.02	(14,208.74)	(2,546.12)	(12,450.83)
2045	6,293.36	6,834.57	7,883.41	21,011.34
2046	1,803.53	2,623.70	(7,941.44)	(3,514.20)
2047	(4,313.97)	(17,175.85)	(1,935.69)	(23,425.52)
2048	(13,246.71)	(21,152.96)	(8,668.17)	(43,067.84)
2049	(19,927.74)	(3,436.77)	(7,092.32)	(30,456.83)
2050	(18,899.52)	1,751.51	(7,714.86)	(24,862.86)
2051	1,738.68	6,681.94	818.32	9,238.94
2052	(4,200.38)	(9,115.17)	(8,966.91)	(22,282.46)
2053	3,742.92	638.92	(16,717.48)	(12,335.64)
2054	(5,887.89)	4,618.14	(10,731.98)	(12,001.74)
2055	3,131.16	1,070.53	(10.63)	4,191.07
2056	6,793.19	386.43	3,053.91	10,233.52
2057	6,793.19	6,092.22	(22,816.09)	(9,930.68)
2058	6,793.19	6,681.94	14,912.58	28,387.71
2059	6,793.19	6,681.94	14,912.58	28,387.71
2060	6,793.19	6,681.94	14,912.58	28,387.71
2061	(588.25)	6,681.94	14,912.58	21,006.28
2062	(1,515.60)	6,681.94	14,912.58	20,078.92
2063	6,793.19	(8,689.19)	3,831.28	1,935.28
2064	2,174.59	(9,922.42)	12,481.34	4,733.51
2065	1,965.67	6,217.95	12,907.27	21,090.89
2066	(1,158.68)	(2,227.36)	(14,064.16)	(17,450.20)
2067	6,793.19	6,691.69	(21,244.78)	(7,759.90)
2068	(2,967.52)	5,183.53	14,912.17	17,128.17
2069	4,304.02	(14,446.78)	(2,546.12)	(12,688.88)
2070	6,293.36	6,594.74	7,602.24	20,490.34
TOTAL	116,123.60	100,941.92	224,209.19	441,274.71

Map 33. Pojected spatial GHG removal from ARR under baseline scenario



6.1.7 Baseline emissions from microbial decompositions of peat, peat burnings and water bodies in peatlands

6.1.7.1 Spatial and temporal variability

Quantification of GHG emissions from microbial decompositions of peat, peat burnings and water bodies in peatlands has been carried out by using a spatially and temporally explicit approach. Each baseline stratum as set out in Table 37 and accompanying sub-section was discretized into parcels of the smallest land or water body unit with relatively uniform combinations of spatial variables as given in Table 44. Temporal discretization has been used by sequencing the calculation into 1 year time-step, while temporal variables determine the sequence of strata changes, temporal variability of GHG emission parameters and temporal restrictions to GHG emissions as given in Table 44. The schematization provides an assurance of the proper use of GHG emission parameters at the correct spatial location and the correct time.

Table 44. Variables used in the schematization of quantification of GHG emissions from microbial decompositions of peat, peat burnings and dissolved organic carbon from water bodies in peatlands in the baseline scenario.

Variables	Description
(A) Spatial Variables	
(A1) Soil Type	Distinction between peat or non-peat. This is used to exclude all non-peat parcels from GHG calculation
(A2) Initial peat thickness available for microbial decompositions and burnings	Derived from DEM, DEL and Peat Thickness maps as described in Section 4.4.1.3. These maps are used to determine the initial condition for subsequent calculations of the remaining peat layer available for microbial decompositions and burnings.
(A3) Initial stratum	Stratum of the corresponding parcel at the project start date (as derived in Annex 14 of the PD and Section 5.4.2.1 of the PD) before conversion into baseline stratum takes effect. This is used to determine the correct Emission Factor for the corresponding parcel for the duration before B1 and B2 (in this table, below) take effect.
(A4) Peat burning tag	This is used to identify whether the corresponding parcel has been marked as possible area for peat burning (PBA_{BSL}). All parcels without tag are excluded from peat burning calculation.
(B) Temporal Variables	
(B1) Year of drainage	Determines the onset of conversion from initial stratum to drained stratum and sets all the drainage related parameters/variables accordingly, such as initial consolidations, bulk density changes, etc. This does not take effect if the initial stratum of the parcel is already a drained stratum. Together with B2 this is used to determine the correct Emission Factor for the corresponding parcel
(B2) Year of deforestation/ planting of the baseline land cover	Determines the onset of conversion of initial stratum to deforested/planted stratum. Together with B1 this is used to determine the correct Emission Factor for the corresponding parcel
(B3) PDT	The PDT is the period of time that it takes to deplete the remaining peat layer by microbial decomposition and burning (conservatively will be assumed that PDT is reached once the remaining peat layer has reached 20 cm). Once the PDT is reached in a given stratum all GHG emissions in that stratum are set to zero.
(B4) Year tag for burning	Determines whether the corresponding parcel has been marked to catch peat burning for the corresponding year, and counting the number of burn scars (and any repetitions)

Variables	Description
	of the parcel since year 1. This is used to set the correct burn scar depth and other related burning parameters for the corresponding parcel accordingly.
(B5) Burning restriction	If the corresponding parcel has been marked for burning in the corresponding year (as being checked in B4), this restriction further checks whether GHG emissions from burning would still be possible based on variables: B1 (Year of drainage), B2 (Year of deforestation/planting) and B3 (Remaining peat thickness available for microbial decomposition and burning). Only drained-deforested parcels with >20 cm peat is categorized as available and would emit GHGs from burning.

6.1.7.2 Emissions calculations

Taking into account the spatial and temporal variability described in Section 5.3.4.1 and Appendix 7, the net CO_2-equivalent emissions from the peat (microbial decomposition and burning) and water bodies were estimated following equation 18 from module BL-PEAT:

$$GHG_{BSL\text{-}WRC}=\sum_{t=1}^{t^*}\sum_{i=1}^{M}\left(E_{peatsoil\text{-}BSL,i,t}+E_{peatditch\text{-}BSL,i,t}+E_{peatburn\text{-}BSL,i,t}\right) \quad (10)$$

Where:

$GHG_{BSL\text{-}WRC}$	Net GHG emissions in the CUPP baseline scenario up to year t* (t CO_2e)
$E_{peatsoil\text{-}BSL,i,t}$	GHG emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO_2e yr^{-1})
$E_{peatditch\text{-}BSL,i,t}$	GHG emissions from water bodies in the baseline scenario in stratum i at year t (t CO_2e yr^{-1})
$E_{peatburn\text{-}BSL,i,t}$	GHG emissions from burning of peat in the base line scenario in stratum i at year t (t CO_2-e yr^{-1})
i	1, 2, 3 …M strata in the baseline scenario (unitless)
t	1, 2, 3, … t* times elapsed since the project start (yr)

For all strata i where the project duration exceeds the peat depletion time (PDT or t_{PDT}), for t > $t_{PDT\text{-}BSL,I}$ the following equations 19, 20 and 21 apply:

$$E_{peatsoil\text{-}BSL,i,t} = 0 \quad (19)$$

$$E_{peatditch\text{-}BSL,i,t} = 0 \quad (20)$$

$$E_{peatburn\text{-}BSL,i,t} = 0 \quad (21)$$

Where:

$t_{PDT\text{-}BSL,i}$	Peat Depletion Time in the baseline scenario in stratum i in years elapsed since the project start (yr)
$E_{peatsoil\text{-}BSL,i,t}$	GHG emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO_2e yr^{-1})
$E_{peatditch\text{-}BSL,i,t}$	GHG emissions from water bodies at year t (t CO_2e yr^{-1})
$E_{peatburn\text{-}BSL,i,t}$	GHG emissions from burning of peat in the base line scenario in stratum i at year t (t CO_2e yr^{-1})
i	1, 2, 3 …M_{BSL} strata in the baseline scenario (unitless)
t	1, 2, 3, … t* time elapsed since the project start (yr)

GHG emissions from peat soils comprise GHG emission as CO_2 and CH_4. Were calculated using the following equation 22:

$$E_{peatsoil\text{-}BSL,i,t}=E_{CO2\text{-}BSL,i,t}+E_{CH4\text{-}BSL,i,t} \qquad (22)$$

Where:

$E_{CO2\text{-}BSL,i,t}$	CO_2 emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO_2e yr^{-1})
$E_{CH4\text{-}BSL,i,t}$	CH_4 emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO_2e yr^{-1})

6.1.7.3 Subsidence related to initial compression, microbial decomposition and burning of peat

The initial peat thickness in the baseline scenario is assumed equal to the initial peat thickness as mapped at the project start date minus the initial thickness loss due to compression resulting from initial drainage (see Annex 6). GHG emissions from peat soils comprise GHG emission as CO_2 and CH_4. Were calculated using the following equation 23:

$$E_{peatsoil\text{-}BSL,i,t}=E_{CO2\text{-}BSL,i,t}+E_{CH4\text{-}BSL,i,t} \qquad (23)$$

Where:

$E_{CO2\text{-}BSL,i,t}$	CO_2 emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO_2e yr^{-1})
$E_{CH4\text{-}BSL,i,t}$	CH_4 emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO_2e yr^{-1})

On peatlands that were undrained and which would remain undrained during the project period (stratum P1L1D0CF) and peatlands that are already drained at the project start date (strata P1L1D1, P1L0D1) the compression is assumed to be absent, therefore $Depth_{peatloss\text{-}BSL\text{-}comp} = 0$.

As a result of the initial compression, the bulk density of peat increases proportionally with associated thickness loss. This is taken into account when quantifying peat carbon stock dynamics.

To maintain consistency between annual net CO_2-equivalent emissions and remaining peat carbon stock, annual rates of peat and carbon stock loss in the baseline scenario were quantified annually based on the rate of emissions from microbial decompositions of peat (CO_2 and CH_4 decomposition), burn scar depths (for areas where peat burning was projected to occur), bulk density of peat above water table, and a conservative carbon content value (48 $kg.kg^{-1}$ dry mass) as calculated using equation 24 as follows:

$$Rate_{peatloss\text{-}BSL,i,t}=D_{peatburn\text{-}BSL,i,t}+\left(\frac{12}{44}\times\frac{EF_{CO2,i,t}}{BD_{BSL,i,t}\times C_c\times 10}\right)+\left(\frac{1}{GWP_{CH4}}\times\frac{12}{16}\times\frac{EF_{CH4,i,t}}{BD_{BSL,i,t}\times C_c\times 10}\right) \qquad (24)$$

Where:

$Rate_{peatloss\text{-}BSL,I,t}$	Rate of peatloss due to microbial decompositions and burning in baseline scenario of stratum i at year t ($m.y^{-1}$)
$D_{peatburn\text{-}BSL,i,t}$	Burn scar depth under baseline scenario in stratum i at year t (m)
$BD_{BSL,i,t}$	Bulk density of peat soil above water table in baseline scenario in stratum i at year t* ($kg.m^{-3}$)
$EF_{CO2,i,t}$	CO_2 emissions from microbial decomposition of peat in baseline scenario in stratum i at year t ($tCO_2.ha^{-1}.y^{-1}$). Equals CO_2 emission factor when peat

	available for decomposition > 20 cm, otherwise zero
$EF_{CH4,i,t}$	CH_4 emissions from microbial microbial decomposition of peat in baseline scenario in stratum i at year t ($tCO_2.ha^{-1}.y^{-1}$). Equals CH_4 emission factor when peat available for decomposition > 20 cm, otherwise zero
GWP_{CH4}	Global Warming Potential of CH_4
Cc	Carbon content of peat soil ($kg.kg^{-1}$)

Remaining peat thickness was assessed annually for the project crediting period based on the rate of peat loss due to microbial decompositions of and burning incidents using equation 25 as follow:

$$Depth_{peat\text{-}BSL,i,t}=Depth_{peat\text{-}BSL,i,t0}-\sum_{t=1}^{t=t^*} Rate_{peatloss\text{-}BSL,i,t} \quad (25)$$

Where:

$Depth_{peat\text{-}BSL,i,t}$	Remaining peat thickness in the baseline scenario in stratum i at year t* (m)
$Depth_{peat\text{-}BSL,i,t0}$	Peat thickness at the baseline scenario in stratum i at year t0 = project start date (initial peat thickness) (m)
$Rate_{peatloss\text{-}BSL,i,t}$	Rate of peat loss due (subsidence) due to microbial decomposition of peat and peat burning in the baseline scenario in stratum i in year t ($m\ yr^{-1}$)
i	Strata

Peat carbon stock and its annual changes were calculated using equation 26 following annual peat carbon loss due to microbial decompositions and burning.

$$C_{stock\text{-}BSL,i,t}=C_{stock\text{-}BSL,i,t-1}-C_{loss\text{-}BSL,i,t-1} \quad (26)$$

Where:

$C_{stock\text{-}BSL,i,t}$	Remaining peat carbon stock in baseline scenario in stratum i at year t ($t\ C.ha^{-1}$)
$C_{stock\text{-}BSL,i,t-1}$	Remaining peat carbon stock in baseline scenario in stratum i at previous year ($t\ C.ha^{-1}$)
$C_{loss\text{-}BSL,i,t-1}$	Equivalent carbon stock loss from microbial decomposition of peat and peat burning in baseline scenario in stratum i at previous year ($t\ C.ha^{-1}$)

By tracking annual peat carbon stock and peat thickness in the baseline scenario it has been assured that there is no GHG emissions has been accounted for within any parcel of each stratum once available carbon stock/peat has been depleted. Conservatively, peat is assumed depleted once peat thickness available for decompositions and burning has been reduced to 20 cm.

A summary of the quantified GHG emissions from peat microbial decomposition, uncontrolled peat burning and water bodies under the baseline scenario are presented in Table 45, and the next Sub-subsections 6.1.7.3, 6.1.7.4 and 6.1.7.5 describe how Table 45 has been calculated.

Table 45. A summary of the annual GHG emissions from peat microbial decomposition, uncontrolled peat burning and water bodies in the Project area under the baseline scenario ($tCO_2e.y^{-1}$) since the start of the project in 2010

Year	CO_2 from peat microbial decomposition	CH_4 from peat microbial decomposition	CO_2 from peat burning	CH_4 from peat burning	CO_2 from DOC	Total
2011	872,262	80,618	113,627	13,693	2,779	1,082,979
2012	966,973	80,528	127,390	15,351	2,779	1,193,020
2013	2,292,138	49,284	205,515	24,766	6,052	2,577,755
2014	2,588,966	48,998	251,623	30,322	6,052	2,925,961
2015	2,910,708	47,418	244,700	29,488	6,314	3,238,629
2016	3,204,660	47,144	269,703	32,501	6,314	3,560,321
2017	3,628,150	42,686	313,518	37,781	7,012	4,029,146
2018	3,932,268	42,398	338,149	40,749	7,012	4,360,576
2019	4,307,185	39,805	349,520	42,119	7,370	4,746,000
2020	4,584,724	39,541	404,301	48,721	7,370	5,084,656
2021	4,973,666	36,356	382,934	46,146	7,965	5,447,067
2022	5,268,302	36,073	386,441	46,569	7,965	5,745,349
2023	5,631,354	34,002	403,044	48,569	8,275	6,125,244
2024	5,923,395	33,720	379,011	45,673	8,275	6,390,075
2025	6,308,103	29,970	388,991	46,876	8,890	6,782,830
2026	6,585,466	29,681	373,954	45,064	8,890	7,043,055
2027	6,906,267	28,391	411,579	49,598	9,127	7,404,961
2028	7,189,341	28,092	417,025	50,254	9,127	7,693,839
2029	7,614,737	23,607	423,444	51,028	9,821	8,122,636
2030	7,894,864	23,301	400,032	48,206	9,821	8,376,224
2031	8,081,433	23,087	379,649	45,750	9,821	8,539,740
2032	8,286,789	22,849	390,765	47,090	9,821	8,757,313
2033	8,278,593	22,832	387,157	46,655	9,821	8,745,058
2034	8,268,410	22,812	346,079	41,705	9,821	8,688,826
2035	8,262,373	22,797	309,556	37,303	9,821	8,641,850
2036	8,255,644	22,783	310,482	37,415	9,821	8,636,144
2037	8,248,377	22,766	310,670	37,438	9,821	8,629,072
2038	8,241,859	22,752	255,033	30,733	9,821	8,560,198
2039	8,234,741	22,737	288,620	34,781	9,821	8,590,699
2040	8,225,122	22,720	274,839	33,120	9,821	8,565,622
2041	8,217,806	22,704	276,610	33,333	9,821	8,560,273
2042	8,209,559	22,682	216,776	26,123	9,821	8,484,961
2043	8,202,803	22,667	228,318	27,514	9,821	8,491,122
2044	8,193,613	22,650	232,271	27,990	9,821	8,486,345
2045	8,185,905	22,633	214,734	25,877	9,821	8,458,970
2046	8,178,125	22,617	196,918	23,730	9,821	8,431,210
2047	8,170,001	22,598	202,848	24,444	9,821	8,429,712
2048	8,161,601	22,583	190,877	23,002	9,821	8,407,884
2049	8,154,522	22,567	176,446	21,263	9,821	8,384,618
2050	8,145,756	22,550	190,277	22,930	9,821	8,391,334

Year	CO_2 from peat microbial decomposition	CH_4 from peat microbial decomposition	CO_2 from peat burning	CH_4 from peat burning	CO_2 from DOC	Total
2051	8,138,962	22,537	183,798	22,149	9,821	8,377,267
2052	8,131,369	22,520	171,602	20,679	9,821	8,355,991
2053	8,123,480	22,506	170,305	20,523	9,821	8,346,635
2054	8,113,478	22,490	167,613	20,198	9,821	8,333,601
2055	8,105,756	22,477	149,992	18,075	9,821	8,306,120
2056	8,096,914	22,461	159,279	19,194	9,821	8,307,668
2057	8,086,643	22,444	150,819	18,175	9,821	8,287,901
2058	8,079,669	22,431	160,835	19,382	9,821	8,292,137
2059	8,069,217	22,414	150,511	18,137	9,821	8,270,101
2060	8,053,640	22,384	151,922	18,308	9,821	8,256,074
2061	8,041,789	22,367	154,261	18,589	9,821	8,246,826
2062	8,030,326	22,348	149,805	18,052	9,821	8,230,353
2063	8,017,565	22,326	152,702	18,402	9,821	8,220,815
2064	8,005,012	22,307	145,495	17,533	9,821	8,200,168
2065	7,993,522	22,289	134,659	16,227	9,821	8,176,517
2066	7,980,530	22,269	143,981	17,351	9,821	8,173,951
2067	7,965,650	22,246	130,055	15,672	9,821	8,143,443
2068	7,949,145	22,218	131,385	15,833	9,821	8,128,402
2069	7,936,436	22,197	133,213	16,053	9,821	8,117,720
2070	7,922,493	22,175	128,773	15,518	9,821	8,098,779

6.1.7.4 Emissions from peat microbial decomposition

It is assumed that the rate of conversion of undrained peatland to drained peatland in the baseline scenario is based on the rate of conversion of the forest by the deforestation agents as outlined in Sub-subsection 6.1.4.2 and Appendix 7. The temporal variability of the emissions from peat microbial decompositions are therefore directly related to the land use and land use changes in the baseline. Table 46 below and Table 37 in Sub-subsection 6.1.4.1 provide details on the WRC related baseline stratification that is used and the area (ha) per stratum. Based on this data, the baseline GHG emissions for the different 'emission strata' were calculated using conservative and scientifically robust (TIER 1) IPCC default emission factors for each stratum i and procedured using equations 27, 28, and 29 defined by the VCS methodology VM0007 module BL-PEAT:

$$E_{peatsoil\text{-}BSL,i,t} = E_{peatsoil\text{-}BSL,CO2,i,t} + E_{peatsoil\text{-}BSL,CH4,i,t} \quad (27)$$

Where:

$E_{peatsoil\text{-}BSL,i,t}$	GHG emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO_2e yr^{-1})
$E_{peatsoil\text{-}BSL,CO2,i,t}$	CO_2 emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO_2e yr^{-1})
$E_{peatsoil\text{-}BSL,CH4,i,t}$	CH_4 emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO_2e yr^{-1})
i	1, 2, 3 …M_{BSL} strata in the baseline scenario (unitless)
t	1, 2, 3, … t* time elapsed since the project start (yr)

For each stratum, the CO_2 emissions from microbial decomposition of the peat within the project boundary were estimated as follows:

$E_{peatsoil\text{-}BSL,CO2,i,t} = A_{i,t} \times EF_{CO2,i,t}$ (28)

Where:

$E_{peatsoil\text{-}BSL,CO2,i,t}$ CO_2 emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO_2e yr^{-1})

$EF_{CO2,i,t}$ Emission factor for CO2 emissions corresponds to each stratum i, as provided by IPCC (t CO_2e ha^{-1} yr^{-1})

$A_{,i,t}$ Area of stratum i at time t (ha)

i 1, 2, 3 …M_{BSL} strata in the baseline scenario (unitless)

t 1, 2, 3, … t* time elapsed since the project start (yr)

For each stratum, the CH_4 emission from the peat soil within the project boundary were estimated as follows:

$E_{peatsoil\text{-}BSL,CH4,i,t} = A_{i,t} \times GWP_{CH4} \times EF_{CH4,i,t}$ (29)

Where:

$E_{peatsoil\text{-}BSL,CH4,i,t}$ CH_4 emissions from the peat soil within the project boundary in the baseline scenario in stratum i at year t (t CO_2e yr^{-1})

$EF_{CH4,t,t}$ Emission factor for CH_4 emissions corresponds to each stratum i, as provided by IPCC (t CO_2e ha^{-1} yr^{-1})

$A_{,i,t}$ Area of stratum i at time t (ha)

GWP_{CH4} Global Warming Potential for CH_4

i 1, 2, 3 …M_{BSL} strata in the baseline scenario (unitless)

t 1, 2, 3, … t* time elapsed since the project start (yr)

Table 46. The stratification used for the calculation of GHG emissions per stratum, the area (ha) per each stratum and the CO_2 and CH_4 default factors used for the specific land use

Strata	Description	Area (ha)	IPCC default emission factor for CO_2 (t CO_2-eq ha-1 yr-1)	IPCC default emission factor for CH_4 (t CO_2-eq ha-1 yr-1)	IPCC default emission factor for ∆ DOC (t CO_2-eq ha-1 yr-1)
Initial					
P1L0D0	Undrained deforested peatland	3,172	1.5	0.20	
P1L0D1	Drained deforested peatland	987	19.43	0.14	
P1L1D0	Undrained forested peatland	141,910	0	0.72	
P1L1D1	Drained deforested peatland	354	19.43	0.14	
WB	Water bodies (rivers and canals) present at the project start date	216			2.09
After conversion					
P1L0D1AC	*Acacia* on drained peatland	102,257	73.33	0.08	

P1L1D0CF	Conservation area (undrained peatland forest)	13,451	0	0.72	
P1L0D1CA	Community crops on drained peatland	11,028	51.33	0.20	
P1L0D1IF	Ground facilities on drained peatland	290	19.43	0.14	
P1L1D1IS	Indigenous species area and river buffer (drained peatland forest)	16,286	19.43	0.14	
WB	Water bodies (rivers and canals)	3,327			3.01

Note: Appendix 9 provides more details on the emission factors used and the references.

Calculated annual GHG emissions from microbial decompositions of peat in the baseline scenario is presented in Table 47.

Table 47. GHG emissions from microbial decompositions of peat in the baseline scenario in tCO_2-e.y^{-1}.

Year	CO_2 from peat microbial decomposition	CH_4 from peat microbial decomposition	Total
2011	872,262	80,618	952,880
2012	966,973	80,528	1,047,500
2013	2,292,138	49,284	2,341,422
2014	2,588,966	48,998	2,637,964
2015	2,910,708	47,418	2,958,127
2016	3,204,660	47,144	3,251,804
2017	3,628,150	42,686	3,670,836
2018	3,932,268	42,398	3,974,666
2019	4,307,185	39,805	4,346,990
2020	4,584,724	39,541	4,624,265
2021	4,973,666	36,356	5,010,022
2022	5,268,302	36,073	5,304,374
2023	5,631,354	34,002	5,665,356
2024	5,923,395	33,720	5,957,115
2025	6,308,103	29,970	6,338,073
2026	6,585,466	29,681	6,615,147
2027	6,906,267	28,391	6,934,658
2028	7,189,341	28,092	7,217,433
2029	7,614,737	23,607	7,638,344
2030	7,894,864	23,301	7,918,165
2031	8,081,433	23,087	8,104,520
2032	8,286,789	22,849	8,309,637
2033	8,278,593	22,832	8,301,426
2034	8,268,410	22,812	8,291,222
2035	8,262,373	22,797	8,285,170
2036	8,255,644	22,783	8,278,427
2037	8,248,377	22,766	8,271,143
2038	8,241,859	22,752	8,264,611

Year	CO_2 from peat microbial decomposition	CH_4 from peat microbial decomposition	Total
2039	8,234,741	22,737	8,257,478
2040	8,225,122	22,720	8,247,843
2041	8,217,806	22,704	8,240,510
2042	8,209,559	22,682	8,232,242
2043	8,202,803	22,667	8,225,470
2044	8,193,613	22,650	8,216,263
2045	8,185,905	22,633	8,208,538
2046	8,178,125	22,617	8,200,742
2047	8,170,001	22,598	8,192,599
2048	8,161,601	22,583	8,184,185
2049	8,154,522	22,567	8,177,089
2050	8,145,756	22,550	8,168,306
2051	8,138,962	22,537	8,161,499
2052	8,131,369	22,520	8,153,889
2053	8,123,480	22,506	8,145,987
2054	8,113,478	22,490	8,135,968
2055	8,105,756	22,477	8,128,233
2056	8,096,914	22,461	8,119,375
2057	8,086,643	22,444	8,109,087
2058	8,079,669	22,431	8,102,100
2059	8,069,217	22,414	8,091,632
2060	8,053,640	22,384	8,076,024
2061	8,041,789	22,367	8,064,155
2062	8,030,326	22,348	8,052,674
2063	8,017,565	22,326	8,039,891
2064	8,005,012	22,307	8,027,319
2065	7,993,522	22,289	8,015,810
2066	7,980,530	22,269	8,002,798
2067	7,965,650	22,246	7,987,896
2068	7,949,145	22,218	7,971,363
2069	7,936,436	22,197	7,958,633
2070	7,922,493	22,175	7,944,667

6.1.7.5 Emissions from peat burning

This section explains in more detail how the numbers for peat burning in the Project area in Table 49 have been calculated.

Peatland fires in Indonesia are widely known as human induced events. Based on this fact it can be inferred that the probability of peat burning events increases according to the decrease in distance to human activity (roads, rivers, agriculture area, etc.). It is common in Kalimantan that local communities use rivers and canals extensively as transportation means. Observations in the project area showed that most burnings occur along the Hantipan canal where human activity is high. Burnt area in this location extended to about 1 km from the canal sides.

Per module E-BPB, GHG emissions from biomass burning can result from:

- Conversion of forest land to non-forest land using fire
- Periodical burning of grassland or agricultural land after deforestation
- Controlled burning in forest land remaining forest land
- Uncontrolled fire in drained peat swamp forest
- Uncontrolled peat burning in (abandoned) drained peat sites

Since it is illegal to clear forests on Acacia plantation it is assumed that the deforestation agents do not perform controlled peat burning during site preparation or (rotational) clearance for plantation/crop establishment. Therefore, only emissions from unintentional/uncontrolled burnings are accounted for in the baseline scenario. Furthermore, above ground biomass lost by combustion is conservatively omitted.

Procedures for quantification of GHG emissions from uncontrolled peat burnings follow the VCS methodology VM0007 module E-BPB using the following equation 30:

$$E_{peatburn-BSL,i,t} = \sum_{g=1}^{G} \left(\left(\left(A_{peatburn-BSL,i,t} \times P_{BSL,i,t} \times G_{g,i} \right) \times 10^{-3} \right) \times GWP_g \right) \quad (30)$$

Where:

$E_{peatburn-BSLi,t}$	Greenhouse emissions due to peat burning under baseline scenario in stratum i in year t of each GHG (CO_2, CH_4, N_2O) (t CO_2e)
$A_{peatburn-BSL,i,t}$	Area peat burnt under baseline scenario in stratum i in year t (ha)
$P_{BSL,i,t}$	Average mass of peat burnt under baseline scenario in stratum i, year t (t d.m. ha^{-1})
$G_{g,i}$	Emission factor in stratum i for gas g (kg t^{-1} d.m. burnt)
GWP_g	Global warming potential for gas g (t CO_2/t g)
g	1, 2, 3 ... G greenhouse gases including carbon dioxide, methane and nitrous oxide (unitless)
i	1, 2, 3 …M strata (unitless)
t	1, 2, 3, … t time elapsed since the start of the project activity (year)

The average mass of peat burnt for a particular stratum is estimated using the equation 31:

$$P_{BSL,i,t} = D_{peatburn-BSL,i,t} \times BD_{upper} \times 10^{-4} \quad (31)$$

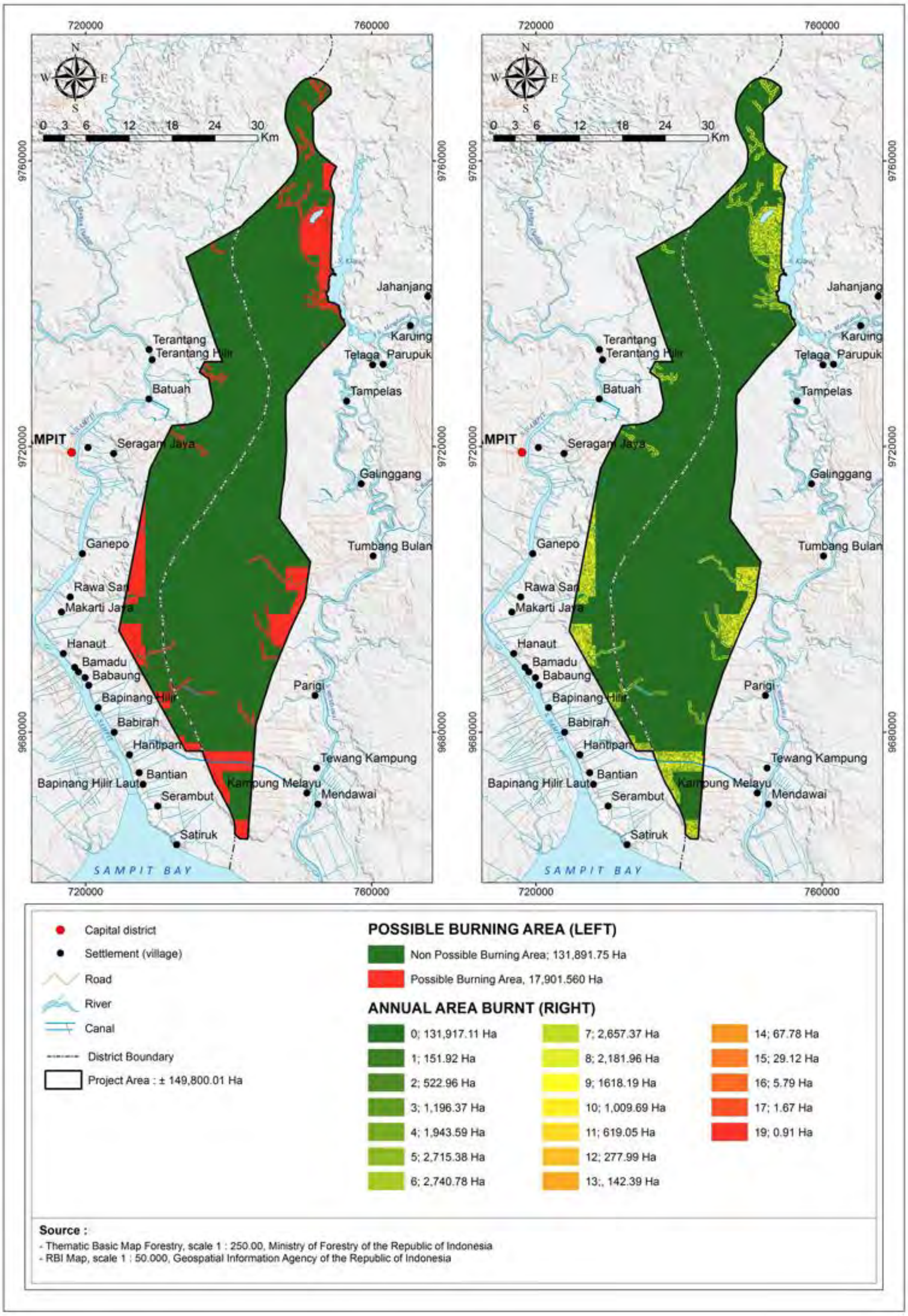
Where:

$P_{BSL,i,t}$	Average mass of peat burnt under baseline scenario in stratum i, year t (t d.m. ha^{-1})
$D_{peatburn-BSL,i,t}$	Average burn scar depth under baseline scenario in stratum i in year t (m)
$BD_{upper,i}$	Bulk density of the upper peat in stratum i (g cm^{-3})
i	1, 2, 3 …M strata
t	1, 2, 3, … t time elapsed since the start of the project activity (years)

Emissions from peat burning in the baseline are thus calculated from the mass of peat lost by combustion and emission factors from scientific literature (see Appendix 9 for the default values that were used for the calculations of baseline carbon losses and emissions from burning).

Uncontrolled burnings in peatlands were assumed to repeat randomly on places that are 'high risk' areas. To determine where the 'high risk areas' are in the baseline of the project area, a hotspot intensity analysis was performed, and the spatial position of burning within the project boundary in the baseline scenario was simulated (details provided in Annex 7). A water body network map from BIG 2008 (rivers and canals) was used to represent human activity variable. NOAA and NASA MODIS Fire hotspot data from 1997-2010 for Kalimantan were plotted on ArcGIS 10.1 and the distances to the nearest human activities (using rivers and canals as proxy) were calculated. Histogram analysis showed that the closer an area is to human activity the higher the probability is for a peat fire. Plotting percentages of hotspot numbers against distances to human activity resulted in a Burning Probability Density (BPD) model with an $R^2 > 0.9$ (Annex 7). The resulted BPD model was used in creating a proportionally scaled down "Possible Burning Area" (PBA_{BSL}) map (Map 34) that shows the area with the highest burning probability (95 percent probability threshold) in the project baseline. This map does not show the "actual area burnt" in the baseline scenario, rather showing possible locations where peat burning can be expected to occur randomly.

Map 14. Map of possible burning area (left) and annual area burnt (right) in the baseline scenario.



To assess the frequency and extent of uncontrolled peat fires in the baseline scenario, remote sensing data of the proxy areas was used, per VCS methodology VM0007 module BL-PEAT (see Annex 7). MODIS fire pixels, which are recorded daily, were downloaded for the seven proxy areas and filtered as to only include the pixels with 100% confidence of the presence of a fire. To identify fires that occurred on bare soil all available Landsat data was subsequently downloaded for the 2000-2010 period, only selected data collected after the individual concession grant dates. When no cloud-free data was available within 2 months prior to the fire pixel acquisition date it was conservatively excluded. Each fire occurring on bare soil was conservatively assumed to have burnt 0.49 km^2 (Giglio, L., et al, 2006). Based on this data the average percentage of burnt area per proxy area was determined to be 1.44% per year. This value was used as a parameter in estimating "Annual Area Burnt Threshold" in the baseline scenario ($AABT_{BSL}$), according to the following equation 32:

$$AABT_{BSL} = 1.44\%.y^{-1} \times A_{Project} = 2{,}157 \text{ ha}.y^{-1} \quad (32)$$

Where:

$A_{project}$ Project area size (149,800 hectares)

The coverage of the Annual Area Burnt for each baseline stratum ($AAB_{BSL,i,t}$) was simulated as a subset of PBA_{BSL} by randomly selecting parcels in PBA_{BSL} annually over 100 years in such a way that the annual average area of the selected parcels approximately equals (but does not exceed) the area of $AABT_{BSL}$. Once a parcel was selected randomly in the first year the parcel is marked as "catching the 1st burning". If it was randomly selected again for the second year it is marked as "catching the 2nd burning", and so forth.

Given the random nature of the $AAB_{BSL,i,t}$ selection, and due to gradual land use change in the baseline scenario, $AAB_{BSL,i,t}$ varies by strata and year with increasing trend following land use change (Figure 14, Table 48). The project has assured that not every burning event would result in peat GHG emissions. At every burning event during the calculation, for the GHG emissions from peat burning to take effect, the corresponding "burnt parcel" must have been drained and deforested first, and that available peat for decomposition and burning exceed 20 cm. By applying these restrictions, net annual area burnt with positive net GHG emissions from peat burning has been calculated as given in Figure 15.

Figure 14. Annual area burnt in baseline scenario

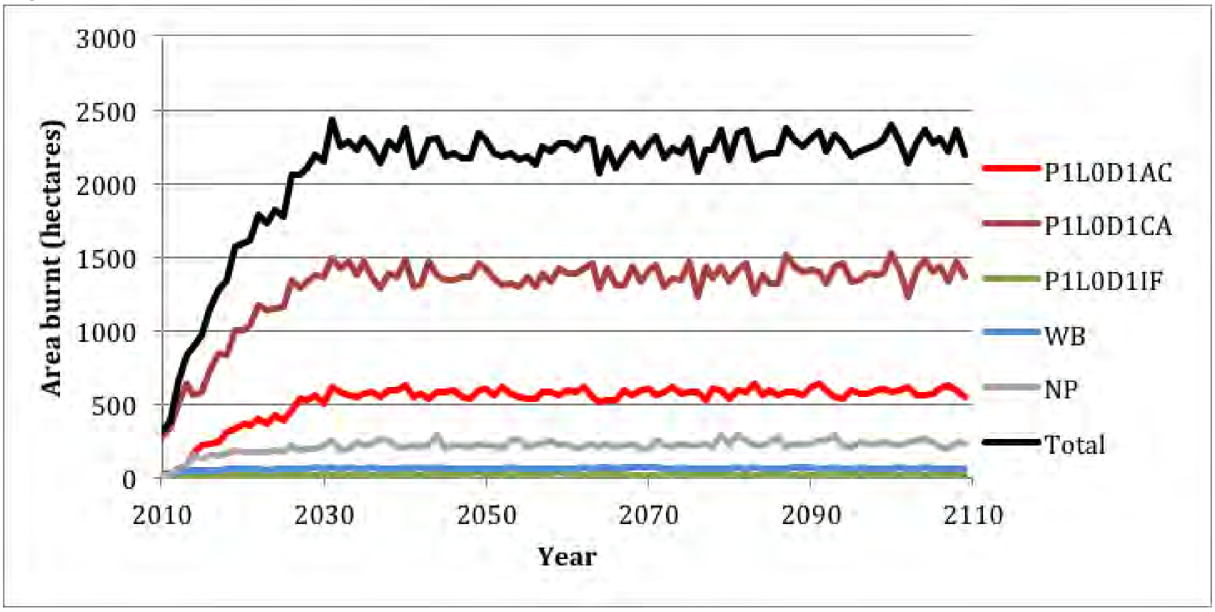


Figure 15. Annual area burnt with positive net GHG emissions from peat burning in baseline scenario

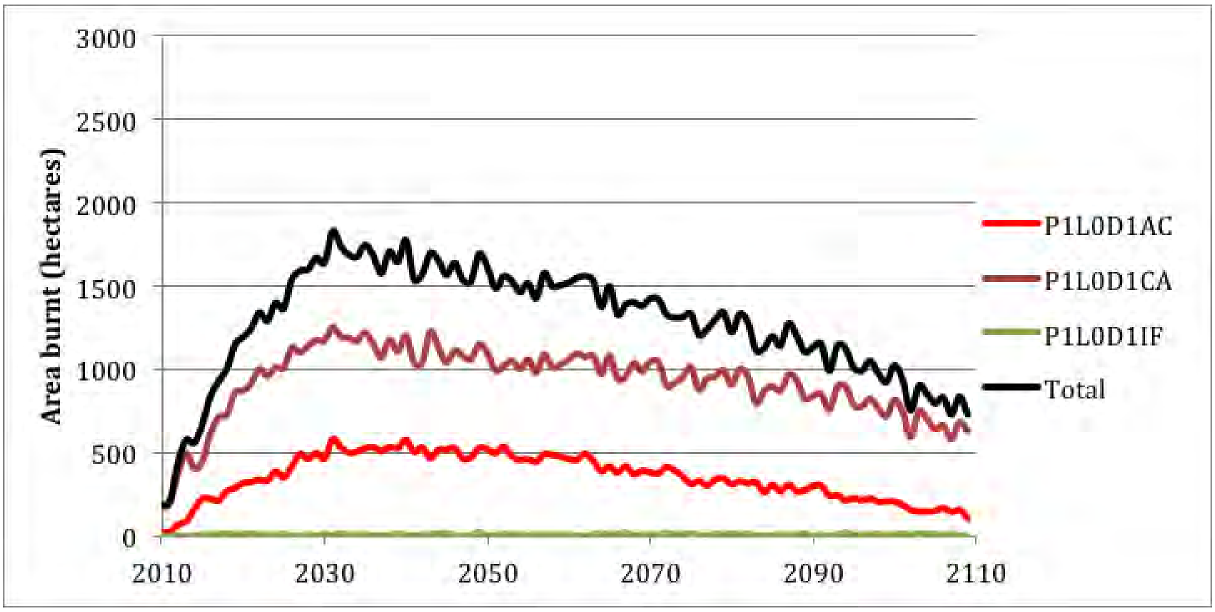


Table 48. GHG emissions from peat burning per stratum and per (repeated) burning

Strata	Strata Area	Total Area Burnt in 60 years	Average Burnt area in 60 years	GHG Emissions from peat burning in 60 years (tCO_2e)			
	(ha)	(ha)	($ha.y^{-1}$)	1st burning	2nd burning	≥3rd burning	Total
P1L0D1AC	102,257	28,631	477.2	1,865,786	1,101,649	1,600,247	4,567,683
P1L0D1CA	11,028	73,039	1,217.3	4,242,612	2,484,608	3,946,775	10,673,995
P1L0D1IF	290	626	10.4	40,996	24,101	36,479	101,575.4
P1L1D0CF	13,451	-	-	-	-	-	-
P1L1D1IS	16,286	-	-	-	-	-	-
WB	3,327	3,205	53.4	-	-	-	-
NP	3,162	11,321	188.7	-	-	-	-
Total	149,800	116,821	1,947	6,149,395	3,610,358	5,583,501	15,343,253

*See Appendix 9 for the defaults used.

Given the fact that there is a difference in burn scar depths between 1st, 2nd and 3rd burnings, calculations took into account the repetition of burnings. Burn scar depths of 18, 11 and 4 cm were assumed for the first, 2nd and 3rd burning respectively [23] (see Appendix 9 for more details).

The peat burning baseline will be re-assessed every 10 years based on observations of burning frequency and extent in reference region and/or based on the latest scientific findings of 'repeated burnings' pattern.

Calculated annual GHG emissions from uncontrolled peat burning are presented in Table 49.

Table 49. GHG emissions from peat burning in the baseline scenario in tCO_2-e.y^{-1}.

Year	CO_2 from peat burning	CH_4 from peat burning	Total
2011	113,627	13,693	127,320
2012	127,390	15,351	142,741
2013	205,515	24,766	230,281
2014	251,623	30,322	281,945
2015	244,700	29,488	274,188
2016	269,703	32,501	302,204
2017	313,518	37,781	351,299
2018	338,149	40,749	378,898
2019	349,520	42,119	391,640
2020	404,301	48,721	453,021
2021	382,934	46,146	429,080
2022	386,441	46,569	433,009
2023	403,044	48,569	451,613
2024	379,011	45,673	424,685
2025	388,991	46,876	435,867
2026	373,954	45,064	419,018
2027	411,579	49,598	461,177
2028	417,025	50,254	467,279
2029	423,444	51,028	474,472
2030	400,032	48,206	448,239
2031	379,649	45,750	425,399
2032	390,765	47,090	437,855
2033	387,157	46,655	433,812
2034	346,079	41,705	387,784
2035	309,556	37,303	346,859
2036	310,482	37,415	347,897
2037	310,670	37,438	348,108
2038	255,033	30,733	285,767
2039	288,620	34,781	323,400
2040	274,839	33,120	307,959
2041	276,610	33,333	309,943
2042	216,776	26,123	242,898
2043	228,318	27,514	255,831
2044	232,271	27,990	260,261
2045	214,734	25,877	240,611
2046	196,918	23,730	220,648
2047	202,848	24,444	227,292
2048	190,877	23,002	213,879
2049	176,446	21,263	197,709
2050	190,277	22,930	213,207
2051	183,798	22,149	205,947
2052	171,602	20,679	192,281
2053	170,305	20,523	190,828

Year	CO_2 from peat burning	CH_4 from peat burning	Total
2054	167,613	20,198	187,812
2055	149,992	18,075	168,067
2056	159,279	19,194	178,473
2057	150,819	18,175	168,994
2058	160,835	19,382	180,216
2059	150,511	18,137	168,648
2060	151,922	18,308	170,229
2061	154,261	18,589	172,850
2062	149,805	18,052	167,858
2063	152,702	18,402	171,103
2064	145,495	17,533	163,028
2065	134,659	16,227	150,886
2066	143,981	17,351	161,332
2067	130,055	15,672	145,727
2068	131,385	15,833	147,218
2069	133,213	16,053	149,266
2070	128,773	15,518	144,291

6.1.7.6 Emissions from water bodies in peatlands

This section explains in more detail how the numbers for emissions from water bodies in the project area in Table 50 have been calculated.

Except for drainage canals, it is assumed that the baseline agents do not create open water such as ponds and lakes. Hence the only type of open water body present in the baseline scenario are rivers and drainage canals. The area of canals in the baseline scenario is determined based on the rate of conversion, topography characteristics and common practice, as set out in Sub-sections 6.1.3 and 6.1.4. In the baseline stratification, all area that is, or would be, water body during the project-life falls into the WB stratum.

Temporal stratification is being applied to this stratum by separating water bodies present at the project start date and drainage canals that would be constructed in later phases by the baseline agents during the project period. Therefore, part of the WB stratum would remain land before the conversion is completed. This situation has been taken into account by using a spatially and temporally explicit quantification approach, as set out in Sub-section 6.1.7. In total 3,327 ha of the peatland area falls into the stratum WB in the baseline scenario. Details on area and sequence of changes from land strata to WB is given in Table 57 and Appendix 7.

No default emission factors are yet provided by IPCC for CO_2 and CH_4 from water bodies. Therefore, IPCC default values for Dissolved Organic Carbon (Δ DOC) were used to calculate the difference in carbon losses between the project scenario and the baseline scenario.

From DOC values it cannot be explained 'how' this carbon will be lost: either transported to the sea, lost as CO_2 within or outside the project area, or lost as CH_4 in- or outside the area (which will be a considerable part). The 'carbon loss' can be calculated, but not the exact proportion of the GHG species CH_4 and CO_2, and therefore all carbon will be assumed to be lost as CO_2 which makes the approach conservative and any double counting will be avoided. Canals and rivers are treated similarly in the use of DOC values. The TIER 1 (IPCC) default annual values for DOC are 0.57 and 0.82 ton C per hectare, for natural and drained peatland respectively. Conservatively, the Hantipan canal (that presents at the project start date) is treated as of producing the same DOC value as that of a natural river despite being man-made water body. Default values used for calculations are given in Appendix 9.

For the quantification procedure, the project used the approach as set out in the VCS methodology VM0007 module BL-PEAT by using the equation 33. ($E_{peatditch\text{-}CO2,i,t}$ + $E_{peatditch\text{-}CH4,i,t}$) found in the equation 7 in the module BL-PEAT was replace with DOC emission, translated into CO_2-equivalents.

$$E_{peatditch\text{-}BSL,i,t} = A_{ditch\text{-}BSL,i,t} \times EF_{DOC\text{-}BSL} \quad (33)$$

Where:

$E_{peatditch\text{-}BSL,i,t}$	GHG emissions from canals and other open water stratum i at year t in the baseline scenario (t CO_2e yr^{-1})
$A_{ditch\text{-}BSL,i,t}$	Total area of canals and other open water stratum i at year t in the baseline scenario (ha)
$EF_{DOC\text{-}BSL}$	IPCC emission factor of Dissolved Organic Carbon from canal and open in the baseline scenario (t CO_2e $ha^{-1}yr^{-1}$)
i	1, 2, 3 …M_{BSL} strata in the baseline scenario (unitless)
t	1, 2, 3, … t time elapsed since the project start (yr)

Projected annual GHG emissions from Dissolved Organic Carbon in water bodies in baseline scenario is presented in Table 50.

Table 50. GHG emissions from Dissolved Organic Carbon in water bodies in the baseline scenario in tCO_2-e.y^{-1}.

Year	CO_2 from DOC
2011	2,779
2012	2,779
2013	6,052
2014	6,052
2015	6,314
2016	6,314
2017	7,012
2018	7,012
2019	7,370
2020	7,370
2021	7,965
2022	7,965
2023	8,275
2024	8,275
2025	8,890
2026	8,890
2027	9,127
2028	9,127
2029	9,821
2030	9,821
2031	9,821
2032	9,821

Year	CO_2 from DOC
2033	9,821
2034	9,821
2035	9,821
2036	9,821
2037	9,821
2038	9,821
2039	9,821
2040	9,821
2041	9,821
2042	9,821
2043	9,821
2044	9,821
2045	9,821
2046	9,821
2047	9,821
2048	9,821
2049	9,821
2050	9,821
2051	9,821
2052	9,821
2053	9,821
2054	9,821
2055	9,821
2056	9,821
2057	9,821
2058	9,821
2059	9,821
2060	9,821
2061	9,821
2062	9,821
2063	9,821
2064	9,821
2065	9,821
2066	9,821
2067	9,821
2068	9,821
2069	9,821
2070	9,821

6.1.8 Significant sources of baseline emissions

No significance tests were necessary since, as described in section 4.4.3, all carbon pools not included in the baseline and project have either been shown to increase more or decrease less in the project relative to the baseline scenario, or been conservatively excluded. All mandatory pools have been included and all sources of GHG emissions have either been included or conservatively excluded.

6.2 Project Emissions

6.2.1 General procedures and assumptions

Project emissions and changes in carbon stocks during this reporting period are calculated based on a combination of site-specific data, land-use proxies and (IPCC) default emissions factors. Emissions in the project scenario that were accounted for result from:

1. Above ground biomass stock changes due to REDD
2. Above ground biomass stock changes due to uncontrolled burning
3. Peat microbial decompositions
4. Dissolved Organic Carbon in Water bodies
5. Peat oxidation from uncontrolled burning

Emissions in the project scenario that were not accounted for during this reporting period, but which will be accounted for in future period result from:

1. Above ground biomass stock changes due to ARR activities
2. Above ground biomass stock changes from forest growth

Specific GHG sources included and excluded from project emissions calculations are listed in the PDD.

6.2.2 Project emissions from deforestation and forest degradation

6.2.2.1 Emissions from deforestation

During the period Nov-2010-Nov-2015, no deforestation was recorded within the project area (as defined by the methodology and expanded in the PD). Therefore, no emissions from deforestation were reported within this reporting period ($A_{defPA,u,i} = 0$).

Remote Sensing (RS) analysis (see Section 5.1.3.1), however, did indicate that some forest disturbance occurred, which was classified as intensive forest degradation, rather than deforestation, and so is considered separately below in the 'Emissions from Forest Degradation' section (Section 6.2.2.2). Forest loss due to fire also occurred, but similarly, this is addressed separately in 'Emissions from uncontrolled biomass burning' (Section 6.2.2.3).

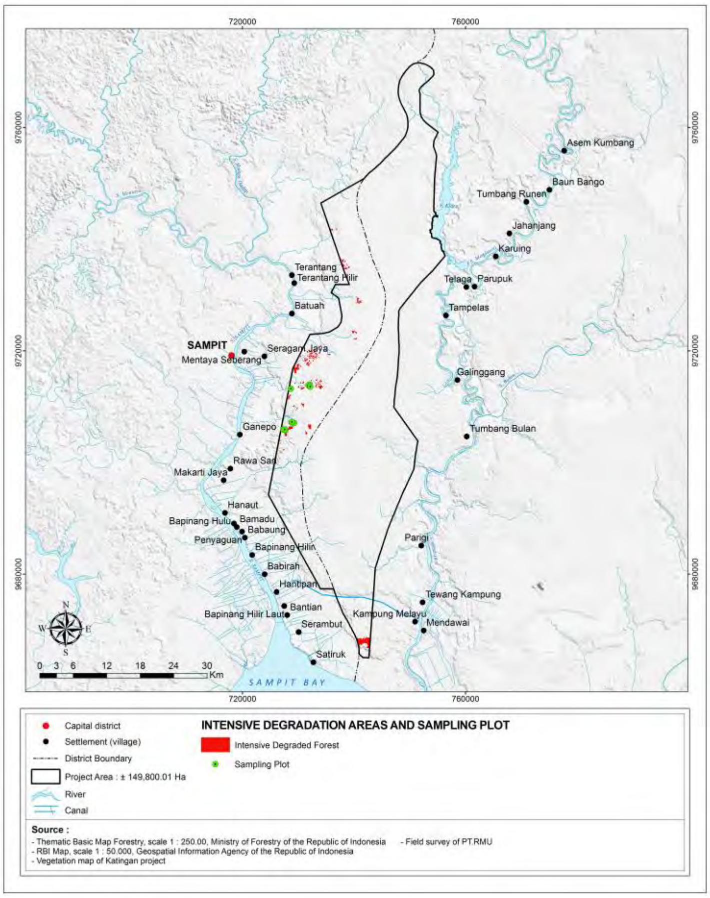
6.2.2.2 Emissions from forest degradation

The project quantified forest degradation using two approaches. The first approach identified areas where degradation was intensive and visible to remote sensing analysis. Such areas were placed in a strata of 'intensive degradation' ($A_{DegW,intens}$). The second approach then used a Participatory Rural Appraisal (PRA) to identify the extent and penetration of less intensive degradation (not visible to remote sensing analysis) and applied the results to create a second strata of forest land 'susceptible to degradation' ($A_{DegW,susc}$). Tree loss in both strata was then assessed by field surveys and the results used to generate estimations of carbon loss. Both approaches are described in more detail below.

For the first approach, based on remote sensing analysis, a Spectral Mixture Analysis (SMA) classification was run on Landsat imagery from 2010-2016 (see section 5.1.3.1). Although this algorithm is effective at identifying small scale degradation, it produces a considerable amount of false positives, particularly in datasets with cloud and haze cover such as most Landsat imagery in the tropics. It also classifies areas such as the low pole forest as being degraded since the sparser canopy cover in low pole forest causes the pixels' signature to be significantly affected by the bare substrate visible through the canopy, therefore causing it to be incorrectly classified as degraded. Per the SMA algorithm results the intensive illegal logging activities primarily occurred in the western part of Katingan, which was subsequently also confirmed by the PRA survey results (see below). To remove the false positives and prevent an overly conservative stratification, high-resolution data from Google earth was reviewed. GoogleEarthPro has high resolution imagery from 15/08/2011 and 024/09/2014 available for the Western part of Katingan. Any areas with visible degradation in these images were digitised and used to mask the SMA results which were then filtered with a 3*3 majority filter per the GOFC GOLD standard recommendations. Since no high resolution data was available for 2015 or 2016, field staff's knowledge and a conservative, inclusive approach was taken during the final filtering of false positives. This process is considered to be highly conservative as it identified a separate degradation strata while a significant portion of this strata would have otherwise still been classified as forest per the standard forest and non-forest stratification used in the project description stratification. The areas comprised 406.76 ha and were placed in a strata of 'intensive degradation' ($A_{DegW,intens}$).

In these areas identified as 'intensive degradation' ($A_{DegW,intens}$) a field survey conducted stump sampling at 12 randomly selected plots within the strata in February 2016. Each plot measured 20 m x 20 m (0.04 ha) and surveys recorded the size and age of all stumps present in each plot (Figure 16; see below for further details).

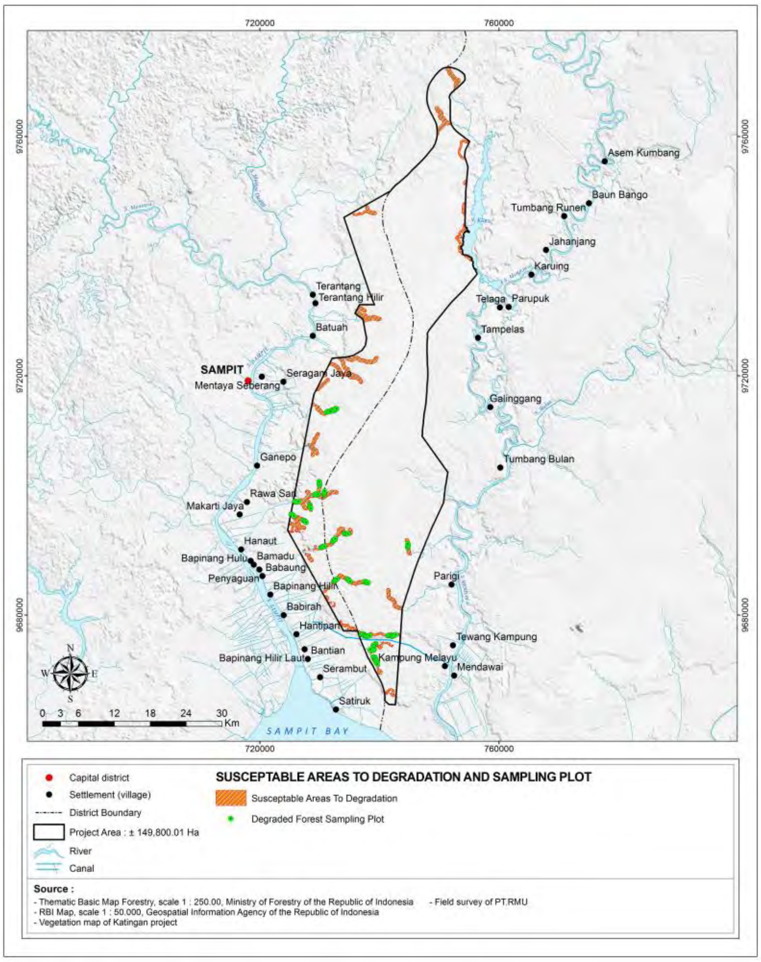
Figure 16. Map of intensive degradation in project area and field sampling plots



To assess loss in areas identified as ‘susceptible to degradation’ ($A_{DegW,susc}$) the project first conducted a Participatory Rural Appraisal (PRA) in October 2015 to obtain information on the characteristics of forest degradation in the wider project area (see Section 5.1.3.4). During the PRA the project team interviewed 103 respondents from fourteen villages surrounding project area; all either known or suspected to have been involved in illegal logging activities during the period Nov-2010-2015. This survey was not intended to be a complete survey of all people engaged in such activities, rather to be a representative sample from which general characteristics of illegal logging activities could be ascertained, particularly regarding access and penetration. Results of the survey confirmed that illegal logging had been conducted in the project area since the 90’s and was still ongoing (although several interviewees indicated that illegal logging had declined since the Katingan Project’s initiation). Respondents were questioned as to the typical penetration distance travelled from major access points (boat accessible rivers or forest-non-forest boundaries). Responses showed a wide range of values (50m to 6,000m) but were heavily skewed to lower distances, significantly non-normally distributed, and included several extreme outliers, suggesting some confusion over the question (data provided by 75 respondents; Kolmogorov-Smirnov Test: $D_{75} = 0.253$; $p<0.000$). Due to this distribution, the median value of 300m was taken as a more representative value of central tendency that the mean (656m) and so following the module M-MON was used to create a buffer around all major access points identified by the PRA (boat-accessible rivers and canals, and forest-non-forest boundaries). This process determined that an area of 7874.14 ha was ‘susceptible to degradation’ ($A_{DegW,susc}$; Figure 17).

Field surveys were then conducted within the susceptible area between March-April 2016, by randomly selecting 19 points along access points within the strata and then conducting surveys at 10 plots of 300 m x 50 m within 225-475 m of the random point (see Figure 16). Plots were arranged no closer than 100 m from each other and distributed with the long-side running perpendicular to the access point (river, canal or edge). This approach provided a total of 190 plots covering a total sampled area of 285 Ha, exceeding the minimum 3% (236 ha) sampling of $A_{DegW,susc}$ as mandated by M-MON. Further detail of this plot design is available in the corresponding Standard Operating Procedure (SOP). As with the survey of the intensive degradation areas (described above) the size and age of all stumps present in each plot was recorded. In both surveys the age of stumps (year felled) was estimated based on information provided by ex-illegal loggers that accompanied the survey teams, combined with an assessment of the physical condition of stumps (to visually assess their age) and a machete test (to physically test the age of stumps).

Figure 17. Map of susceptible areas to forest degradation in project area and sampling plots



The total number of stumps detected in each age class, in each survey, is shown below in Table 51. By extrapolating the sampled data, the total number of trees logged in both intensive degradation areas and susceptible areas to degradation was estimated to be 346,374, of which 142,829 were logged prior to the start of the project, and 203,545 logged within this monitoring report. Year 2014 (Nov-2013-Oct-2014) recorded the highest loss, with 62,268 trees estimated to have been logged, while 2012 recorded the lowest, with 28,265 trees estimated to have been lost.

Table 51. Stump count and tree loss data based on degradation strata

Year	**Intensive Area**		**Susceptible Area to degradation**		**Total**
	Total Count	Average / Ha	Total Count	Average / Ha	
Pre-project (to Oct 2010)	9,604		133,225		142,829
Sub-total – Pre-Project	**9,604**		**133,225**		142,829
2011	3,390	8.3	24,875	3.2	28,265
2012	16,101	39.6	14,178	1.8	30,279
2013	29,942	73.6	13,718	1.7	43,660
2014	15,254	37.5	47,015	6.0	62,268
2015	1,977	4.9	37,096	4.7	39,073
Sub-total – Monitoring Period	**66,663**	**163.9***	**136,881**	**17.4***	203,545
Total	**76,268**		**270,106**		**346,374**

*Average/Ha over 5-year monitoring period

For both surveys, tree biomass loss was estimated from the stump data by using allometric equations specifically developed for mixed Peat Swamp Forest species using DBH as parameter (Manuri et.al, 2015). This is the same equation applied for biomass estimation under baseline scenario and provided an estimate of the average biomass carbon of trees cut and removed due to illegal logging in degraded forest ($C_{DegW,i,t}$). To meet conservative principles, the stump diameter was assumed to be the same as the DBH, as suggested by M-MON.

Net carbon stock change as result from forest degradation ($\Delta C_{P,DegW,i,t}$) was then calculated by extrapolating the sampled loss by strata to all areas potentially subjected to degradation in each strata respectively and then summing the values.

$$\Delta C_{P,DegW,i,t} = A_{DegW,i} * C_{DegW,i,t}$$

Where:

$\Delta C_{P,DegW,i,t}$ = Net carbon stock change as a result of forest degradation in the project area at time t; tCO2-e

$A_{DegW,i}$ = Area of recorded forest degradation in stratum i; ha

$C_{DegW,i,t}$ = Biomass carbon of trees cut and removed through degradation; tCO_2-e ha^{-1}

By applying the above equation to each strata, net carbon stock change as a result of illegal logging in intensive degraded areas ($\Delta C_{P,DegW,intens,t}$) within the reporting period was determined to be **40,059.41** tCO_2-e, while in the areas susceptible to degradation, the net carbon stock change as a result of illegal logging ($\Delta C_{P,DegW,susc,t}$) within the monitoring period was determined to be **87,097.33** tCO_2-e. Combining both provides an estimate of the total emission from forest degradation in the project area within monitoring period ($\Delta CP_{DegW,i,t}$), estimated to be **127,156.74** tCO_2-e (Table 52).

Table 52. Emission from forest degradation in project area within the current monitoring period

Year	Intensive areas			Susceptible areas			Total
	$A_{DegW,i}$	$C_{DegW,i,t}$	$\Delta CP_{DegW,intens,t}$	$A_{DegW,i}$	$C_{DegW,i,t}$	$\Delta CP_{DegW,susc,t}$	$\Delta CP_{DegW,i,t}$
2011	406.76	0.77	1,141.37	7874.14	0.64	18,491.04	19,632.41
2012	406.76	6.78	10,116.17	7874.14	0.59	17,058.23	27,174.40
2013	406.76	13.25	19,760.02	7874.14	0.46	13,300.63	33,060.66
2014	406.76	5.45	8,126.63	7874.14	0.81	23,419.01	31,545.63
2015	406.76	0.61	915.22	7874.14	0.51	14,828.42	15,743.64
Total			**40,059.41**			**87,097.33**	**127,156.74**

6.2.2.3 Emissions from uncontrolled biomass burning

Landsat imagery and NASA Fire Information for Resource Management System (FIRMS) hotspot data were used to monitor uncontrolled biomass burning in the project area during the monitoring period (see Section 5.1.3.4 for more detail). This process identified uncontrolled biomass burning occurred in 2011, 2012, 2014, and 2015 within project area (Figure 18 - 21). The total burnt area was 11,061.09 ha of which 8,598.87 ha (77.7%) was forest and 2,462.21 ha (22.3%) was non-forest. No fire incidents were detected in 2013. Table 53 summarizes the annual uncontrolled biomass burning during the monitoring period.

Table 53. Annual uncontrolled biomass burning the monitoring period

Year	Areas burnt (Ha)	
	Forest	Non Forest
2011	13.41	487.66
2012	0.22	345.36
2013	-	-
2014	403.17	930.75
2015	8,368.93	1,326.25
Total	**8,785.73**	**3,090.02**

Figure 18. Uncontrolled burning occurred in 2011

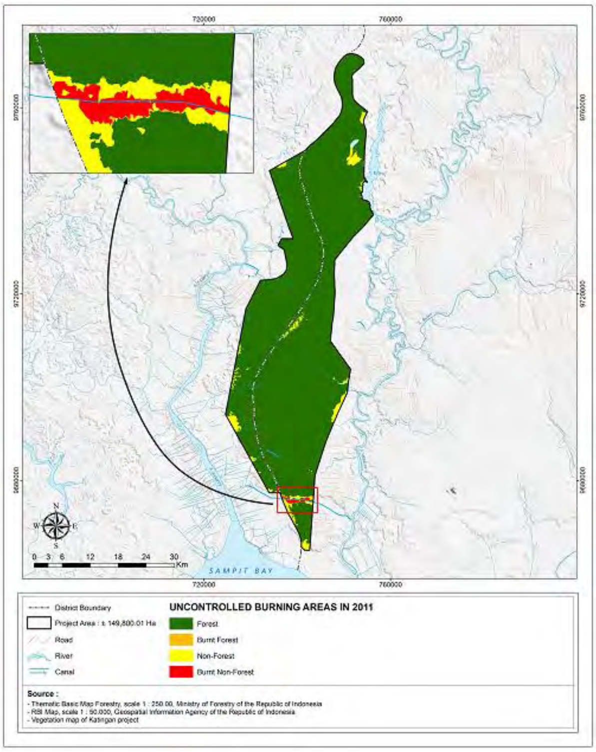


Figure 19. Uncontrolled burning occurred in 2012

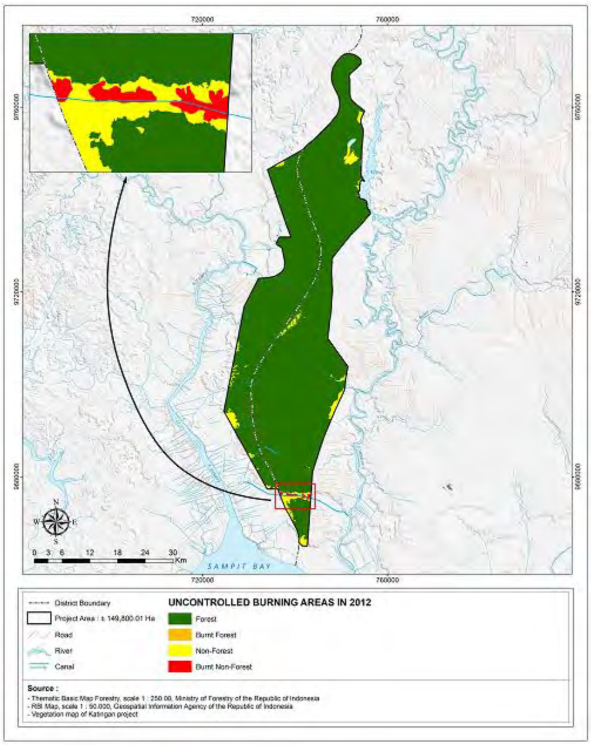


Figure 20. Uncontrolled burning occurred in 2014

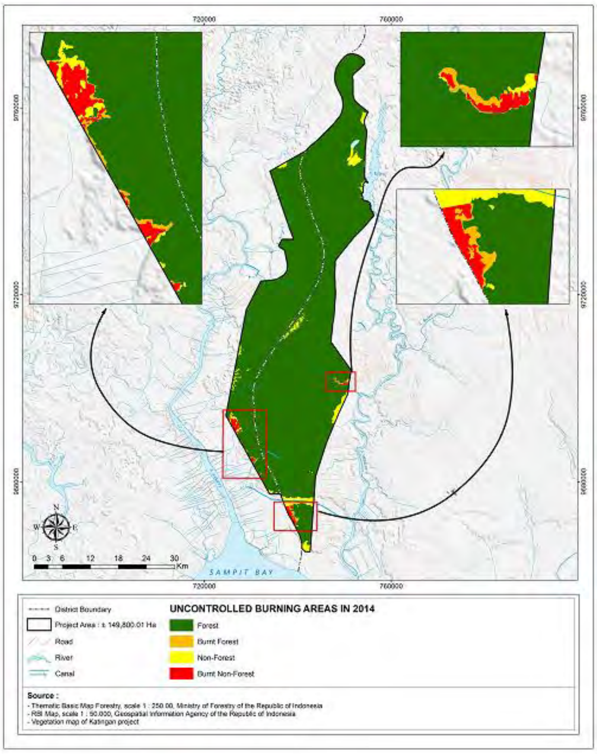
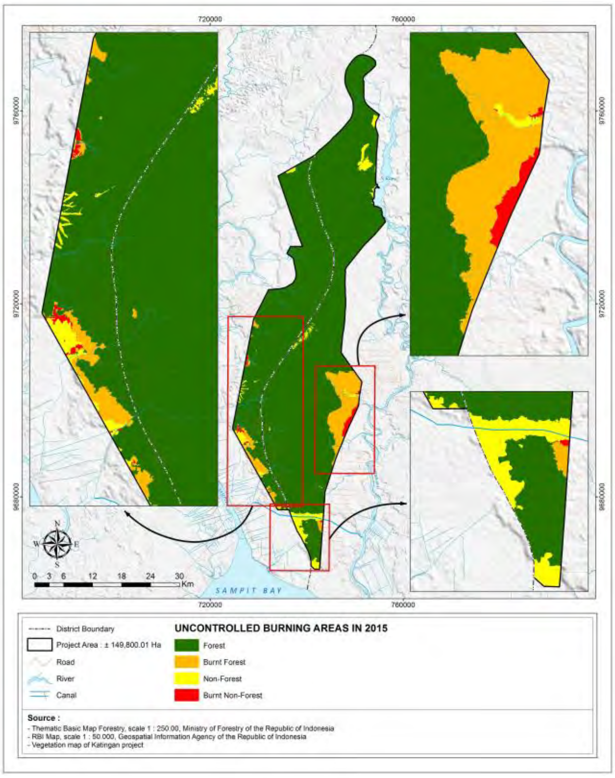


Figure 21. Uncontrolled burning occurred in 2015



As described in Section 5.1.3.4 a drone survey was conducted to investigate the condition of forest in the area affected by fires in 2015. This led to the conclusion shown in Table 54 below (see Section 5.1.3.4 for a detailed description of the approach adopted and used).

Table 54. UAV imagery stratification results

	Live standing %	Dead standing %	Fallen %
Average	11.44	33.00	55.55
Standard Error	2.21	4.12	5.39

An accuracy assessment was run on all 40 images used to determine the percentage of live standing, dead standing and fallen trees. Given there doesn't exist any higher resolution data and it wasn't feasible to ground truth each point, the unprocessed imagery was used to test the ISOCLASS unsupervised classification algorithm's ability to distinguish live vegetation from dead vegetation as well as to check the user accuracy in detecting fallen and standing trees. Given the exceptionally high resolution of the data it was easy for both the algorithm as well as the remote sensing analysts to visually detect each of the three strata. After conducting the accuracy assessment on each image, the average accuracy was calculated to be 94.38%, well above the required 90%.

- Characteristic of biomass burnt in Forest

  Based on observations by the field team (See Figure 22) the 2015 fire events caused the non-tree vegetation to combust but only killed, rather than combusted, affected trees (which either fell, or remained standing). The survey also observed that a significant amount of trees were still alive, as indicated by the condition of the cambium (through a slash test) and/or re-sprouting from the stem.

This was confirmed from the high resolution drone data, in which fallen and standing dead trees were observed, but not fully combusted trees. Based on this finding, the emission calculations for burnt biomass in 2015 combined two approaches as follow:

– Tree biomass

Since the team's observations determined the tree biomass didn't combust and the emissions of the trees' combustion would be significantly less than the emissions from its decomposition, the emissions were conservatively calculated by assuming the affected tree biomass in 2015 would decompose. Emission from dead wood decomposition were calculated using the following equation:

$$C_{DW_{decay,t}} = \left(EXP\left(-(t-1) \times k_{decay}\right) \times C_{DW,t0}\right) - \left(EXP\left(-t \times k_{decay}\right) \times C_{DW,t0}\right)$$

Where:

$C_{DW_{decay},t}$	=	Annual carbon leaving the deadwood pool due to the decay in year t (tCO_2)
$C_{DW,t0}$	=	Carbon input to the deadwood pool before burnt (t0)
k_{decay}	=	Rate of decay of the deadwood pool

– Non-Tree biomass

Based on field observations it was assumed all non-tree biomass combusted and therefore instantaneously released CO_2. Based on this, E-BPB is applied using the following equation:

$$E_{biomassburn,i,t} = \sum_{g=1}^{G} \left(\left(\left(A_{burn,i,t} \times B_{i,t} \times COMF_t \times G_{g,i} \right) \times 10^{-3} \right) \times GWP_g \right)$$

Where:

$E_{biomassburn,i,t}$	=	Greenhouse gas emissions due to biomass burning in stratum i in year t of each GHG (CO_2, CH_4, N_2O) (t CO_2e)
$A_{burn,i,t}$	=	Area burnt for stratum i in year t (ha)
$B_{i,t}$	=	Average aboveground biomass stock before burning stratum i, year (t d.m. ha^{-1})
$COMF_t$	=	Combustion factor for stratum i (unit less)
$G_{g,i}$	=	Emission factor for stratum i for gas g (kg t^{-1} d.m. burnt)
GWP_g	=	Global warming potential for gas g (t CO_2/t gas g)
g	=	1, 2, 3 ... G greenhouse gases including carbon dioxide[1], methane and nitrous oxide (unitless)
i	=	1, 2, 3 …M strata (unitless)
t	=	1, 2, 3, … t* time elapsed since the start of the project activity (years)

Total greenhouse gas emission resulting from uncontrolled burning in Forest ($E_{FBiomassburn,i,t}$) in 2015 was calculated as the sum up of carbon leaving the deadwood pool due to the decay ($C_{DWDecay,t}$) and Greenhouse gas emissions due to biomass burning ($E_{biomassburn,i,t}$)

Figure 22. Example of typical fire affected areas in 2015, showing most of tree biomass has not combusted.

- Characteristic of biomass burnt in Non-Forest areas

  The drone survey and field observation found most vegetation (mostly dominated by ferns) was combusted. Therefore in the emission calculation it was conservatively assumed all non-tree biomass combusted (E-BPB equation).

In regard to the uncontrolled burning that occurred in 2011, 2012, and 2014, as no data was available to determine whether tree biomass was killed or combusted, it was assumed that it was combusted. Accordingly, in those years emissions were calculated using the E-BPB equation. In this calculation, combustion factors (COMF) are used; 0.95 for Non-Forest and 0.5 for Forest (Table 3A.1.12, IPCC, 2006).

By applying an instantaneous combustion scenario in 2011, 2012 and 2014, and a mixed decomposition/combustion scenario for 2015 (as explained above), total greenhouse gas emissions due to uncontrolled biomass burning within the monitoring period in project area were estimated to be 140,979.08 tCO_2-e, as summarized in Table 55 below.

Table 55. Greenhouse gas emission resulted from uncontrolled burning in the project area

Year	Areas burnt (Ha)		Emission from Forest burnt (tCO_2-e)				Emission from Non-forest burnt (tCO_2-e)	Total Annual Emission (tCO_2-e)
	Forest	Non Forest	DW Decom-position	Non tree biomass burnt	Forest burnt	Total		
2011	13.41	487.66	N/A	N/A	2,559.16	2,559.16	6,523.39	9,082.55
2012	0.22	345.36	N/A	N/A	41.05	41.05	4,619.87	4,660.92
2013	0	0	N/A	N/A	0	0.00	0	0.00
2014	403.17	930.75	N/A	N/A	76,939.74	76,939.74	12,450.58	89,390.32
2015	8,368.93	1,326.25	0	23,900.50	N/A	23,900.50	17,741.19	41,641.69
Total	8,785.73*	3,090.02*	0	23,900.50	79,539.95	103,440.45	41,335.03	144,775.48

*Based on total cumulative area burnt (including areas that were burnt repeatedly).

6.2.3 Project emissions from ARR activities

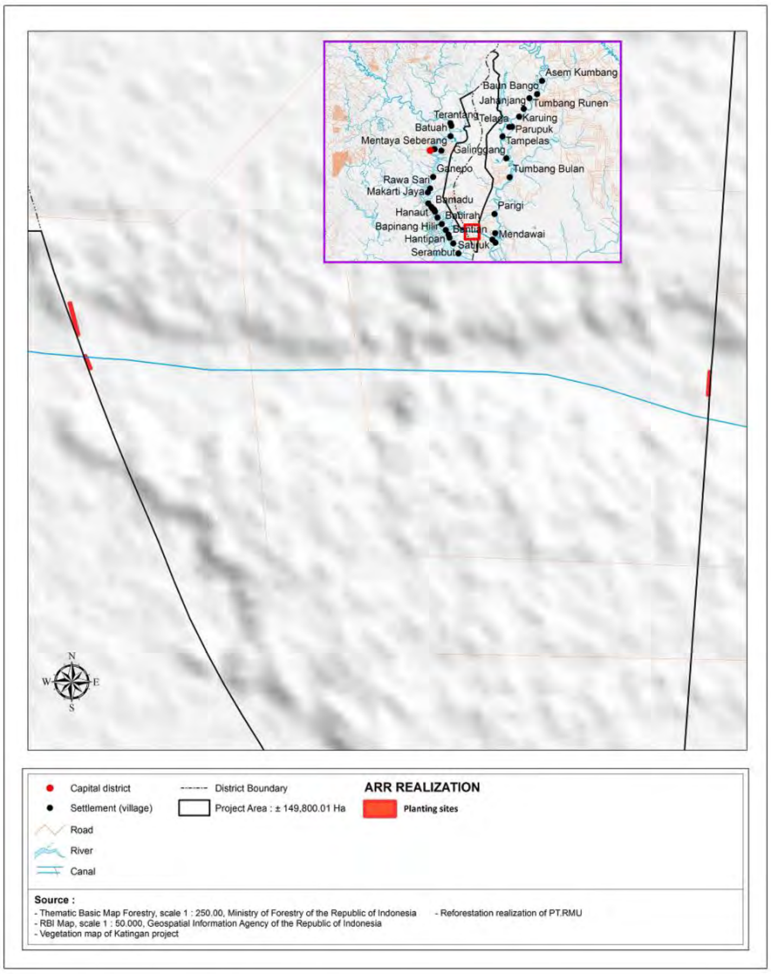
ARR project activities were initiated by planting indigenous pioneer species in areas designated as fire break plantations. The planting was carried out in August 2015 when 600 saplings were planted in an area of 1.23 Ha. Table 56 and Figure 23 below describes ARR planting implementation in this reporting period.

Table 56. Planting realization in ARR project

Planting site	n saplings	Area (Ha)	Species
Fire break plantation, West-North	272	0.54	*Shorea belangeran, Combretocarpus rotundatus, Alstonia spp, Melaleuca cajuputi*
Fire break plantation, West-South	128	0.29	
Fire break plantation, East – North*	200	0.40	
Total	600	1.23	

*All saplings planted were affected by 2015 fire incident

Figure 23. ARR Planting realization within monitoring report period.



GHG removal from ARR is not reported and claimed in this reporting period. Biomass growth and GHG removal will be monitored and claimed in the next reporting period.

6.2.4 Carbon enhancement from forest growth

Forest that are saved from conversion to plantations have significant potential for regrowth and hence are expected to accumulate biomass, removing CO_2 from the atmosphere in the process. However in this reporting period, carbon enhancement is not monitored as the carbon plots were not measured. The carbon stock of unchanged strata were therefore conservatively assumed to have remained constant during the monitoring period. As scheduled, it will be monitored and claimed in the next reporting period.

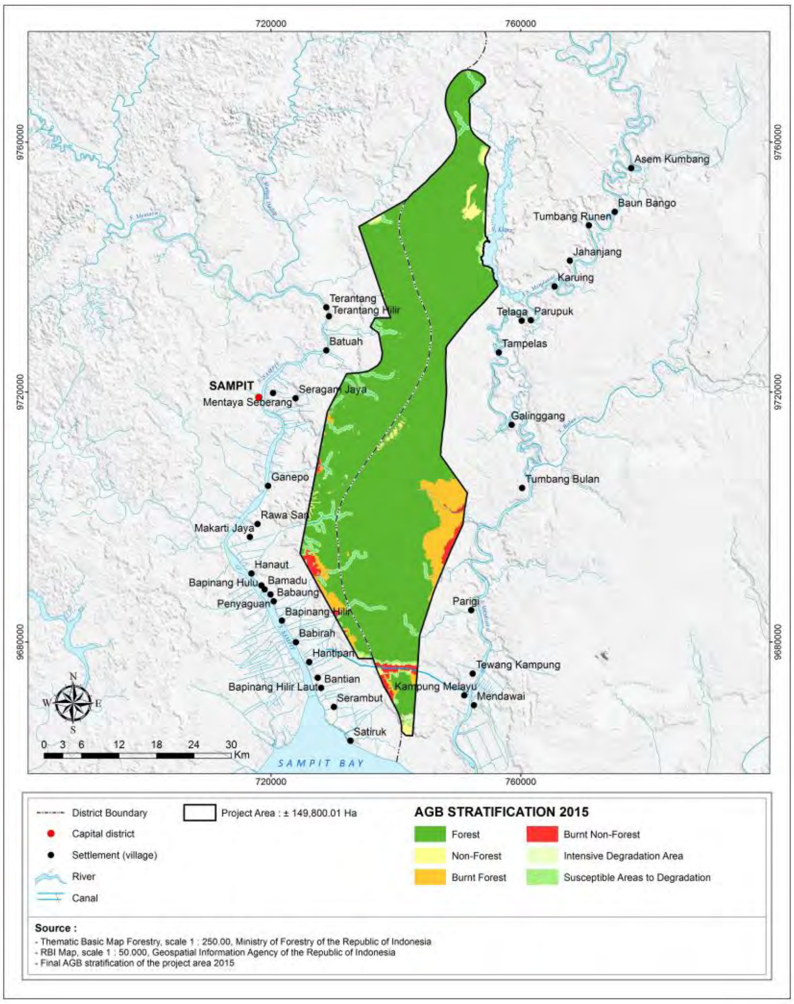
6.2.5 Summary of stratification changes

Due to the uncontrolled burning and illegal logging activities witnessed during the monitoring period, and described in the previous sections, the project description stratification was updated to include four newly created strata, namely burnt forest, burnt non-forest, intensive degradation areas and areas susceptible to degradation (see Table 57 and Figure 24).

Table 57. 2015 Stratification classes and areas

2015 Stratification classes	Area (ha)
Forest	127,905.64
Non-Forest	2,552.38
Burnt Forest	8,598.88
Burnt Non-Forest	2,462.21
Intensive Degradation Area	406.76
Susceptible Areas to Degradation	7,874.14
Total	149,800.01

Figure 24. Updated stratification at end of monitoring period (Nov 2015)



6.2.6 Project emissions from peat and water body

Relevant stratification for WRC activities is given in PDD. The strata that are distinguished in the project scenario for the purposes of the calculation of emissions from peat and water bodies are as follows:

- Drained forested peatland (P1L1D1)
- Undrained forested peatland (P1L1D0)
- Drained non-forested peatland (P1L0D1)
- Undrained non-forested peatland, and (P1L0D0)
- Water bodies

As described in Section 5.1.3.1 and in relevant sections above, remote sensing analysis and ground surveys were used to quantify the area of each of these strata during the current monitoring period, as shown in Table 58 below.

Table 58. Stratification of the project area based on peat and water body emission characteristics

Year	P1L0D0	P1L1D0	P1L0D1	P1L1D1	WB	Total
2011	3,546.62	141,511.62	980.43	382.28	218.41	146,639.36
2012	3,546.62	141,511.62	980.65	382.06	218.41	146,639.36

2013	3,546.62	141,511.62	980.65	382.06	218.41	146,639.36
2014	3,883.44	141,174.80	980.67	382.04	218.41	146,639.36
2015	11,509.59	133,548.66	1,032.24	330.47	218.41	146,639.36

Quantification of GHG emissions from peat and water bodies are made up of three elements: microbial decomposition of peat, dissolved organic content (DOC) loss via water bodies, and emissions from peat burning. These emission sources are then combined to produce an overall estimate of emissions using the procedures provided in VCS methodology VM0007, modules BL-PEAT and M-PEAT (equation 34):

$$GHG_{WPS\text{-}WRC} = \sum_{t=1}^{t^*} \sum_{i=1}^{M} (E_{peatsoil\text{-}WPS,i,t} + E_{peatditch\text{-}WPS,i,t} + E_{peatburn\text{-}WPS,i,t}) \quad (34)$$

Where:

$GHG_{WPS\text{-}WRC}$ Net CO_2 equivalent peat GHG emissions in the project scenario up to year t* (t CO_2e)

$E_{peatsoil\text{-}WPS,i,t}$ GHG emissions from microbial decomposition of the peat soil within the project boundary in the project scenario in stratum i in year t (t CO_2e yr^{-1})

$E_{peatditch\text{-}WPS,i,t}$ GHG emissions from water bodies within the project boundary in the project scenario in stratum i in year t (t CO_2e yr^{-1})

$E_{peatburn\text{-}WPS,i,t}$ GHG emissions from burning of peat within the project boundary in the project scenario in stratum i in year t (t CO_2e yr^{-1})). In this project this term equals zero.

i 1, 2, 3 …M strata in the project scenario (unitless)

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

Methods for estimating carbon stock, subsidence, and peat thickness dynamics are described in PDD (Section 6.2.6). Emissions are conservatively assumed to cease when peat has been depleted to a depth of 20cm or less. However, as no area of the project has been depleted to this extent (See Appendix 4 [Climate MRV]) no corresponding adjustment of the emissions calculations is applied in this monitoring period.

6.2.6.1 Emissions from microbial decomposition of peat

For each land stratum, GHG emissions from microbial decomposition of peat soil was calculated using equation 35:

$$E_{peatsoil\text{-}WPS,i,t} = E_{proxy\text{-}WPS,i,t} \quad (35)$$

Where:

$E_{peatsoil\text{-}WPS,i,t}$ Greenhouse gas emissions from the peat soil within the project boundary in the project scenario in stratum i in year t (t CO_2e yr^{-1})

$E_{proxy\text{-}WPS,i,t}$ GHG emissions as per the chosen proxy in the project scenario in stratum i in year t, in this project, based on IPCC default values (t CO_2e yr^{-1})

i 1, 2, 3 …M_{WPS} strata in the project scenario (unitless)

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

While $E_{proxy\text{-}WPS,i,t}$ in the was estimated using equation 36:

$$E_{proxy\text{-}WPS,i,t} = A_i \times (E_{proxy\text{-}CO2,i,t} + E_{proxy\text{-}CH4,i,t}) \quad (36)$$

Where:

$E_{proxy-WPS,i,t}$	GHG emissions as per the chosen proxy in the project scenario in stratum i in year t (t CO_2e yr^{-1})
A_i	Total area of stratum I (ha)
$E_{proxy-CO2,i,t}$	Emission of CO_2 as per the chosen proxy in stratum i in year t, for TIER 1 approach this equals default CO_2 emission factor for stratum i (t CO_2e $ha^{-1}yr^{-1}$)
$E_{proxy-CH4,i,t}$	Emission of CH_4 as per the chosen proxy in stratum i in year t, for TIER 1 approach this equals default CH_4 emission factor for stratum i (t CO_2e $ha^{-1}yr^{-1}$)
i	1, 2, 3 …M_{WPS} strata[14] in the project scenario (unitless)
t	1, 2, 3, … t* time elapsed since the project start (years)

For the current monitoring period sufficient long-term, site-specific direct measurements of peat related emissions are not yet available, therefore GHG emission factors provided in the PDD were used as a conservative and scientifically robust alternative (TIER 1 IPCC default emission factors). Procedures followed the VCS methodology VM0007 modules BL-PEAT and M-PEAT based on annual strata area (Table 58, above), resulting in estimated annual GHG emissions from microbial decomposition of peat as presented below in Table 59.

[14] Note that different water table classes result in different strata.

Table 59. GHG emissions from microbial decomposition of peat by strata and by year during the current monitoring period, in tCO_2-e.y^{-1}.

Year	P1L1D0		P1L1D1		P1L0D0		P1L0D1		Total	
	CO_2	CH_4	CO_2	CH_4	CO_2	CH_4	CO_2	CH_4	CO_2	CH_4
2011	0.00	101,888.37	7,427.65	53.52	5,319.93	709.32	19,049.79	137.26	31,797.37	102,788.47
2012	0.00	101,888.37	7,423.47	53.49	5,319.93	709.32	19,053.97	137.29	31,797.37	102,788.47
2013	0.00	101,888.37	7,423.47	53.49	5,319.93	709.32	19,053.97	137.29	31,797.37	102,788.47
2014	0.00	101,645.86	7,422.95	53.48	5,825.17	776.69	19,054.49	137.29	32,302.61	102,613.33
2015	0.00	95,155.04	6,421.02	46.27	17,264.38	2,301.92	20,056.42	144.51	43,741.82	98,647.73
Total	0.00	503,466.00	36,118.57	260.25	39,049.34	5,206.58	96,268.64	693.65	171,436.55	509,626.48

6.2.6.2 Emissions from water bodies in peatlands

The water body stratum includes rivers and canals. During the current monitoring period no changes were detected in the extent of rivers and canals (Table 58, see also Section 5.1.3.3). Double accounting of water born losses was avoided by using DOC value only (TIER 1 IPCC values) as given in PDD.

GHG emissions through loss of dissolved organic content (DOC) via water bodies was calculated following procedures set out in the VCS methodology VM0007 module M-PEAT for each water body stratum, using the equation 37, resulting in the estimated annual GHG emissions presented below in Table 60.

$$E_{peatditch\text{-}WPS,i,t} = A_{ditch\text{-}WPS,i,t} \times EF_{DOC\text{-}WPS} \quad (37)$$

Where:

$E_{peatditch\text{-}WPS,i,t}$ GHG emissions from canals and other open water stratum i in year t in the project scenario (t CO_2e yr^{-1})

$A_{ditch\text{-}WPS,,i,,t}$ Total area of canal and other open water stratum i in year t in the project scenario (ha)

$EF_{DOC\text{-}WPS}$ IPCC emission factor of Dissolved Organic Carbon from canal and open in the project scenario (t CO_2e $ha^{-1}yr^{-1}$)

i 1, 2, 3 …M_{WPS} strata[15] in the project scenario (unitless)

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

Table 60. GHG emissions from Dissolved Organic Carbon in water bodies in the project scenario in tCO_2-e.y^{-1}.

Year	CO_2 from DOC
2011	456.47
2012	456.47
2013	456.47
2014	456.47
2015	456.47

6.2.6.3 Emissions from uncontrolled burning

Fire events were monitored and assessed as described in detail in Section 5.1.3.4. Emissions resulting from fire events were conservatively estimated using IPCC default burn scar depths based on number of previous incidents of burning (1st, 2nd or 3rd event, etc.), bulk density estimates, combustion factors and GHG potential. Further detail of each parameter used is provide in the PDD.

Table 61. Area of uncontrolled burning of peat in the project area for 2011 – 2015 monitoring period, in hectares

Year	1st Fire	2nd Fire	≥3rd Fire	Total
2011	13.41	-	487.66	501.07
2012	0.22	-	345.36	345.58
2013	-	-	-	-
2014	402.79	-	928.53	1,331.33
2015	7,832.30	189.28	1,023.04	9,044.63

15 Note that different proxy classes result in different strata.

Parameters were combined to estimate GHG emissions from peat burning following the VCS methodology VM 0007 module E-BPB, using equation 38.

$$E_{peatburn-WPS,i,t} = \sum_{g=1}^{G} \left(\left(\left(A_{peatburn-WPS,i,t} \times (P_{WPS,i,t} + B_{WPS,i,t}) \times G_{g,i} \right) \times 10^{-3} \right) \times GWP_g \right) \quad (38)$$

Where:

$E_{peatburn-WPS,i,t}$	Greenhouse emissions due to peat and biomass burning under project scenario in stratum i in year t of each GHG (CO_2, CH_4, N_2O) (t CO_2e)
$A_{peatburn-WPS,i,t}$	Area peat burnt under project scenario in stratum i in year t (ha)
$P_{WPS,i,t}$	Average mass of peat burnt under project scenario in stratum i, year t (t d.m. ha^{-1})
$B_{WPS,i,t}$	Average biomass burnt under project scenario in stratum i, year t (t d.m. ha^{-1})
$G_{g,i}$	Emission factor in stratum i for gas g (kg t^{-1} d.m. burnt)
GWP_g	Global warming potential for gas g (t CO_2/t g)
g	1, 2, 3 .. G greenhouse gases including carbon dioxide, methane and nitrous oxide (unitless)
i	1, 2, 3 …M strata (unitless)
t	1, 2, 3, … t time elapsed since the start of the project activity (year)

The average mass of peat burnt for a particular stratum is then estimated using the equation as follows:

$$P_{WPS,i,t} = D_{peatburn-WPS,i,t} \times BD_{upper} \times 10^{-4} \quad (39)$$

Where:

$P_{WPS,i,t}$	Average mass of peat burnt under project scenario in stratum i, year t (t d.m. ha^{-1})
$D_{peatburn-WPS,i,t}$	Average fire scar depth under project scenario in stratum i in year t (m)
$BD_{upper,i}$	Bulk density of the upper peat in stratum I (g cm^{-3})
i	1, 2, 3 …M strata
t	1, 2, 3, … t time elapsed since the start of the project activity (years)

In the case of the extensive 2015 fires, results obtained from the drone and ground survey were used to adjust the average burn scar depth to reflect the partially burned status of the affected area (see Section 5.1.3.4 for further details). Based on the significant relationship observed between tree status and peat burn status the default burn scar was adjusted based on the predicted percentage burn for that area based on the following formula:

$$EBSD_{TS} = BS\%_{TS} \times 18cm$$

Where:

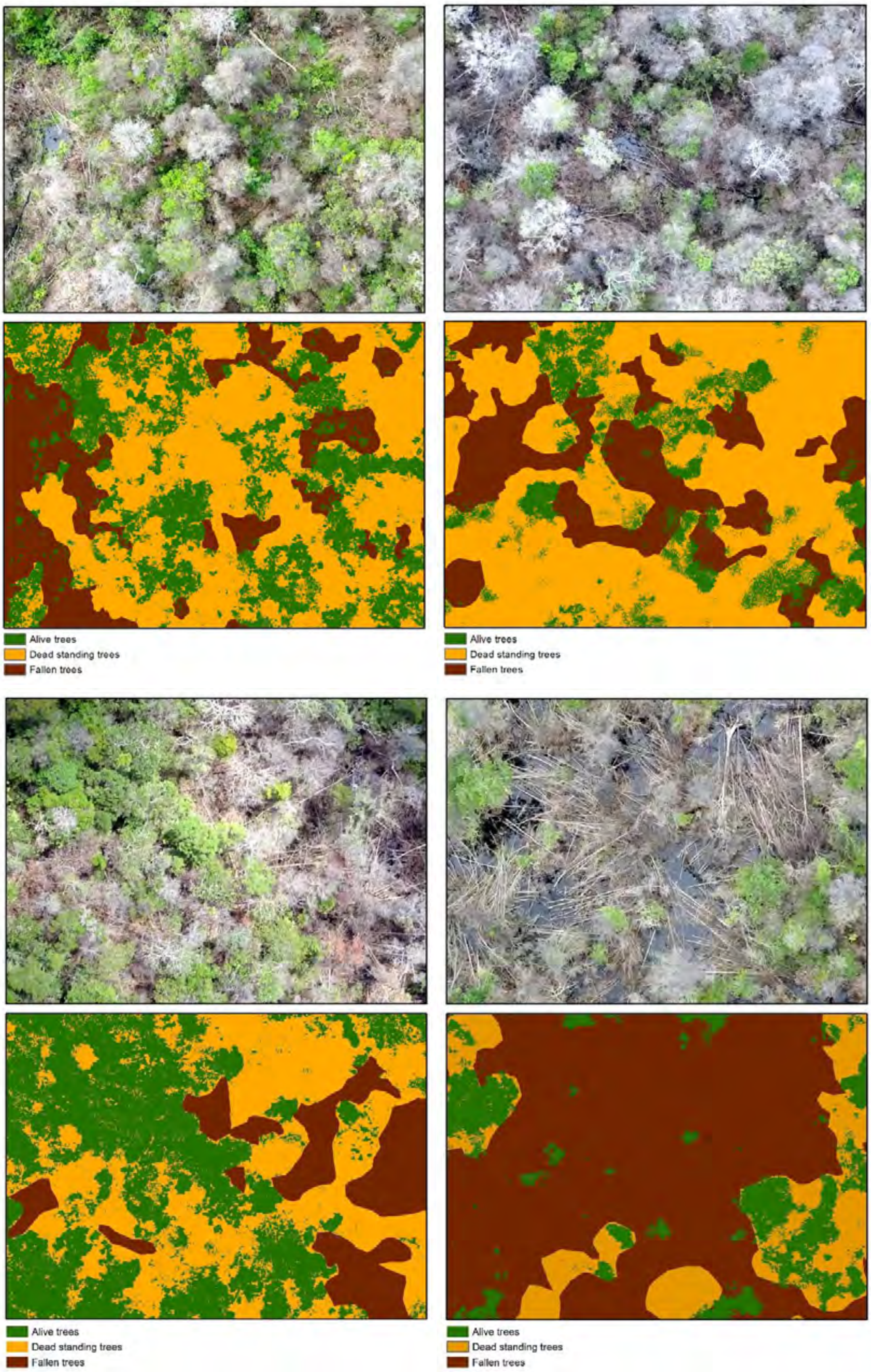
$EBSD_{TS}$	=	Equivalent burn scar depth by tree status
$BS\%_{TS}$	=	Percentage of peat burnt by tree status
18 cm	=	IPCC default value for burn scar depth of the first burning incident.

Observed results of the field and drone survey (see Figure 25) were then used in conjunction with the above equation to produce equivalent burn scar depths that were then used in the estimation of GHG emissions from uncontrolled burning of peat in 2015, shown in Table 62 below, and combining results presented previously in Section 5.1.3.4.

Table 62. Adjusted burn scar depths used in 2015 analysis.

Burning strata	Percentage of 2015 fire affected area (%)	Percentage of peat burnt (BS%)	Equivalent burn scar depth (EBSD; cm)
Fallen trees	55.6%	85.0%	15.30
Live-Standing trees	11.4%	9.5%	1.71
Dead-Standing trees	33.0%	56.6%	10.19

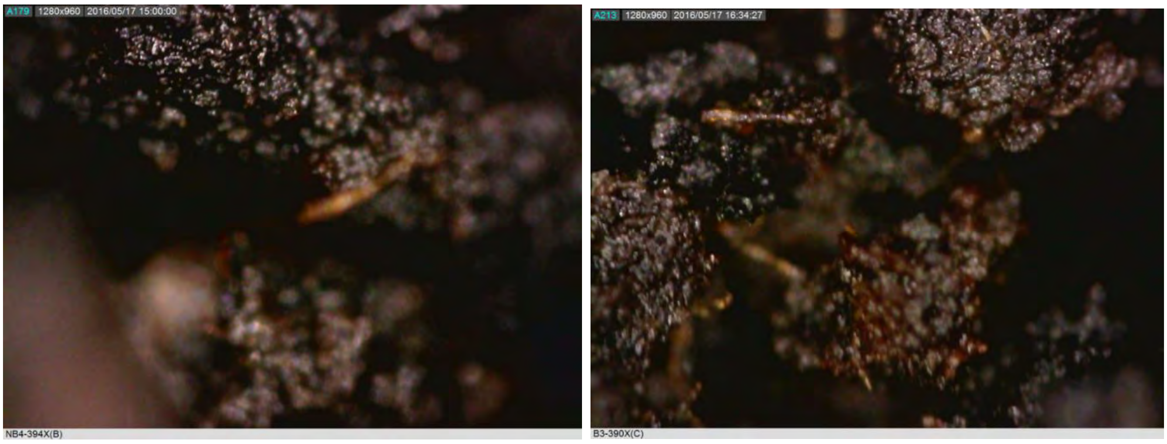
Figure 25. Raw UAV images and accompanying stratification for images DSC01876, DSC03747, DSC0647 and DSC4667



In those small non-forest areas of the project that were affected by a 3rd burn in 2015 field survey results indicated that only above ground vegetation (typically ferns) was burned. This was further evidenced by samples taken from representative burnt and unburnt areas in the same year, followed by microscopic imagery to investigate the presence of cinders, litters and roots (see Figure 26). No significant difference was found in the proportion of samples that contained litter and roots between burnt and unburnt areas (8 out 15 samples, and 9 out of 15 samples respectively: $Chi^2_1=0.136$, $P=0.713$) indicating the absence of peat burning, which otherwise would have been consumed by fires. Accordingly, third burn area in 2015 was assumed to have had no peat burnt.

For fire events in years prior to 2015, no equivalent field data was available to allow actual burn impact to be accurately measured, so to be conservative unadjusted IPCC burn scar depths corresponding to 1st, 2nd and 3rd burns of 18, 11 and 4cm were used respectively.

Figure 26. Microscopic images of samples taken from unburnt area (left) and burnt area (right) showing the presence of roots and litters in both samples



GHG emissions from uncontrolled burning, by year and by GHG, are summarised below in Table 63, and combined with emissions from other sources in Section 6.4.

Table 63. GHG emissions resulting from uncontrolled burning of peat soil in the project area in $tCO2e.ha^{-1}.yr^{-1}$

Year	1st Fire		2nd Fire		≥3rd Fire		Total	
	CO_2	CH_4	CO_2	CH_4	CO_2	CH_4	CO_2	CH_4
2011	4,843.6	583.7	-	-	39,141.5	4,716.8	43,985.1	5,300.5
2012	77.7	9.4	-	-	27,720.1	3,340.4	27,797.8	3,349.8
2013	-	-	-	-	-	-	-	-
2014	145,483.6	17,531.7	-	-	74,527.8	8,981.1	220,011.4	26,512.8
2015	1,895,178.6	228,381.0	41,780.1	5,034.8	-	-	1,936,958.7	233,415.8
Total	2,045,583.5	246,505.8	41,780.1	5,034.8	141,389.4	17,038.3	2,228,753.0	268,578.8

6.2.6.4 Summary of emissions from peat and water bodies

A summary of the GHG emissions from peat microbial decomposition, dissolved organic content via water bodies, and uncontrolled burning during the monitoring period are presented below.

Table 64. Summary of annual GHG emissions from peat and water bodies during the current monitoring period, in $tCO_2e.y^{-1}$.

Year	CO_2 from peat decomposition	CH_4 from peat decomposition	CO_2 from DOC	CO_2 from peat uncontrolled burning	CH_4 from peat uncontrolled burning	Total
2011	31,797.37	102,788.47	456.47	43,985.13	5,300.49	184,327.93
2012	31,797.37	102,788.47	456.47	27,797.75	3,349.80	166,189.86
2013	31,797.37	102,788.47	456.47	0	0	135,042.31
2014	32,302.61	102,613.33	456.47	220,011.42	26,512.77	381,896.60
2015	43,741.82	98,647.73	456.47	1,936,958.68	233,415.78	2,313,220.48

6.3 Leakage

Applicable leakage modules were determined according to requirements in the VCS methodology VM0007 REDD+ MF. As described in Section 4, the baseline activity is identified as planned deforestation and peatland drainage as a result of conversion to industrial acacia (pulp wood) plantations. The project is therefore categorized as a combination of Avoiding Planned Deforestation (APD) and Reforestation (ARR), in combination with Conservation of Undrained and Partially drained Peatland (CUPP) and Rewetting of Drained Peatland (RDP) activities. As a consequence, potential sources of leakage emissions stem from the displacement of planned deforestation activities and displacement of pre-project agricultural activities on non-forest land, and ecological leakage due to possible alterations of mean annual water table depth in adjacent areas. These potential sources are covered in the VCS Methodology VM0007 Modules **LK-ASP**, **LK-ARR**, and **LK-ECO** respectively, which are therefore identified as the applicable modules for the quantification of total leakage emissions (see Table 65).

Table 65. Applicability of leakage modules

Module	Applicability
Estimation of emissions from activity shifting for avoiding planned deforestation and planned degradation (**LK-ASP**)	**Applicable.** The project may cause activity shifting of avoided planned deforestation.
Estimation of emissions from activity shifting for avoiding unplanned deforestation (**LK-ASU**)	**Not applicable.** The project is not categorized as avoiding unplanned deforestation.
Estimation of emissions from displacement of fuelwood extraction (**LK-DFW**)	**Not applicable.** The project is not categorized as avoiding unsustainable fuelwood extraction.
Estimation of emissions from displacement of pre-project agricultural activities (**LK-ARR**)	**Applicable.** The project is categorized as afforestation, reforestation, and revegetation and may cause displacement of pre-project agricultural activities.
Estimation of emissions from market-effects (**LK-ME**)	**Not applicable.** The project does not reduce the production of timber, fuelwood, or charcoal.
Estimation of emissions from ecological leakage (**LK-ECO**)	**Applicable.** The project is categorized as WRC and may cause ecological leakage.

6.3.1 Estimation of emissions from activity shifting for avoiding planned deforestation and planned degradation

Activity shifting leakage was monitored against the leakage baseline defined in the PDD (Section 6). As per the methodology, and the steps defined in the PDD, 'area deforested by the baseline class of agents through the years in which planned deforestation was forecast to occur'($A_{defLK,i,t}$) was monitored and compared to the baseline leakage scenario (Step 3, as per Section 6 of the PDD), using the following method.

The most up-to-date data on active acacia (pulp wood) concessions in Indonesia, up to and including the current monitoring period, were obtained from Greenpeace since the official government data on such concessions is not publicly accessible (http://www.greenpeace.org/seasia/id/Global/seasia/Indonesia/Code/Forest-Map/en/data.html). The downloaded shapefile contains the spatial delineation of the concessions, the year each concession was granted, and the company that owns it (where known). In some cases the concession date is not listed, so these concessions were conservatively assumed to have been granted prior to 2010 (despite the fact that some may have been issued post-2010) so that any deforestation that occurred within them was included in the calculation of $NewR_{i,t}$. Prior to analysis, the concession data was reviewed to remove any listed areas that were not attributable to the baseline class of deforestation agent (acacia or other pulp wood plantations). This included the removal of a number of concessions (92) listed in the Greenpeace dataset as "candidate areas" ("Calon Areal") as such areas do not refer to active concessions. Similarly a number of concessions known to not to be associated with acacia or other pulp-wood plantations were removed: these included concessions known to be growing timber for plywood or biomass power generation as well as those growing non-timber crops such as rubber, oil palm, cloves or sagu. In total 166 such non-acacia plantations were removed, leaving a total of 557 known active acacia or other pulp wood plantations.

Annual area deforested throughout all concessions during the monitoring period was quantified by using satellite imagery. Due to the large area and time-period, the best and most accurate dataset available is the Global Forest Watch data (http://earthenginepartners.appspot.com/science-2013-global-forest/download_v1.2.html). The major drawback of this dataset is that it doesn't quantify deforestation specifically; rather it quantifies tree cover loss. This means that any tree cover loss attributed to harvesting operations within the plantation are also included in the tree cover loss data, therefore significantly inflating the forest cover loss results. Despite the considerable drawbacks of the data and its overly conservative nature, the data was extracted for all concessions to quantify the annual deforested area by the class of deforestation agent throughout the monitoring period. In future it may become possible to subtract forest gain data over the same periods to generate a net loss value more closely attributable to actual deforestation, however currently the GFW dataset only includes such data for 2000-2012, and warns against direct comparisons. During this period the same set of concessions gained 1,530,482 ha of tree cover, a large proportion of which will relate to the plantations themselves, and subsequently be lost in harvesting. An alternative approach might be to model harvesting losses based on a set of assumed parameters.

Areas of deforestation and leakage were determined using equation 40. The area of deforestation attributable to peatland and non-peatland plantations was allocated following the approach described in the PDD, Section 5.5.1, whereby deforestation was assumed to occur at an equivalent rate within plantations on peat and in non-peat areas so was proportionally allocated based on the corresponding areas (20.5% and 79.5% respectively, see PDD Section 5.5.1 for more details). At the time of writing data from GFW for the calendar year 2015 was unavailable, so provisionally 2015 was conservatively allocated a deforestation rate equivalent to the highest rate observed in the preceding four years (the rate recorded for 2012). Results are shown in Table 66:

$$LKA_{planned\,i,t} = A_{defLK,i,t} - NewR_{i,t} \tag{40}$$

Where:

$LKA_{planned,i,t}$	The area of activity shifting leakage in stratum i in year t (ha)
$NewR_{i,t}$	New calculated forest clearance by the baseline agent of the planned deforestation in stratum i in year t where no leakage is occurring (ha)
$A_{defLK,i,t}$	The total area of monitored deforestation by the baseline agent of the planned deforestation in stratum i in year t (ha)
i	1, 2, 3, … M strata (unitless)
t	1, 2, 3, … t^* time elapsed since the start of the project activity (years)

Table 66. Monitored area of deforestation by the class of agent of deforestation (Acacia/other-pulpwood plantations) during the monitoring period

	$A_{defLK,i,t}$		$NewR_{i,t}$		$LKA_{planned,i,t}$	
Year	Peatland	Non-Peatland	Peatland	Non-Peatland	Peatland*	Non-Peatland*
2011	59,311.46	230,212.33	84,897.33	329,521.67	-25,585.87	-99,309.34
2012	83,297.77	323,313.10	88,254.15	342,550.85	-4,956.38	-19,237.75
2013	39,157.94	151,988.15	90,569.26	351,536.74	-51,411.32	-199,548.59
2014	48,967.20	190,061.94	94,023.17	364,942.83	-45,055.97	-174,880.89
2015	83,297.77	323,313.10	97,255.64	377,489.36	-13,957.87	-54,176.26

Since this analysis confirmed there was no leakage throughout the monitoring period (all values of $LKA_{planned,i,t}$ in Table 66 are negative), Steps 4 through 7 as described in the project description were not required.

6.3.2 Estimation of emissions from displacement of pre-project agricultural activities (LK-ARR)

The VM0007 Module LK-ARR requires the use of the latest version of the CDM tool "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" [[24]]. Step 1 of the CDM tool requires that the area subject to pre-project agricultural activities that is expected to be afforested/reforested (therefore the activities having to be displaced) be identified.

The project area includes only comparatively small areas of non-forest land which will be reforested in the project scenario. The vast majority of these areas are not forested as a result of uncontrolled burning that occurred prior to the project's start. Only a small fraction of area (< 2 ha) has some existing planted rubber trees, however this will be fully incorporated within a larger (262 ha) area of community-managed rubber/jelutong agroforests which will border the Hantipan canal area. As a result, no pre-project agricultural activities will be displaced by ARR project activities, and hence leakage from the displacement of pre-project agricultural activities did not, and will not, occur (Change_C_LK-ARR = 0).

6.3.3 Estimation of emissions from ecological leakage (LK-ECO)

During this monitoring period, and as per the project's implementation plan the project did not initiate rewetting activities. Therefore ecological leakage (LK-ECO) is deemed zero.

6.4 Summary of GHG Emission Reductions and Removals

Net GHG emission reductions from REDD, WRC, and ARR activities are calculated using equation (54). This section provides an overview of total net emission reductions and details activity specific calculations in sub-sections.

$$NER_{REDD+} = NER_{REDD} + NGR_{ARR} + NER_{WRC} \quad (54)$$

Where:

NER_{REDD}	Total net GHG emission reductions of the REDD project activity up to year t*; t CO_2-e
NGR_{ARR}	Total net GHG removals of the ARR project activity up to year t*; t CO_2-e
NER_{WRC}	Total net GHG emission reductions of the WRC project activity up to year t*; t CO_2-e

6.4.1 Uncertainty Analysis

Per module X-UNC, uncertainties were calculated for the project's REDD and WRC components in both the project and baseline scenarios.

6.4.1.1 REDD Uncertainty

The REDD baseline uncertainty remained unchanged and was calculated per the methods described in the project description. Per the calculations the REDD baseline uncertainty was determined to be 10.61%. For the REDD project uncertainty, the uncertainty for each strata caused by degradation and other loss events in the project were calculated per the methods outlined in module X-UNC and was calculated to be 28.3%.

6.4.1.2 WRC Uncertainty

The WRC baseline uncertainty remained unchanged and was calculated per the methods outlined in the project description. For the WRC project uncertainty the proxyCO_2, proxy CH_4 and peatditchCO_2 uncertainties were also calculated using the same assumptions used in the methods outlined in the project description using the updated areas for the respective strata. The peatburn uncertainty needed a more elaborate calculation method due to the significant fire event in 2015 and the methods used to quantify its peat emissions.

The peat burn uncertainty was calculated using the following methods:

For the 1st fire-occurrence in 2015, where the default burn scar depth values were adjusted based on the percentage of burn areas and their associated tree status (fallen, dead-standing, and live-standing), the Standard Error of the adjusted burn scar depths were assumed proportional to the Standard Error of the percentage of the burn scar area

$$SE_{BSD\text{-}A,i,t} = \frac{SE_{BSA,i,t}}{100} \times BS_D$$

Where:

$SE_{BSD\text{-}A,i,t}$: Standard Error of the adjusted burn scar depth of stratum i year t (m)
$SE_{BSA,i,t}$: Standard Error of the burn scar area of stratum i year t (%)
BS_D : Default burn scar depth (m)

The Standard Error of GHG emissions from the burning of peat were then derived by tracking the formula for the GHG calculations:

$$E_{peatburn,g,i,t} = A_{peatburn,i,t} \times BS_{D\text{-}A,i,t} \times BD_{upper} \times G_g \times GWP_g$$

Where:

$E_{peatburn,g,i,t}$: GHG emissions from peat burning of GHG species g, of stratum i, and year t (tCO_2e)
$A_{peatburn,i,t}$: Area of peat burning of stratum i and year t (m^2), later will be symbolized by A
$BS_{D-A,i,t}$: Adjusted burns scar depth of stratum i year t (m), later will be symbolized by D
BD_{upper} : Bulk density of peat upper layer ($kg.m^{-3}$), later will be symbolized by P
G_g : Default value of combustion factor of GHG species g ($kg.kg^{-1}$)
GHG_g : Default value of GHG potential of GHG species g (-)

The uncertainty in $E_{peatburn,g,i,t}$ arises from the uncertainty of the terms on the right side of the equation,

$$E_{peatburn,G,i,t}+U_{g,i,t}=\left(A_{peatburn,i,t}+SE_{Apb,i,t}\right)\times\left(BS_{D-A,i,t}+SE_{BSD-A,i,t}\right)\times\left(BD_{upper}+SE_{BDupper}\right)\times G_g\times GWP_g$$

Where:

$SE_{Apb,i,t}$: Standard Error area of peat burning (m^2), later will be symbolized by a
$SE_{BSD-A,i,t}$: Standard Error adjusted burn scar depth (m), later will be symbolized by d
$SE_{BDupper}$: Standard Error of bulk density of the upper peat layer ($kg.m^{-3}$), later will be symbolized by p

Rearranging the equation and dropping the equal terms on both sides returns a formula for estimating uncertainty of GHG emissions from the burning of peat

$$U_{g,i,t} = ADp + AdP + Adp + aDP + aDp + adP + adp$$

For the 3rd fire occurrence in 2015 where it was statistically demonstrated that the burn scar depth is zero, the project assumes zero uncertainty. Furthermore, for 2011 – 2015 fire incidents the project used default IPCC burn scar depth values and conservatively assumed the entire affected area burnt, therefore making their uncertainty zero.

The total error in the REDD+ project was calculated to be 0.90%. Considering the 15% uncertainty threshold, no VCU deductions were made due to uncertainty. Further detail on all calculations is provided in Annex 8.

6.4.2 Total net GHG emission reductions of the REDD project activity

Net GHG emission reductions from REDD project activities are calculated by subtracting project emissions and emissions due to leakage from baseline emissions.

Table 67. Total net GHG emission reductions of the REDD project activity

Years	Estimated baseline emissions or removals (tCO2e)	Estimated project emissions or removals (tCO2e)	Estimated leakage emissions (tCO2e)	Estimated net GHG emission reductions or removals (tCO2e)
2011	657,473	19,632	-	637,841
2012	529,293	27,174	-	502,119
2013	1,970,386	33,061	-	1,937,325
2014	1,682,357	31,546	-	1,650,811
2015	1,768,045	15,744	-	1,752,301
Total	6,607,554	127,157	-	6,480,397

6.4.3 Total net GHG emission reductions of the WRC project activity

Net GHG emission reductions from WRC project activities are calculated by subtracting project emissions and emissions due to leakage from baseline emissions (see Table 68).

Table 68. Total net GHG emission reductions of the WRC project activity

Years	Estimated baseline emissions or removals (tCO2e)	Estimated project emissions or removals (tCO2e)	Estimated leakage emissions (tCO2e)	Estimated net GHG emission reductions or removals (tCO2e)
2011	1,082,979	135,042	-	947,937
2012	1,193,020	135,042	-	1,057,978
2013	2,577,755	135,042	-	2,442,713
2014	2,925,961	135,372	-	2,790,589
2015	3,238,629	142,846	-	3,095,783
Total	11,018,344	683,345	-	10,334,999

6.4.4 Total net GHG removals of the ARR project activity

In this monitoring period, no estimated project carbon removals from ARR are calculated. Therefore, the net GHG removal of the ARR project activities are calculated by subtracting baseline removals from with project removals, accounting for any leakage (see Table 69).

Table 69. Total net GHG removals of the ARR project activity

Years	Estimated baseline emissions or removals (tCO2e)	Estimated project emissions or removals (tCO2e)	Estimated leakage emissions (tCO2e)	Estimated net GHG emission reductions or removals (tCO2e)
2011	295	-	-	(295)
2012	628	-	-	(628)
2013	1,66	-	-	(1,686)
2014	2,632	-	-	(2,632)
2015	2,924	-	-	(2,924)
Total	8,164	-	-	(8,164)

6.4.5 Total net GHG removals from uncontrolled burning

Net GHG emission reductions from uncontrolled burning are calculated by subtracting estimated project emissions from estimated baseline emissions (see Table 70).

Table 70. Total net GHG removals from uncontrolled burning

Years	Estimated baseline emissions or removals (tCO2e)	Estimated project emissions or removals (tCO2e)	Estimated net GHG emission reductions or removals (tCO2e)
2011	-	58,368	(58,368)
2012	-	35,808	(35,808)
2013	-	-	-
2014	-	335,915	(335,915)
2015	-	2,212,016	(2,212,016)
Total	-	2,642,107	(2,642,107)

6.4.6 Calculation of the VCS Non-Permanence Risk Buffer Withholding

The combined non-permanence risk buffer for the project was determined as 10% (Section 2.3.1). Per VSC methodology VM0007 modules REDD+ MF, the annual buffer withholding for all activities was determined as a percentage of the total carbon stock benefits including fire which excludes emissions due to leakage (see Table 71). As the project does not account for emissions from fossil fuel combustion, and direct N_2O emissions, these were also omitted from calculations.

Table 71. Annual non-permanence risk buffer withholding

Years	REDD total carbon stock benefits	WRC total carbon stock benefits	ARR total carbon stock benefits	Estimated carbon emission from Fire	Non-Permanence Risk Buffer (10%)
2011	637,841	947,937	(295)	(58,368)	152,711
2012	502,119	1,057,978	(628)	(35,808)	152,366
2013	1,937,325	2,442,713	(1,686)	-	437,835
2014	1,650,811	2,790,589	(2,632)	(335,915)	410,285
2015	1,752,301	3,095,783	(2,924)	(2,212,016)	263,314
Total	6,480,397	10,334,999	(8,164)	(2,642,107)	1,416,512

6.4.7 Calculation of Verified Carbon Units

VCU are calculated by subtracting the VCS non-permanence risk buffer withholding from the uncertainty adjusted net emission reductions for each project activity (see Table 72).

Table 72. Calculation of estimated verified carbon units

Years	NGR_{ARR}	$NER_{REDD+WRC+Fire}$	$Adjusted\_NER_{REDD+WRC+FIRE+ARR}$	Non-Permanence Risk Buffer	Estimated VCU
2011	(295)	1,527,409	1,527,114	152,711	1,374,402
2012	(628)	1,524,288	1,523,660	152,366	1,371,294
2013	(1,686)	4,380,038	4,378,352	437,835	3,940,517
2014	(2,632)	4,105,485	4,102,854	410,285	3,692,568
2015	(2,924)	2,636,068	2,633,144	263,314	2,369,830
Total	(8,164)	14,173,289	14,165,124	1,416,512	12,748,612

6.5 Climate Change Adaptation Benefits

6.5.1 Likely regional climate change

6.5.1.1 Climate variability scenarios for the project zone

Regional climate change was projected using the SERVIR-based Climate One-Stop[16] portal. In summary, the project zone is likely to exhibit various effects of climate change over the next 50 years with greater weather anomalies. Temperatures will increase consistently over the years, and there will be a considerable shift in precipitation patterns, evapotranspiration rates, humidity, surface runoffs and soil moisture levels. Seasonal climate variability is expected to be greater, which suggests a substantial increase in rainfall and its intensity for the wet season (December to May), and warmer and longer dry months during the dry season (June to November). This is likely to pose a high risk of floods, surface runoffs, severe droughts and heat waves. Because of climate variability and anomalies, it will be difficult to predict weather and seasons in the project zone.

6.5.1.2 Likely impacts of regional climate change

Climate change will pose various impacts on the project zone's environment, economy and society, as it is likely to result in extreme weather conditions. Table 73 highlights most affected sectors and likely impacts on them.

Table 73. Likely climate change impacts

Sector	Likely impacts
Environmental	Loss of aquatic biodiversity and fish population
	Damage to mangroves and peat swamp ecosystems
	Forest degradation and biodiversity loss
	Decreased quality and quantity of surface and ground water
Economic	Loss of rural productivity and infrastructure
	Loss of crop productivity and yields
	Loss of economic activities from forest/non-timber forest products
	Livestock deaths
	Increased burden from disaster management

[16] Jointly developed by NASA, USAID, the National Science Foundation, the Institute for the Application of Geospatial Technology, the University of Alabama-Huntsville, and CATHALAC in Panama, Climate One-Stop uses NASA's SERVIR datasets and UNFCCC data and downscaled models to show average historical and projected climate information in many locations across the globe.

Social	Spread of water and vector borne infectious diseases
	Reduced food security and loss of incomes
	Reduced quantity and quality of potable drinking water
	Increased number of human injuries and deaths
	Increased risk of cardiovascular and respiratory diseases

6.5.2 Climate change adaptation measures

The project-zone communities are extremely vulnerable to probable climate change impacts because their livelihoods and well-being are dependent on the healthy ecosystem of the surrounding peat swamp forest in the project area. Although some negative impacts of climate change are inevitable and beyond the control of the Katingan Project, the project has begun to strengthen community and biodiversity resilience by implementing adaptation options through various project activities. These include:

- Integrated fishery management through water management and improved aquaculture techniques. The project has supported the development of 42 fish ponds in 7 villages, affecting 360 individuals during the first monitoring period.
- Restoration of peat swamp ecosystems and reforestation. This activity is planned to begin in the next monitoring period.
- Planning and designing of climate resilient infrastructural development. The Project conducted energy assessments in 2 pilot villages and provided information to both regarding the benefits of sustainable and renewable energy. Solar lighting was purchased by 421 households significantly altering the energy profiles of the 2 villages.
- Agroforestry capacity building. In the first monitoring period, the Project assisted 4 villages with rubber agroforestry efforts, involving 154 community members.
- Adjustment of agricultural calendars, crop patterns and planting practices. Participatory mapping and village planning, integrating elements of agricultural management, crop selection and timing was completed for 26 and 13 villages respectively during this monitoring period, with the remainder of villages due to complete the processes during 2016-17. Further support and technical advice on agricultural planning has also been incorporated into activities related to sustainable forest management, animal husbandry, agroforestry and agricultural advice, as described above and below.
- Diversification of economic activities by introducing sustainable livelihood options. In order to stimulate sustainable alternative livelihoods the Project established 8 microfinance institutes in villages in addition to providing the training needed to build capacity to independently operate the institutes. An addition 13 trainings were provided to interested individuals wishing to learn more about financial planning and management. The trainings were coordinated with the microfinance approvals to enable recipients to attend the appropriate training prior to obtaining the loans, thereby increasing their chance for long-term success. A total of 882 women and 516 men received microfinancing during the first five years of the Project. This financial assistance and increased access to capital supported the alternative livelihood activities described above and below. Activities already identified include the development of non-timber forest products, agroforestry, ecotourism, livestock, salvaged wood production, and aquaculture and sustainable fisheries.
- Capacity building for forest management and NTFP development. In the first monitoring period, the Project assisted 15 different NTFP-based enterprises, involving 145 community members. Ten individuals benefited from salvaged wood production development during the first monitoring period.

- Improvement of animal husbandry practices. Eighty-seven people in 2 villages received management support and training for livestock management during the first monitoring period.
- Integrated natural disaster management and prevention systems (e.g., early warning systems, monitoring protocols, and improved techniques and technologies). Participatory mapping and village planning, integrating elements of disaster management and prevention, was completed for 26 and 13 villages respectively during this monitoring period, with the remainder of villages due to complete the processes during 2016-17.
- Improved access to public health care services. This activity is planned for the next monitoring period.
- Disease prevention and control through early warning education and information dissemination. This activity is planned for the next monitoring period.
- Improved access to clean water and sanitation facilities: In the first monitoring period, 20 households received grants to build latrines to prevent the discharge of waste into the local rivers. Further health and sanitation initiatives are planned for the next monitoring period.
- Improved access to rain/river water collection systems. This activity is planned for the next monitoring period.

7 COMMUNITY

7.1 Net Positive Community Impacts

The project area contains no permanent human settlements. This distribution is no accident, as the project area was essentially defined as the area that was not occupied by communities or was targeted for excision from the forest estate. The wider project zone outside of the project area, on the other hand, encompasses 34 village communities and a population estimated in 2010 to be 43,000 people living in 11,475 households. These villages fall under the territorial administration of Mendawai and Kamipang sub-districts of Katingan District, and Seranau and Pulau Hanaut sub-districts of Kotawaringin Timur District. These communities typically make their living from the land and from the rivers, predominantly relying on small-scale agriculture and traditional fisheries. Rice, rubber, coconut, rattan, fruits, non-timber forest products (gemor, jelutong, honey, medicinal plants) and freshwater fish are among the most common livelihood commodities in the project zone.

7.1.1 Summary of net positive community impacts

The project has had a net positive impact on all groups in the communities in the project zone and no high conservation values related to community well-being have been negatively affected.

To measure community well-being, the Katingan Project adopted the measure of five key livelihood assets – human, social, financial, physical and natural capitals – as defined by the UK Department for International Development [[25]]. These assets are fundamental elements in achieving community benefits and are summarized below (see Table 74).

Table 74. Livelihood assets and key criteria

Livelihood asset	Criteria
Natural capital	Natural resource stocks (soil, water, air, genetic resources, etc.) and environmental services
Human capital	Education, health, physical capability, knowledge and skills possession
Social capital	Community cohesiveness, responsibility, affiliation and socio-political relations
Physical capital	Access to infrastructure (e.g., roads, transport, electricity), production equipment, shelter, and technology (e.g., communication systems)
Financial capital	Access to financing support and financial assets including cash, loans, savings and cattle

* Table adapted from references [26] and [27].

Monitoring results as they relate to HCV areas and the five livelihood assets are presented below. An updated Community MRV Tracker is presented in Appendix 5.

Table 75. Summary of net positive community benefits, based on CCB critera

Criteria	Baseline scenario (without project)	Projected with-project scenario	Relevant Monitoring Parameter(s)	2010 Data	2015 Data
A: Area-based					
1. Natural capital	Under the baseline scenario, the natural capital of the Katingan Project area would be exploited for short-term gain largely to the benefit of a distant elite. While there may be some short-term benefits to some individuals within the project area communities, through employment or provision of services, the effects would be short-lived and negated by the long-term impacts as described above.	Under the project scenario, the vast natural capital of the Katingan Project area will be safeguarded and project-zone communities will be assisted to develop ways that sustainably exploit these resources in a way in which the benefits are retained locally.	Number of sustainable livelihood assessments and village planning documents completed	0	13
			Number of community members benefiting from NTFP enterprises	0	145
			Number of community members benefiting from agroforestry	154 (4 villages, rubber)	154 (4 villages, rubber)
			Number of community members benefiting from aquaculture	0	360 (7 villages with 42 fishponds)
			Number of community members benefiting from improved livestock management	0	87 (2 villages)
			Number of community members benefiting from ecotourism	0	0
			Number of community members benefiting from salvaged wood production	0	10
			Number of community members trained in fire prevention	0	168
			Number of community members trained in reforestation	0	65
2. Human capital	Under the baseline scenario it is likely that mixed results will be seen on human capital. In the short-term some aspects	Under the project scenario project-zone communities will be assisted to develop sustainably and self-reliantly,	Number of trainings regarding financial planning and management	2	13

Criteria	Baseline scenario (without project)	Projected with-project scenario	Relevant Monitoring Parameter(s)	2010 Data	2015 Data
	may be enhanced through increased commercial employment opportunities and a potential increase in social services, but this will be counterbalanced by the loss of traditional knowledge and the creation of dependency on a short-lived commercial provider. Communities will become less self-reliant and as a result more at risk.	making full use of existing knowledge. Access to education and basic services will be increased through close collaboration with local government and efforts will focus on developing sustainable business opportunities that remove dependency and build resilience.	Number of village-wide trainings regarding sustainable energy use and maintenance	0	2
			Scholarships for students to attend schools beyond their local community	0	0
3. Social capital	Under the baseline scenario social capital will be at risk. The typical response to the arrival of a large commercial exploiter is the erosion of social cohesion as benefits and costs become unequally distributed and factions form. Increased immigration and competition for scarce resources further creates opportunities for conflict.	Under the project scenario social capital will be enhanced by the project working with, and in support of, legitimate social institutions at and within project-zone communities. The decisions of such institutions will be respected and support delivered in line with their requirements, while great efforts will be made to ensure benefits are equitably distributed.	Number of participatory village profile maps completed	4	30
			Number of village boundary agreements completed	0	15
4. Physical capital	Under the baseline scenario it is likely that there would be some short-term increase in infrastructure, however this would be primarily in support of commercial operations, and so both short-term and poorly aligned with local needs. In such cases long-term impacts	Under the project scenario the Katingan Project will work closely with both project area communities and local government to ensure the sustainable development of infrastructure. This will include improved communication by sharing resources put in place	Number of new public facilities	1 (bridge)	2 (bridges)
			Number of village energy use assessments completed	0	2
			Number of households receiving grants for renewable energy sources	0	421 (solar lighting)

Criteria	Baseline scenario (without project)	Projected with-project scenario	Relevant Monitoring Parameter(s)	2010 Data	2015 Data
	may be even greater as local government may abrogate responsibility to the commercial exploiter, eventually leaving communities worse off when production stops.	by the project, improved river transport by the maintenance of hydrology, and development of renewable energy sources. Business development activities will focus on both access to processing equipment and markets.	Number of households receiving grants to build infrastructure	0	40 (latrines)
5. Financial capital	Under the baseline scenario effects on financial capital are likely to be unbalanced. Some members of the projects area may benefit in the short-term through employment or the provision of goods and services, while other will be negatively impacted by the loss of livelihood. Eventually all will lose however, as the underlying natural capital is consumed leaving a degraded wasteland to follow.	The goal of the Katingan Project is to bring substantial benefits to the project-zone communities through sustainable economic development and land use. This will be achieved through a range of measures including direct employment, preferential purchasing of local services and goods, improved planning, both agricultural and local business development support and increased access to investment capital.	Number of local Microfinance Institutions established and trained to build local management capacity	0	8
			Number of women or women's groups receiving loans	0	882 (516 men also received loans)

As can be seen from the data, the Project has had a clear net positive impact on the project zone communities. Efforts to actively involve communities in a participatory planning process have led to activities being designed in the most beneficial and sustainable manner possible and have ensured that all community sub-groups have been included and derive benefit from the project. Neither the monitoring data nor information obtained by the project team while working with the communities has indicated that any sub-group has been negatively impacted by the project.

The project's design ensures that appropriate training and financial support is provided as communities and families identify their short and long-term goals for an independent, sustainable future. As the project progresses, communities will continue to become more independent and self-sufficient.

The project's activities that have focused on conserving the intact peat swamp forest and replanting degraded areas to lessen the threat of fire and improve the overall ecosystem has ensured and will continue to ensure that the HCV areas important to communities are protected. Communities will therefore have access to areas that meet their needs, provide critical ecosystem services and are critical for maintaining their cultural identity.

7.2 Other Stakeholder impacts

As expected, no positive or negative impacts have been identified for offsite stakeholders. The project team has worked closely with regional and national government organizations regarding project planning and community engagement. This transfer of knowledge is expected to have an indirect positive impact on other similar projects and communities in Indonesia.

7.3 Exceptional Community Benefits

At its inception, the Katingan Project conducted a social survey (see Annex 5), referring to the global socio-economic indicator of the Human Development Index (HDI). This survey indicated that the average income of the project-zone households ranged between IDR 250,000 and IDR 1,500,000 per month. In comparison, while the HDI classifies Indonesia as a Medium Human Development country, with a rank of 108 amongst 169 countries across the world [28], the Indonesian Bureau of Statistics (Badan Pusat Statistik) defines the national poverty line for Central Kalimantan Province as the minimum purchasing power per capita to be able to afford staple food and non-food items, equivalent in cash terms to IDR 212,790 per month [29]. While the baseline survey results indicated that the average income in the project zone is already below the regional poverty level, in reality the average income per capita is likely to be even lower – well under the national extreme poverty level – as typical household around the concession area consists of four to eight family members including children and the elderly. Thus, the project zone is qualified as a rural area of a high concentration of population living under the national poverty line.

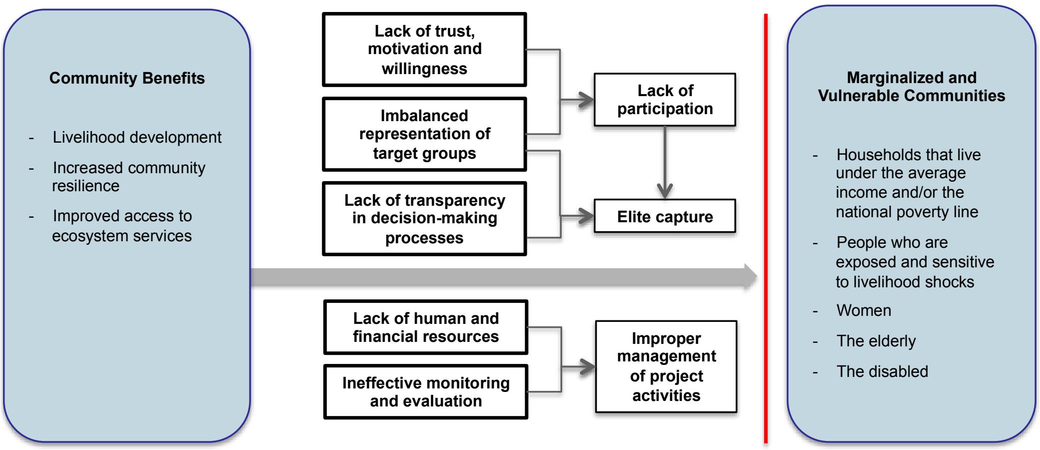
In the project zone, basic social services are extremely limited. Social service disparity extends to access to electricity, quality education, public health facilities, clean drinking water, and sanitation systems. While people in Kotawaringin Timur District who have easier access to Sampit tend to earn higher incomes and receive better public services, the majority of communities in the project zone, particularly those in Katingan District, make lower average incomes due to the lack of access to markets and employment opportunities. Furthermore, inadequate land transportation systems isolate many project-zone communities and push the cost of living higher because the daily activities of these communities depend on water transportation. The project-zone communities are extremely vulnerable to various external shocks including environmental stresses if left without social safety nets.

The Katingan Project has provided benefit to communities through a variety of socio-economic activities which also target the most vulnerable and marginalized community members. This includes the poor, women, elderly and the disabled. The project aims at reaching these poorer and marginalized communities through a variety of socio-economic programs that would otherwise be unavailable to them. These programs are designed to lift the poorest out of poverty by engaging them in community-based business development such as microfinance, women's empowerment, sustainable agroforestry, renewable energy development, and NTFPs. The project has already and will continue to create a multitude of positive economic effects from these programs, as they increase employment opportunities, crop yields, access to markets and revolving finances, and new business and investment opportunities building on the communities' self-defined goals. Therefore, the Katingan Project directly delivers benefits to a large proportion of the vulnerable and marginalized people and bring about positive impacts on the overall economy of the area.

Consistent with the requirements of the CCB Standard, the project monitors parameters related to the well-being of community members and changes attributed to the project activities. A summary of these parameters were presented in Section 7.1 and a full list in provided in Appendix 5. Community members provide continual feedback through the participatory processes described throughout this report.

The success of community programs is largely dependent on participation, transparent decision-making processes based on mutual trust, and proper management of project activities. Three main potential barriers to community benefits in reaching the marginalized and/or vulnerable communities were identified, and mitigation measures were implemented as discussed below (also see Figure 27).

Figure 27. Potential barriers to benefits reaching the marginalized and vulnerable communities



Lack of participation: The marginalized poor communities tend to live remotely away from village centres, and often lack the means or time required to attend community meetings, due to distance and other constraints. Also, it is common for the project-zone communities that the marginalized feel discouraged to voice their opinions in front of dominant groups. This can trigger mistrust toward other community members, and leads to lack of motivation and willingness to participate. Also, unbalanced or misrepresented target groups for certain project activities could entail non-participation of the poorer and marginalized community members. The Katingan Project has and will continue to encourage all community stakeholders, particularly the poorer and marginalized, to participate in project activities through differentiated approaches. Our participatory planning processes enables all project-zone communities to be involved in decision-makings. Understanding barriers to meaningful participation to the project, socialization, information dissemination and community meetings take place at various locations and times by considering the needs of the marginalized. For example, some meetings are facilitated only for women, and take place at their houses in the evening when they usually have spare time. Community message boards, booklets, flyers and videos, and local radio programs have also been used to reach target audience effectively.

Elite captures: A lack of participation and transparency in decision-making processes generally creates an opportunity for elite captures in which dominant groups can steer decisions to their favour, while hindering the flow of benefits to the marginalized households. When making decisions regarding an infrastructural development project such as road construction, for example, community board members may choose a location based on their personal benefits, rather than communal benefits as a whole. Without transparent decision-making systems and well-represented board of communities in place, community programs may be manipulated to satisfy the personal interests of certain individuals and may not produce overall positive impacts on the marginalized households. In order to address the risk of elite captures, the Katingan Project has encouraged the poorer and marginalized communities to participate (see above) and aimed to enhance the balance of community representation. To increase transparency in decision-making processes, meeting records and decisions have been maintained and made publically available. A mixed representation of community members, including the marginalized groups, will reinforce more equitable and democratic distribution of benefits, thereby placing checks and balances on decision-making processes and safeguarding the interest of communities as a whole.

Improper management of project activities: Another potential barrier to anticipated project benefits reaching target community members is improper management of project activities due to the lack of human and financial resources and effective monitoring and evaluation systems. The implementation and progress of project activities should be regularly monitored in order to assess the impacts of these activities on the marginalized households, to ensure appropriate allocation and use of community funds, and to enforce rules. Without a stringent system of checks and balances, the risk of the elite capture of benefits, ineffective performance and misappropriation of funds remains high. The Katingan Project seeks to remove this barrier by supporting the project-zone communities to have access to sufficient resources which are necessary to carry on project activities. Proper training has been and will continue to be provided to build the capacity of local people. Community-based adaptive management will reinforce checks and balances on decision-making processes and lead to a form of democratic natural resources governance.

Monitoring parameters to continue evaluating the mitigation strategies, such as participation of women in microlending and trainings on financial planning and management, are included in the monitoring results presented in Section 7.1 and Appendix 5.

8 BIODIVERSITY

8.1 Net Positive Biodiversity Impacts

8.1.1 Summary of net positive biodiversity impacts

The project has had a significant net positive biodiversity benefit in relation to the baseline. The project activities were successfully implemented as described above to further the objectives of preserving intact forest from illegal logging and hunting, minimizing forest loss due to man-made fires, improving forest resiliency and community response against natural fires, replanting and rewetting efforts, and supporting community development through education and financial support for community-led projects. Specific parameters monitored for biodiversity are highlighted below, although community parameters such as fire prevention and response trainings, improved agricultural and aqua-cultural business development, forest protection and other similar parameters also contributed to the project's successful net positive impacts on biodiversity. Despite some project areas being affected by natural fires and illegal logging, forest loss would have had a much more significant impact without the project activities having taken place. Under the baseline scenario, during this monitoring period, it is predicted that around 22,136 ha (15%) of the project area would have been deforested as a result of plantation development activities, with a commensurate rise in hunting and fire risk due to the increased ease of access and peat drainage. Such a loss of habitat would have had a significant negative impact on the biodiversity of the area. A summary of the benefits is presented in Table 76 while the full Biodiversity MRV Tracker is available in Appendix 6.

Table 76. Summary of net positive biodiversity benefits

Biodiversity criteria	Baseline scenario	With-project scenario	Relevant Monitoring Parameter:	2010 data	2015 data
1. Globally, regionally or nationally significant concentrations of biodiversity values (**HCV1**) 2. Globally, regionally or nationally significant large landscape-level areas where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance (**HCV2**). 3. Threatened or rare ecosystems (**HCV3**)	Under the baseline scenario (see Section 0) almost the entire project area (149,800 ha) would be cleared, drained and converted to industrial acacia plantations. This would have a catastrophic effect on the biodiversity value of the area as almost all of the key species present at the site are dependent on the presence of large blocks of undisturbed intact forest (see below). The continued presence of these species would become untenable. Outside of the project area, within the wider project zone,	Under the project scenario the entire project area (149,800 ha) will be protected, and any degraded areas restored. This will ensure the long-term survival of the habitat and the species supported by it. Outside of the core project area, within the wider project zone, project activities will seek to protect and conserve all remaining intact forest areas, despite the project not having legal management rights. This will include working with communities, government and industry to maintain and enhance all current biodiversity values through sounds	Number of incidence of illegal hunting	No data	26 hunters reported (63 predicted). 4 species.
			Number of incidence of illegal logging	29	34
			Number of stump due to illegal logging	28,265 (Av 0.19/ha)	39,073 (Av 0.26 /ha)
			Volume of timber logged	5,863 m³	4,717 m³
			Number of flora and fauna hunted and kept	No data	48 hunters reported (117 predicted). 31 species. Number trapped/kept varying widely by species (see table)
			Area of ecological disturbance (Encroachment, Illegal logging, etc.)	8,281 ha	8,281 ha
			Number of fire cases	8	165
			Area of fire scars	501 ha	9,695 ha
			Area of fire break	0 ha	1.2 ha
			Number of key species population	See section 8.3	See section 8.3
			Number of species	157 birds, 67 mammals, 49 herptiles, 111 fish, 314 plants	167 birds, 67 mammals, 49 herptiles, 111 fish, 314 plants
			Distribution of key species	144,778 ha of suitable habitat (forest	136,1867 ha of suitable habitat (forest

Biodiversity criteria	Baseline scenario	With-project scenario	Relevant Monitoring Parameter:	2010 data	2015 data
	further degradation is also inevitable, including small-medium scale conversion of forest to agriculture, including oil palm plantations and drainage. Fire risk would remain very high. The negative effect of these impacts in terms of biodiversity would be multiplied by the loss of the core project area leaving only isolated fragments of natural habitat remaining none of which are likely to be able to support long terms viable populations of key species.	planning and by promoting sustainable agricultural practices. As a result the project is anticipated to provide net positive benefits within the wider project zone both directly, through these activities, and indirectly through the complete protection of the core project area and the viable source populations of biodiversity contained within it.		dependent species)	dependent species)
			Number of trees planted in degraded forest areas	0	0
			Total area reforested in degraded forest areas	0 ha	0 ha
			Number of trees planted in agroforestry areas	0	97,000 (Project Zone)
			Total area reforested in agroforestry areas	0 ha	194 ha (Project Zone)
			Number of trees planted in swampy areas	0	600 (Project Area)
			Total area reforested in swampy areas	0 ha	1.2 ha (Project Area)
			Water level	Not planned this period	Not planned this period
			Area of peatland restored	Not planned this period	Not planned this period

As stated above, the project successfully delivered significant net positive impacts on biodiversity in comparison to the baseline scenario of commercial drainage and conversion to acacia plantation. Several aspects of the project's performance, however, merit further consideration:

Forest loss to fire: As discussed in multiple sections of this report, parts of the project were affected by fire. Most of the fire damage occurred in 2015, the worst year on record for peat land fires in Indonesia and associated with the exceptionally dry weather created by the El Niño weather system. The loss of forest to fire clearly has an impact on the biodiversity found there, although the slow-moving nature of peatland fires mean that the impact will be most severe on immobile or slow-moving species, while more mobile species (including birds, primates and medium-large terrestrial mammals) can probably move away from the fire affected areas to safety. In any event, the loss of forest to fire (and illegal logging) is significantly less that the level of forest loss predicted under the baseline scenario (around half).

Population and Distribution of Key species: Direct assessment of species population level and spatial distribution is extremely challenging. Typically the level of accuracy of population estimates that is associated even with the most intensive survey effort is such that repeat surveys are unlikely to be able to detect significant variation in population status over short periods other than cataclysmic loss or unprecedented increase. Initial population estimates were made for several key primate species, and it is the project's intention to repeat these surveys within a 10-year interval. However, in order to monitor population status in the interval, a combination of a proxy indicator and a measure of flux was used. The extent of intact forest cover is the best proxy indicator, as all key species present at the site are forest dependent, while hunting off-take was monitored to measure flux.

Hunting Data: A village level survey was undertaken in a sample of 14 villages to determine the extent of hunting and the species targeted. This survey interviewed 105 individuals, of which 90 were specifically targeted as previously identified hunters. A further 15 people were chosen at random, none of which were engaged in hunting. Of the 105 potential hunters questioned, 48 confirmed that they regularly hunted within the project zone, while the remainder travelled to areas outside the project zone for convenience and to hunt specific species so were not considered further. Extrapolating the number of identified hunters identified within the sampled villages (14 of 34) suggests that approximately 120 hunters could be active in all the villages surrounding the project area. Of those hunters interviewed, around two-thirds said they hunted on a monthly or annual basis, while around one quarter did so on a weekly basis, and the remainder on a daily basis (4%). The most common reason given for hunting was to trap animals for sale (85%) while the second largest reason given was for consumption (71%). None of the interviewed hunters stated that they considered hunting to be their primary profession, with the bulk made up of farmers and fishermen, hunting as opportunity allowed.

Based on the results of the survey the following tables show the identified offtake. This is divided into illegal hunting (hunting of protected species) and legal hunting (permitted hunting of unprotected species). Data is presented as the average **annual** catch per hunter, the total number of hunters predicted across all villages (based on the fraction of hunters identified during the survey) and the resulting total predicted annual offtake. In several cases 'no data' is given. In these cases either no confirmed cases were identified, or offtake numbers were not provided. However the species are listed here for completeness, and where relevant discussed further below.

Table 77. Protected Species (illegal hunting)

English Name	Scientific Name	Total Hunters	Average/Hunter	Total offtake
Heron sp.	*Ardea sp.*	2	30	73
Mouse Deer spp	*Tragulus spp.*	12	11	134
Sambar Deer	*Rusa unicolor*	51	15	784
Sunda Pangolin	*Manis javanica*	19	no data	no data

Table 78. Unprotected Species (legal hunting)

English Name	Scientific Name	Total Hunters	Average/Hunter	Total offtake
Asian Box Turtle	*Cuora amboinensis*	2	No data	No data
Asian Water Monitor	*Varanus salvator*	2	No data	No data
Black-headed Bulbul	*Pycnonotus atriceps*	5	24	117

Blue-crowned Hanging Parrot	*Loriculus galgulus*	12	203	2,459
Blue-winged Leafbird	*Chloropsis cochinchinensis*	15	60	874
Green Imperial Pigeon	*Ducula aenea*	2	90	219
Hill Myna	*Gracula religosa*	22	113	2,459
Leafbird spp.	*Chloropsis spp.*	51	148	7,524
Lesser Whistling Duck	*Dendrocygna javanica*	2	30	73
Magpie Robin	*Copsycus saularis*	34	64	2,188
Pink-necked green pigeon	*Treron vernans*	58	524	30,524
Reticulated Python	*Python reticulatus*	2	No data	No data
Snake spp.	*Snake spp.*	2	No data	No data
Soft-shell Turtle spp.	*Amyda cartilaginea?*	5	No data	No data
Spotted Dove	*Streptopelia chinensis*	10	34	330
White-breasted Waterhen	*Amaurornis phoenicurus*	15	378	5,508
White-rumped Shama	*Copsychus malabaricus*	44	45	1,979
White-vented Myna	*Arcidotheres javanicus*	12	No data	No data
Wild Pig	*Sus scrofa*	53	36	1,935
Yellow-vented Bulbul	*Pycnonotus goiavier*	39	221	8,580

In addition the survey recorded incidences of species being kept in captivity. As with the tables above, data from the survey is extrapolated into a prediction for the incidence across all villages.

Table 79. Species recorded being kept in captivity (indicating protected status)

English Name	Scientific Name	Protected	Total Incidence
Heron sp./Lesser Adjutant	*Ardea sp./Leptoptilos javanicus*	Y	2
Proboscis Monkey	*Nasalis larvatus*	Y	2
Asian Glossy Starling	*Aplonis panayensis*	N	2
Blue-crowned Hanging Parrot	*Loriculus galgulus*	N	5
Green Imperial Pigeon	*Ducula aenea*	N	5
Hill Myna	*Gracula religosa*	N	7
Leafbird spp.	*Chloropsis spp.*	N	19
Lesser Whistling Duck	*Dendrocygna javanica*	N	2
Long-tailed Macaque	*Macaca fascicularis*	N	5
Long-tailed Parakeet	*Psittacula longicauda*	N	2
Long-tailed Shrike	*Lanius schach*	N	2
Magpie Robin	*Copsycus saularis*	N	19
Pig-tailed Macaque	*Macaca nemestrina*	N	2
Pink-necked green pigeon	*Treron vernans*	N	2
Slender-billed Crow	*Corvus enca*	N	2
Spotted Dove	*Streptopelia chinensis*	N	10
White-breasted Waterhen	*Amaurornis phoenicurus*	N	2

White-rumped Shama	*Copsychus malabaricus*	N	17
White-vented Myna	*Arcidotheres javanicus*	N	7
Yellow-vented Bulbul	*Pycnonotus goiavier*	N	5

As can be seen from the tables, the incidence of hunting is very varied between species. A relatively low level of hunting was recorded involving protected species (illegal hunting) and the vast majority of these cases involved Sambar Deer for which there is generally a low knowledge locally of its protected status under Indonesian law. In future the project will seek to address this. In several cases the hunting of Pangolin was suspected, but it was never actually confirmed and no visible evidence of such hunting was found.

In terms of legal hunting, the distribution of species trapped is typical. The bulk either relates to species caught for food (Pink-necked Pigeon, White-breasted Waterhen) or for the pet bird trade (hanging parrot, leafbirds, Hill Myna, White-rumped Shama, Yellow-vented Bulbul). Controlling such hunting is difficult for the project, as it is both fully legal and typically conducted on land outside of the core project area for which a degree of control is available. In future the project will seek to reduce the offtake of such hunting by education and outreach, and by monitoring access to the core project area.

In terms of species kept in captivity, the range reflected the same range of species trapped, but with the addition of a number of thankfully restricted cases of keeping primates as pets. As above, the project will work to educate local communities regarding the risks and costs of such practices in an attempt to reduce them.

8.1.2 Implementation of mitigation measures for any negative impacts on HCV attributes

No negative impacts of the project on HCV values related to biodiversity were encountered. The project will continue to monitor and will propose and implement mitigation measures if needed.

8.1.3 Species to be used in project activities and confirmation of status

Species used in the rehabilitation of degraded areas within the project area during this monitoring period are shown below. All are native to Central Kalimantan.

Local Name:	**Scientific Name:**
Tumih	*Combretocarpus rotundatus*
Pulai	*Alstonia spp*
Gelam	*Melaleuca cajuputi*
Belangiran	*Shorea belangeran*

8.1.4 Use of non-native species, fertilizers, chemical pesticides and other inputs

No genetically modified organisms, fertilizers or chemical pesticides were used by the project.

8.1.5 Description of waste products management resulting from project activities

The Katingan Project adopts the principles of Reduce, Reuse and Recycle. Organic waste was separated and composted through village composting initiatives, or disposed of through burial. Inorganic waste was separated into recyclable components – which were entered into village- and local-government led recycling initiatives – while residual inorganic waste was removed from the site and disposed of through government-run waste disposal facilities in Sampit.

8.2 Offsite Biodiversity Impacts

All project activities were designed to deliver positive biodiversity impacts. As such, no offsite biodiversity impacts were anticipated or detected during this monitoring period.

8.3 Exceptional Biodiversity Benefits

The project has generated exceptional biodiversity benefits based on multiple achievement of the criteria defined in the CCB Standards Third Edition.

At the time the project started the project area supported three Critically Endangered species. In early 2016 this was increased to five, with the addition of Helmeted Hornbill (Rhinoplax vigil) and Bornean Orangutan (*Pongo pygmaeus*) to the category. In addition to the critical species, the project area also supports eight species listed as Endangered, and 31 species considered Vulnerable (IUCN 2016). For two of these at least, Orangutan and Proboscis Monkey, the project zone is estimated to hold over 5% of the entire global population.

Each species listed as Critically Endangered or Endangered is shown in the table below, together with a summary of their status during this monitoring period.

Table 80. Status of Critically Endangered or Endangered species in project zone

Status	Species	Baseline	Status during 2010-2015 monitoring period
CR	Sunda Pangolin (*Manis javanica*)	Threatened by loss of forest habitat and unsustainable hunting, mainly for the Chinese medicine market. Under the baseline such hunting pressure would likely increase as isolated forest fragments became more accessible.	Core project area has remained intact. Some anecdotal suggestion of hunting, but no confirmed evidence amongst 105 interviewed potential hunters. The project will, however, remain vigilant to the threat and will work with the relevant authorities if and when identified.
CR	White-shouldered ibis (*Pseudibis davisoni*)	Threatened by habitat loss, disturbance and hunting pressure. Under the baseline scenario this species is unlikely to survive.	Core project area has remained intact. No evidence of hunting offtake. This species has remained elusive during the entire project period, with no confirmed sighting in the project area or zone.
CR	Kahui/Red Balau (*Shorea balangeran*)	Threatened by commercial over-extraction and general forest loss. This species would be lost from the project area and remain over-exploited within the wider project zone.	Core project area has remained intact. Likely to have suffered proportional loss from fire and illegal logging, but not to extent of baseline scenario.
CR	Helmeted Hornbill (*Rhinoplax vigil*)	Threatened by habitat loss, disturbance and hunting pressure. Under the baseline scenario this species is unlikely to survive.	As a forest-dependent species the core project area has remained intact for this species. No evidence, either anecdotal or confirmed, of hunting pressure was found.
CR	Bornean Orangutan (*Pongo pygmaeus*)	Threatened by forest habitat loss and hunting. Population would be drastically reduced under the baseline scenario,	Core forest habitat has remained intact. Some habitat loss due to fire and illegal logging likely to have had a local effect, but as a mobile species

		further exacerbated by a likely rise in hunting of any remaining individuals, as usually accompanies commercial conversion.	the impact should be limited. Importantly no evidence was found of hunting, animals kept as pets, or of conflict between animals and farmers over crops, suggesting the local population should have remained stable.
EN	Proboscis monkey (*Nasalis larvatus*)	Threatened by habitat loss and disturbance, particularly along forested river borders. Such areas would be amongst the most negatively affected under the baseline scenario.	The project has continued to protect the riverine forest areas used by this species, and the hunting survey found no evidence of ongoing hunting pressure, and only one incidence of an animal being kept as a pet.
EN	Bornean Gibbon (*Hylobates albibarbis*)	Threatened by forest habitat loss. Population would be drastically reduced under the baseline scenario.	Core area has remained intact with no evidence of hunting offtake suggesting the population should have remained stable during this reporting period.
EN	Hairy-nosed Otter (*Lutra sumatrana*)	Threatened by forest habitat loss and hunting. Both likely to increase under the baseline scenario.	Forests and riverine habitat has been protected and no evidence of hunting offtake was detected.
EN	Flat-headed Cat (*Prionailurus planiceps*)	Threatened by forest habitat loss and hunting. Any remaining population would be drastically reduced under the baseline scenario.	Protection of forest within the core project area and wider zone will have ensured continued high population presence. No evidence of hunting offtake was detected.
EN	Storms Stork (*Ciconia stormi*)	Very vulnerable to forest loss, fragmentation and disturbance. This species would likely become locally extinct under the baseline scenario.	Core forests habitat has remain protected, particularly along small river and waterways, safeguarding the local population. No evidence of hunting offtake was detected.
EN	Bornean River Turtle (*Orlitia borneensis*)	Threatened by habitat loss and unsustainable hunting for food and the pet trade; both likely to increase under the baseline scenario.	Core project area including the species habitat has remained stable. No evidence of systematic hunting which is the key threat to this species.
EN	Spiny Hill Turtle (*Heosemys spinosa*)	Threatened by habitat loss and unsustainable hunting for food and the pet trade; both likely to increase under the baseline scenario.	Core project area including the species habitat has remained stable. No evidence of systematic hunting which is the key threat to this species.
EN	Meranti Semut (*Shorea teysmaniana*)	Threatened by commercial over-extraction and general forest loss. This species would be lost from the project area and remain over-exploited within the wider project zone.	Core project area has remained intact. Likely to have suffered proportional loss from fire and illegal logging, but not to extent of baseline scenario.

9 ADDITIONAL INFORMATION

All necessary information is provided in the relevant sections of this report.

Appendix 1. FAUNA AND FLORA OF THE PROJECT ZONE

This appendix lists all species of fauna and flora recorded in the project zone. For further details see PD Sub-section 1.3.7 (“Current Biodiversity”) and Sub-section 1.3.8 (“Identification of High Conservation Values”), PD Annex 3 (“HCV Assessment”) and references [8] and [9].

Each table shows IUCN categories (CR = critically endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC= Least Concern DD = Data Deficient, NE= Not Evaluated); CITES categories (I = international trade prohibited, except in exceptional non-commercial cases; II = international trade may be permitted, but requires export permit; III = limited trade); Protected status in Indonesia (Peraturan Pemerintah No. 7/1999; Y = protected), and endemicity (Y = endemic to Borneo).

1. Mammals

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
INSECTIVORA						
Soricudae	*Crocidura fuliginosa*	South-east Asian white-toothed shrew	LC			
Soricudae	*Tupaia glis*	Common treeshrew	LC	II		
Soricudae	*Tupaia gracilis*	Slender treeshrew	LC	II		
Soricudae	*Tupaia minor*	Lesser treeshrew / Pygmy tree shrew	LC	II		
Soricudae	*Tupaia picta*	Painted treeshrew	LC	II		
Soricudae	*Tupaia splendidula*	Ruddy treeshrew	LC	II		
DERMOPTERA						
Cynocephalidae	*Galeopterus variegatus*	Colugo / Sunda flying lemur	LC		Y	
CHIROPTERA						
Pteropidae	*Megaerops ecaudatus*	Tailless fruit bat	LC			
Pteropidae	*Pteropus vampyrus natunae*	Large flying fox	NT	II		
Rhinolophidae	*Rhinolophus trifoliatus*	Trefoil horseshoe bat	LC			
Vespertilionidae	*Kerivoula hardwickii*	Hardwicke’s / Common woolly bat	LC			
Vespertilionidae	*Kerivoula intermedia*	Small woolly bat	NT			
Vespertilionidae	*Kerivoula minuta*	Least woolly bat	NT			

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
Vespertilionidae	*Kerivoula pellucida*	Clear-winged woolly bat	NT			
Vespertilionidae	*Kerivoula whiteheadi*	Whitehead’s woolly bat	LC			
Vespertilionidae	*Murina suilla*	Lesser / Brown tube-nosed bat	LC			
Vespertilionidae	*Myotis muricola*	Nepalese whiskered myotis bat	LC			
PRIMATA						
Lorisidae	*Nycticebus menagensis*	Bornean Slow loris	VU	I	Y	
Tarsiidae	*Tarsius bancanus borneanus*	Western/Horsfield’s tarsier	VU	II	Y	
Cercopithecidae	*Macaca fascicularis*	Long-tailed/crab eating macaque	LC	II		
Cercopithecidae	*Macaca nemestrina*	Southern pig-tailed macaque	VU	II		
Cercopithecidae	*Nasalis larvatus*	Proboscis monkey	EN	I	Y	Y
Cercopithecidae	*Presbytis rubicunda*	Red langur	LC	II	Y	Y
Cercopithecidae	*Trachypithecus cristatus*	Silver langur/Silvery Luntung	NT	II		
Hylobatidae	*Hylobates albibarbis*	Bornean southern gibbon	EN	I	Y	Y
Hominidae	*Pongo pygmaeus*	Bornean orangutan	CR	I	Y	Y
PHOLIDOTA						
Manidae	*Manis javanica*	Sunda Pangolin	CR	II	Y	
RODENTIA						
Sciuridae	*Aeromys tephromelas*	Black flying squirrel	DD			
Sciuridae	*Petaurista petaurista*	Red Giant Flying Squirrel	LC			
Sciuridae	*Callosciurus notatus*	Plantain squirrel	LC			
Sciuridae	*Callosciurus prevostii*	Prevost's squirrel	LC	II		
Sciuridae	*Exilisciurus exilis*	Plain/least pygmy squirrel	DD			Y
Sciuridae	*Nannosciurus melanotis*	Black-eared pygmy squirrel	LC			
Sciuridae	*Petinomys genibarbis*	Whiskered flying squirrel	VU			
Sciuridae	*Ratufa affinis*	Pale Giant squirrel	NT	II		
Sciuridae	*Rhinosciurus laticaudatus*	Shrew-faced ground squirrel	NT			
Sciuridae	*Sundasciurus hippurus*	Horse-tailed squirrel	NT			
Sciuridae	*Sundasciurus lowii*	Low's squirrel	LC			
Erinaceidae	*Echinosorex gymnura*	Moonrat	LC			

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
Muridae	*Lenothrix canus*	Grey tailed tree rat	LC			
Muridae	*Maxomys rajah*	Red spiny rat	VU			
Muridae	*Maxomys whiteheadi*	Whiteheads rat	VU			
Muridae	*Niviventer cremoriventer*	Dark tailed tree rat	VU			
Muridae	*Rattus exulans*	Polynesian rat	LC			
Muridae	*Sundamys muelleri*	Mulle'rs Giant Sunda rat	LC			
Hystricidae	*Hystrix brachyura*	Common/Malayan porcupine	LC		Y	
Hystricidae	*Hystrix crassispinis*	Thick-spined porcupine	LC			Y
CARNIVORA						
Ursidae	*Helarctos malayanus*	Malayan Sun-bear	VU	I	Y	
Mustelidae	*Lutra sumatrana*	Hairy-nosed otter	EN	II	Y	
Mustelidae	*Martes flavigula*	Yellow-throated marten	LC	III		
Mustelidae	*Mustela nudipes*	Malay weasel	LC			
Mustelidae	*Aonyx cinerea*	Oriental/Asian small-clawed otter	VU	II		
Viverridae	*Arctictis binturong*	Binturong	VU	III	Y	
Viverridae	*Arctogalidia trivirgata*	Small-toothed palm civet	LC			
Viverridae	*Herpestes brachyurus*	Short-tailed mongoose	LC		Y	
Viverridae	*Herpestes semitorquatus*	Collared mongoose	DD			
Viverridae	*Paradoxurus hermaphroditus*	Common palm civet	LC	III		
Viverridae	*Prionodon linsang*	Banded Linsang	LC		Y	
Viverridae	*Viverra tangalunga*	Malay civet	LC			
Felidae	*Neofelis nebulosa*	Clouded leopard	VU	I	Y	
Felidae	*Pardofelis marmorata*	Marbled cat	NT	I	Y	
Felidae	*Prionailurus bengalensis*	Leopard cat	LC	I	Y	
Felidae	*Prionailurus planiceps*	Flat-headed cat	EN	I	Y	
ARTIODACTYLA						
Suidae	*Sus barbatus*	Bearded pig	VU			
Tragulidae	*Tragulus kanchil*	Lesser mouse-deer/Chevrotain	LC		Y	
Tragulidae	*Tragulus napu*	Greater mouse-deer	LC		Y	

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
Cervidae	*Cervus unicolor*	Sambar deer	VU		Y	
Cervidae	*Muntiacus atherodes*	Bornean yellow muntjac	LC			Y

2. Birds

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
GALLIFORMES						
Phasianidae	*Argusianus argus*	Great argus	NT	II	Y	
Phasianidae	*Lophura erythrophthalma*	Crestless fireback	VU			
Phasianidae	*Melanoperdix nigra*	Black partridge	VU			
CICONIIFORMES						
Ardeidae	*Ardea purpurea*	Purple heron	LC			
Ardeidae	*Ardea sumatrana*	Great billed heron	LC			
Ardeidae	*Ardeola speciosa*	Javan pond-heron	LC			
Ardeidae	*Butorides striatus*	Striated heron	LC			
Ardeidae	*Egretta garzetta*	Little egret	LC		Y	
Ardeidae	*Ixobrychus cinnamomeus*	Cinnamon bittern	LC			
Ciconiidae	*Ciconia stormi*	Storms stork	EN			
Ardeidae	*Ixobrychus flavicollis*	Black Bittern	LC			
Ciconiidae	*Leptoptilos javanicus*	Lesser adjutant stork	VU		Y	
Threskiorbithidae	*Pseudibis davisoni*	White-shouldered ibis	CR		Y	
ANSERIFORMES						
Anatidae	*Dendrocygna javanica*	Lesser whistling duck	LC			
PELICANIFORMES						
Anhingidae	*Anhinga melanogaster*	Oriental Darter	NT		Y	
FALCONIFORMES						
Accipitridae	*Accipiter trivirgatus*	Crested goshawk	LC	II	Y	
Accipitridae	*Aviceda jerdoni*	Jerdon's baza	LC	II	Y	
Accipitridae	*Haliaeetus leucogaster*	White-bellied fish eagle	LC	II	Y	

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
Accipitridae	*Haliastur indus*	Brahminy kite	LC	II	Y	
Accipitridae	*Spilornis cheela*	Crested serpent-eagle	LC	II	Y	
Accipitridae	*Spizaetus cirrhatus*	Changeable hawk eagle	LC		Y	
Accipitridae	*Icthyophaga humilis*	Lesser Fish Eagle	NT	II	Y	
Accipitridae	*Elanus caeruleus*	Black-shouldered Kite	LC		Y	
Falconidae	*Microhierax fringillarius*	Black-thighed falconet	LC	II	Y	
GRUIFORMES						
Rallidae	*Amaurornis phoenicurus*	White breasted waterhen	LC			
CHARADIFORMES						
Laridae	*Sterna nilotica*	Gull-billed tern	LC		Y	
Scolopacidae	*Actitis hypoleucos*	Common sandpiper	LC			
COLUMBIFORMES						
Columbidae	*Chalcophaps indica*	Emerald dove	LC			
Columbidae	*Ducula aenea*	Green imperial pigeon	LC			
Columbidae	*Ducula badia*	Mountain imperial pigeon	LC			
Columbidae	*Ducula bicolor*	Pied imperial pigeon	LC			
Columbidae	*Streptopelia chinensis*	Spotted dove	LC			
Columbidae	*Treron curvirostra*	Thick-billed green pigeon	LC			
Columbidae	*Treron fulvicollis*	Cinnamon headed green pigeon	NT			
Columbidae	*Treron vernans*	Pink-necked green pigeon	LC			
PSITTIFORMES						
Psittacidae	*Loriculus galgulus*	Blue-crowned hanging parrot	LC			
Psittacidae	*Psittacula longicauda*	Long-tailed parakeet	NT			
CUCULIFORMES						
Cuculidae	*Cacomantis merulinus*	Plaintive cuckoo	LC			
Cuculidae	*Cacomantis sonneratii*	Banded bay cuckoo	LC			
Cuculidae	*Cuculus micropterus*	Indian cuckoo	LC			
Cuculidae	*Carpococcyx radiatus*	Bornean ground-cuckoo	NT			Y

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
Cuculidae	*Centropus bengalensis*	Lesser coucal	LC			
Cuculidae	*Centropus sinensis*	Greater coucal	LC			
Cuculidae	*Chrysococcyx xanthorhynchus*	Violet cuckoo	LC			
Cuculidae	*Phaenicophaeus chlorophaeus*	Raffles malkoha	LC			
Cuculidae	*Phaenicophaeus curvirostris*	Chestnut breasted malkoha	LC			
Cuculidae	*Phaenicophaeus sumatranus*	Chestnut bellied malkoha	NT			
Cuculidae	*Surniculus lugubris*	Drongo cuckoo	LC			
STRIGIFORMES						
Tytonidae	*Phodilus badius*	Oriental bay owl	LC			
Strigidae	*Ketupa ketupu*	Buffy fish-owl	LC	II		
Strigidae	*Ninox scutulata*	Brown hawk-owl	LC	II		
Strigidae	*Bubo sumatranus*	Barred Eagle-Owl	LC			
Strigidae	*Strix leptogrammica*	Brown wood owl	LC	II		
CAPRIMULGIFORMES						
Caprimulgidae	*Caprimulgus affinis*	Savanna nightjar	LC			
Caprimulgidae	*Caprimulgus concretus*	Bonaparte's/Sunda nightjar	VU			
Caprimulgidae	*Eurostopodus temminckii*	Malaysian Eared nightjar	LC			
Podargidae	*Batrachostomus stellatus*	Gould's frogmouth	NT			
APODIFORMES						
Apodidae	*Apus affinis*	Little swift	LC			
Apodidae	*Caprimulgus concretus*	Bonaparte's nightjar	VU			
Apodidae	*Collocalia esculenta*	Glossy swiftlet	LC			
Apodidae	*Collocalia fuciphaga*	Edible-nest Swiftlet	LC			
Apodidae	*Hemiprocne longipennis*	Grey rumped tree swift	LC			
Apodidae	*Rhaphidura leucopygialis*	Silver rumped spinetail	LC			
TROGONIFORMES						
Alcedinidae	*Alcedo coerulescens*	Small Blue kingfisher	LC		Y	
Alcedinidae	*Ceyx erithacus*	Black backed kingfisher	LC		Y	
Alcedinidae	*Ceyx rufidorsa*	Rufous backed kingfisher	LC		Y	

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
Alcedinidae	*Pelargopsis capensis*	Stork-billed kingfisher	LC		Y	
Alcedinidae	*Todirhamphus chloris*	Collared kingfisher	LC		Y	
Bucerotidae	*Aceros corrugatus*	Wrinkled hornbill	NT	II	Y	
Bucerotidae	*Anorrhinus galeritus*	Bushy-crested hornbill	LC	II	Y	
Bucerotidae	*Anthracoceros albirostris*	Oriental Pied Hornbill	LC	II	Y	
Bucerotidae	*Anthracoceros malayanus*	Asian black hornbill	NT	II	Y	
Bucerotidae	*Buceros rhinoceros*	Rhinoceros hornbill	NT	II	Y	
Bucerotidae	*Buceros vigil*	Helmeted hornbill	CR	I	Y	
Coraciidae	*Eurystomus orientalis*	Asian Dollarbird	LC			
CORACIIFORMES						
Meropidae	*Merops philippinus*	Blue-tailed bee-eater	LC			
Meropidae	*Merops viridis*	Blue-throated bee-eater	LC			
Trogonidae	*Harpactes diardii*	Diard's trogon	NT		Y	
Trogonidae	*Harpactes duvaucelii*	Scarlet rumped trogon	NT		Y	
Trogonidae	*Harpactes kasumba*	Red-naped trogon	NT		Y	
PICIFORMES						
Picidae	*Blythipicus rubiginosus*	Maroon woodpecker	LC			
Picidae	*Dendrocopos moluccensis*	Sunda woodpecker	LC			
Picidae	*Dendrocopus canicapillus*	Grey capped woodpecker	LC			
Picidae	*Dinopium rafflesii*	Olive-backed woodpecker	NT			
Picidae	*Dryocopus javensis*	White-bellied woodpecker	LC	I		
Picidae	*Hemicircus concretus*	Grey and buff woodpecker	LC			
Picidae	*Meiglyptes grammithorax*	Buff-rumped woodpecker	LC			
Picidae	*Meiglyptes tukki*	Buff-necked woodpecker	NT			
Picidae	*Mulleripicus pulverulentus*	Great slaty woodpecker	LC			
Picidae	*Picus puniceus*	Crimson-winged woodpecker	LC			
Picidae	*Reinwardtipicus validus*	Orange-backed woodpecker	LC			
Picidae	*Sasia abnormis*	Rufous piculet	LC			
Ramphastidae	*Calorhamphus fuliginosus*	Brown barbet	LC			

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
Ramphastidae	*Megalaima australis*	Blue-eared barbet	LC			
Ramphastidae	*Megalaima rafflesii*	Red-crowned barbet	NT			
PASSERIFORMES						
Aegithinidae	*Aegithina tiphia*	Common iora	LC			
Aegithinidae	*Aegithina viridissima*	Green iora	NT			
Artamidae	*Artamus leucorynchus*	White breasted woodswallow	LC			
Campephagidae	*Coracina fimbriata*	Lesser cuckooshrike	LC			
Campephagidae	*Coracina striata*	Bar-bellied cuckooshrike	LC			
Campephagidae	*Pericrocotus flammeus*	Scarlet minivet	LC			
Campephagidae	*Pericrocotus igneus*	Fiery minivet	NT			
Chloropseidae	*Chloropsis cyanopogon*	Lesser green leafbird	NT			
Chloropseidae	*Chloropsis sonnerati*	Greater green leafbird	LC			
Cisticolidae	*Orthotomus ruficeps*	Ashy tailorbird	LC			
Cisticolidae	*Orthotomus sericeus*	Rufous-tailed tailorbird	LC			
Cisticolidae	*Prinia flaviventris*	Yellow-bellied prinia	LC			
Corvidae	*Corvus enca*	Slender-billed crow	LC			
Corvidae	*Platysmurus leucopterus*	Black Magpie	NT			
Dicaeidae	*Dicaeum cruentatum*	Scarlet-backed flowerpecker	LC			
Dicaeidae	*Dicaeum trigonostigma*	Orange-bellied flowerpecker	LC			
Dicaeidae	*Prionchilus percussus*	Crimson breasted flowerpecker	LC			
Dicaeidae	*Prionochilus maculatus*	Yellow-breasted flowerpecker	LC			
Dicaeidae	*Prionochilus thoracicus*	Scarlet-breasted flowerpecker	NT			
Dicruridae	*Dicrurus paradiseus*	Greater racket-tailed drongo	LC			
Estrildidae	*Lonchura fuscans*	Dusky munia	LC			Y
Estrildidae	*Lonchura Malacca*	Black-headed Munia	LC			
Eurylaimidae	*Calyptomena viridis*	Asian Green broadbill	NT			
Eurylaimidae	*Cymbirhynchus macrorhynchos*	Black and red broadbill	LC			
Eurylaimidae	*Eurylaimus javanicus*	Banded broadbill	LC			
Eurylaimidae	*Eurylaimus ochromalus*	Black and yellow broadbill	NT			

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
Hirundinidae	*Hirundo rustica*	Barn swallow	LC			
Hirundinidae	*Hirundo tahitica*	Pacific swallow	LC			
Incertae	*Hemipus hirundinaceus*	Black-winged flycatcher shrike	LC			
Incertae	*Philentoma pyrhopterum*	Rufous-winged philentoma	LC			
Irenidae	*Irena puella*	Asian fairy-bluebird	LC			
Laniidae	*Lanius schach*	Long-tailed shrike	LC			
Monarchidae	*Hypothymis azurea*	Black naped monarch	LC			
Monarchidae	*Terpsiphone paradisi*	Asian paradise flycatcher	LC			
Muscicapidae	*Copcychus malabaricus*	White-rumped shama	LC			
Muscicapidae	*Copcychus saularis*	Magpie robin	LC			
Muscicapidae	*Muscucapadauurica*	Asian brown flycatcher				
Muscicapidae	*Pycnonotus goiavier*	Yellow vented bulbul	LC			
Muscicapidae	*Rhinomyias umbratilis*	Grey-chested jungle-flycatcher	NT			
Muscicapidae	*Trichixos pyrrhopygus*	Rufous tailed shama	NT			
Nectarinidae	*Aethopyga siparaja*	Crimson sunbird			Y	
Nectarinidae	*Anthreptes malacensis*	Plain throated sunbird	LC		Y	
Nectarinidae	*Anthreptes rhodolaema*	Red-throated sunbird	NT		Y	
Nectarinidae	*Anthreptes singalensis*	Ruby cheeked sunbird	LC		Y	
Nectarinidae	*Arachnothera longirostra*	Little spiderhunter	LC		Y	
Nectarinidae	*Arachnothera sp.*	Spiderhunter sp.			Y	
Nectarinidae	*Hypogramma hypogrammicum*	Purple-naped sunbird	LC		Y	
Nectarinidae	*Nectarinia jugularis*	Olive-backed sunbird	LC		Y	
Nectarinidae	*Nectarinia sperata*	Purple throated sunbird	LC		Y	
Oriolodae	*Oriolus xanthonotus*	Dark-throated oriole	NT			
Pachycephalidae	*Pachycephala grisola*	Mangrove whistler	LC			
Passeridae	*Passer montanus*	Eurasian tree sparrow	LC			
Pittidae	*Pitta granatina*	Garnet pitta	NT		Y	
Pityriaseidae	*Pityriasis gymnocephala*	Bornean bristlehead	NT			Y
Pycnonotidae	*Pycnonotus atriceps*	Black headed bulbul	LC			

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
Pycnonotidae	*Pycnonotus simplex*	Cream vented bulbul	LC			
Pycnonotidae	*Setornis criniger*	Hook-billed bulbul	VU			
Rhipiduridae	*Rhipidura javanica*	Pied fantail	LC		Y	
Sittidae	*Sitta frontalis*	Velvet-fronted nuthatch	LC			
Sturnidae	*Gracula religiosa*	Hill mynah	LC	II		
Sturnidae	*Acridotheres javanicus*	Javan mynah	LC			
Timaliidae	*Macronous gularis*	Pin striped tit babbler	LC			
Timaliidae	*Macronous ptilosus*	Fluffy-backed tit babbler	NT			
Timaliidae	*Macronous bornensis*	Bold-striped Tit-Babbler	LC			
Timaliidae	*Malacocincla malaccensis*	Short-tailed babbler	NT			
Timaliidae	*Malacopteron affine*	Sooty capped babbler	NT			
Timaliidae	*Malacopteron cinereum*	Scaly crowned babbler	LC			
Timaliidae	*Malacopteron magnum*	Rufous crowned babbler	NT			
Timaliidae	*Pellorneum capistratum*	Black-capped babbler	LC			
Timaliidae	*Stachyris erythroptera*	Chestnut winged babbler	LC			
Timaliidae	*Stachyris maculata*	Chestnut rumped babbler	NT			
Timaliidae	*Stachyris nigricollis*	Black throated babbler	NT			
Timaliidae	*Trichastoma rostratum*	White-chested babbler	NT			

3. Herpetofauna (reptiles and amphibians)

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
REPTILIA						
SQUAMATA						
Agamidae	*Bronchocela cristatella*	Green-crested lizard				
Agamidae	*Draco quinquefasciatus*	Flying lizard				
Colubridae	*Ahaetulla fasciolata*	Banded vine snake				
Colubridae	*Ahaetulla prasina*	Green vine snake				
Colubridae	*Boiga jaspidea*	Jasper cat snake				
Colubridae	*Chrysopelea paradisi*	Paradise tree snake				

Colubridae	*Dendrelaphis caudolineatus*	Striped bronze-back				
Colubridae	*Dendrelaphis formosus*	Elegant bronze-back				
Colubridae	*Dendrelaphis pictus*	Painted bronze-back				
Colubridae	*Homalopsis buccata*	Puff-faced water snake				
Colubridae	*Oligodon octolineatus*	Striped kukri snake				
Colubridae	*Psammodynastes pictus*	Painted mock viper				
Colubridae	*Rhabdophis chrysargos*	Speckle-bellied Keelback				
Colubridae	*Stegonotus borneensis*	Bornean black snake				Y
Colubridae	*Xenelaphis hexagonotus*	Malayan brown snake				
Crotalinae	*Trimeresurus sumatranus*	Sumatran pit viper				
Crotalinae	*Tropidolaemus wagleri*	Waglers pit viper				
Cylindrophiidae	*Cylindrophis ruffus*	Red tailed pipe snake				
Elapidae	*Bungarus flaviceps*	Yellow-headed Krait				
Elapidae	*Maticora bivirgata/Calliophi bivirgatus*	Blue Malaysian coral snake				
Elapidae	*Naja sumatrana*	Sumatran cobra				
Elapidae	*Ophiophagus hannah*	King Cobra				
Gekkonidae	*Cyrtodactylus pubisulcus*	Inger's bow-fingered gecko				Y
Gekkonidae	*Gekko smithii*	Forest gecko				
Gekkonidae	*Hemidactylus frenatus*	House gecko				
Pythonidae	*Python reticulatus*	Reticulated python		II		
Scincidae	*Dasia vittatum*	Banded tree skink				
Scincidae	*Dasia/Lamprolepis group*	Skink sp.				
Scincidae	*Lygosoma sp. (sens. lat.)*	Skink sp.				
Scincidae	*Mabuya multifasciata / Rubis complex*	Skink sp.				
Scincidae	*Sphenomorphus sp.*	Skink sp.				
Varanidae	*Varanus salvator*	Monitor lizard			Y	
Xenopeltidae	*Xenopeltis unicolor*	Iridescent earth snake				
CROCODILIA						
Crocodylidae	*Crocodylus porosus / raninus*	Estuarine / Bornean crocodile			Y	
Crocodylidae	*Tomistoma schlegelii*	Malayan/False Gharial	VU	I/w	Y	

TESTUDINES						
Bataguridae	*Orlitia borneensis*	Bornean river turtle	EN	II	Y	Y
Geoemydidae	*Cuora amboinensis*	South Asian box turtle	VU	II		
Geoemydidae	*Cyclemys dentata*	Asian Leaf Turtle	NT			
Geoemydidae	*Heosemys spinosa*	Spiny/sunburst turtle	EN	II		
Trionychidae	*Amyda cartilaginea*	South Asian softshell turtle	VU	II		
Trionychidae	*Pelochelys bibroni*	Asian Giant Softshell Turtle	VU	II		
ANURA						
Bufonidae	*Pseudobufo subasper*	Aquatic swamp toad				
Ranidae	*Meristogenys phaeomerus*	Brown torrent frog				Y
Ranidae	*Paramacrodon / Malesianus* sp.	Unknown				
Rhacophoridae	*Polypedates colletti*	Collett's Tree Frog	LC			
Rhacophoridae	*Polypedates leucomystax*	Four-lined Tree Frog	LC			
Rhacophoridae	*Polypedates macrotis*	Darl-eared Tree Frog	LC			
Rhacophoridae	*Racophorus spp.*	Tree frog spp.				

4. Fish

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
RAJIFORMES						
Dasyatidae	*Himantura signifer*					
OSTEOGLOSSIFORMES						
Osteoglossidae	*Scleropages formosus*			Y		
Notopteridae	*Noptopterus borneensis*	Pipih				
CYPRINIFORMES						
Cyprinidae	*Barbodes gonionotus*					
Cyprinidae	*Barbodes schwanenfeldii*					
Cyprinidae	*Cyclocheilichthys apogon*					
Cyprinidae	*Cyclocheilichthys armatus*					
Cyprinidae	*Cyclocheilichthys enoplos*					

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
Cyprinidae	*Cyclocheilichthys janthochir*	Saluang				
Cyprinidae	*Cyclocheilichthys repasson*					
Cyprinidae	*Cyprinus carpio*	Ikan mas				
Cyprinidae	*Epalzeorhynchos kalopterus*					
Cyprinidae	*Hampala bimaculata*					
Cyprinidae	*H. macrolepidota*					
Cyprinidae	*Labiobarbus festivus*					
Cyprinidae	*Labiobarbus ocellatus*					
Cyprinidae	*Lobocheilos falcifer*	Ikan mas				
Cyprinidae	*Luciosoma trinema*					
Cyprinidae	*Osteochilus melanoptera*					
Cyprinidae	*Osteochilus triporos*					
Cyprinidae	*Osteochilus sclegelii*					
Cyprinidae	*Pectenocypris balaena*					
Cyprinidae	*Pectenocypris balaena*					
Cyprinidae	*Puntioplites waandersi*					
Cyprinidae	*Rasbora borneensis*					
Cyprinidae	*Rasbora caudimaculata*					
Cyprinidae	*Rasbora cephalotaenia*	cf. saluang				
Cyprinidae	*Tor tambra*					
Cyprinidae	*Rasbora kalochroma*					
Balitoridae	*Homaloptera ocellata*					
Balitoridae	*Nemacheilus* sp.					
Balitoridae	*Neohomalopter johorensis*	Tjajiu				
SILURIFORMES						
Bagridae	*Botia hymenophysa*					
Bagridae	*Botia macrocanthus*					
Bagridae	*Bagrichthys macracanthus*					

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
Bagridae	*Bagroides melapterus*	Kasak pisang				
Bagridae	*Leiocassis myersi*					
Bagridae	*Leiocassis stenomus*					
Bagridae	*Mystus gulio*					
Bagridae	*Mystus micracanthus*					
Bagridae	*Mystus nemurus*					
Bagridae	*Mystus olyroides*					
Bagridae	*Mystus nigriceps*					
Bagridae	*Mystus wyckii*					
Bagridae	*Mystus olyroides*	Darap				
Bagridae	*Mystus wyckii*	Baung				
Siluridea	*Belodontichthys dinema*	Bamban				
Siluridea	*Hemisilurus heterorhynchus*	Lais				
Siluridea	*Kryptopterus apogon*	Lais				
Siluridea	*Kryptopterus limpok*	Sirang bulu				
Siluridea	*Kryptopterus macrocephalus*	Sirang bulu				
Siluridea	*Kryptopterus parvanalis*					
Siluridea	*Ompok eueneiatus*					
Siluridea	*Silurichthys hasseltii*					
Siluridea	*Wallago leeri*	Tampatnas				
Pangasiidae	*Heliocophagus waandersii*					
Pangasiidae	*Laides hexanema*					
Pangasiidae	*Pangasius lithostoma*	Patin				
Pangasiidae	*Pangasius nasutus*	Rariu				
Clariidae	*Clarias meladerma*	Pentet pendeck				
Clariidae	*Clarias nieuhofii*	Pentet panjang				
Clariidae	*Clarias teijsmanni*					
Clariidae	*Encheloclarias tapeinopterus*	Pentet panjang				

Order / Family	Latin Name	English name	IUCN	CITES	Protected	Endemic
Ariidae	*Hemiarius stormii*					
CYPINODONTIFORMES						
Hemiramphidae	*Dermogenys weberi*					
Hemiramphidae	*Hemirhamphodon chrysopunctatus*	Jenjulung				
ANTHERINIFORMES						
Telmatherinidae	*Telmatherina ladigesi*					
SYNGNATHIFORMES						
Syngnathidae	*Doryichthys sp.*					
SYNBRANCHIFORMES						
Synbranchidae	*Monopterus albus*					
PERCIFORMES						
Centropomidae	*Lates calcarifer*					
Chandidae	*Ambassis nalua*					
Lutjanidae	*Coius microlepis*					
Lutjanidae	*Coius quadrifasciatu*					
Toxotidae	*Toxotes jaculatrix*					
Toxotidae	*Toxotes microlepis*					
Nandidae	*Nandus nebulosus*	Tatawun				
Pristolepididae	*Pristolepis grootii*	Pantung				
Pomacentridae	*Pomacentrus taeniometopon*					
Mugiloidae	*Liza macrolepis*					
Mugiloidae	*Liza parmata*					
Polynemidae	*Polynemus borneensis*					
Eleotrididae	*Ophieleotris aporos*					
Eleotrididae	*Oxyeleotris marmorata*					
Eleotrididae	*Oxyeleotris urophthalmoides*					
Gobiidae	*Periophalmodon septemradiatus*					
Luciocephalidae	*Luciocephalus pulcher*	Lanjulung				

Order / Family	Latin Name	English name	IUCN	CITES	Protecte d	Endemic
Helostomatidae	*Helostoma temminickii*	Tabakan				
Anabantidae	*Anabas testudineus*	Bapuyu				
Belontidae	*Belontia hasselti*	Kakapar				
Belontidae	*Betta akarensis*	Tempala				
Belontidae	*Betta anabatoides*	Tempala				
Belontidae	*Betta edithae*	Tempala				
Belontidae	*Betta foerschi*	Tempala				
Belontidae	*Sphaerichthys vaillanti*	Sapat layang				
Belontidae	*Sphaerichthys selatanensis*	Sapat				
Belontidae	*Trichogaster leerii*	Sapat				
Belontidae	*Trichogaster pectoralis*	Sesapat				
Belontidae	*Trichogaster trichopterus*	Sapat				
Channidae	*Channa bankanensis*	Miyau				
Channidae	*Channa cyanospilos*					
Channidae	*Channa gachua*					
Channidae	*Channa lucius*	Kihung				
Channidae	*Channa maruliodes*					
Channidae	*Channa melasoma*	Peyang				
Channidae	*Channa micropeltes*	Tahuman				
Channidae	*Channa pleurophthalmus*	Karandang				
Channidae	*Channa striata*	Behau				
Mastacembelidae	*Macrognathus maculates*	Telan				
Mastacembelidae	*Mastacembelus unicolor*	Jajili				
TETRAODONTIFORMES						
Tetraodontidae	*Chonerhinos modestrus*					
Tetraodontidae	*Tetraodon biocellatus*					

5. Plants

Order / Family	Latin Name	Local name(s)	IUCN	CITES	Protected	Endemic
Anacardiaceae	*Bouea oppositofolia*	Tamehas				
Anacardiaceae	*Buchanania cf. arborescens*	Kenyem Burung/Sangeh				
Anacardiaceae	*Campnosperma auriculatum*	Hantangan				
Anacardiaceae	*Campnosperma coriaceum*	Terantang				
Anacardiaceae	*Campnosperma squamatum*	Nyating				
Anacardiaceae	*Mangifera* sp.	Binjai	VU			
Anisophyllaceae	*Combretocarpus rotundatus*	Tumih	VU			
Annonaceae	*Artobotrys cf. roseus*	Kalalawit hitam				
Annonaceae	*Artobotrys suaveolins*	Bajakah balayan				
Annonaceae	*Cyathocalyx biovulatus*	Kerandau				
Annonaceae	*Cyathocalyx* sp.	Kerandau				
Annonaceae	*Fissistigma* sp.	Unknown				
Annonaceae	*Polyalthia glauca*	Kayu Bulan				
Anonnaceae	*Polyalthia hypoleuca*	Alulup/Saluang/Banitan				
Anonnaceae	*Polyalthia sumatrana*	Alulup/Saluang/Banitan				
Anonnaceae	*Mezzetia leptopoda / parviflora*	Pisang-pisang besar/Mahabai-mahabai				
Anonnaceae	*Mezzetia umbellata*	Pisang-pisang kecil/Mahabai				
Annonaceae	*Xylopia coriifolia*	Nonang				
Anonnaceae	*Xylopia fusca*	Jangkang kuning/Jangkar/Rahanjang				
Annonaceae	*Xylopia cf. malayana*	Tagula				
Apocynaceae	*Alstonia scholoris*	Pulai/Palawi				
Apocynaceae	*Alyxia* sp.	Bajakah kelanis/Pulas santan				
Apocynaceae	*Dyera lowii / polyphylla*	Jelutung/Pantung	VU			
Apocynaceae	*Parameria* sp.	Unknown				
Apocynaceae	*Willughbea* sp.	Bajakah dango				
Aquifoliaceae	*Ilex cymosa*	Unknown				
Aquifoliaceae	*Ilex hypoglauca / wallichi*	Sumpung/Kambasira				
Aquifoliaceae	*Ilex* sp.	Unknown				

Order / Family	Latin Name	Local name(s)	IUCN	CITES	Protected	Endemic
Araceae	*cf. Anthurium* sp.	Lampuyang				
Araceae	*Raphidophora* sp.	Unknown				
Araliaceae	*Schleffera* sp.	Sapahurung				
Arecaceae (*Palmae*)	*Calamus* sp.	Uey liling				
Arecaceae (*Palmae*)	*Calamus* sp. *cf. caesius*	Uey Sigi				
Arecaceae (*Palmae*)	*Calamus* sp. *cf. trachycoleus*	Uey Irit				
Arecaceae (*Palmae*)	*Korthalsia hispida*	Uwei ahaas/Rotan ahas				
Arecaceae (*Palmae*)	*Korthalsia* sp.	Uey paka				
Palmae	*Pinanga* sp.	Pinang Jouy				
Arecaceae (*Palmae*)	*Salacca* sp.	Salak hutan/Lokip				
Asclepiadaraceae	*Astrostemma spartioides*	Anggrek Rangau				
Asclepiadaraceae	*Dischidia cf. latifolia*	Unknown				
Asclepiadaraceae	*Dischidia* sp.	Bajakah Tapuser				
Asclepiadaraceae	*Hoya* sp.	Unknown				
Asparagaceae	*Dracaena* sp.	Akar tewu kaak				
Blechnaceae	*Stenochlaena palustri*	Kalakai				
Burseraceae	*Canarium* sp.	Geronggang Putih	VU			
Burseraceae	*Santiria cf. laevigata*	Irat/ Kayu kacang				
Burseraceae	*Santiria griffithii*	Teras bamban/ Roko-roko	LR/NT			
Burseraceae	*Santiria* spp.	Gerrongang Putih/ Hampuak				
Celastraceae	*Kokoona* sp.	Bunga-bunga/Culokut				
Celesteraceae	*Lophopetalum* sp.	Mahuwi				
Chrysobalanaceae	*Licania splendens*	Bintan				
Clusiaceae (*Guttiferae*)	*Calophyllum hosei*	Jinjit/Bintangor/Nangka-nangka				
Clusiaceae (*Guttiferae*)	*Callophyllum sclerophyllum*	Kapurnaga jangkar				
Clusiaceae (*Guttiferae*)	*Calophyllum soulattri*	Takal				
Clusiaceae (*Guttiferae*)	*Calophyllum* sp.	Kapurnaga Kalakei				
Clusiaceae (*Guttiferae*)	*Calophyllum* sp.	Mahadingan				
Clusiaceae (*Guttiferae*)	*Calophyllum* sp.	Kapurnaga/Kapur naga				

Order / Family	Latin Name	Local name(s)	IUCN	CITES	Protected	Endemic
Clusiaceae (*Guttiferae*)	*Calophyllum* sp.	Mahadingan/Parut				
Clusiaceae (*Guttiferae*)	*Calophyllum* sp.	Kapurnaga laut/Meranti putih				
Clusiaceae (*Guttiferae*)	*Garcinia bancana*	Manggis				
Clusiaceae (*Guttiferae*)	*Garcinia* sp.	Aci/ Gandis				
Clusiaceae (*Guttiferae*)	*Garcinia* sp.	Manggis/Gantalang				
Clusiaceae (*Guttiferae*)	*Garcinia* sp.	Aci/Mahalilis				
Clusiaceae (*Guttiferae*)	*Garcinia* sp.	Gantalan				
Clusiaceae (*Guttiferae*)	*Garcinia* sp.	Mahalilis				
Clusiaceae (*Guttiferae*)	*Garcinia* sp. *cf. parvifolia*	Gandis				
Clusiaceae (*Guttiferae*)	*Garcinia* sp. *cf. hombroniana*	Unknown				
Clusiaceae (*Guttiferae*)	*Mesua* sp.	Tabaras akar tinggi/Nangka-nangka				
Combretaceae	*Combretum* sp.	Bajakah Tampelas ?				
Crypteroniaceae	*Dactylocladus stenostachys*	Mertibu				
Cyperaceae	*Thoracostachyum bancanum*	Unknown				
Dipterocarpaceae	*cf. Anisoptera* sp.	Keruing Sabun				
Dipterocarpaceae	*Cotylebium cf. lanceolatum*	Rasak Galeget				
Dipterocarpaceae	*Cotylebium melanoxylon*	Unknown				
Dipterocarpaceae	*Dipterocarpus borneensis*	Keruwing/Nangka-nangka				
Dipterocarpaceae	*Shorea balangeran*	Kahui	CR			
Dipterocarpaceae	*Shorea crassa*	Unknown				
Dipterocarpaceae	*Shorea platycarpa*	Meranti				
Dipterocarpaceae	*Shorea teysmanianna*	Meranti semut/Bunga/Karamunting	EN			
Dipterocarpaceae	*Shorea uliginosa*	Meranti batu/Bijai/Bajang	VU			
Dipterocarpaceae	*Vatica mangachopai*	Rasak Napu				
Ebenaceae	*Diospyros bantamemsis*	Malam-malam/Kacapuri				
Ebenaceae	*Diospyros cf. evena*	Gulung haduk/Ehang/Uwar ehang				
Ebenaceae	*Diospyros confertiflora*	Arang				
Ebenaceae	*Diospyros lanceifolia*	Arang				
Ebenaceae	*Diospyros siamang*	Ehang				

Order / Family	Latin Name	Local name(s)	IUCN	CITES	Protected	Endemic
Ebenaceae	*Diospyros* sp.	Kayu Arang Apui				
Ebenaceae	*Diospyros* sp.	Arang				
Elaeocarpaceae	*Elaeocarpus acmocarpus*	Patanak				
Elaeocarpaceae	*Elaeocarpus cf. griffithi*	Rarumpuit				
Elaeocarpaceae	*Elaeocarpus marginatus*	Kejinjing				
Elaeocarpaceae	*Elaeocarpus mastersii*	Mangkinang/ Rimai/Sangeh				
Elaeocarpaceae	*Elaeocarpus* sp.	Patanak galeget/Bangkinang tikus/Hampuak				
Elaeocarpaceae	*Elaeocarpus* sp.	Pasir Payau				
Elaeocarpaceae	*Elaeocarpus* sp.	Ampaning Nyatu				
Euphorbiaceae	*Antidesma coriaceum*	Dawat/Mata undang				
Euphorbiaceae	*Antidesma phanerophe*	Matan undang				
Euphorbiaceae	*Antidesma* sp.	Matan undang/Asam				
Euphorbiaceae	*Baccaurea bracteata*	Rambai hutan daun besar/Hampuak				
Euphorbiaceae	*Baccaurea stipulata*	Kayu Tulang				
Euphorbiaceae	*Blumeodendron elateriospermum*	Kenari/ Kerandau				
Euphorbiaceae	*Cephalomappa* sp.	Karandau putih/Jangkang				
Euphorbiaceae	*Cephalomappa* sp.	Karandau putih/Sarakat/Tempurung				
Euphorbiaceae	*Glochidion cf glomerulatum*	(Buah) Bintang/Gandis				
Euphorbiaceae	*Glochidion* sp.	Rasak				
Euphorbiaceae	*Macaranga* sp.	Mahang Batu				
Euphorbiaceae	*Maccaranga caladiifolia*	Mahang bitik/Sumut				
Euphorbiaceae	*Neoscortechinia forbesii*	Kerandau putih				
Euphorbiaceae	*Neoscortechinia kingii*	Pupu pelanduk/Sarakat				
Euphorbiaceae	*Pimelodendron griffithianum*	Unknown				
Fabaceae (*Leguminosae*)	*Adenanthera pavonina*	Tapanggang/Bure-bure				
Fabaceae (*Leguminosae*)	*Archidendron borneensis*	Kacing Nyaring				

Order / Family	Latin Name	Local name(s)	IUCN	CITES	Protected	Endemic
Fabaceae (*Leguminosae*)	*Dalbergia* sp.	Unknown				
Fabaceae (*Leguminosae*)	*Dialium patens*	Kala Pimping Napu				
Fabaceae (*Leguminosae*)	*Dialium* sp.	Roko-roko				
Fabaceae (*Leguminosae*)	*Koompassia malaccensis*	Bangaris	LC			
Fabaceae (*Leguminosae*)	*Leucomphalos callicarpus*	Bajakah tampelas				
Fabaceae (*Leguminosae*)	*Ormosia* sp.	Unknown				
Fabaceae (*Leguminosae*)	*Pithecellobium clypearia*	Tabure/Tapanggang/Sabure				
Fagaceae	*Castanopsis foxworthyii / jaherii*	Takurak				
Fagaceae	*Lithocarpus conocarpus*	Pampaning Bayang				
Fagaceae	*Lithocarpus rassa*	Pampaning				
Fagaceae	*Lithocarpus* sp.	Pampaning Bayang Buah Besar				
Fagaceae	*Lithocarpus* sp.	Pampaning Suling				
Fagaceae	*Lithocarpus* sp. *cf. dasystachys*	Pampaning Bitik/Putar-putar				
Fagaceae	*Lithocarpus spp.*	Pampaning				
Flagellariaceae	*Flagellaria* sp.	Uey Namei				
Gesneraceae	*Aeschynanthus* sp.	Unknown				
Gnetaceae	*Gnetum* sp.	Bajakah Luaa				
Gnetaceae	*Gnetum* sp.	Oto Oto				
Hypericaceae	*Cratoxylon arborescens*	Geronggang				
Hypericaceae	*Cratoxylum glaucum*	Garunggaang merah				
Icacinaceae	*Platea exelsa*	Kambalitan/Jangkar				
Icacinaceae	*Platea* sp.	Lampesu				

Order / Family	Latin Name	Local name(s)	IUCN	CITES	Protected	Endemic
Icacinaceae	*Stemonurus scorpiodes* / spp.	Tabaras/Sarakat/Tempurung/Otak udang				
Icasinaceae	*Stemonorus secondiflorus*	Tabaras yang tdk punya akar				
Icasinaceae	*Stemonorus* sp.	Tabaras				
Lauraceae	*Actinodaphne* sp.	Unknown				
Lauraceae	*Alseodaphne coreacea*	Gemor				
Lauraceae	*Cinnamomum* sp. *cf. sintoc*	Sintok				
Lauraceae	*Crypthocarya* sp.	Tampang/Medang				
Lauraceae	*Litsea / Crytocaria* sp.	Tampang/Kayu bulan				
Lauraceae	*Litsea / Crytocaria* sp.	Tampang/Pirawas				
Lauraceae	*Litsea cf. elliptica*	Medang (Species Medang)				
Lauraceae	*Litsea cf. rufo-fusca*	Tampang				
Lauraceae	*Litsea grandis*	Medang /Tabitik/ Katiau				
Lauraceae	*Litsea ochrea*	Unknown				
Lauraceae	*Litsea* sp.	Medang/Gula-gula				
Lauraceae	*Litsea* sp.	Medang				
Lauraceae	*Litsea* sp.	Medang/Katiau				
Lauraceae	*Litsea* sp.	Tampang				
Lauraceae	*Litsea* sp. *cf. resinosa*	Medang Marakuwung				
Lauraceae	*Nothaphoebe* sp.	Medang				
Lauraceae	*Phoebe* sp. *cf. grandis*	Tabitik/Madang				
Lecythidaceae	*Barringtonia longisepala*	Katune/Putat				
Lecythidaceae	*Barringtonia* sp.	Katune/Putat				
Liliaceae	*Hanguana malayana*	Bakong himba/Bakung				
Linaceae	*Ctenolophon parvifolius*	Kayu Cahang/Kalepek				
Loganiaceae	*Fragraea accuminatisma*	Unknown				
Loganiaceae	*Fragraea* sp.	Bajakah kalamuhe				
Loranthaceae	*Dendrophtoe incurvata*	Unknown				
Loranthaceae	*Lepidaria* sp.	Mentawa				
Magnoliaceae	*Magnolia bintulensis*	Medang limo/Asam-asam				

Order / Family	Latin Name	Local name(s)	IUCN	CITES	Protected	Endemic
Melastomataceae	*Melastoma malabathricum*	Karamunting				
Melastomataceae	*Melastoma* sp.	Karamunting Danum				
Melastomataceae	*Memecylon* sp.	Tabati/ Nasi-nasi				
Melastomataceae	*Memecylon* sp.	Tabati himba/Bati-bati				
Melastomataceae	*Memecylon* sp.	Milas daun kecil/Galam tikus				
Melastomataceae	*Memecylon* sp.	Tabati himba/Ubar merah				
Melastomataceae	*Pternadra* sp.	Kambusulan				
Melastomataceae	*Pternandra cf. coerulescens*	Kemuning yg bergaris tiga				
Meliaceae	*Aglaia rubiginosa*	Kajalaki	LR/NT			
Meliaceae	*Aglaia* sp.	Bangkuang Napu	LR/NT/VU			
Meliaceae	*Chisocheton amabilis*	Bunga matahari/Babaka				
Meliaceae	*Chisocheton* sp.	Bunga matahari				
Meliaceae	*Chisocheton* sp.	Mariuh				
Meliaceae	*Chisocheton* sp.	Latak Manuk				
Meliaceae	*Sandoricum beccanarium*	Papong				
Menispermaceae	*Fibraurea tinctoria*	Bajakah kalamuhe				
Moraceae	*Ficus cf. spathulifolia*	Lunuk Punai				
Moraceae	*Ficus cf. stupenda*	Lunuk Tingang				
Moraceae	*Ficus deltoidea*	Lunuk/Tabat barito				
Moraceae	*Ficus* sp.	Lunuk buhis				
Moraceae	*Ficus* sp.	Lunuk tabuan				
Moraceae	*Ficus* sp.	Sasendok				
Moraceae	*Ficus* sp.	Lunuk sasendok				
Moraceae	*Ficus* sp.	Lunuk Bunyer				
Moraceae	*Ficus* sp.	Lunuk Sambon				
Moraceae	*Ficus* sp.	Lunuk				
Moraceae	*Ficus* spp.	Lunuk				
Moraceae	*Parartocarpus venenosus*	Tapakan/lilin-lilin				
Myristicaceae	*Gymnacranthera farquhariania*	Mendarahan daun kecil				

Order / Family	Latin Name	Local name(s)	IUCN	CITES	Protected	Endemic
Myristicaceae	*Gymnacranthera* sp.	Mandarahan /Darah-darah				
Myristicaceae	*Horsfieldia crassifolia*	Mendarahan daun besar /Dara-dara	LR/NT			
Myristicaceae	*Knema intermedia*	Karandau merah /Latak manuk / jangkang	LR/NT			
Myristicaceae	*Knema* sp.	Mendarahan daun kecil /Kayu daha	LR/NT/VU			
Myristicaceae	*Myristica lowiana*	Mahadarah Hitam	LR/NT			
Myrsinaceae	*Ardisia cf. sanguinolenta*	Kalanduyung himba				
Myrsinaceae	*Ardisia* sp.	Kamba Sulan				
Myrsinaceae	*cf. Rapanea borneensis*	Mertibu				
Myrtaceae	*Eugenia spicata*	Kayu lalas daun besar /Galam tikus				
Myrtaceae	*Syzygium caladiifolia*	Hampuak /Tatumbu				
Myrtaceae	*Syzygium cf. valevenosum*	Kayu Lalas Daun Besar				
Myrtaceae	*Syzygium clavatum*	Unknown				
Myrtaceae	*Syzygium havilandii*	Tatumbu /Ubar putih				
Myrtaceae	*Syzygium* sp.	Galam tikus				
Myrtaceae	*Syzygium* sp.	Galam tikus/ Jambu-jambu				
Myrtaceae	*Syzygium* sp.	Hampuak galeget /Ubar merah				
Myrtaceae	*Syzygium* sp.	Hampuak galeget/ Ubar putih				
Myrtaceae	*Syzygium* sp.	Milas				
Myrtaceae	*Syzygium* sp.	Kemuning Putih				
Myrtaceae	*Syzygium* sp.	Milas				
Myrtaceae	*Syzygium sp. cf. campanulatum*	Tampohot Batang /Ubar merah				
Myrtaceae	*Syzygium* sp. *Elaeocarpus spicata*	Kayu Lalas Daun Kecil				
Myrtaceae	*Syzygium sp. cf. lineatum*	Jambu Jambu				
Myrtaceae	*Syzygium sp. cf. nigricans*	Jambu Burung Kecil				
Myrtaceae	*Syzygium* sp.	Jambu Burung Kecil				
Myrtaceae	*Syzygium sp. cf. garcinifolia*	Jambu burung/ jambuan				
Myrtaceae	*Tristaniopsis obovata*	Blawan				

Order / Family	Latin Name	Local name(s)	IUCN	CITES	Protected	Endemic
Myrtaceae	*Tristaniopsis* sp.	Blawan merah				
Myrtaceae	*Tristaniopsis* sp.	Blawan punai				
Myrtaceae	*Tristaniopsis* sp.	Blawan /Plawan				
Myrtaceae	*Tristaniopsis* sp. *cf. bakhuizena*	Blawan Buhis				
Myrtaceae	*Tristaniopsis* sp. *cf. merguensis*	Blawan putih				
Myrtaceae	*Tristaniopsis whiteana*	Blawan				
Nepenthaceae	*Nepenthes ampullaria*	Pusuk kameluh/Ketupat hinut/Kantong semar	LR/NT	II	Y	
Nepenthaceae	*Nepenthes gracilis*	Ketupat hinut/Kantong semar	LR/NT	II	Y	
Nepenthaceae	*Nepenthes rafflesiana*	Ketupat hinut/kantong semar/cepet sangumang	LR/NT	II	Y	
Nephrolepiadaceae	*Nephrolepis* sp.	Paku Jampa				
Ochnaceae	*Euthemis leucarpa*	Unknown				
Ochnaceae	*Euthemis* sp.	Unknown				
Oleaceae	*Chionanthus* sp.	Unknown				
Orchidaceae	*Eria* sp.	Anggrek bawang		II		
Orchidaceae	Unknown	Pahakung		II		
Orchidaceae	Unknown	Pahakung tanduk		II		
Orchidaceae	Unknown	Anggrek garu		II		
Orchidaceae	Unknown	Anggrek hitam		II		
Orchidaceae	Unknown	Anggrek buntut naga				
Pandanaceae	*Freycinetia* sp.	Akar gerising				
Pandanaceae	*Freycinetia* sp.	Katipei Pari				
Pandanaceae	*Pandanus / Freycinetia* sp.	Gerising				
Pandanaceae	*Pandanus* sp.	Pandan				
Pandanaceae	*Pandanus* sp.	Rasau				
Pandanaceae	*Pandanus* sp.	Rasau kelep				
Pandanaceae	*Pandanus* sp.	Sambalaun				
Pandanaceae	Unknown	Lampasau				

Order / Family	Latin Name	Local name(s)	IUCN	CITES	Protected	Endemic
Piperaceae	*Piper* sp.	Sirih himba /samuang				
Piperaceae	cf. *Piper* sp.	Sirih sangahau				
Pittosporaceae	*Pittosporum* sp.	Parupuk				
Poaceae (*Palmae*)	*Metroxylon* sp.	Hambiey				
Podacarpaceae	*Dacrydium pectinateum*	Alau	LR/NT			
Polygalaceae	*Xanthophyllum ellipticum*	Kemuning				
Polygalaceae	*Xanthophyllum stipitatum*	Kemuning /Ubar putih				
Rhamnaceae	*Zizyphus angustifolius*	Bajakah karinat				
Rhamnaceae	*Zyzyphus angustifolius*	Karinat				
Rhizophoreaceae	*Cariliia brachiata*	Gandis				
Rhizophoreaceae	*Gynotroches* sp.	Kelumun				
Rubiaceae	*Canthium sp. dydimum.*	Kopi-kopi /Kayu kalalawit				
Rubiaceae	*Gardenia tubifera*	Saluang Belum /Rangda				
Rubiaceae	*Ixora havilandii*	Keranji				
Rubiaceae	*Jakiopsis ornata*	Unknown				
Rubiaceae	*Lucinea* sp.	Bajakah Tabari				
Rubiaceae	*Nauclea* sp.	Unknown				
Rubiaceae	*Timonius* sp.	Unknown				
Rubiaceae	*Uncaria* sp.	Kalalawit bahandang/ merah				
Rutaceae	*Evodia glabra*	Sagagulang				
Rutaceae	*Tetractomia tetrandra*	Rambangun /Asam-asam /Sagagulang				
Sapindaceae	*cf. Cubilia cubili*	Kahasuhuy				
Sapindaceae	*Nephellium lappaceum*	Manamun				
Sapindaceae	*Nephellium maingayi*	Kelumun Buhis /Piais / ubar putih				
Sapindaceae	*Nephellium* sp.	Kaaja				
Sapindaceae	*Pometia pinnata*	Rambutan gundul /Takasai				
Sapindaceae	*Xerospermum laevigatum*	Kelumun Bakei				
Sapotaceae	*Isonandra lanceolate*	Nyatoh Palanduk				
Sapotaceae	*Isonandra* sp.	Nyatoh Palanduk				

Order / Family	Latin Name	Local name(s)	IUCN	CITES	Protected	Endemic
Sapotaceae	*Madhuca cf. pierri*	Nyatoh Undus				
Sapotaceae	*Madhuca mottleyana*	Katiau /Kanjalaki				
Sapotaceae	*Palaquium cochlearifolium*	Nyatu gagas/ duduk / babi				
Sapotaceae	*Palaquium leiocarpum*	Hangkang				
Sapotaceae	*Palaquium pseudorostratum*	Nyatoh Bawoi				
Sapotaceae	*Palaquium* spp. *Ridleyii*	Nyatu burung				
Sapotaceae	*Planchonella cf. maingayi*	Sangkuak				
Selaginellaceae	*Selaginella* sp.	Jenis pakis /Hawok				
Simaroubaceae	*Quassia borneensis*	Kayu Takang				
Smilacaceae	*Smilax* sp.	Bajakah Tolosong				
Sterculiaceae	*Sterculia rhoiidifolia*	Loting				
Sterculiaceae	*Sterculia* sp.	Muara bungkang				
Sterculiaceae	*Sterculia* sp.	Galaga				
Tetrameristaceae	*Tetramerista glabra*	Ponak /Kayu sabun				
Theaceae	*Ploiarium alternifolium*	Asam Asam				
Theaceae	*Ternstroemia bancanus*	Tabunter				
Theaceae	*Ternstroemia hosei*	Unknown				
Theaceae	*Ternstroemia magnifica*	Tabunter				
Thymeleaeaceae	*Gonystylus bancanus*	Ramin	VU	II		
Tiliaceae	*Microcos (Grewia)* sp.	Brania Himba /Kayu saluang				
Verbenaceae	*Clerodendron* sp.	Supang				
Vitaceae	Unknown	Unknown				
Vitaceae	*Ampelocissus rubiginosa*	Bajakah Panamar Pari				
Vitaceae	*Ampelocissus* sp.	Bajakar oyang / liana anggur				
Vitaceae	Unknown	Anggur hutan				
Vitaceae	*Vitis* sp.	Anggur hutan				
Zingiberaceae	*Alpinia* sp.	Suli Batu				
Zingiberaceae	*Zingiber* sp.	Suli tulang				
Unknown	Unknown	Kalakai palanduk				

Order / Family	Latin Name	Local name(s)	IUCN	CITES	Protected	Endemic
Unknown	Unknown	Tagentu				
Unknown	Unknown	Rampiang				
Unknown	Unknown	Sirih sangumang				
Unknown	Unknown	Bari-bari				
Unknown	Unknown	Takapal				
Unknown	Unknown	Silu kelep				
Unknown	Unknown	Langkabuk				
Unknown	Unknown	Mali-mali				
Unknown	Unknown	Pasak bumi				

Appendix 2. VCS AFOLU Non-permanence risk analysis

1 Internal Risk

Project Management		
Risk Factor	Risk Factor and/or Mitigation Description	Risk Rating
a)	As described in Section 2.2.1 - B) of the PDD, the project only carries out planting of native species, in particular those adapted to wet conditions of rewetted peatland.	0
b)	While the project does enforce against possible encroachment, the impact of possible encroachment on carbon stocks is very limited not only because it is limited to small areas (less than 50% of the carbon stock) but due to the fact that encroachment does not involve commercial drainage of peatlands and hence does not significantly affect total carbon stocks on which credits are issued.	0
c)	As described in Sub-section 1.5.2 of the PDD, the project employs staff with several decades in combined experience covering all areas of expertise required. Resumes of involved staff have been made available to the validator separately.	0
d)	The management team is headquartered in Indonesia with all offices located within one day of travel from the project area. See PDD Section 1.4.	0
e)	As described in Sub-section 1.5.2 of the PDD, the project and its partners employ a range of employees who have successfully managed projects, written and managed approval (double validation) of VCS methodologies and successfully overseen the development, validation and verification, and credit issuance of numerous VCS projects as well as carbon projects under other programs. Resumes of involved staff have been made available to the validator separately.	-2
f)	Please refer to Section 6.3 and Chapter 8 of the PDD for a detailed description of the adaptive management plan.	-2
Total Project Management (PM) [as applicable, (a + b + c + d + e + f)] Total may be less than zero.		**-4**

Financial Viability		
Risk Factor	Risk Factor and/or Mitigation Description	Risk Rating
a)	n/a	0
b)	n/a	0
c)	The financial model made available to the validator confirms that the project breaks even between years 4-7 from the project start date.	1
d)	n/a	0
e)	n/a	0
f)	n/a	0
g)	n/a	0
h)	Financial resources to cover funding until break-even have been secured, as demonstrated by documents made available to the validators.	0
i)	Per the above comment, financial recourses required until breakeven have been secured and set aside.	-2
Total Financial Viability (FV) [as applicable, ((a, b, c or d) + (e, f, g or h) + i)] Total may not be less than zero.		**0**

Opportunity Cost		
Risk Factor	Risk Factor and/or Mitigation Description	Risk Rating
a)	n/a	0
b)	n/a	0
c)	n/a	0
d)	The project carried out an extended cost-benefit analysis, made available to validators, which demonstrated the net present value for the project scenario was 5% higher than that of the business as usual scenario (the most profitable alternative land-use scenario).	0
e)	n/a	0
f)	n/a	0
g)	n/a	0
h)	n/a	0
i)	n/a	0
Total Opportunity Cost (OC) [as applicable, (a, b, c, d, e or f) + (g + h or i)] Total may not be less than 0.		**0**

Project Longevity		
a)	n/a	0
b)	The project hold licenses that represent legal agreements that cover the entire project area for the entire project lifetime with the possibility of extension. (30-60/2 = 0)	0
Total Project Longevity (PL) May not be less than zero		**0**

Internal Risk	
Total Internal Risk (PM + FV + OC + PL) -4+0+0+0 Total may not be less than zero.	**0**

2 External Risks

Land Tenure and Resource Access/Impacts		
Risk Factor	Risk Factor and/or Mitigation Description	Risk Rating
a)	n/a	0
b)	As described in Section 1.4, the land ownership and resource access/use rights are held by different entities as the land is owned by the government with the project having right of use.	2
c)	No disputes exist over the project area. The process of ERC issuance takes into account possible disputes before approving the final boundary. In addition, a Memorandum of Understanding has been signed with communities around the project area.	0
d)	No disputes exist over access or use rights.	0
e)	The project area consists of a domed peatland with higher elevation (upstream) areas at the center of the project. Hence upstream areas are located at the core of the project	0

	which are largely inaccessible and without current population/impact. Therefore, there are no upstream impacts on the project. The project is not impacted by sea level.	
f)	n/a	0
g)	n/a	0
Total Land Tenure (LT) [as applicable, ((a or b) + c + d + e + f + g)] Total may not be less than zero.		**2**

Community Engagement		
Risk Factor	Risk Factor and/or Mitigation Description	Risk Rating
a)	As described in Sub-section 2.7.3 of the PDD, the project has conducted extensive stakeholder/community consultation and development programs in the project-zone villages. Approximately 11% (1262 households) of the project-zone communities located within 20 km outside of the project area boundary are found to be reliant on the area's natural resources for their livelihoods and affected by the project. All of the communities have been socialized on the Katingan Project, ecosystem restoration activities, and a variety of community development programs (see the statistics in the "Community Consultation Activity Log" file). As described in Section 6.2, there are no offsite stakeholder impacts anticipated, and only the project-zone communities rely on the project-area's natural resources.	0
b)	n/a	0
c)	As described in Section 2.2 of the PDD, the project is actively driving community development both in social and economic terms and is expected to have a net positive community impact. The project is undergoing CCB validation and verification to transparently monitor and document the community impacts it has.	-5
Total Community Engagement (CE) [where applicable, (a + b + c)] Total may be less than zero.		**-5**

Political Risk		
Risk Factor	Risk Factor and/or Mitigation Description	Risk Rating
a)	n/a	0
b)	See attached spreadsheet showing applicable scores	4
c)	n/a	0
d)	n/a	0
e)	n/a	0
f)	Indonesia is implementing REDD+ Readiness activities and Central Kalimantan, where the project is located, is a member of the Governors' Climate and Forest Taskforce (GCF).	-2
Total Political (PC) [as applicable ((a, b, c, d or e) + f)] Total may not be less than zero.		**2**

External Risk	
Total External Risk (LT + CE + PC) (2-5+2) Total may not be less than zero.	**0**

3 Natural Risks

Natural Risk (Fire)	
Significance	Fires around the project area and on the project's borders have occurred more frequently than every 10 years but have affected far less than 5% of carbon stocks as the area is mostly wet and fires only burn the surface of the peat layer. It should be noted that most all fires in the project area are anthropogenic in nature.
Likelihood	Unlikely, fires do not naturally occur on peatlands due to permanently wet conditions of the soil. Fire in peatland and peatland forest in Indonesia occur almost exclusively as a result of anthropogenic activities (Harrison, et.al 2009; Tacconi, L. 2003; Murdiyarso & Ardiningsih, 2007). Naturally occurring fires are as yet undocumented in peat swamp forest. In regions such as North America where they are recorded, such fires account for around 10% of forest fires and are typically caused by 'dry lightning' – lightning strikes in the absence of heavy rain – or from volcanic activity. The Katingan project region is unaffected by volcanic activity, and lightning strikes are almost always accompanied by heavy rainfall. Furthermore, the nature of peat swamp ecosystems, where the water table is close to the soil surface, suggests the impact of dry lightning strikes would minimal. By contrast, fires resulting from anthropogenic activities are common in the region, however their risk, impact and mitigation is considered separately (as a component of 'external' risk). Also, as described in subsection 2.2, extensive fire prevention activities are being carried out to mitigate the threat of fires.
Score (LS)	2
Mitigation	0.5

Natural Risk (Pest and Disease outbreaks)	
Significance	May have significant impact on above ground carbon stock but not in the peat layer, which is the major carbon pool.
Likelihood	No pest or disease outbreak event has been reported within peat swamp forest in Indonesia (Wiryono, 2013). The only documented event traceable within SE Asian peat swamps relates to an apparent outbreak of hairy caterpillars within a 12.000 ha stand of natural *Shorea albida* in Brunei Darussalam (Anderson 1961 in Nair, 2000), however it was not reported whether the outbreak had any detrimental effect on the trees. As a result, the likelihood and impact of pest and disease outbreaks on the natural forests of the project area are considered very low. By contrast, pest and disease outbreaks in mono-culture forest plantations are known to occur occasionally (Barber 2004; Nair & Sumardi 2000; Rimbawanto 2005; Purnomo 2006; Hardi et al 1996). Such disease outbreaks almost always occur when introduced species are grown in monoculture. For those areas of the project where replanting will occur, this will exclusively utilize mixed native species, and as a consequence, the risk and potential impact of pest and disease outbreak is considered very low.
Score (LS)	0
Mitigation	0.5

Natural Risk (Extreme Weather)	
Significance	Water table in peat swamp forest is known to be close to soil surface throughout the year, naturally flooded in rainy season (Andriesse, 1988;

	Wosten et.al., 2006a; Wosten, et.al., 2006b). Drought in peat will have less significant impact as water table is shallow, Ritzema and Wosten (2002) reported that extreme dry spell may lead to slight persistent moisture deficit and water table may drop below 1 m. However, water level record from intact peat swamp forest in Air Hitam Laut catchment, Jambi for 2003 - 2004 shows that in dry season water tables do not drop below 80 cm from soil surface (Wosten, et. al. 2006b). The only detrimental condition is that the upper layer of peat soil may become susceptible to fire, but without an external trigger fire does not occur (see comments under fire risk). There is no record that peat swamp forest trees died due to prolonged dry season, except those being damaged by wild fires. Impact on carbon stock is negligible however. The project area however is unaffected by flooding, due to its nature as a naturally rain fed water storage ecosystem, lying above the surrounding drainage. Heavy rainfall conditions actually benefit the project by ensuring water table depths are close to the peat surface, thereby reducing oxidation and fire risk. So while heavy rainfall and flooding of low lying areas remains likely within the project area, the impact is actually net positive.
Likelihood	Floods and droughts may occur less than every 10 years. Historical records (BNPB data 2015) show that flood and drought may happen yearly during the high rainfall season or prolonged dry season subsequently on the outside the project zone where it is only impacting area adjacent to river. Drought in Borneo is associated with prolonged dry season period that lasts from June to September. Peat swamp forest occurs naturally within this region however, and is fully adapted to the prolonged dry season. Flooding in the lowlands of Borneo is associated with heavy and prolonged rainfall in the wet seasons, typically October to May.
Score (LS)	0
Mitigation	0.5

Natural Risk (Geological events)	
Significance	Impact on carbon stocks would be negligible as there would be no significant impact on below ground biomass
Likelihood	The project area is unaffected by volcanoes, earthquakes or resulting tsunami. Within Indonesia such geological phenomena are closely associated with the boundary of tectonic plates. These lie primarily to the south and east of the Sundaic region (south of Sumatra, Java and the Lesser Sunda arc, east of Sulawesi and north Maluku), with major island groups blocking the passage of potential tsunamis. The project area lies within southern Borneo, which itself lies squarely on the Eurasian tectonic plate. There are no active volcanoes in Borneo (Simkin & Siebert 1994) and no historical records of major earthquakes (Hamilton & Warren 1974).
Score (LS)	0
Mitigation	1

Natural Risk (other risk)	
Significance	There are no other natural risks.
Likelihood	There are not historic records of other risk in the project area except those already stated in the above sections.
Score (LS)	0

Mitigation	1

Score for each natural risk applicable to the project (Determined by (LS × M)	
Fire (F)	1
Pest and Disease Outbreaks (PD)	0
Extreme Weather (W)	0
Geological Risk (G)	0
Other natural risk (ON)	0
Total Natural Risk (as applicable, F + PD + W + G + ON)	**1**

4 Overall Non-Permanence Risk Rating and Buffer Determination

4. 1 Overall Risk Rating

Risk Category	Rating
a) Internal Risk	0
b) External Risk	0
c) Natural Risk	1
Overall Risk Rating (a + b + c)	**1**

Per the VCS non-permanence risk tool's requirements, the project will use the minimum risk rating of 10.

4.2 Calculation of Total VCUs

The project will allocate 10% of emission reductions and removals to the VCS AFOLU Buffer Pool. See Section 6 of this report.

4.3 References

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Appendix 3. Copy of the licenses granted to PT. RMU

Copies of the licenses will be provided to the verifier upon request.

Appendix 4. Climate MRV Tracker

The Climate MRV tracker lists all parameters available at validation and/or to be monitored and their monitoring frequency as required by the VCS methodology VM0007. They are presented in an Excel format and available to validators upon request.

Appendix 5. Community MRV tracker

The Community MRV tracker lists all parameters (i.e., monitoring indicators) to be monitored by the Katingan Project and their monitoring frequency. They are presented in an Excel format and available to validators upon request.

Appendix 6. Biodiversity MRV tracker

The Biodiversity MRV tracker lists all parameters (i.e., monitoring indicators) to be monitored by the Katingan Project and their monitoring frequency. They are presented in an Excel format and available to validators upon request.

Appendix 7. STRATA CHANGES IN the BASELINE SCENARIO FOR WRC ACTIVITIES

1. Strata changes in the baseline scenario for WRC activities

From Strata	To		To		Area (ha)	Remarks
	Strata	Year	Strata	Year		
P1L0D0	P1L0D1	2011	P1L0D1AC	2011	122.94	Acacia zone
P1L0D0	P1L0D1	2011	P1L0D1AC	2023	4.81	Acacia zone
P1L0D0	P1L0D1	2011	P1L0D1AC	2025	57.99	Acacia zone
P1L0D0	P1L0D1	2011	P1L0D1AC	2026	8.99	Acacia zone
P1L0D0	P1L0D1	2011	P1L0D1AC	2028	8.20	Acacia zone
P1L0D0	P1L0D1	2011	P1L0D1AC	2029	26.69	Acacia zone
P1L0D0	P1L0D1	2011	P1L0D1AC	2030	21.47	Acacia zone
P1L0D0	P1L0D1	2011	P1L0D1AC	2031	20.83	Acacia zone
P1L0D0	P1L0D1	2011	P1L0D1AC	2017	6.38	Acacia zone
P1L0D0	P1L0D1	2011	P1L0D1AC	2018	34.86	Acacia zone
P1L0D0	P1L0D1	2011	P1L0D1AC	2019	7.97	Acacia zone
P1L0D0	P1L0D1	2023	P1L0D1AC	2025	37.28	Acacia zone
P1L0D0	P1L0D1	2023	P1L0D1AC	2026	8.54	Acacia zone
P1L0D0	P1L0D1	2025	P1L0D1AC	2026	5.98	Acacia zone
P1L0D0	P1L0D1	2029	P1L0D1AC	2031	39.06	Acacia zone
P1L0D0	P1L0D1	2013	P1L0D1AC	2026	4.57	Acacia zone
P1L0D0	P1L0D1	2013	P1L0D1AC	2031	14.47	Acacia zone
P1L0D0	P1L0D1	2013	P1L0D1AC	2032	4.31	Acacia zone
P1L0D0	P1L0D1	2013	P1L0D1AC	2016	24.51	Acacia zone
P1L0D0	P1L0D1	2013	P1L0D1AC	2017	0.42	Acacia zone
P1L0D1	P1L0D1	2011	P1L0D1AC	2032	0.11	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2011	1,566.40	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2020	947.69	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2021	298.20	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2022	745.90	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2023	1,103.90	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2024	1,014.19	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2025	608.18	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2026	1,311.44	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2027	1,636.34	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2028	2,211.90	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2029	1,708.80	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2012	1,640.12	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2030	1,958.26	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2031	832.57	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2013	1,646.38	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2014	1,635.56	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2015	1,498.39	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2016	1,155.94	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2017	578.93	Acacia zone
P1L1D0	P1L1D1	2011	P1L0D1AC	2018	1,543.15	Acacia zone

From Strata	To		To		Area (ha)	Remarks
	Strata	Year	Strata	Year		
P1L1D0	P1L1D1	2011	P1L0D1AC	2019	488.22	Acacia zone
P1L1D0	P1L1D1	2021	P1L0D1AC	2021	351.19	Acacia zone
P1L1D0	P1L1D1	2021	P1L0D1AC	2022	1,955.17	Acacia zone
P1L1D0	P1L1D1	2021	P1L0D1AC	2023	1,217.96	Acacia zone
P1L1D0	P1L1D1	2021	P1L0D1AC	2024	1,268.83	Acacia zone
P1L1D0	P1L1D1	2023	P1L0D1AC	2023	680.57	Acacia zone
P1L1D0	P1L1D1	2023	P1L0D1AC	2024	899.77	Acacia zone
P1L1D0	P1L1D1	2023	P1L0D1AC	2025	920.90	Acacia zone
P1L1D0	P1L1D1	2023	P1L0D1AC	2026	426.81	Acacia zone
P1L1D0	P1L1D1	2023	P1L0D1AC	2029	0.11	Acacia zone
P1L1D0	P1L1D1	2025	P1L0D1AC	2025	1,406.59	Acacia zone
P1L1D0	P1L1D1	2025	P1L0D1AC	2026	1,828.17	Acacia zone
P1L1D0	P1L1D1	2025	P1L0D1AC	2027	1,242.80	Acacia zone
P1L1D0	P1L1D1	2025	P1L0D1AC	2028	993.97	Acacia zone
P1L1D0	P1L1D1	2025	P1L0D1AC	2029	124.01	Acacia zone
P1L1D0	P1L1D1	2025	P1L0D1AC	2030	153.76	Acacia zone
P1L1D0	P1L1D1	2027	P1L0D1AC	2027	503.26	Acacia zone
P1L1D0	P1L1D1	2027	P1L0D1AC	2028	536.80	Acacia zone
P1L1D0	P1L1D1	2027	P1L0D1AC	2029	474.04	Acacia zone
P1L1D0	P1L1D1	2027	P1L0D1AC	2030	119.72	Acacia zone
P1L1D0	P1L1D1	2029	P1L0D1AC	2029	1,558.59	Acacia zone
P1L1D0	P1L1D1	2029	P1L0D1AC	2030	2,551.98	Acacia zone
P1L1D0	P1L1D1	2029	P1L0D1AC	2031	1,381.15	Acacia zone
P1L1D0	P1L1D1	2029	P1L0D1AC	2032	1,469.43	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2020	1,991.04	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2021	3,102.16	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2022	1,385.10	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2023	2,385.16	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2024	1,908.39	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2025	1,737.80	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2026	1,368.41	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2027	1,774.45	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2028	1,347.12	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2029	1,285.51	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2030	290.44	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2031	1,170.52	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2032	2,324.70	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2013	3,562.39	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2014	3,535.33	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2015	3,298.92	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2016	3,392.92	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2017	1,914.90	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2018	2,019.63	Acacia zone
P1L1D0	P1L1D1	2013	P1L0D1AC	2019	1,307.35	Acacia zone

From Strata	To		To		Area (ha)	Remarks
	Strata	Year	Strata	Year		
P1L1D0	P1L1D1	2015	P1L0D1AC	2015	156.23	Acacia zone
P1L1D0	P1L1D1	2015	P1L0D1AC	2016	490.23	Acacia zone
P1L1D0	P1L1D1	2015	P1L0D1AC	2017	973.57	Acacia zone
P1L1D0	P1L1D1	2015	P1L0D1AC	2018	105.01	Acacia zone
P1L1D0	P1L1D1	2015	P1L0D1AC	2019	379.14	Acacia zone
P1L1D0	P1L1D1	2017	P1L0D1AC	2020	1,125.33	Acacia zone
P1L1D0	P1L1D1	2017	P1L0D1AC	2021	31.73	Acacia zone
P1L1D0	P1L1D1	2017	P1L0D1AC	2022	138.65	Acacia zone
P1L1D0	P1L1D1	2017	P1L0D1AC	2017	1,523.63	Acacia zone
P1L1D0	P1L1D1	2017	P1L0D1AC	2018	1,554.72	Acacia zone
P1L1D0	P1L1D1	2017	P1L0D1AC	2019	2,160.18	Acacia zone
P1L1D0	P1L1D1	2019	P1L0D1AC	2020	747.42	Acacia zone
P1L1D0	P1L1D1	2019	P1L0D1AC	2021	1,351.50	Acacia zone
P1L1D0	P1L1D1	2019	P1L0D1AC	2022	903.25	Acacia zone
P1L1D0	P1L1D1	2019	P1L0D1AC	2019	844.17	Acacia zone
P1L1D1	P1L1D1	2011	P1L0D1AC	2032	13.26	Acacia zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2011	48.09	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2020	3.22	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2021	31.42	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2022	74.44	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2023	119.68	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2024	163.20	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2025	154.51	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2026	43.03	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2027	50.07	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2028	22.79	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2029	76.89	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2012	93.84	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2030	22.31	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2013	6.79	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2014	89.96	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2015	74.86	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2016	66.07	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2018	68.86	Community Crops zone
P1L0D0	P1L0D1	2011	P1L0D1CA	2019	17.68	Community Crops zone
P1L0D0	P1L0D1	2029	P1L0D1CA	2030	9.68	Community Crops zone
P1L0D0	P1L0D1	2029	P1L0D1CA	2032	0.01	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2020	41.87	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2021	14.13	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2025	26.23	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2026	5.69	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2027	53.56	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2028	49.49	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2029	162.77	Community Crops zone

From Strata	To		To		Area (ha)	Remarks
	Strata	Year	Strata	Year		
P1L0D0	P1L0D1	2013	P1L0D1CA	2030	119.06	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2031	52.02	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2032	21.88	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2013	118.81	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2014	113.35	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2015	0.16	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2016	172.47	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2017	211.78	Community Crops zone
P1L0D0	P1L0D1	2013	P1L0D1CA	2019	103.25	Community Crops zone
P1L0D0	P1L0D1	2015	P1L0D1CA	2018	1.57	Community Crops zone
P1L0D0	P1L0D1	2017	P1L0D1CA	2017	7.53	Community Crops zone
P1L0D0	P1L0D1	2017	P1L0D1CA	2018	0.00	Community Crops zone
P1L0D1	P1L0D1	2011	P1L0D1CA	2021	130.68	Community Crops zone
P1L0D1	P1L0D1	2011	P1L0D1CA	2022	102.23	Community Crops zone
P1L0D1	P1L0D1	2011	P1L0D1CA	2023	140.87	Community Crops zone
P1L0D1	P1L0D1	2011	P1L0D1CA	2024	130.04	Community Crops zone
P1L0D1	P1L0D1	2011	P1L0D1CA	2025	143.96	Community Crops zone
P1L0D1	P1L0D1	2011	P1L0D1CA	2026	82.13	Community Crops zone
P1L0D1	P1L0D1	2011	P1L0D1CA	2027	93.54	Community Crops zone
P1L0D1	P1L0D1	2011	P1L0D1CA	2028	137.57	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2011	124.65	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2020	173.57	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2021	193.13	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2022	131.90	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2023	55.47	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2024	15.40	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2025	18.50	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2026	103.00	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2027	90.02	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2028	120.31	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2029	82.73	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2012	109.93	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2030	115.90	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2013	173.97	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2014	92.17	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2015	103.96	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2016	104.20	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2017	174.45	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2018	110.07	Community Crops zone
P1L1D0	P1L1D1	2011	P1L0D1CA	2019	176.18	Community Crops zone
P1L1D0	P1L1D1	2021	P1L0D1CA	2021	0.05	Community Crops zone
P1L1D0	P1L1D1	2021	P1L0D1CA	2022	1.00	Community Crops zone
P1L1D0	P1L1D1	2021	P1L0D1CA	2023	1.00	Community Crops zone
P1L1D0	P1L1D1	2021	P1L0D1CA	2024	0.23	Community Crops zone

From Strata	To		To		Area (ha)	Remarks
	Strata	Year	Strata	Year		
P1L1D0	P1L1D1	2029	P1L0D1CA	2030	0.21	Community Crops zone
P1L1D0	P1L1D1	2029	P1L0D1CA	2032	0.17	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2020	281.33	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2021	222.77	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2022	254.32	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2023	234.77	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2024	258.98	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2025	158.03	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2026	143.26	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2027	236.09	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2028	171.23	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2029	156.21	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2030	152.00	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2031	160.64	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2032	167.79	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2013	327.39	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2014	282.10	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2015	226.67	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2016	321.38	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2017	193.27	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2018	392.43	Community Crops zone
P1L1D0	P1L1D1	2013	P1L0D1CA	2019	242.40	Community Crops zone
P1L1D0	P1L1D1	2015	P1L0D1CA	2016	1.49	Community Crops zone
P1L1D0	P1L1D1	2015	P1L0D1CA	2017	0.25	Community Crops zone
P1L1D0	P1L1D1	2015	P1L0D1CA	2018	4.51	Community Crops zone
P1L1D0	P1L1D1	2017	P1L0D1CA	2020	123.37	Community Crops zone
P1L1D0	P1L1D1	2017	P1L0D1CA	2024	0.93	Community Crops zone
P1L1D0	P1L1D1	2017	P1L0D1CA	2017	9.17	Community Crops zone
P1L1D0	P1L1D1	2017	P1L0D1CA	2018	89.13	Community Crops zone
P1L1D0	P1L1D1	2017	P1L0D1CA	2019	138.10	Community Crops zone
P1L1D1	P1L1D1	2011	P1L0D1CA	2021	10.10	Community Crops zone
P1L1D1	P1L1D1	2011	P1L0D1CA	2022	59.27	Community Crops zone
P1L1D1	P1L1D1	2011	P1L0D1CA	2023	45.72	Community Crops zone
P1L1D1	P1L1D1	2011	P1L0D1CA	2024	55.59	Community Crops zone
P1L1D1	P1L1D1	2011	P1L0D1CA	2025	64.16	Community Crops zone
P1L1D1	P1L1D1	2011	P1L0D1CA	2026	79.28	Community Crops zone
P1L1D1	P1L1D1	2011	P1L0D1CA	2027	17.85	Community Crops zone
P1L1D0	P1L1D0CF	2011	N/A	N/A	13,424.70	Conservation Forest zone
P1L0D0	P1L0D1IS	2011	N/A	N/A	34.62	equal to P1L0D1
P1L0D0	P1L0D1IS	2025	N/A	N/A	0.16	equal to P1L0D1
P1L0D0	P1L0D1IS	2029	N/A	N/A	5.72	equal to P1L0D1
P1L0D0	P1L0D1IS	2013	N/A	N/A	14.11	equal to P1L0D1
P1L1D0	P1L1D0IS	2011	N/A	N/A	1,993.90	equal to P1L1D0CF

From Strata	To		To		Area (ha)	Remarks
	Strata	Year	Strata	Year		
P1L1D0	P1L1D1CF	2011	N/A	N/A	15.55	equal to P1L1D1IS
P1L1D0	P1L1D1CF	2013	N/A	N/A	10.48	equal to P1L1D1IS
P1L0D0	P1L0D1	2011	P1L0D1IF	2011	18.98	Ground Fascility zone
P1L0D0	P1L0D1	2011	P1L0D1IF	2027	2.68	Ground Fascility zone
P1L0D0	P1L0D1	2013	P1L0D1IF	2017	0.25	Ground Fascility zone
P1L1D0	P1L1D1	2011	P1L0D1IF	2011	25.20	Ground Fascility zone
P1L1D0	P1L1D1	2011	P1L0D1IF	2023	9.80	Ground Fascility zone
P1L1D0	P1L1D1	2011	P1L0D1IF	2025	9.72	Ground Fascility zone
P1L1D0	P1L1D1	2011	P1L0D1IF	2027	18.15	Ground Fascility zone
P1L1D0	P1L1D1	2011	P1L0D1IF	2015	30.05	Ground Fascility zone
P1L1D0	P1L1D1	2011	P1L0D1IF	2019	20.51	Ground Fascility zone
P1L1D0	P1L1D1	2027	P1L0D1IF	2027	7.90	Ground Fascility zone
P1L1D0	P1L1D1	2013	P1L0D1IF	2021	3.77	Ground Fascility zone
P1L1D0	P1L1D1	2013	P1L0D1IF	2025	21.63	Ground Fascility zone
P1L1D0	P1L1D1	2013	P1L0D1IF	2029	17.14	Ground Fascility zone
P1L1D0	P1L1D1	2013	P1L0D1IF	2013	93.03	Ground Fascility zone
P1L1D0	P1L1D1	2013	P1L0D1IF	2017	11.64	Ground Fascility zone
P1L0D0	P1L0D0IS	2011	N/A	N/A	13.88	Indigeneous Species zone
P1L1D0	P1L1D1IS	2011	N/A	N/A	8,363.18	Indigeneous Species zone
P1L1D0	P1L1D1IS	2021	N/A	N/A	25.61	Indigeneous Species zone
P1L1D0	P1L1D1IS	2025	N/A	N/A	52.44	Indigeneous Species zone
P1L1D0	P1L1D1IS	2027	N/A	N/A	8.46	Indigeneous Species zone
P1L1D0	P1L1D1IS	2029	N/A	N/A	0.16	Indigeneous Species zone
P1L1D0	P1L1D1IS	2013	N/A	N/A	5,658.75	Indigeneous Species zone
P1L1D0	P1L1D1IS	2015	N/A	N/A	48.50	Indigeneous Species zone
P1L1D0	P1L1D1IS	2017	N/A	N/A	66.17	Indigeneous Species zone
P1L0D0	Canal	2011	N/A	N/A	57.60	Water Body zone
P1L0D0	Canal	2023	N/A	N/A	1.34	Water Body zone
P1L0D0	Canal	2025	N/A	N/A	0.13	Water Body zone
P1L0D0	Canal	2029	N/A	N/A	1.53	Water Body zone
P1L0D0	Canal	2013	N/A	N/A	47.20	Water Body zone
P1L0D0	Canal	2015	N/A	N/A	0.09	Water Body zone
P1L0D0	Canal	2017	N/A	N/A	0.02	Water Body zone
P1L0D1	Canal	2011	N/A	N/A	32.42	Water Body zone
P1L1D0	Canal	2011	N/A	N/A	838.26	Water Body zone
P1L1D0	Canal	2021	N/A	N/A	131.15	Water Body zone

From Strata	To		To		Area (ha)	Remarks
	Strata	Year	Strata	Year		
P1L1D0	Canal	2023	N/A	N/A	75.76	Water Body zone
P1L1D0	Canal	2025	N/A	N/A	146.13	Water Body zone
P1L1D0	Canal	2027	N/A	N/A	43.87	Water Body zone
P1L1D0	Canal	2029	N/A	N/A	175.79	Water Body zone
P1L1D0	Canal	2013	N/A	N/A	1,225.65	Water Body zone
P1L1D0	Canal	2015	N/A	N/A	55.29	Water Body zone
P1L1D0	Canal	2017	N/A	N/A	179.75	Water Body zone
P1L1D0	Canal	2019	N/A	N/A	96.39	Water Body zone
P1L1D1	Canal	2011	N/A	N/A	9.20	Water Body zone
River	River	N/A	N/A	N/A	208.94	Water Body zone, No Changes
NP	NP	N/A	N/A	N/A	3,161.84	Non Peatland, No Changes

Note: N/A = Not available, indicates no changes in the corresponding sequence
Strata with the same symbol in a consecutive change indicates no changes

Appendix 8. Baseline stratification based on emission characteristics

1. For ARR activities

Activity	LC pre (LC0)	LC post (LC1)	Area (ha)	Planting/ harvesting year	Description
Planting	Non forest	Rubber tree plantation	-	2010	GHG removal
Planting	Non forest	Rubber tree plantation	44	2011	GHG removal
Planting	Non forest	Rubber tree plantation	49	2012	GHG removal
Planting	Non forest	Rubber tree plantation	156	2013	GHG removal
Planting	Non forest	Rubber tree plantation	140	2014	GHG removal
Planting	Non forest	Rubber tree plantation	43	2015	GHG removal
Planting	Non forest	Rubber tree plantation	271	2016	GHG removal
Planting	Non forest	Rubber tree plantation	215	2017	GHG removal
Planting	Non forest	Rubber tree plantation	67	2018	GHG removal
Planting	Non forest	Rubber tree plantation	243	2019	GHG removal
Planting	Non forest	Rubber tree plantation	45	2020	GHG removal
Planting	Non forest	Rubber tree plantation	190	2021	GHG removal
Planting	Non forest	Rubber tree plantation	308	2022	GHG removal
Planting	Non forest	Rubber tree plantation	424	2023	GHG removal
Planting	Non forest	Rubber tree plantation	349	2024	GHG removal
Planting	Non forest	Rubber tree plantation	315	2025	GHG removal
Planting	Non forest	Rubber tree plantation	113	2026	GHG removal
Planting	Non forest	Rubber tree plantation	300	2027	GHG removal
Planting	Non forest	Rubber tree plantation	241	2028	GHG removal
Planting	Non forest	Rubber tree plantation	239	2029	GHG removal
Planting	Non forest	Rubber tree plantation	143	2030	GHG removal
Planting	Non forest	Rubber tree plantation	107	2031	GHG removal
Planting	Non forest	Rubber tree plantation	227	2032	GHG removal
Planting	Non forest	Rubber tree plantation	44	2036	GHG removal
Planting	Non forest	Rubber tree plantation	49	2037	GHG removal
Planting	Non forest	Rubber tree plantation	156	2038	GHG removal
Planting	Non forest	Rubber tree plantation	140	2039	GHG removal
Planting	Non forest	Rubber tree plantation	43	2040	GHG removal
Planting	Non forest	Rubber tree plantation	271	2041	GHG removal
Planting	Non forest	Rubber tree plantation	215	2042	GHG removal
Planting	Non forest	Rubber tree plantation	67	2043	GHG removal
Planting	Non forest	Rubber tree plantation	243	2044	GHG removal
Planting	Non forest	Rubber tree plantation	45	2045	GHG removal
Planting	Non forest	Rubber tree plantation	190	2046	GHG removal
Planting	Non forest	Rubber tree plantation	308	2047	GHG removal
Planting	Non forest	Rubber tree plantation	424	2048	GHG removal
Planting	Non forest	Rubber tree plantation	349	2049	GHG removal
Planting	Non forest	Rubber tree plantation	315	2050	GHG removal
Planting	Non forest	Rubber tree plantation	113	2051	GHG removal
Planting	Non forest	Rubber tree plantation	300	2052	GHG removal
Planting	Non forest	Rubber tree plantation	241	2053	GHG removal
Planting	Non forest	Rubber tree plantation	239	2054	GHG removal
Planting	Non forest	Rubber tree plantation	143	2055	GHG removal
Planting	Non forest	Rubber tree plantation	107	2056	GHG removal
Planting	Non forest	Rubber tree plantation	227	2057	GHG removal
Planting	Non forest	Rubber tree plantation	44	2061	GHG removal
Planting	Non forest	Rubber tree plantation	49	2062	GHG removal

Activity	LC pre (LC0)	LC post (LC1)	Area (ha)	Planting/ harvesting year	Description
Planting	Non forest	Rubber tree plantation	156	2063	GHG removal
Planting	Non forest	Rubber tree plantation	140	2064	GHG removal
Planting	Non forest	Rubber tree plantation	43	2065	GHG removal
Planting	Non forest	Rubber tree plantation	271	2066	GHG removal
Planting	Non forest	Rubber tree plantation	215	2067	GHG removal
Planting	Non forest	Rubber tree plantation	67	2068	GHG removal
Planting	Non forest	Rubber tree plantation	243	2069	GHG removal
Harvesting	Rubber tree plantation	Non forest	44	2036	GHG emission
Harvesting	Rubber tree plantation	Non forest	49	2037	GHG emission
Harvesting	Rubber tree plantation	Non forest	156	2038	GHG emission
Harvesting	Rubber tree plantation	Non forest	140	2039	GHG emission
Harvesting	Rubber tree plantation	Non forest	43	2040	GHG emission
Harvesting	Rubber tree plantation	Non forest	271	2041	GHG emission
Harvesting	Rubber tree plantation	Non forest	215	2042	GHG emission
Harvesting	Rubber tree plantation	Non forest	67	2043	GHG emission
Harvesting	Rubber tree plantation	Non forest	243	2044	GHG emission
Harvesting	Rubber tree plantation	Non forest	45	2045	GHG emission
Harvesting	Rubber tree plantation	Non forest	190	2046	GHG emission
Harvesting	Rubber tree plantation	Non forest	308	2047	GHG emission
Harvesting	Rubber tree plantation	Non forest	424	2048	GHG emission
Harvesting	Rubber tree plantation	Non forest	349	2049	GHG emission
Harvesting	Rubber tree plantation	Non forest	315	2050	GHG emission
Harvesting	Rubber tree plantation	Non forest	113	2051	GHG emission
Harvesting	Rubber tree plantation	Non forest	300	2052	GHG emission
Harvesting	Rubber tree plantation	Non forest	241	2053	GHG emission
Harvesting	Rubber tree plantation	Non forest	239	2054	GHG emission
Harvesting	Rubber tree plantation	Non forest	143	2055	GHG emission
Harvesting	Rubber tree plantation	Non forest	107	2056	GHG emission
Harvesting	Rubber tree plantation	Non forest	227	2057	GHG emission
Harvesting	Rubber tree plantation	Non forest	44	2061	GHG emission
Harvesting	Rubber tree plantation	Non forest	49	2062	GHG emission
Harvesting	Rubber tree plantation	Non forest	156	2063	GHG emission
Harvesting	Rubber tree plantation	Non forest	140	2064	GHG emission
Harvesting	Rubber tree plantation	Non forest	43	2065	GHG emission
Harvesting	Rubber tree plantation	Non forest	271	2066	GHG emission
Harvesting	Rubber tree plantation	Non forest	215	2067	GHG emission
Harvesting	Rubber tree plantation	Non forest	67	2068	GHG emission
Harvesting	Rubber tree plantation	Non forest	243	2069	GHG emission

2. Appendix. Baseline stratification based on emission characteristic for REDD

LC pre def (LC0)	LC post def (LC1)	Area (ha)	Year of deforestation	Description
Forest	Acacia plantation	-	2010	Acacia plantation area
Forest	Acacia plantation	1,589	2011	Acacia plantation area
Forest	Acacia plantation	1,640	2012	Acacia plantation area
Forest	Acacia plantation	5,225	2013	Acacia plantation area
Forest	Acacia plantation	5,203	2014	Acacia plantation area
Forest	Acacia plantation	5,194	2015	Acacia plantation area
Forest	Acacia plantation	5,196	2016	Acacia plantation area

LC pre def (LC0)	LC post def (LC1)	Area (ha)	Year of deforestation	Description
Forest	Acacia plantation	5,248	2017	Acacia plantation area
Forest	Acacia plantation	5,257	2018	Acacia plantation area
Forest	Acacia plantation	5,187	2019	Acacia plantation area
Forest	Acacia plantation	5,231	2020	Acacia plantation area
Forest	Acacia plantation	5,164	2021	Acacia plantation area
Forest	Acacia plantation	5,141	2022	Acacia plantation area
Forest	Acacia plantation	5,392	2023	Acacia plantation area
Forest	Acacia plantation	5,184	2024	Acacia plantation area
Forest	Acacia plantation	4,966	2025	Acacia plantation area
Forest	Acacia plantation	4,954	2026	Acacia plantation area
Forest	Acacia plantation	5,157	2027	Acacia plantation area
Forest	Acacia plantation	5,098	2028	Acacia plantation area
Forest	Acacia plantation	5,169	2029	Acacia plantation area
Forest	Acacia plantation	5,074	2030	Acacia plantation area
Forest	Acacia plantation	3,286	2031	Acacia plantation area
Forest	Acacia plantation	3,809	2032	Acacia plantation area
Forest	Non-Forest	423	2011	Infrastructure
Forest	Non-Forest	780	2013	Infrastructure
Forest	Non-Forest	189	2015	Infrastructure
Forest	Non-Forest	365	2017	Infrastructure
Forest	Non-Forest	189	2019	Infrastructure
Forest	Non-Forest	336	2021	Infrastructure
Forest	Non-Forest	161	2023	Infrastructure
Forest	Non-Forest	359	2025	Infrastructure
Forest	Non-Forest	182	2027	Infrastructure
Forest	Non-Forest	361	2029	Infrastructure
Forest	Rubber tree plantation	133	2011	Community crops
Forest	Rubber tree plantation	155	2012	Community crops
Forest	Rubber tree plantation	523	2013	Community crops
Forest	Rubber tree plantation	502	2014	Community crops
Forest	Rubber tree plantation	579	2015	Community crops
Forest	Rubber tree plantation	398	2016	Community crops
Forest	Rubber tree plantation	463	2017	Community crops
Forest	Rubber tree plantation	600	2018	Community crops
Forest	Rubber tree plantation	435	2019	Community crops
Forest	Rubber tree plantation	588	2020	Community crops
Forest	Rubber tree plantation	431	2021	Community crops
Forest	Rubber tree plantation	316	2022	Community crops
Forest	Rubber tree plantation	174	2023	Community crops
Forest	Rubber tree plantation	275	2024	Community crops
Forest	Rubber tree plantation	260	2025	Community crops
Forest	Rubber tree plantation	461	2026	Community crops
Forest	Rubber tree plantation	259	2027	Community crops
Forest	Rubber tree plantation	269	2028	Community crops
Forest	Rubber tree plantation	307	2029	Community crops
Forest	Rubber tree plantation	382	2030	Community crops
Forest	Rubber tree plantation	282	2031	Community crops
Forest	Rubber tree plantation	191	2032	Community crops

Appendix 9. Default Values Used in Quantification of GHG Emissions

1. Default Emission Factors for Quantification of GHG Emissions from Peat Microbial Decomposition and Dissolved Organic Carbon in Baseline (BSL) and Project Scenario (WPS) (ton CO2e.ha-1.y-1). Numbers in bracket signify half with 95% confidence interval.

Strata	Description	CO_2	CH_4	DOC	Reference	Scenario
P1L1D0	Peat, Forest, Not Drained	0 (0)	0.72 (0.22)	-	IPCC Wetlands Supplement 2013, Chapter 3, Tables 3.1 and 3.3 and 3A.3*	BSL Initial Stratum and WPS
P1L1D1	Peat, Forest, Drained	19.43 (5.74)	0.14 (0.03)	-	IPCC Wetlands Supplement 2013, Chapter 2, Tables 2.1 and 2.3	BSL Initial Stratum and WPS
P1L0D0	Peat, Non Forest, not Drained	1.50 (2.39)	0.20 (0.12)	-	IPCC, Wetlands Supplement 2013, Dariah et al 2013, Hairiah et al 1999; Ishida et al 2001; Lamade & Bouillet 2005; Matthews et al 2000; Melling et al 2005a, 2007a; Watanabe et al 2009	BSL Initial Stratum and WPS
P1L0D1	Peat, non Forest, Drained	19.43 (5.74)	0.14 (0.03)	-	IPCC Wetlands Supplement 2013, Chapter 2, Tables 2.1 and 2.3	BSL Initial Stratum and WPS
P1L0D1AC	Peat, Non Forest, Drained, Acacia	73.33 (5.64)	0.08 (0.06)	-	IPCC Wetlands Supplement 2013, Chapter 2, Tables 2.1 and 2.3	BSL
P1L1D0CF	Peat, Forest, Not Drained, Conservation	0 (0)	0.72 (0.22)	-	IPCC Wetlands Supplement 2013, Chapter 3, Tables 3.1 and 3.3*	BSL, unchanged stratum during the project course,

Strata	Description	CO_2	CH_4	DOC	Reference	Scenario
						equal to P1L1D0
P1L0D1IF	Peat, Non Forest, Drained, Infrastructure	19.43 (5.74)	0.14 (0.03)	-	IPCC Wetlands Supplement 2013, Chapter 2, Tables 2.1 and 2.3	BSL
P1L1D1IS	Peat, Forest, Drained, Indigeneous Species+River Buffer	19.43 (5.74)	0.14 (0.03)	-	IPCC Wetlands Supplement 2013, Chapter 2, Tables 2.1 and 2.3	BSL, equal to P1L1D1
P1L0D1CA	Peat, Non Forest, Drained, Community Crops	51.33 (16.02)	0.20 (0.12)	-	IPCC Wetlands Supplement 2013, Chapter 2, Tables 2.1 and 2.3	BSL
WB	Natural	-	-	2.1 (0.27)	IPCC Wetlands Supplement 2013, Chapter 2, Tables 2.2	WPS
WB	Drained	-		3.0 (1.22)	IPCC Wetlands Supplement 2013, Chapter 2, Tables 2.2	BSL

2. Default Burn Scar Depths for Quantification of GHG Emissions from Peat Burning in Baseline and With-Project Scenario

Repeated Burning Order	Average burn scar depth (cm)	Reference
1^{st}	18	Page, et. al., 2014 [28]
2^{nd}	11	Page, et. al., 2014 [28]
3^{rd} onward	4	Wösten

3. IPCC default values for Combustion Factors and Global Warming Potential used in Quantification of GHG Emissions from Peat and Biomass Burning

Gas	Global Warming Potential (GWP_g)	Combustion Factor (G_g) (g.kg^{-1} dry mass)	Reference
CH_4	28	6.8	IPCC Table 2.5
CO_2	1	1,580	IPCC Table 2.5

LIST OF ANNEXES

Annexes are provided in separate documents and available upon request.

ANNEX 1. METHODS FOR MEASURING PEAT THICKNESS AND MAPPING PEAT DISTRIBUTIONS

Annex 1 describes methods for peat thickness measurement in field as well as auger used is described in detail. Based on measured peat thickness the generation of peat thickness map, by using supporting data and geomorphological correlation analysis is described.

ANNEX 2. DRAINABILITY ELEVATION LIMIT MAPPING METHOD

Annex 2 provides drainability elevation limit concept and generation of drainability elevation limit map based on water level elevations of the nearest water body.

ANNEX 3. LEVELLING AND DEM CREATION METHOD

Annex 3 describes levelling measurements in the field, correlating relative elevation to mean sea level datum, as well as method for creating digital elevation model by using geomorphological correlation analysis is described .

ANNEX 4. PEAT BULK DENSITY MEASUREMENT AND STATISTICAL ANALYSIS METHOD

Annex 4 describes detailed method of peat bulk density measurement in field as well as instrumentation. Analisis results based on field surveys in 2010 – 2011 are also presented along with statistical analysis method and summary statistics of bulk density.

ANNEX 5. COMMUNITIES IN THE PROJECT ZONE

Annex 5 describes the socioeconomic conditions of the project-zone communities.

ANNEX 6. SUBSIDENCE CALCULATION METHOD

The basic concept of Initial subsidence due to compaction and consolidation is explained. Consolidation. Compaction and compression equations are given. Subsidence due to mass loss in microbial decomposition of peat is also presented. Total subsidence is treated as the summation of all subsidence component.

ANNEX 7. UNCONTROLLED BURNING ANALYSIS METHOD

This annex describes measurement of burn scar boundaries and determination of burning repetition in project scenario. Estimation of peat and above ground biomass burnt are also treated. Modelling high risk areas in baseline scenario based on a stochastic model of burning frequency in relation to distance to human access is given.

ANNEX 8. UNCERTAINTY ANALYSIS

This annex provides the underlying calculations and data for the uncertainty analysis.

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